# 1 Introduction

Differences in cigarette taxes create incentives for consumers to cross borders, either physically or online, and purchase in lower-tax jurisdictions. The potential savings to smokers are significant - in many cases, cigarette excise taxes vary substantially in neighboring states. For example, in January 2003, state cigarette taxes differed by $1.26 per pack in New Jersey and Delaware (at $1.50 and $0.24 per pack), by $0.99 per pack in Massachusetts and New Hampshire (at $1.51 and $0.52 per pack), and by $0.70 per pack in Michigan and Ohio (at $1.25 and $0.55 per pack). Moreover, tax differentials between states have increased over the past decade. In 1997, 46 states bordered a neighbor with a lower cigarette excise tax - in real terms, the mean difference between a state's cigarette excise tax and the lowest excise tax in a neighboring state was 21.9 cents per pack with a maximum differential of 71 cents per pack. By 2003, the mean differential increased to 39 cents per pack, and the maximum differential has increased to 126 cents per pack.

State policy makers recognize the implications of border crossing for both fiscal and health policy. As noted during Maryland's 2003 debate over increasing cigarette taxes,

> Increasing the tobacco tax by $.36 to $1.36 will increase revenues by $73.9 million . . . Currently there is an incentive for Maryland residents to travel to Delaware, Virginia, Pennsylvania or West Virginia because of the lower tax rates in the states. Increasing the tobacco tax will further increase this incentive.
>
> -Maryland General Assembly,
> Department of Legislative Services,
> 2003 Session, SB 324.

The degree to which cigarette taxes deter smoking or generate tax revenue depends upon the extent to which smokers are able to avoid higher taxes by crossing state borders. While consumer avoidance of cigarette taxes (and other

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state. Our estimates lie between those by Lovenheim (2008) and Stehr (2005). Lovenheim (2008) finds that between 13 and 25 percent of all individuals within an MSA close to the border will purchase cigarettes in border localities. In contrast, Stehr finds less border crossing; he estimates that border crossing accounts for less than one percent of all sales of cigarettes.

Secondly, this is the first paper to provide an estimate of how stockpiling behavior differs between light and heavy smokers, a relationship plausibly of interest for policy if the health costs of smoking vary with smoking intensity. Previous literature implicitly assumes that light and heavy smokers face similar

Finally, by observing a consumer's location of residence and purchase, we can separately estimate the effect of a tax increase on state sales and revenues in the presence of border crossing and also in the counterfactual scenario with the absence of border crossing. To our knowledge, this is the

## 2 Previous Literature

A well-developed literature studies consumer tax avoidance in response to differential excise taxation of cigarettes. The literature examines how differences in state cigarette taxes create incentives for consumers to cross the border from high tax states (such as Massachusetts) to low tax states (such as New Hampshire). The standard approach in the existing literature, including Yurekli examine individual survey data and study the extent to which California smokers avoided a $0.50 per pack increase in the excise taxes by purchasing from lower-tax jurisdictions. They find that very few California smokers avoided the excise tax by purchasing cigarettes from the Internet, military bases, or out-of-state outlets. Finally, Crawford and Tanner (1995) use household expenditure data for the United Kingdom to identify whether households close to France are more sensitive to local alcohol taxes. They find that after relaxing alcohol importing quotas, the demand for alcohol became more elastic for British consumers near lower-tax jurisdictions than those who lived far.

In contrast to the previous literature, our data has the advantage that it reports both location and quantity choice for a large representative sample of U.S. smokers. We use data on the smoking habits and purchase decisions of individual smokers to estimate a discrete model of location choice and a continuous model of cigarette consumption. Rather than inferring border crossing from reduced-form regressions of consumption decisions, we explicitly model a consumer's choice of venue as a tradeoff between the price and distance to each neighboring state. Our approach allows us to identify substitution between home-state purchases, cross-border purchases, and Internet purchases.

