Institute for Fiscal Studies

MANCHESTER 1824

Griliches Lectures

Lecture 2

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Motivation

Policy has the potential to improve welfare when consumption generates social costs; applies to "sin goods" - tobacco, alcoholic drinks, sugary drinks and other unhealthy foods (such as fast food)

- this motivates corrective taxes and regulations to availability, advertising, reformulation
- social costs include
  - externalities: second hand smoking, alcohol related crime, healthcare costs due to rising obesity
  - internalities: poor performance at school, future poor health, worse social and economic outcomes
- role of policy is to discourage socially costly consumption

Motivation

How effective are policies

- what the direct and indirect effects of policies?
- do they discourage socially costly consumption?
- what are the welfare implications? who gains and who loses?
- could we design better policies, that discourages socially cost consumption at lower cost?

Empirical approaches to learn about these questions ex ante

Plan of the lectures

Lecture 1

- what are the effects of sin taxes?
- empirical approaches to estimate suitably flexible demand models

Lecture 2

- what are the effects of restrictions to advertising?
- empirical approaches to estimate suitably flexible demand models
- evaluating welfare with possible behavioural effects

Lecture 3

- how do taxes and advertising interact?
- empirical approaches to learn about supply side dynamics

Motivation

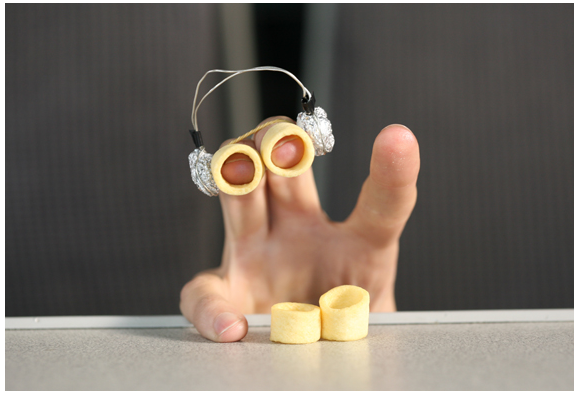
- Advertising of some sin good is restricted - e.g. tobacco, alcohol
- calls to restriction advertising junk foods
- ex ante we don't know what impact, depends on
  - how the demand shape changes with advertising
  - strategic response of firms: price equilibrium
- counterfactual evaluation of supply and demand can be informative
- Welfare effects will depend on whether advertising is: informative, distortionary, characteristic

Dubois, Griffith and O'Connell (2018)
"The effects of banning advertising in junk food markets"
Review of Economic Studies, 85:1, 396 - 436

Policy aims

- Policy makers are interested in encouraging people to consider nutrition when deciding what foods to buy
- one area of concern has been advertising for unhealthy snacks
- from an economic perspective advertising can be (see Bagwell, 2007)
  - Informative about prices/characteristics (Stigler, 1961; Nelson, 1995)
  - A characteristic that consumers value (Stigler and Becker, 1977)
  - Persuasive (Marshall, 1921; Robinson, 1933; Kaldor, 1950)

Advertising for crisps



Persuasive view of advertising

- Advertising can lead consumers to act as non-standard decision makers, by providing environmental "cues" to consumers (Bernheim and Rangel, 2005).
- Bernheim and Rangel (2009): *"choices made in the presence of those cues are predicated on improperly processed information, and welfare evaluations should be guided by choices made under other conditions"*

Nutrient score

- government regulation uses a nutrient profile score
  - aggregates nutrient characteristics into a single score
  - lower score is healthier product

Brand	Nutrient score	Energy (kj per 100g)	Saturated fat (g per 100g)	Sodium (g per 100g)
Pringles	16	2160	6.31	0.62
Walkers Reg	10	2164	2.56	0.59
Walkers Sens	11	2023	2.16	0.71
Walkers Dor	12	2095	2.86	0.66
Walkers Oth	15	2020	2.50	0.82
KP	18	2158	5.87	0.85
GW	16	2101	4.01	0.92
Asda	15	2125	4.13	0.75
Tesco	15	2145	4.65	0.77
Other	12	2084	3.84	0.70

score is the sum of points, 1 point for each 335kJ per 100g, 1 for each 1g of saturated fat per 100g, and 1 for each 90mg of sodium per 100g

