

# Advertising and Demand for Addictive Goods: The Effects of E-Cigarette Advertising

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# What Are E-Cigarettes? Why Study This Industry?

| E-Cigarette Brand   | Cigarette Brand   |
|---|---|
|  |  |
|  |    |
|  |    |
|  |    |

# Research Questions

1. What is the effect of e-cigarette advertising on demand for cigarettes?
  - ▶ Direct: advertising spillovers?
  - ▶ Indirect: substitutes or complements?
2. What would be the impact of banning e-cigarette advertising?

# Ad Spillovers - Renormalization & Visual Smoking Cues



**SMOKE IN STYLE**  
With blu Electronic Cigarettes

Freedom never goes out of fashion. Control when and where you want to smoke with blu electronic cigarettes. blu produces no smoke and no ash, only vapor, making it the ultimate accessory and the smarter alternative to regular cigarettes. Step out in style with blu.

SCAN FOR A CHANCE TO WIN A STARTER KIT

 **'like' us on Facebook**  
facebook.com/blucigs

**blu**

blucigs.com

Availability of these fine retailers:

© 2010 Philip Morris Inc. All rights reserved.

**18+ only.** CALIFORNIA PROPOSITION 65 Warning: This product contains nicotine, is derived from tobacco in the state of California. Nicotine is addictive and may be harmful to you.



*Rewrite The Rules.*

**FIN**  
Electronic Cigarettes

REDEEM YOUR \$5 OFF COUPON AT [FINCIGS.COM/STYLE](http://FINCIGS.COM/STYLE)

**FIN**  
Premium Cigarettes



# Product Complementarities - Indoor Use



**DEAR SMOKING BAN,**

**blu ELECTRONIC CIGARETTE**

Take back your freedom to smoke anywhere with blu electronic cigarettes. blu produces no smoke and no ash, only vapor, making it the smarter alternative to regular cigarettes. It's the most satisfying way to tell the smoking bans to kiss off. Okay, maybe the second-most satisfying way.

**blu**  
New blu Green Pack

**blucigs.com**

18+ only. CALIFORNIA PROPOSITION 65 Warning: This product contains nicotine, a chemical known to the state of California to cause birth defects or other reproductive harm.

# Overview of Empirical Analyses

## 1. Descriptive analysis

Market data: identification of ad effects

Household data: addiction and substitution patterns

## 2. Structural demand model

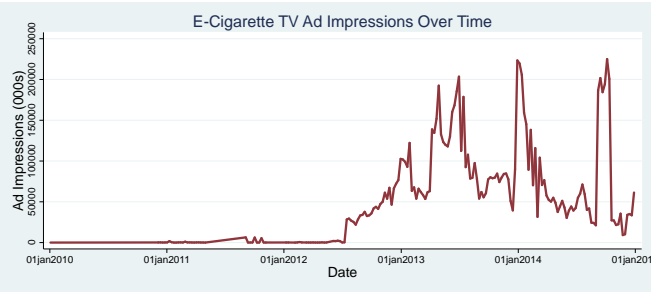
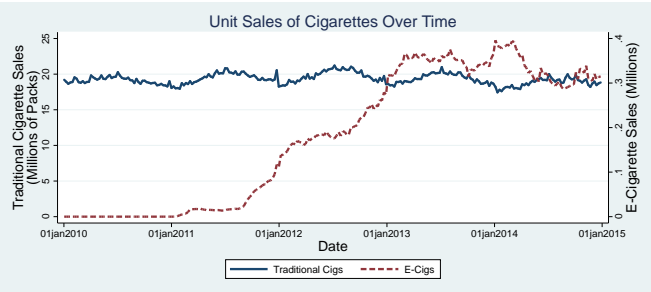
Both market and household data

## 3. Counterfactual analysis: e-cigarette ad ban

# Data Description - Aggregate and Household-Level Data

- ▶ Nielsen Advertising Data
  - Weekly DMA-level TV ad impressions and GRPs
  - 2009-2014
- ▶ Nielsen Purchase Data
  - Weekly store sales volume and prices
  - Daily household purchase panel
  - 2010-2014