Our paper also relates closely to work on the competition across different retail venues. For example, Goolsbee (2000) studies competition between online and traditional retailers. He finds that eliminating the sales tax differential between online and traditional retailers would reduce the number of online buyers by 24 percent. Goolsbee, Lovenheim, and Slemrod (2007) quantify the extent to which consumers avoid state taxation through Internet purchases. In other markets, Chiou (2008) examines a consumer's choice of retailer for DVDs, and Ellison and Ellison (2007) also examine the extent of consumer tax avoidance in the market for offline and online computer parts. Our approach allows for multiple venue choices for each consumer (not just in-state versus out-of-state), and we combine this discrete choice model with estimates of quantity consumed to predict sales under different counterfactual scenarios.

# 3 Data

We obtained information on individual purchase quantities and locations from

[6]Although our paper focuses on avoidance by consumers rather than "long distance" or commercial cigarette smuggling, Gruber, Sen, and Stabile (2003) and Thursby and Thursby (2000) find evidence of commercial cigarette smuggling in response to heterogenous taxation.

the CPS Tobacco Use Supplement (TUS) for February, June, and November 2003. The 2003 wave of the TUS asks each individual the last quantity of cigarettes purchased, price paid per pack of cigarettes, and the location of the purchase. The dataset also includes questions on the frequency of smoking (e.g., daily, occasional) and the history of smoking within the past year. We restrict our sample to individuals with non-missing data on demographics and who report their county of residence. The final dataset consists of 9745 smokers who report the location of their last cigarette purchase and 9588 smokers who report their daily quantity of cigarettes consumed.

The main advantage of our dataset is that we directly observe each consumer's location of purchase. The TUS asks individuals to report the state of their last purchase or "other" if they purchased from the Internet, Indian reservations, or another country (e.g., Canada). For each individual, we compute the distance to each of the nearby states using the latitude and longitude of her county's centroid and the nearest county in a neighboring state. As shown in Table 1, approximately forty percent of consumers live within 40 miles of another state, and 17 percent live nearby at least 3 other states. Consumers do not report traveling very far to purchase cigarettes.

cigarettes from "other" locations, which include the Internet, Indian reservations, and international purchases (e.g., Canada).

In this context, we are concerned with two sources of reporting bias, which would lead the TUS survey to underreport online-purchases, on-reservation purchases and border crossing. First, an individual might be reluctant to report purchasing over the internet, on-reservation, internationally, or from another state if she perceives border crossing as quasi-illegal. Second, our

[illegible]

| | Obs | Mean | Std. Dev. |
|---|---|---|---|
| distance<10 miles | | | |
| income = $ 0,000 | 90 | 0.2 | 0. |
| age | 2 | . 1 | 1 .70 |
| male | 2 | 0. 1 | 0. 0 |
| married | 2 | 0.2 | 0. |
| white | 2 | 0. 8 | 0. 9 |
| black | 2 | 0. 7 | 0. 0 |
| hispanic | 2 | 0.1 | 0. |
| daily quantity of cigarettes | 1 | 11. 2 | 8. |
| price paid (dollars per pack) | 1 | . 9 | 1. 8 |
| 10<distance<20 miles | | | |
| income = $ 0,000 | 1209 | 0. | 0. 8 |
| age | 1 7 | . 2 | 1 . 0 |
| male | 1 7 | 0. 7 | 0. 0 |
| married | 1 7 | 0. 2 | 0. 9 |
| white | 1 7 | 0.70 | 0. |
| black | 1 7 | 0.18 | 0. 8 |
| hispanic | 1 7 | 0.08 | 0.28 |
| daily quantity of cigarettes | 1 21 | 1 .12 | 9.7 |
| price paid (dollars per pack) | 9 1 | .21 | 1. |
| 20<=distance< 0 miles | | | |
| income = $ 0,000 | 1 2 | 0. 0 | 0. |
| age | 1 17 | 2. 2 | 1 .7 |
| male | 1 17 | 0. 8 | 0. 0 |
| married | 1 17 | 0. | 0. 0 |
| white | 1 17 | 0.8 | 0. |

