The Effects of Banning Advertising in Junk Food Markets

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Introduction

The Paper on a glance

Main question: Could a ban on junk food ads help tackle the obesity epidemic?

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But let's have a look at the paper anyway, shall we?

- Study of UK potato chips market and TV ads
- Effects of ban are complex: expand vs. steal, substitutes, price reactions, tilt demand curves
- In total: reduction by 10-15%
- Identification: Exploit variation in consumers' TV ads exposure
- Flexibility in specification of demand

Consumer Demand

Model

Random utility discrete choice model with consumer specific Ad measure. i's payoff from j is:

$$\begin{aligned}\overline{v}_{ijt} &= v_{ijt} + \epsilon_{ijt} \\ &= \alpha_{1i} p_{jt} + \psi_{1i} \mathbf{x}_j + \left[\lambda_i \mathfrak{a}_{ib(j)t} + \alpha_{2i} \mathfrak{a}_{ib(j)t} p_{jt} + \psi_{2i} \mathfrak{a}_{ib(j)t} n_{b(j)} + \rho_i \left(\sum_{l \neq b(j)} \mathfrak{a}_{ilt} \right) \right] \\ &\quad + \xi_{ib(j)} + \tau^d_{b(j)t} + \epsilon_{ijt}\end{aligned}$$

- The term in brackets is a flexible specification of how Ads influence demand
- First is direct effect of Ads
- Second allows Ads to have effect on price elasticities
- Third allows effect on willingness to pay for nutrients
- Fourth gives possibility of cooperative or predatory Ads and for either market expansion or contraction

$\rightarrow$ Allow for heterogeneity in all preference parameters

Model

Payoff from unhealthy option:

$$\begin{aligned}\overline{v}_{i\underline{0}t} &= v_{i\underline{0}t} + \epsilon_{i\underline{0}t} \\ &= \xi_{i\underline{0}j} + \psi_{1i} x_{\underline{0}} + \tau^{d}_{\underline{0}t} + \epsilon_{i\underline{0}t}\end{aligned}$$

Healthy option's mean utility is zero:

$$\overline{v}_{i\overline{0}t} = \epsilon_{i\overline{0}t}$$

Consumer chooses whichever product has highest $\overline{v}_{ijt}$. Assume ϵ_{ijt} is i.i.d. and of type I extreme value distribution. Probability is then

$$s_{ij}\left(\mathfrak{a}_{it}, \mathbf{p}_t, \tau^{\mathbf{d}}_{\mathbf{t}}\right) = \frac{\exp\left(v_{ijt}\right)}{1 + \exp\left(v_{i\underline{0}t}\right) + \sum_{j'=1}^{J} \exp\left(v_{ij't}\right)}$$

Consumer Heterogeneity

Coefficients on price, own advertising, competitor advertising, nutrient characteristic and major brand effects modelled as random coefficients, with distribution

$$(-\ln \alpha_{1i}, \psi_{1i}^{n}, \lambda_i, \rho_i, \xi_{iW})' \Big| \, i \in \mathcal{D}_d \sim \mathcal{N}(\overline{\mu}_{\mathbf{d}}, \Sigma_d)$$

Allow for preference heterogeneity across observable demographic groups

Identification

Three challenges:

- Identifying causal impact of advertising on demand $\rightarrow$ use variation in timing and channels of Ads and variation in individuals' TV viewing. Allows also to identify demand at zero Ads.
- Identifying causal effect of price on demand $\rightarrow$ exploit differences in the non-linear within brand price schedules. Key assumption: No unobserved taste shocks for pack-sizes different between brands.
- Identification of distribution of unobserved heterogeneity $\rightarrow$ Micro longitudinal data with cross-sectional and within consumer variation across time.