# Data - Aggregate Trends in Sales and Advertising



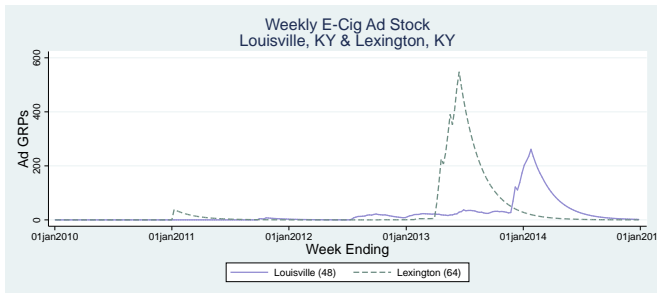
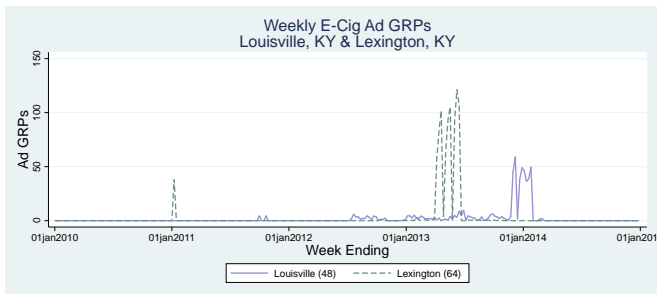


## Data Description - E-Cigarette Shares by Brand

|                    | Market Share  | Ad Impression Share |
|--------------------|---------------|---------------------|
| Blu (Lorillard)    | 57.8%         | 74.1%               |
| Vuse (RJ Reynolds) | 1.1%          | 10.7%               |
| NJOY               | 8.5%          | 8.4%                |
| Fin                | 12.0%         | 4.2%                |
| Other              | 20.6%         | 2.7%                |
| Total              | \$289,500,000 | 10,328,566,000      |



# Across Border Variation in Advertising Over Time



# Market Level Border Counties Regression Results

$$Q_{mt} = \beta_m + \beta_{bt} + \phi \vec{A}_{mt} + \alpha \vec{p}_{mt} + \epsilon_{mt}$$

|                                       | E-Cig Cartridges     |
|---------------------------------------|----------------------|
| E-Cigarette Ad GRPs                   | 0.191***<br>(0.035)  |
| Smoking Cessation GRPs                | -0.047***<br>(0.013) |
| Price Controls                        | Y                    |
| N Obs                                 | 52,236               |
| E-Cig Ad Elasticity                   | 0.02                 |
| % $\Delta Q$ from 1 SD $\uparrow A^e$ | 4.86%                |
| *** p<0.01, ** p<0.05, * p<0.1        |                      |

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|                                       | E-Cig Cartridges     | Cigarette Packs      |
|---------------------------------------|----------------------|----------------------|
| E-Cigarette Ad GRPs                   | 0.191***<br>(0.035)  | -2.811***<br>(0.806) |
| Smoking Cessation GRPs                | -0.047***<br>(0.013) | -0.478<br>(0.315)    |
| Price Controls                        | Y                    | Y                    |
| N Obs                                 | 52,236               | 52,236               |
| E-Cig Ad Elasticity                   | 0.02                 | -0.004               |
| % $\Delta Q$ from 1 SD $\uparrow A^e$ | 4.86%                | -0.90%               |
| *** p<0.01, ** p<0.05, * p<0.1        |                      |                      |

# Household Data Description

- ▶ Observe all household purchases between 2010-2014
- ▶ Cigarettes, e-cigarettes, and smoking cessation products

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- ▶ Cigarettes, e-cigarettes, and smoking cessation products
- ▶ 881 households buy e-cigarettes
- ▶ Mean HH: 3 packs cigarettes per week & 6 e-cig purchases
- ▶ Majority of HHs (83%) buy cigarettes before e-cigarettes

# Substitution and Addiction in Household Purchase Data

$$c_{it} = \alpha_i + \alpha_t + \gamma E_{it} + \beta C_{it} + \delta_1 P_{it} + \delta_2 G_{it} + \epsilon_{it}$$

|                                  | Cig Packs            |
|----------------------------------|----------------------|
| E-Cig Cartridges in Prev 4 Weeks | -0.030***<br>(0.008) |
| Cig Packs in Prev 4 Weeks        | 0.060***<br>(0.007)  |
| Nicotine Patches                 | Y                    |
| Nicotine Gum                     | Y                    |
| HH FE & Week FE                  | Y                    |
| N Obs                            | 1,970,419            |
| Mean DV                          | 1.410                |
| Effect +1 E-Cig as % of DV       | -2.13%               |
| *** p<0.01, ** p<0.05, * p<0.1   |                      |



# Summary of Descriptive Results

1. E-cigarette advertising  $\uparrow$  e-cig demand and  $\downarrow$  cigarette demand
2. Household purchase patterns consistent with addiction
3. Traditional cigarettes and e-cigarettes are substitutes