[illegible]

| Variable | Obs | Mean | Std. Dev. |
|---|---|---|---|
| Closest state has lower tax | | | |
| income = $ 0,000 | 118 | 0.2 | 0. |
| age | 1 1 | .27 | 1 .99 |
| male | 1 1 | 0. 8 | 0. 0 |
| married | 1 1 | 0. | 0. 8 |
| white | 1 1 | 0.70 | 0. |
| black | 1 1 | 0.2 | 0. 2 |
| hispanic | 1 1 | 0.0 | 0.19 |
| daily quantity of cigarettes | 1 0 | 1 . | 9.71 |
| price paid (dollars per pack) | 899 | .82 | 0.9 |
| Closest state has higher tax | | | |
| income = $ 0,000 | 181 | 0. 0 | 0. |
| age | 2070 | 2. 1 | 1 . 2 |
| male | 2070 | 0. 7 | 0. 0 |
| married | 2070 | 0. | 0. 0 |
| white | 2070 | 0.78 | 0. 2 |
| black | 2070 | 0.1 | 0. |
| hispanic | 2070 | 0.0 | 0.22 |
| daily quantity of cigarettes | 2009 | 1 .1 | 9.79 |
| price paid (dollars per pack) | 129 | . | 1.2 |

[illegible]

| Variable | Obs | Mean | Std. Dev. |
|---|---|---|---|
| **Light smoker** | | | |
| income = $ 0,000 | 80 | 0.27 | 0. |
| age | 20 | 0.8 | 0. 0 |
| male | 20 | 0. | 1 .1 |
| married | 20 | 0. 9 | 0. 9 |
| white | 20 | 0. 2 | 0. 8 |
| black | 20 | 0.1 | 0. |
| hispanic | 20 | 0.1 | 0. |
| daily quantity of cigarettes | 20 | .8 | . 2 |
| price paid (dollars per pack) | 1 9 | .7 | 1.09 |
| **Heavy smoker** | | | |
| income = $ 0,000 | 78 | 0.28 | 0. |
| age | 1 | .71 | 0. 0 |
| male | 1 | 0. | 1 .91 |
| married | 1 | 0. | 0. 0 |
| white | 1 | 0.8 | 0. 7 |
| black | 1 | 0.0 | 0.2 |
| hispanic | 1 | 0.0 | 0.22 |
| daily quantity of cigarettes | 1 | 22.21 | 7. 8 |
| price paid (dollars per pack) | 2729 | . 7 | 1.02 |

to decrease in magnitude. Table 6 reports the estimated coe□cients from the regression

$$p_i^{TUS} = \quad + \quad p_j^{TBT} + \quad De \quad o_i + \quad (p_j^{TBT} - p_k^{TBT}) \quad (1)$$

$$+$$

[illegible]

| | (1) OLS | (2) IV | ( ) OLS | ( ) IV |
|---|---|---|---|---|
| TBT Average State Price | 1.0 2** | 1.0 9** | 1.080** | 1.09 ** |
| | (0.019) | (0.022) | (0.020) | (0.02 ) |
| Price Differential / Distance | -0. 20** | -0.99 ** | -0.081 | -0.2 + |
| | (0.11 ) | (0.282) | (0.1 9) | (0.1 2) |
| Tax-Inclusive Price Differential | | | -0.09 ** | -0.109** |
| | | | (0.019) | (0.022) |
| Inverse Distance to Nearest State | | | 17.0 + | 8.8 |
| | | | (9.89 ) | (9.87 ) |
| Age | -0. ** | -0. ** | -0. 7** | -0. 8** |
| | (0.07 ) | (0.07 ) | (0.07 ) | (0.07 ) |
| Married | - .7 ** | -7.28 ** | - . 19** | - .728** |
| | (2.079) | (2.089) | (2.07 ) | (2.07 ) |
| Male | -2.2 7 | -1.711 | -2.217 | -2.127 |
| | (1.897) | (1.908) | (1.892) | (1.89 ) |
| White | -0. | -0.09 | -0.081 | 0.017 |
| | ( .29 ) | ( .2 ) | ( .299) | ( .290) |
| Black | 11.9 7* | 1 .8 ** | 11.1 8* | 11.7 * |
| | ( .911) | ( .9 ) | ( .010) | ( .001) |
| Hispanic | 20.108** | 20.2 ** | 21.0 ** | 21. 0 ** |
| | ( .0 7) | ( .99 ) | ( .0 2) | ( .0 1) |
| Income | 10. 89** | 10.280** | 10.0 9** | 9.9 ** |
| | (1.28 ) | (1.29 ) | (1.27 ) | (1.288) |
| Observations | 17 | 17 | 17 | 17 |

