Exploring Border Effects: Sensitivity of Cigarette Consumption to Excise Tax

Aisha Baisalova

CERGE-EI

Aisha.Baisalova@cerge-ei.cz

26th August 2022

Disclosure Slide

- This study was supported by Charles University, GAUK project No 440120. I thank Nikolas Mittag and Jan Hanousek for their valuable feedback and suggestions.

Overview

Research Question

- Tax avoidance opportunities can serve as an important determinant of a consumer's purchase decision in response to an excise tax increase. Indeed, cross-state purchasing in the nearest lower-tax state decreases the impact of excise tax policy measures.

- Ignoring these 'border effects' leads to a biased estimate of the tax elasticity of consumption.

- Using Nielsen Consumer Panel data, we estimate the bias arising from border effects and investigate how sensitivity to cigarette excise tax and the size of bias vary for different demographic groups. We specifically concentrate on excise taxation of cigarettes in the US, where we can track the variability of state excise taxes across states.

Literature Review [1]

The negative effect of excise tax increases on tobacco consumption has been discussed in numerous studies.

Study	Research area
[Lee (2008)]	Evaluates the effect on cigarette consumption of a large increase in cigarette tax using data from telephone survey conducted from April to July 2004 in 23 major cities and counties in Taiwan.
[Cotti et al.(2018)]	Use Nielsen Consumer Panel data for the years 2011 through 2015 to investigate how tobacco control polices, such as excise taxes and smoke-free laws, affected purchases of cigarettes, electronic cigarettes and smoking cessation products.
[Pesko et al.(2020)]	Find evidence that higher traditional cigarette tax rates reduce adult traditional cigarette use and increase adult e-cigarette use.The estimates are based on the data from the Behavioral Risk Factor Surveillance System and National Health Interview Survey over the period from 2011 to 2018.

Literature Review [2]

Tax sensitivity can be affected by possible tax avoidance actions of consumers such as cross-border purchasing in the nearest lower-tax state. Since consumer decision is determined by final purchase price, imperfect tax pass-through to prices may bias the estimate of tax sensitivity and decrease applicability of the obtained results.

Study	Research area
[Harding et al.(2012)],	Showed that in the USA cigarette taxes are less that fully passed through to prices due to cross border purchasing.
[Kim and Lee (2020)]	Find that cigarette taxes are shifted significantly less to consumer prices in cities with large minority (Black and Hispanic) populations.
[Xu et al.(2014)]	Investigated how tax pass-through rate differs between premium and generic brands of cigarettes.
[Chiou et al.(2008)]	Introduces a discrete choice model to examine state border crossing in the market of cigarettes.

Data Description[1]

The data allow us to incorporate in the econometric model:

- Estimate border effects (geographic information);
- Analyze how the tax sensitivity of cigarette consumption and the size of bias vary among households with different demographic composition (demographic characteristics);

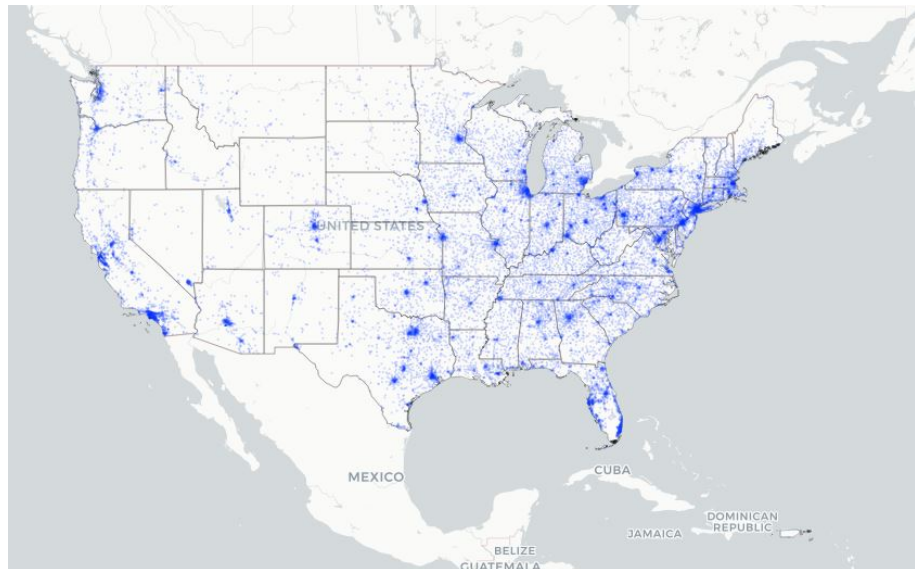| Source	Data description
Nielsen Consumer Panel Data	Data for the period: 2004-2019, 40000-60000 panelists, the USA. For each consumer: weekly purchase history of cigarettes, product characteristics, individual-level prices, demographic characteristics, address of residence