# Modeling Objectives and Challenges

## 1. Objectives

- Leverage both individual and market-level data

  - Identify advertising effects using border discontinuities

  - Capture dynamic dependencies resulting from addiction

  - Allow for heterogeneity in preferences

- Simulate a counterfactual ban on e-cigarette advertising

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## 2. Challenges

- Aggregation of individual-level model with state dependence and heterogeneity

- Border discontinuity identification in structural model

# Demand Model w/ Addiction - HH & Aggregate Demand

## 1. Household Demand

Addiction:  $t - 1$  consumption  $c_{t-1}$  increases utility in  $t$

$$u_{ijt} = \underbrace{\beta_j + \alpha p_{jt} + \phi A_t + \xi_{jt}}_{\delta_{jt}(\theta)} + \gamma c_{it-1} + \varepsilon_{ijt}$$

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## 2. Aggregate Demand

$$\sigma_{jt}(c_{t-1}|\theta) = \frac{e^{\delta_{jt}(\theta) + \gamma c_{t-1}}}{1 + \sum_k e^{\delta_{kt}(\theta) + \gamma c_{t-1}}}$$

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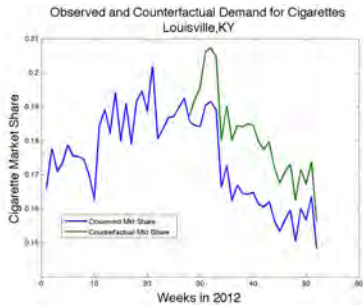
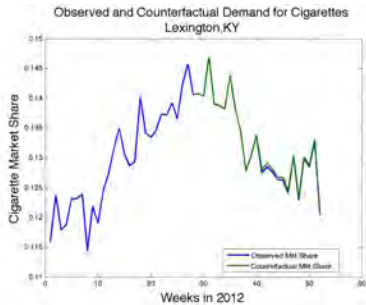
$$\sigma_{jt}(c_{t-1}|\theta) = \frac{e^{\delta_{jt}(\theta) + \gamma c_{t-1}}}{1 + \sum_k e^{\delta_{kt}(\theta) + \gamma c_{t-1}}}$$

- ▶ Weight logit purchase probabilities for each consumption state by probability of the consumption state

$$\begin{aligned} s_{jt} &= \mathbb{E}_{c_{t-1}}[\sigma_{jt}] \\ &= \sigma_{jt}(c_{t-1} = 1|\theta) \times Pr(c_{t-1} = 1|\theta) + \sigma_{jt}(c_{t-1} = 0|\theta) \times Pr(c_{t-1} = 0|\theta) \\ &= \sigma_{jt}(c_{t-1} = 1|\theta) \times (1 - s_{0t-1}) + \sigma_{jt}(c_{t-1} = 0|\theta) \times s_{0t-1} \end{aligned}$$

# Counterfactual E-Cigarette Advertising Ban

- ▶ Impose a ban on e-cigarette advertising
- ▶ Simulate market demand using the counterfactual ad stock
- ▶ Median  $\% \Delta$  in cigarette market share:  $\uparrow 2.64\%$ .





# Contributions

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Advertising spillovers across categories

First empirical analysis of e-cigarette ad effects at scale

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## 2. Methodological

Aggregation of structural model with state dependence & unobserved heterogeneity

Identification of ad effects w/ border discontinuities w/in nonlinear model

THANK YOU!

## E-Cigarette Advertising Market Share by Media Type

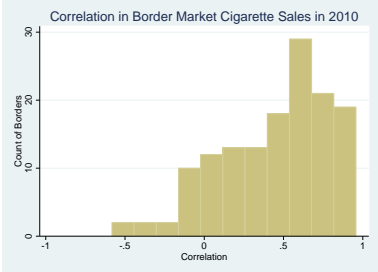
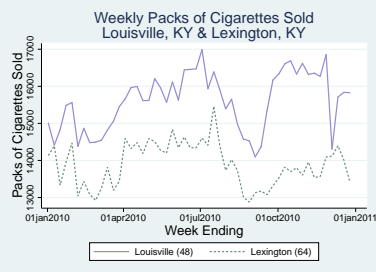
|          | Media Type            | Dollar Share | Impression Share |
|----------|-----------------------|--------------|------------------|
| National | Cable                 | 73.4%        | 85.7%            |
|          | Network               | 3.0%         | 6.4%             |
|          | Syndicated            | 0.4%         | 0.5%             |
| Local    | Spot                  | 23.1%        | 6.6%             |
|          | Network Clear Spot    | 0.0%         | 0.6%             |
|          | Syndicated Clear Spot | 0.0%         | 0.2%             |
| Total    |                       | \$54,185,012 | 10,328,566,000   |