another state, taxes vary across borders on an average of 64 cents per pack. Conditional on having a neighboring state with a higher or lower tax, the average difference between the tax in the home state and the tax of the neighbors consumer $i$ perfectly observes prices $p_j$ and taxes $_j$ for cigarettes in each of the jurisdictions. The utility of consumer $i$ purchasing from location $j$ is given by:

$$_{ij} = (p_j + _j) + (p_j + _j) * NC_i - d_{ij} * NC_i - f(d_{ij}) + _{ij} \quad (2)$$

where $p_j$ and $_j$ are the tax-exclusive price and tax (in cents per pack) reported in Tax Burden on Tobacco for state $j$, $NC_i$ is a dummy for whether consumer $i$'s income is above $60 000, $d_{ij}$ is the distance in miles between consumer $i$'s county of residence reported in the TUS data and the nearest county in state $j$.[3] The variable $_{ij}$ is an idiosyncratic error term that captures preferences for purchase jurisdiction, and it follows a Type I Extreme Value distribution.

It is important to note that a consumer's expected choice of quantity affects her location decision - faced with a lower tax-inclusive price, the consumer will purchase more of the taxed good in a lower tax jurisdiction. While quantity does not explicitly enter the location model, the current baseline model captures this effect in a reduced-form way through the coefficient of price on the probability of choosing a location. A higher price makes it less likely that a consumer will travel to that location, presumably due to decreased consumption (and disposable income - i.e., consumption of other goods). In addition, the changes in consumption across locations are likely to be small as the demand for cigarettes is inelastic. For elastic goods, a consumer's quantity may change substantially when purchasing in a lower tax jurisdiction. For less elastic goods, like cigarettes, the change in purchase behavior when traveling to a lower tax jurisdiction will be less.

Consistent with the TUS reporting, we define the outside good as purchasing cigarettes from a location other than the 50 states and D.C., such as the Internet, an Indian reservation, or international purchases (e.g., Canada). Since we do not observe the specific nature of the outside good, we normalize the price and distance of the outside good to zero, and we incorporate a dummy for the outside good into the location model to capture its attractiveness relative to other alternatives. We restrict a consumer's choice set to all states that lie within a 40 mile radius of her county of residence.

[12] Our qualitative results are not sensitive to the income threshold we use - $50 000, $60 000, or $70 000.

[13] Although a subset of individuals in the TUS report the price for their last pack of cigarettes, we use prices from Tax Burden on Tobacco because we need to observe prices for all alternatives in a consumer's choice set.

[14] In Section 5.1, we estimate an intensive e02.348(u)1.48504(s)-3.0436(e)-29056.ii2.26 -62.64-8.284(r)-5.81959(i)0.7

We include interactions of price and distance with income to allow an individual's price sensitivity and disutility of distance to vary by income. In addition, we allow distance to enter into the utility function linearly, quadratically, and non-parametrically through successive 10-mile incremental dummy variables.