Data Description[2]

Data	Data description
Nielsen Scanner Data	Covers 3,158,152 cigarette purchase transactions made by 52,726 households spanning from 2004 until 2019.
Created Panel Dataset	The transactional data set was transformed to panel data by aggregating the data to the household-quarter level. The frequency of the panel data set coincides with the frequency of historical cigarette tax data obtained from the CDC database. The resulting panel data set comprises 378,101 observations of quarterly cigarette purchases.

Data Description[3]

- We estimate the distance between consumers and lower-tax borders using United States Census Bureau TIGER/Line shape files as the distance from the household's census tract of residence provided in the data to the border of the closest lower tax state. The lower tax state does not need to be a border state.

- We identify the coordinates of boundaries for each US state and calculate the distance from each consumer zip code to the state boundaries of every US state.

- We estimate the distance to the lower tax state for each time period and consumer zip code as the closest distance to the border of the state with the lower state cigarette tax.

- Since we measure the distance to the lower tax state for each time period, we are able to properly capture the state and time level heterogeneity in cigarette taxes and the cost of cross-border purchasing.
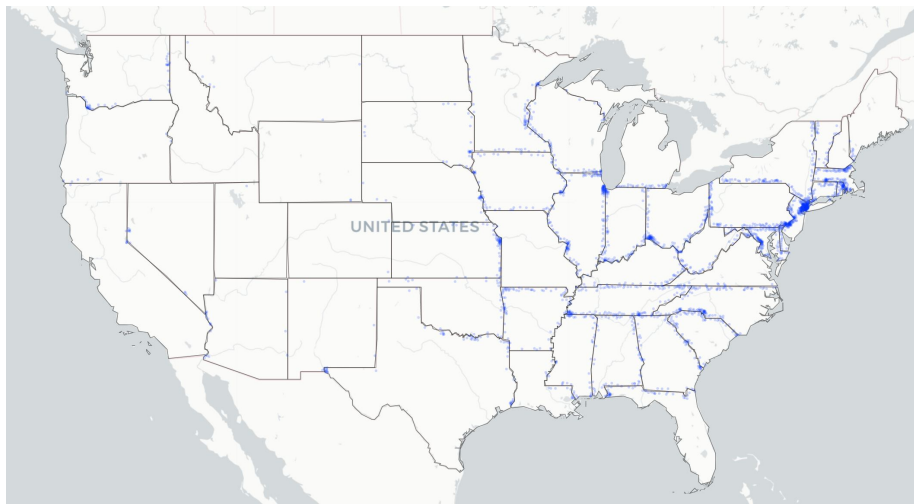
Data Description[4]