## Within and Across Market Variation in Ad Stock

|                                 | N   | Min  | Median | Mean  | Max    |
|---------------------------------|-----|------|--------|-------|--------|
| Ave E-Cig GRP Stock             | 300 | 0.03 | 14.88  | 21.84 | 138.45 |
| Ave Abs $\Delta$ E-Cig Ad Stock | 150 | 0.70 | 21.25  | 27.89 | 139.54 |
| Coeff Var E-Cig GRPs            | 300 | 1.64 | 3.56   | 4.01  | 10.00  |

# Common Trends: Across Border Variation in Cig Sales



# Identification Strategy - Challenges

- ▶ Identification relies on common trends assumption
- ▶ Problem if unobserved shock on one side of border correlated with sales and advertising.
  - County excise taxes increase
  - County indoor smoking legislation tightens



## Average Characteristics in Border and Non-Border Markets

|                       | Border<br>Counties | Non-Border<br>Counties | <i>p</i> -value |
|-----------------------|--------------------|------------------------|-----------------|
| % Female              | 50.14              | 50.16                  | 0.764           |
| % Population Under 18 | 22.22              | 22.74                  | 0.000           |
| % HS Diploma          | 83.31              | 85.16                  | 0.000           |
| % White               | 86.08              | 85.08                  | 0.148           |
| % Black               | 8.99               | 10.10                  | 0.085           |
| Per Capita Income     | 23,228             | 24,380                 | 0.000           |
| Population Density    | 169.4              | 502.1                  | 0.001           |
| N Counties            | 772                | 1,202                  |                 |

## Normalized Absolute Deviations in Demographics Across Bordering Markets

$$d_b^x = \frac{|x_{bi} - x_{bj}|}{\sigma_x}$$

|                       | N   | Min  | Median | Mean | Max  |
|-----------------------|-----|------|--------|------|------|
| % Female              | 150 | 0.00 | 0.57   | 0.87 | 5.59 |
| % Population Under 18 | 150 | 0.00 | 0.58   | 0.79 | 3.59 |
| % HS Diploma          | 150 | 0.01 | 0.46   | 0.61 | 3.88 |
| % White               | 150 | 0.00 | 0.30   | 0.48 | 2.38 |
| % Black               | 150 | 0    | 0.17   | 0.36 | 2.49 |
| Per Capita Income     | 150 | 0.00 | 0.41   | 0.64 | 4.47 |
| Population Density    | 150 | 0.00 | 0.17   | 0.48 | 4.81 |



# Market Level Border Counties Regression Results

$$Q_{mt} = \beta_m + \beta_{bt} + \phi \vec{A}_{mt} + \alpha \vec{p}_{mt} + \epsilon_{mt}$$

|                                       | Patches            | Gum                  |
|---------------------------------------|--------------------|----------------------|
| E-Cigarette Ad GRPs                   | -0.024<br>(0.019)  | -1.546***<br>(0.347) |
| Nicotine Patch Ad GRPs                | -0.039*<br>(0.020) | 1.062***<br>(0.299)  |
| Nicotine Gum Ad GRPs                  | -0.005<br>(0.015)  | -0.310<br>(0.217)    |
| Price Controls                        | Y                  | Y                    |
| N Obs                                 | 37,077             | 37,077               |
| E-Cig Ad Elasticity                   | -0.003             | -0.006               |
| % $\Delta Q$ from 1 SD $\uparrow A^e$ | -0.72%             | -1.40%               |
| *** p<0.01, ** p<0.05, * p<0.1        |                    |                      |



# Assumptions on Error Term

$$Q_{mt} = \beta_m + \beta_{bt} + \phi \vec{A}_{mt} + \alpha \vec{p}_{mt} + \epsilon_{mt}$$

$\uparrow \quad \uparrow$

$$\epsilon_{mt} = u_m + v_{bt} + \nu_{mt}$$

## Assumptions

1.  $Cov(\nu_{mt}, \nu_{mt-1}) = 0$

No market-specific serial correlation after FEs  
Implied by common trends assumption

2.  $Cov(\nu_{mt}, A_{mt}) = 0$

Advertising not targeted based on demand in border markets