We estimate the model using Maximum Likelihood. For each consumer, we calculate the predicted probability of her making her observed location choice. Conditional on the vector $\theta = ( \quad )$ of parameters to be estimated and right-hand side variables $X$, we can express the predicted probability of consumer $i$ choosing location $j$ as:

$$prob_{ij}(\theta) = \frac{exp(X_{ij}\theta)}{\sum_k exp(X_{ik}\theta)} \tag{3}$$

We form the log likelihood function from the predicted probabilities and maximize this expression over $\theta$.

## 4.2 Identification and Results

Identification of the effects of price and distance on location choice is achieved by comparing the behavior of consumers under different choice sets - i.e., different number of alternatives or potential purchase locations. The estimation strategy compares the choices of consumers who live "far" from borders (and can only purchase online or within their home state) to those who live "close" to borders and may be able to purchase from several other localities. Essentially, this comparison is done while conditioning on a consumer's demographics. For instance, the effect of distance on location choice can be identified by observing the behavior of individuals with similar demographics that live far from the border to those that live near borders. The effect of income on the probability of traveling is found by comparing high and low income individuals who live within the same proximity to a border.

Table 7 reports the results of the discrete choice model; standard errors are clustered by an individual's state of residence. Columns (1)-(3) give the estimates under different specifications for distance. As expected, the nega-

| | (1) | (2) | ( ) | ( ) | ( ) | ( ) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| price+tax | -0.00 * | -0.008** | -0.010** | -0.007* | -0.00 | -0.00 | -0.008** | -0.008** |
| | (0.00 ) | (0.002) | (0.002) | (0.00 ) | (0.00 ) | (0.00 ) | (0. | |

cent of smokers in our sample will purchase cigarettes outside of their home state. Interestingly, we find less border crossing than Lovenheim (2008), who estimates that between 13 and 25 percent of consumers purchase cigarette in border localities, and our estimates lie above those of Stehr (2005), who finds that border crossing accounts for less than one percent of all sales of cigarettes. Although our data contains self-reported measures of quantity smoked as similar to Lovenheim (2008) and Stehr (2005), our identification strategy differs in that we directly estimate travel cost and location of purchase using variation in observed location choices of individuals living "far" and "near" borders. Lovenheim uses variation over time to infer border crossing by individuals in metropolitan statistical areas near borders. Stehr uses differences in average taxes between the home state and nearby states with higher taxes to identify the effect of border crossing. As Lovenheim discusses, these estimates provide a lower-bound for the amount of border crossing because when a state raises its tax level, the average difference will increase by less than the amount of the tax increase; furthermore, raising the tax changes the set of states that have higher taxes, and tax differences may be weakly correlated with price differences across states. Our location model circumvents this issues as consumers choose explicitly among all alternative within a given radius of her residence; the choice set is fixed for a given consumer, and she must decide where to purchase cigarettes based upon her personal tradeoff between distance and the tax inclusive price.

Finally, we find that the propensity of an individual to travel varies significantly according to her quantity of purchase. An implicit assumption in our base model (and other existing studies of cigarette purchases) is that the marginal costs of traveling and the stockpiling behavior for light and heavy smokers are similar. Since heavy smokers purchase more cigarettes, they may capture a greater benefit from the differences in taxes by crossing to a lower cost jurisdiction. In this case, a specification which estimates a common travel cost for all smokers would tend to underestimate the number of heavy smokers who will cross borders and would overestimate the number of light smokers who do.

We separately estimate our earlier specification for smokers that report smoking "everyday" versus "some days" in the TUS. As expected, smokers who report smoking "everyday" have a significantly lower marginal cost of traveling than smokers who only report smoking "some days". Columns (4) and (5) of Table 7 indicate that the marginal cost of travel for an "everyday" and "some days" smoker are 26 cents (= 0 181 0 007) and 83 cents (= 0 248 0 003).