Supply

Need to aggregate individual choice probabilities into market shares. Assume random coefficients are i.i.d. across consumers.

$$s_j\left(\mathfrak{a}_t, \mathbf{p}_t, \tau_t\right) = \int s_{ij}\left(\mathfrak{a}_{it}, \mathbf{p}_t, \tau_t^{\mathbf{d}}\right) f(\pi|d) f(d) \mathrm{d}\pi \mathrm{d}d$$

Conditional on the state variables, equilibrium prices are chosen by firms to maximize current static profits $\rightarrow$ identify firms' marginal costs:

$$\sum_{j \in \mathcal{J}_f} \left(p_{jt} - c_{jt}\right) s_j\left(\mathfrak{a}_t, \mathbf{p}_t, \tau_t\right) M_t - \sum_{b \in \mathcal{B}_f} e_{bt}$$

FOCs:

$$s_j\left(\mathfrak{a}_t, \mathbf{p}_t, \tau_t\right) + \sum_{j' \in \mathcal{J}_f} \left(p_{j't} - c_{j't}\right) \frac{\partial s_{j'}\left(\mathfrak{a}_t, \mathbf{p}_t, \tau_t\right)}{\partial p_{jt}} = 0 \quad \forall j \in \mathcal{J}_f$$

$\rightarrow$ Nash-Bertrand game price setting. In the absence of Ads we have these conditions hold at $\mathbf{p}_t^0$ and $\mathfrak{a} = 0$.

Application

Application

- U.K. potato chips market; few firms, large budgets
- Purchase for future or on-the-go
- Data sources: Kantar Worldpanel (grocery transaction barcode data & media viewing) and advertising data by AC Nielsen for 144,898 ads in Feb ’09 - Oct ’10

$\rightarrow$ generate exposure to brand level advertising measure for HHs.

Argue that variation in timing and extent of exposure leads to cross HH variation in ad exposure that is unrelated to shocks to chip products, conditional on all controls.

Ad exposure

$$a_{ibt} = \sum_{s,c,k} w_{iskc} T_{bskct}$$

is the HHs total exposure to ads and

$$\mathfrak{a}_{ibt} \equiv \mathcal{A}(a_{ibt}, a_{ibt-1}, \ldots, a_{ib0}) = \sum_{n=0}^{t-t_0} \delta^n a_{ibt-n}$$

so like a decaying stock.

Product definition

- When no potato chips are bought $\rightarrow$ outside option. This assumes that Ads and pricing can influence propensity to buy, but not to go shopping.
- Aggregation to 37 products (brand-pack size combination)
- Different choice sets for future & on-the-go
- Allow for influence of future on on-the-go
- Nutrient index

HHs:

- distinguished along (i) HH composition, (ii) education, (iii) income
- all coefficients vary across groups

Estimates

Results

Effect on willingness to pay

TABLE 5

Effect of advertising on willingness to pay for an increase in healthiness (a 1 point reduction in nutrient profiling score)

	Difference relative to zero exposure:	Position in advertising exposure distribution		
		10th percentile	Median	90th percentile
At home	Willingness to pay (in pence)	−4.7 [−6.8, −3.1]	−7.2 [−10.7, −4.4]	−9.2 [−14.0, −5.5]
	% of mean price	−2.3 [−3.3, −1.5]	−3.5 [−5.2, −2.1]	−4.5 [−6.8, −2.7]
On−the−go	Willingness to pay (in pence)	−0.4 [−1.0, −0.2]	−0.6 [−1.3, −0.3]	−0.6 [−1.5, −0.3]
	% of mean price	−0.9 [−2.0, −0.5]	−1.1 [−2.6, −0.5]	−1.2 [−2.9, −0.5]

Results

For the three most heavily advertised brands

TABLE 6
Effect of advertising on market own price elasticities

	Walkers Regular	Pringles	KP
Own price elasticity in observed equilibrium			
<150 g			−1.22
			[−1.25, −1.18]
150 g–300 g	−1.63	−1.45	−1.57
	[−1.68, −1.57]	[−1.51, −1.40]	[−1.62, −1.52]
300 g+	−2.61	−2.66	−2.53
	[−2.73, −2.50]	[−2.78, −2.54]	[−2.62, −2.43]
% reduction in price elasticity under zero market advertising			
<150 g			1.13%
			[0.86, 1.44]
150 g–300 g	1.78%	1.74%	1.25%
	[1.44, 2.07]	[1.38, 2.14]	[0.97, 1.56]
300 g+	2.65%	2.48%	1.72%
	[2.14, 3.09]	[2.01, 3.03]	[1.30, 2.14]

Results

For a number of brands, advertising is cooperative:

TABLE 7
Effect of advertising on brand demand

	Walkers Regular	Pringles	KP
% change in row brand demand if column brand advertising is set to zero			
Walkers Regular	−1.60	−0.06	0.05
	[−2.13, −0.95]	[−0.15, 0.08]	[−0.01, 0.14]
Walkers Sensations	−0.51	−0.14	−0.17
	[−0.72, −0.37]	[−0.24, −0.06]	[−0.23, −0.09]
Walkers Doritos	−0.24	−0.06	−0.05
	[−0.40, −0.06]	[−0.15, 0.01]	[−0.11, 0.01]
Walkers Other	0.32	−0.05	0.13
	[0.15, 0.49]	[−0.17, 0.08]	[0.06, 0.21]
Pringles	0.24	−4.45	0.06
	[0.07, 0.43]	[−5.07, −3.75]	[−0.03, 0.17]
KP	−0.03	−0.12	−1.29
	[−0.16, 0.10]	[−0.22, 0.03]	[−1.73, −0.94]
Golden Wonder	−1.05	−0.26	−0.81
	[−1.19, −0.92]	[−0.35, −0.12]	[−0.96, −0.69]
Asda	−0.31	−0.29	−0.33
	[−0.43, −0.14]	[−0.37, −0.17]	[−0.41, −0.19]
Tesco	−0.44	−0.35	−0.48
	[−0.57, −0.27]	[−0.42, −0.22]	[−0.59, −0.34]
Other	0.17	−0.15	0.23
	[0.04, 0.36]	[−0.31, 0.06]	[0.10, 0.35]
% change in total potato chips demand if column brand advertising is set to zero			
	−0.43	−0.41	−0.22
	[−0.53, −0.34]	[−0.46, −0.32]	[−0.25, −0.19]

Results

Counterfactual ad ban:

- Stopping to advertise has biggest effect on largest pack sizes
- Tougher price competition (↓ 4%)
- Reduction mainly due to less frequent purchase

TABLE 10
Effect of advertising ban on purchases

	Pre ban	Advertising banned	
		No price response	With price response
Expenditure (£m)	100.85 [99.78, 101.91]	85.62 [82.44, 88.26]	87.11 [84.25, 89.77]
% change		−15.10 [−17.83, −12.67]	−13.62 [−16.18, −11.18]
Quantity (mKg)	14.80 [14.64, 14.98]	12.55 [12.05, 12.97]	13.36 [12.96, 13.71]
% change		−15.24 [−17.93, −12.61]	−9.72 [−11.83, −7.40]

Results

Impact on health:

- Ban leads to less energy (15.2% / 9.7%), fat (16.3% / 11.9%), salt (15.4% / 10.3%)
- Remember that other junk-foods are worse than chips

TABLE 12
Substitution to alternatives

Probability of selecting	Pre ban	Advertising banned	
		no price response	price response
Potato chips	35.34 [34.85, 35.61]	30.07 [28.82, 31.13]	31.31 [30.14, 32.60]
Change		−5.27 [−6.25, −4.16]	−4.03 [−5.03, −2.80]
Less healthy outside option	38.93 [38.61, 39.45]	42.44 [41.72, 43.41]	41.61 [40.75, 42.53]
Change		3.51 [2.87, 4.15]	2.67 [2.01, 3.24]
More healthy outside option	25.72 [25.44, 26.02]	27.49 [27.00, 28.10]	27.09 [26.54, 27.70]
Change		1.77 [1.28, 2.17]	1.36 [0.87, 1.78]

Welfare

Advertising can be persuasive or a characteristic. Persuasive: Like distinction between decision and experience utility. So consumer is not really maximising experience utility function $\rightarrow$ “Choice distortion effect”.
Additionally: “Price competition effect”

Characteristic: Consumers value advertising $\rightarrow$ “Characteristics effect”

Welfare measure of direct monetary cost $\rightarrow$ converted to compensating variation

Total changes in welfare: $+13.6m£$ vs. $-24.6m£$

Robustness

Robustness

Address 2 concerns:

- Control function approach for endogeneity (advertising and price)
- Collusive price setting

Summary

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- Demand and Supply model with competition over prices and ads
- Ads affects demand in a flexible way: past demand, predatory vs. cooperative, price sensitivities, willingness to pay
- Ad ban effects
- Ad effects on utility

Thank you!

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