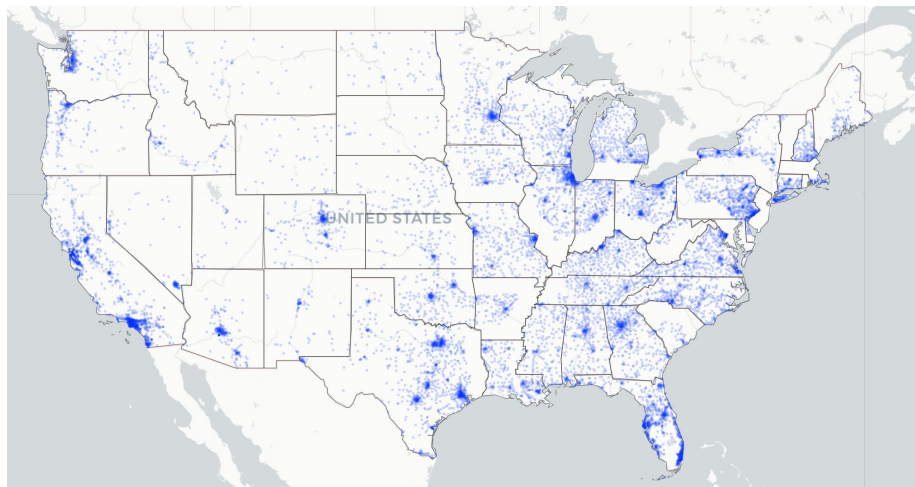Distribution of Panelists over US States.

Data Description[5]

Distribution of Panelists Residing Near the Border of a Lower Tax State.

Data Description[6]

Distribution of Panelists Residing Far from the Border.

Panel Data Regression Specification (1)

We regress cigarette consumption on excise tax rate, distance to the nearest border of lower-tax state, difference in the tax rate between state of residence and lower-tax state, interaction between distance and tax difference, and household's demographic characteristics.

$$cig_{ijt} = \alpha_0 + \alpha_1 \tau_{jt}^h + \alpha_2 \left(\tau_{jt}^h - \tau_{jt}^b \right) + \alpha_3 D_{ijt} + \alpha_4 D_{ijt}$$
$$\times \left(\tau_{jt}^h - \tau_{jt}^b \right) + \beta X_i + \sigma_i + \omega_j + \epsilon_{ijt},$$

Variable	Description
cig_{ijt}	is the number of cigarette packs consumed by a household i in state j and time t
τ_{jt}^h and τ_{jt}^b	excise tax rate in the state of household's residence and in the nearest low-tax state respectively
D_{ijt}	is the distance to the closest lower-tax state
X_i	is a vector of household demographic characteristics
σ_i and ω_j	are individual and state level fixed-effects

We use the same model but without variables related to border effects, which are distance to the nearest border of lower-tax state, difference in the tax rate between state of residence and lower-tax state, interaction between distance and tax difference

$$cig_{ijt} = \alpha_0 + \alpha_1 \tau_{jt}^h + \beta X_i + \sigma_i + \omega_j + \epsilon_{ijt},$$

Variable	Description
cig_{ijt}	is the number of cigarette packs consumed by a household i in state j and time t
τ_{jt}^h	excise tax rate in the state of household's residence
X_i	is a vector of household demographic characteristics
σ_i and ω_j	are individual and state level fixed-effects

Estimation of Baseline Model on the Whole Sample

We observe that tax sensitivity in the model specification with variables related to border effects is larger than in the similar specification excluding these variables.

	Spec (1)	Spec (2)
Tax difference	4.858***	
	(0.484)	
Lower tax state distance	−0.004***	
	(0.001)	
Tax distance interaction	−0.024***	
	(0.002)	
Tax value	−13.902***	−12.294***
	(0.300)	(0.221)
Demographic characteristics:	yes	yes
Consumer fixed effects:	yes	yes
State fixed effects:	yes	yes
Observations	378,101	378,101
F Statistic	87.288***	86.855***

Estimated Tax Sensitivity among Heterogeneous Groups [1]