After conditioning on smokers' characteristics which affect travel costs, we would expect smoking intensity to affect the marginal cost of travel solely

results of our location model to tackle these two questions and draw comparisons with results from previous studies. First, we examine how changes in price a□ect the quantity of cigarettes consumed in the absence of border crossing. Then, we examine how changes in price a□ect sales by the state and their neighbors while taking into account the incentive for individuals to cross borders. Finally, we explore the magnitude of the di□erence between these two scenarios in the particular case of the Maryland tax increase.

## 5.1 Demand for Cigarettes in the Absence of Smuggling

A useful counterfactual to consider is how changes in price would a□ect an individual's demand in the absence of cross-border e□ects. This could correspond to a situation in which all states raise their taxes in such a way that the border crossing incentive is unchanged. To calculate the consumer response in the absence of smuggling, we must first estimate the relationship between quantity demanded for cigarettes and an individual's characteristics. In our baseline model, the quantity of cigarettes consumed depends upon the location of purchase only through prices and taxes. To obtain an estimate of the quantity of cigarettes consumed, we regress the daily quantity of cigarettes smoked on the price paid and a consumer's demographics using state tax rates as an instrument for the tax-inclusive price faced by consumers.

Previous studies with micro data had to include additional variables that measured the strength of the l6948(e)6-14.4T8ao f then estimates of the price elasticity will not biased (Stehr, 2005). Since our sample is restricted to smokers, equation (4) estimates the intensive margin on which behavior changes - how smoking intensity changes in response to a change in price, conditional on the decision to smoke.

We estimate the quantity regression using $o$ ( ) as an instrument for the full price paid by consumers. Table 8 reports the results.

L n y n

| | (1) | (2) | ( ) | ( ) | ( ) |
|---|---|---|---|---|---|
| log(price at location of purchase) | -0.112+ | -0. 0** | | | |
| | (0.0 2) | (0.0 ) | | | |

purchase locations as calculated from *Tax Burden on Tobacco*. In columns (3)-(5), we replicate the individual-level regressions of previous studies using our dataset. Column (3) contains the naive regression where quantity demanded is a function of the home state price; this assumes that consumers do not engage in border crossing. Column (4) contains the OLS estimates of a regression similar to Chaloupka and Pacula (1998) and Lewit et al. (1981) where quantity purchased by an individual is a function of her home state price and a measure of her incentive to cross the border. This measure is the price di□nice diiii n c n

(1) (2)

We can use equation (5) to calculate price elasticities under border crossing. Note that the conditional price elasticity of -0.26 given by our quantity regression in the previous section captures demand responsiveness when there is no change in border crossing behavior. This gives the percentage decrease in the optimal consumption, irrespective of the location of purchase.

The first column of Table 10 reports the own-price elasticities when border crossing can occur. [7] The optimal quantities for each location are now weighted by the probability of an individual traveling to that location. Note that own-price elasticities are higher in states such as West Virginia (-2.3) and Connecticut (-3.3) where individuals live in close proximity to other states. For instance, individuals who live close to or within West Virginia also reside in areas with anywhere from 2 to 4 states nearby - not including the outside option. Over half of individuals living near or within Connecticut also live near 3 other physical states.e p0.972873(m)2.923a

| state | own-price elasticity | state tax elasticity | state tax revenue elasticity |
| --- | --- | --- | --- |

## 5.3 Simulation and Comparison of Tax Changes in Maryland and D.C.

The two preceding sections calculated the change in sales with and without border crossing. In this section, we apply these techniques to the particular case of Maryland and compare how the consumer response changes under these two scenarios. Recall from the Introduction that we described a particular debate in the Maryland legislature regarding a tax increase from $1 00 to $1 36 per pack in 2003. We use Maryland as an example to illustrate the impacts of border crossing behavior on tax revenues because potentially large gains from border crossing exist for Maryland residents due to the proximity of neighboring states, and in our dataset, we observe smokers in Maryland and all its neighboring states.

We use the estimates of price elasticity from the two previous sections to compute the state tax elasticity (responsiveness of sales to changes in the state tax) and the state revenue tax elasticity (the percentage change in state tax revenues due to a state tax increase) in the presence and absence of border crossing. Under the first scenario, we examine what would happen if no change in the border crossing incentive occurred. This resembles a situation where either no border crossing occurs, or this could correspond gerennna46948(6432(469)-270.04(w)34.65

pected quantity at each location is due solely to the percentage change in the optimal quantity of cigarettes $\hat{q}$ given by the quantity regression. Recall that the quantity regression from the previous section gives the relationship between the price and the optimal quantity of cigarettes to smoke, irrespective of location of purchase. The estimated state tax revenue elasticity is 0.94. [29]

For our second scenario, we allow for border crossing, and consequently, we need to account for how changes in taxes affect the probability of traveling to a given location. Equation (5) reveals that the overall change in expected quantity can be decomposed into two parts: the change in the probability of choosing a given location $\hat{pr}_{\ell}$ and in the optimal quantity of cigarettes $\hat{q}$. The own-price elasticities in Table 10 reflect these two margins. Applying the formulas from equations (6) and (7), we calculate the state tax elasticity and state tax revenue elasticity in columns (2) and (3) of Table 10. We find that for Maryland, a one percent increase in its state tax will increase revenues by 0.75 percent when consumers can respond by border crossing as opposed to the naive estimate of 0.94 percent in the absence of changes in border crossing behavior.

For the 36 cent increase in the Maryland tax, we can use these state tax revenue elasticities to approximate and compare the changes in revenues with and without border crossing. We present the results in in Table 11.[30] We estimate that increasing the tax by 36 cents from \$1 00 to \$1 36 per pack in Maryland increases state tax revenues by nearly 31 percent in Maryland, by 11 percent in West Virginia, and by smaller amounts in neighboring states. Absent changes in consumers' border crossing behavior, we estimate that Maryland tax revenues would increase 34 percent.[3]

Table 11 also presents the results from simulating a similar tax increase in D.C. from \$1 00 to \$1 36 per pack. A tax increase of 36 cents in D.C. increases

[29] Using equations (6) and (7), we let $_s$ = \$1 00 and $_f$ = \$0 39. We use \$4 105 for the

[illegible]

| | Maryland | District of Columbia |
|---|---|---|
| Delaware | 0. 11% | - |
| | (0.192) | |
| District of Columbia | .9 8% | 1 .917% |
| | (1.7 7) | (8.090) |
| Maryland | 2 .7 2% | 2.0 0% |
| | ( . 1) | (0. ) |
| New Jersey | 0.00 % | - |
| | (0.0029) | |
| Pennsylvania | 0. 10% | - |
| | (0.0 0) | |
| Virginia | 2.2 1% | .927% |
| | (1.197) | (1.8 ) |
| West Virginia | 10. 00% | - |
| | ( .7 8) | |

[illegible]

tax revenues by 34 percent absent a change in border crossing and by only 17 percent once consumers reoptimize their location of purchase.[3]

Our simulation conditions on the decision to smoke[33], and we also assume that the simulated tax changes do not aect the decision to smoke. In addition, we implicitly assume that a one cent increase in the tax will lead to a one-cent increase in the price paid by consumers. Chaloupka and Warner (2000) note that early studies have produced inconsistent findings regarding the relationship between taxes and prices in the U.S.; Keeler et al. (1996) estimated that a one-cent increase in a state's cigarette tax would raise retail prices in that state by 1.11 cents.

[32] Using equations (6) and (7), we let s = $1 00 and f = $0 39. We use $4 104 for the average price (inclusive of tax) for a pack of cigarettes as reported in Tax Burden on Tobacco in 2003 for D.C. For the own-price elasticity, we consider values between -0.2 and -0.3 as given in Table 8. The travel costs from our location model represent the average costs in the population and may tend to understate actual travel costs in dense urban areas such as D.C.; if this is the case, our border crossing estimate will be an upper bound.