Demographic Group	Coefficient Estimate on τ^h	
	Spec (1)	Spec (2)
Border resident: $\leq$ 25 km. from the border	-19.929^{***}	-9.639^{***}
Not border resident: $\succ$ 25 km. from the border	-14.225^{***}	-12.798^{***}
Heavy smoker: $\geq$ 80th percentile	-24.079^{***}	-20.863^{***}
Average smoker: 30th percentile - 80th percentile	-6.451^{***}	-5.402^{***}
Light smoker: $\leq$ 30th percentile	-0.271^{***}	-0.176^{***}
High income: annual income $\geq$ 70,000$	-13.294^{***}	-11.832^{***}
Middle income: annual income 30.000$ - 69.999$	-13.600^{***}	-11.689^{***}
Low income: annual income $<$ 30.000$	-15.243^{***}	-13.606^{***}
Head employment: 35+ hours	-12.106^{***}	-10.509^{***}
Head employment: $\leq$35 hours	-11.741^{***}	-9.158^{***}
Head employment: Not employed	-16.019^{***}	-14.069^{***}

Demographic Group	Coefficient Estimate on τ^h	
	Spec (1)	Spec (2)
Head education: HS graduate or lower	-15.975^{***}	-13.493^{***}
Head education: Some college	-12.556^{***}	-11.541^{***}
Head education: BA +	-11.426^{***}	-10.100^{***}
Head age: $\geq$50	-14.310^{***}	-13.011^{***}
Head age: 35-49	-13.756^{***}	-11.183^{***}
Head age: $<$ 35 years	-6.843^{***}	-5.418^{***}
Presence of children: yes	-12.079^{***}	-9.181^{***}
Presence of children: no	-14.298^{***}	-12.913^{***}
Gender composition: Female head only	-12.354^{***}	-10.523^{***}
Gender composition: Female and male head	-14.764^{***}	-13.266^{***}
Gender composition: Male head only	-12.536^{***}	-10.615^{***}

Estimation results

- The bias is particularly large for border residents.
- Estimated elasticities are larger for the low income group. Higher tax sensitivity estimated for unemployed consumers and consumers without college degree can be potentially explained by the fact that, on average, these demographic groups have lower income.
- We identify that estimated tax elasticity increases with smoking intensity in contrast to [Lee (2008)] and [Cotti et al.(2018)], who show that heavy smokers do not respond to excise tax policy measures.

Robustness analysis

- As a robustness check, we want to ensure that tax sensitivity τ^h in model specification (2) on average exhibits a decreasing pattern when we subsequently remove households residing near a lower-tax state border from the estimation.

- We start with the whole population sample and estimate the tax elasticity of cigarette demand for each demographic group. Further, we subsequently exclude border residents residing less than 5, 10, 15, ..., 50 kilometers away from the border and re-estimate the tax sensitivity for each population group.

- The decreasing pattern of the negative coefficient on the home state tax τ^h implies that the cost of cross-border purchasing increases with the distance to the lower-tax state border. Therefore, the tax sensitivity estimate gradually converges to the unbiased estimate when border effects are eliminated.