[33] If we incorporate the extensive margin (the decision to smoke), then the responsiveness of demand to price changes will depend upon changes in the smoking participation rate. Assuming the participation rate does not change dierentially by state, then we would expect the unconditional elasticities to be even larger in magnitude; an increase in the tax-inclusive price will cause some individuals to stop smoking (quantity consumed = 0).

in October 2003 on computer and Internet penetration. We consider four measures of computer and Internet access: (1) home computer ownership, (2) home Internet access, (3) use of e-mail, and (4) purchase of goods online. Sixty-nine percent and 61 percent of respondents own a home computer and have Internet access at home. Forty-seven percent of participants have used e-mail, and 26 percent have made an online purchase.

We use a probit regression to estimate Internet access conditional on an individual's demographics, and we regress each of the four measures of computer and Internet access on educational attainment, gender, income bracket, ethnicity, state of residence, and a quadratic function of age. We find that the explanatory variables do a fairly good job of predicting our Internet use variables; the pseudo R-squared for each of the regressions lies between 0.2 and 0.25.

Table 12 presents the results of the four regressions on online use. We find similar relationships between demographics and each of our four metrics.

[illegible] 2 M [illegible] n [illegible] c [illegible] M [illegible] n [illegible] n Acc

| | (1) Computer at Home | (2) Internet in Home | ( ) Email | ( ) Online |
|---|---|---|---|---|

as our baseline model where all individuals were assumed to have access to the Internet, since variation in price and distance among the states (i.e., offline options) drive the identification of these coefficients.[34] As expected, the disutility of the outside good has declined slightly, since individuals now may not have access to the outside good (online) with some positive probability. The coefficients on the interactions between price and income are now positive, indicating that higher income individuals are less price sensitive. Higher income individuals are more likely to have Internet access and therefore buy online when they face higher offline prices.

# 7 Conclusion

In this paper, we estimate individuals' decisions to travel across borders in response to differential tax rates. Unlike previous studies, our rich dataset allows us to directly observe a consumer's location of purchase as well as demographics. Consequently, we can apply a discrete choice model to directly estimate a consumer's choice of purchase location.

Our approach contributes to the literature in four important ways. First, the richness of our dataset allows us to estimate how an individual's characteristics affects her propensity to travel. Since we directly observe an individual's location of choice, we can obtain more reliable estimates of the border crossing behavior relative to previous studies, which indirectly infer border crossing from smoking intensity. We find that the average individual who lives nearby a lower-tax jurisdiction is willing to travel 3 miles to save one dollar on a pack of cigarettes. Secondly, this is the first paper to provide an estimate of how stockpiling behavior differs between light and heavy smokers who choose to cross borders to purchase cigarettes. We find evidence that heavy smokers have a stronger incentive to cross borders and purchase in a lower-tax jurisdiction. Thirdly, we find evidence that the tax-inclusive price in a state declines as an individual lives closer to a border with a lower-tax jurisdiction, and rises as she lives closer to a border with a higher tax jurisdiction. Finally, we can separately estimate the effect of a tax increase on state sales and revenues in the presence of border crossing and also in the counterfactual scenario in the absence of border crossing. We find that a given state's increase in tax can differentially impact the sales of its neighboring states, depending on the distribution of the location and demographics of a state's population.

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Our ultimate goal is to investigate the public policy implications of tax changes and differences in taxes across neighboring jurisdictions in the absence and presence of border crossing. We apply the estimated parameters from our location model and consumption regression to simulate several counterfactual tax scenarios. In particular, we examine the effect of a 36 cent increase in the tobacco tax as debated by the Maryland General Assembly.

t iandlooss9482(m)2..26309(f)-282.991.26432(x)4.86191(e)3.56312(r)-291.736.7933(u)1.94646948(a different geographic locales or at the very least, incorporating these constraints when determining regulation stringency.

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