Aggregate Sample

The error bands show the bounds of the 95 percent confidence interval.
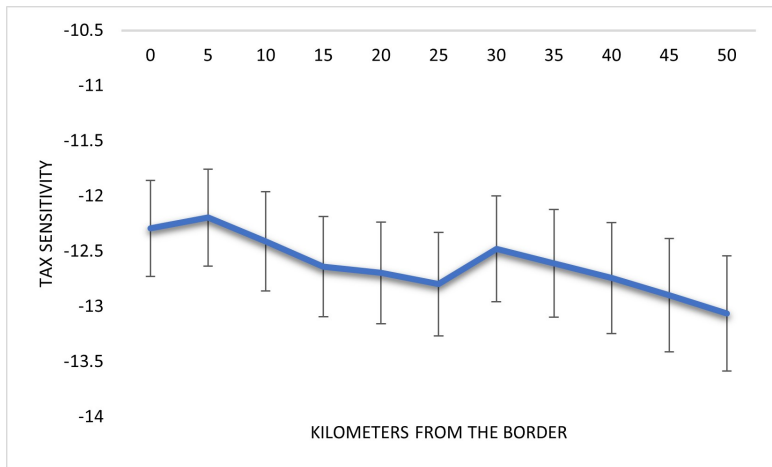
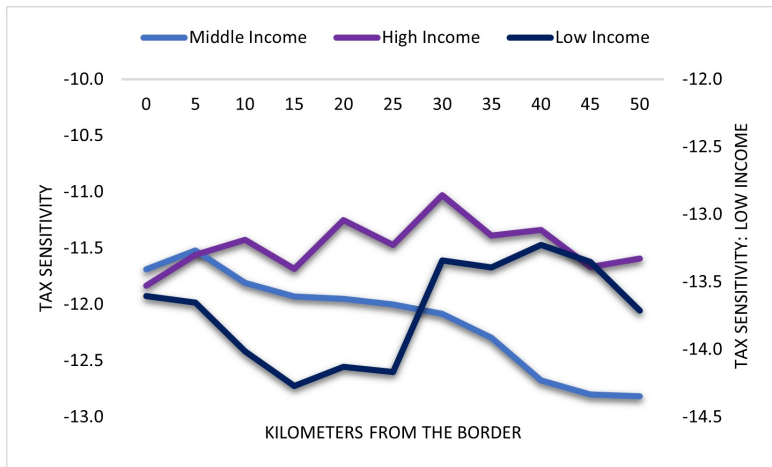Figure: Excluding households residing near the border: Aggregate Sample

Household Income

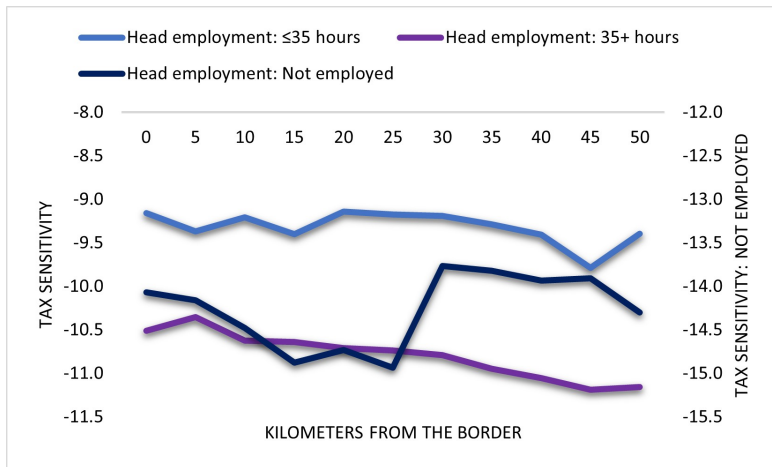Figure: Excluding households residing near the border: Household Income

Figure: Excluding households residing near the border: Head Employment

Head Education

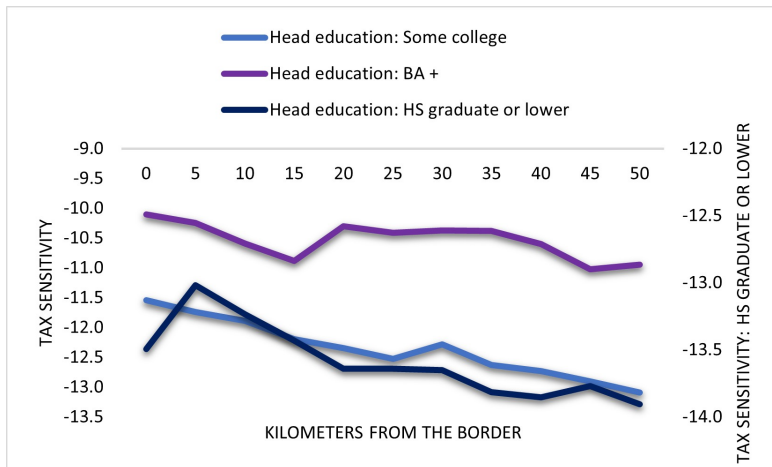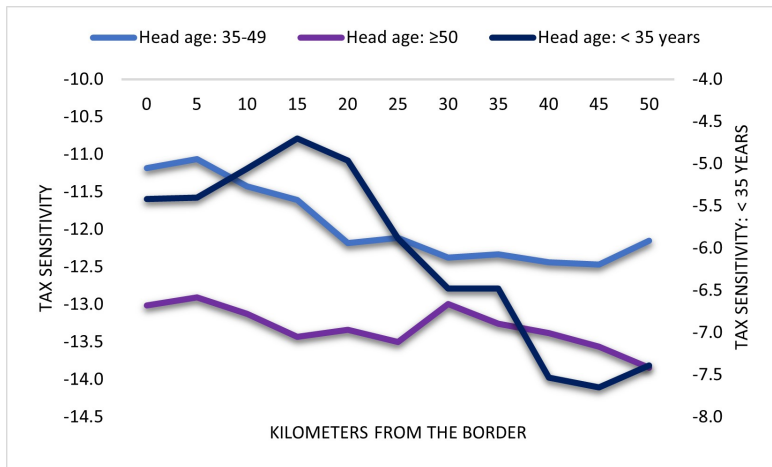Figure: Excluding households residing near the border: Head Education

Figure: Excluding households residing near the border: Head Age

Gender Composition

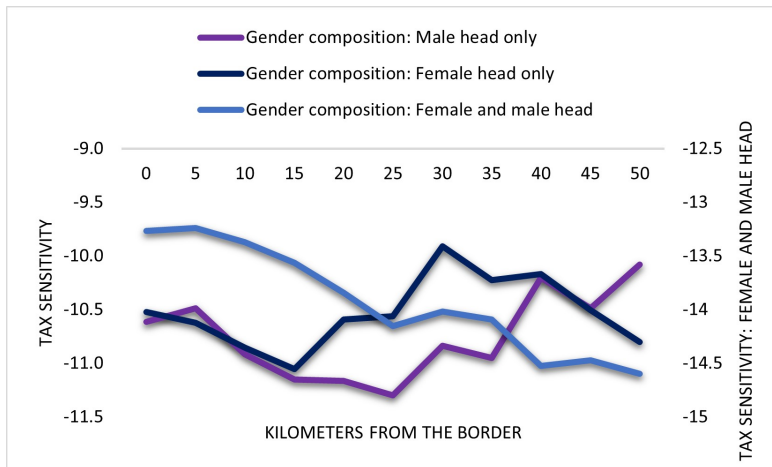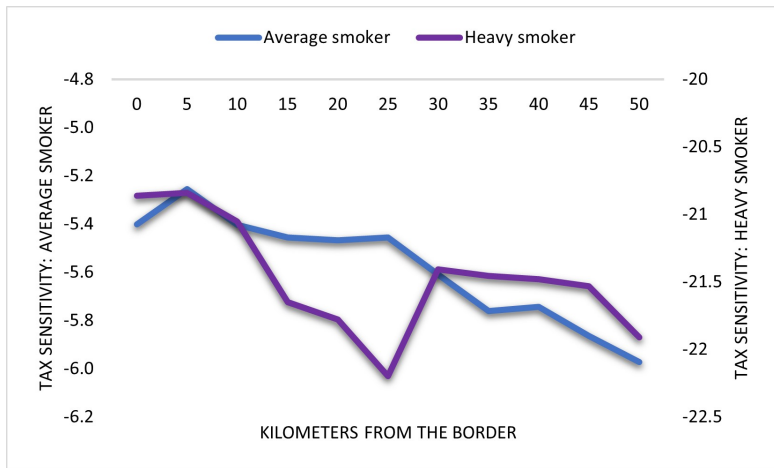Figure: Excluding households residing near the border: Gender Composition

Figure: Excluding households residing near the border: Smoking Intensity by Heavy and Average Smokers
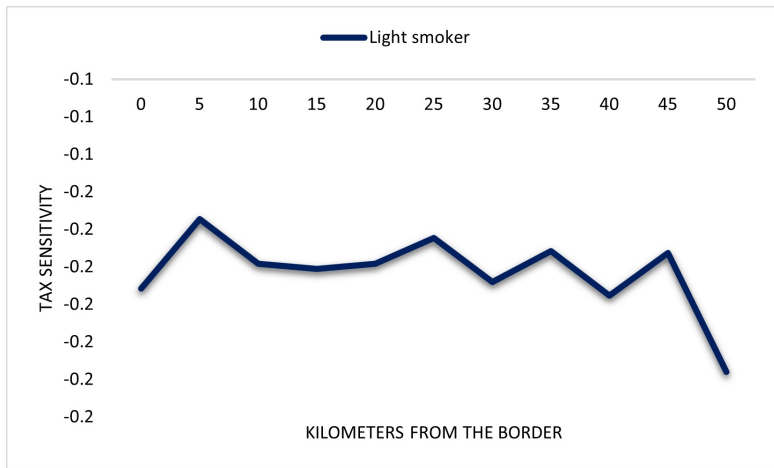
Smoking Intensity by Light Smokers

Figure: Excluding households residing near the border: Smoking Intensity by Light Smokers

Conclusion

- We find that border effects create a bias in the estimate of tax elasticity, which is present for all demographic groups. The bias is particularly large for border residents.

- We analyze how the consumer response to a cigarette tax increase varies between households with different demographic compositions. We observe higher tax elasticity for the low income group. Higher tax sensitivity estimated for unemployed consumers and consumers without college degree can be potentially explained by the fact that, on average, these demographic groups have lower income.

- Furthermore, we identify that estimated tax sensitivity is statistically significant for heavy smokers and increases with smoking intensity, which can be beneficial from the perspective of potential public health implications, unlike [Lee (2008)] and [Cotti et al.(2018)], who show that heavy smokers do not respond to excise tax policy measures.

References[1]

Chiou, Lesley and Muehlegger, Erich
Crossing the Line: Direct Estimation of Cross-Border Cigarette Sales and the Effect on Tax Revenue.
The B.E. Journal of Economic Analysis and Policy 8(1), 1-41

Cotti, C. and Nesson, E. and Tefft, N.
The relationship between cigarettes and electronic cigarettes: Evidence from household panel data.
Journal of Health Economics 61, 205-219

Harding, Matthew and Leibtag, Ephraim and Lovenheim, Michael F.
The Heterogeneous Geographic and Socioeconomic Incidence of Cigarette Taxes: Evidence from Nielsen Homescan Data
American Economic Journal: Economic Policy 4(4), 169-198

Kim, Hyunchul and Lee, Dongwon
Racial demographics and cigarette tax shifting: evidence from scanner data
Empirical economics 61(2), 1011-1037

References[2]

📄 Lee, Jie-Min

Effect of a large increase in cigarette tax on cigarette consumption: an empirical analysis of cross-sectional survey data

Public health (London) 122(10), 1061-1067

📄 Lovenheim, M. F.

How far to the border?: The extent and impact of cross-border casual cigarette smuggling.

National Tax Journal 7-33

📄 Pesko, Michael F and Courtemanche, Charles J and Maclean, Johanna Catherine

The effects of traditional cigarette and e-cigarette tax rates on adult tobacco product use

Public Finance Review 60(3) 229-258

📄 Xu, Xin and Malarcher, Ann and O'Halloran, Alissa and Kruger, Judy

Does every US smoker bear the same cigarette tax?

Addiction 109(10), 1741-1749