Dubois, Griffith and O'Connell (2018)

Develop model of consumer demand and oligopoly supply with multi-product firms competing in price and advertising

- allow advertising to impact demand in a flexible way
- allow past advertising to impact current demand, meaning firms play a dynamic game
- estimate the model on the UK potato chips
- simulate the impact of advertising ban on equilibrium outcomes (prices, expenditures, quantities, nutrition)
  - because consider a ban don't need to solve dynamic supply side equilibrium
- consider welfare evaluation - depends on whether advertising distorts consumer's choices or enters utility as a characteristic

Advertising in consumer demand model

Model consumer choice:

- Allow cooperative or rival effects of advertising, such that increase in advertising of one brand may:
  - increase demand for another brand (cooperative)
  - decrease demand for another brand (predatory)
  - lead to expansion or contraction of market
- Allow dynamic effects of advertising on demand:
  - advertising state vector for brand b, $\mathbf{a}_{bt}$, depends on current and past advertising expenditures
  - Denote

$$\mathbf{a}_{bt} = \mathbf{f}(e_{bt}, e_{bt-1}, e_{bt-2}, ..., e_{b0})$$

Discrete choice demand model

- consumer i's payoff (decision utility) from brand b, pack size s, time (market) t:

$$\bar{v}_{ibst} = \alpha_i\left(\mathbf{a_{bt}}, p_{bst}\right) + \psi_i\left(\mathbf{a_{bt}}, x_b\right) + \gamma_{bi}(\mathbf{a_t}) + \eta_i(\mathbf{z}_{bs}, \xi_b) + \epsilon_{ibst}$$

  where:

  - p_{bst}: price
  - x_b: nutrient quality
  - $\mathbf{a_{bt}}$: advertising states for brand b; $\mathbf{a_t} = (\mathbf{a_{1t}}, ..., \mathbf{a_{Bt}})$
  - z_{bs}: functions of pack size
  - ξ_b: an unobserved brand characteristic
  - ϵ_{ibst}: individual deviation that may contain some product specific time varying unobservables

- Outside good : $\bar{v}_{i00t} = \zeta_{d0t} + \epsilon_{i00t}$

A suitably flexible demand specification

$$\begin{aligned}
\alpha_i\left(\mathbf{a_{bt}}, p_{bst}\right) &= \left(\alpha_{0i} + \alpha_{1i}\mathbf{a_{bt}}\right) p_{bst} \\
\psi_i\left(\mathbf{a_{bt}}, x_b\right) &= \left(\psi_{0i} + \psi_{1i}\mathbf{a_{bt}}\right) x_b \\
\gamma_{bi}(\mathbf{a_t}) &= \lambda_i \mathbf{a_{bt}} + \rho_i \left(\sum\nolimits_{l \neq b} \mathbf{a_{lt}}\right) \\
\eta_i(\mathbf{z}_{bs}, \xi_b) &= \eta_{1i} z_{bs} + \eta_{2i} z_{bs}^2 + \eta_i \xi_b
\end{aligned}$$

where $\pi_i^u = (\alpha_{0i}, \lambda_i, \rho_i, \eta_i)$ such that $\pi_i^u = \pi_0^u + \pi_1^u d_i + \upsilon_i d_i$ with $\upsilon_i \sim N(0, \Sigma_\pi)$ and $\pi_i^o = (\alpha_{1i}, \psi_{1i}, \eta_{1i}, \eta_{2i})$ with $\pi_i^o = \pi_0^o + \pi_1^o d_i$

- Coefficients differ by demographics (d_i) and purchase occasion
- All advertising coefficients allow potential shift with consumer's observed and unobserved exposure to advertising

A suitably flexible demand specification

- interaction of the advertising state variable with price and the nutrient characteristic, and the possibility that competitor advertising directly enters the payoff function are important in allowing for advertising to flexibly impact demands
- by including competitor advertising in the payoff function we allow for the possibility that, regardless of the sign of own demand advertising effects, advertising may be predatory or cooperative and it may lead to market expansion or contraction

Market demand

- Consumer faces choice set Ω_κ, chooses (b, s) if:

$$\bar{v}_{ibst} \geq \bar{v}_{ib's't} \text{ for all } (b', s') \in \Omega_\kappa$$

- Probability of purchasing (b, s) is $s_{ibs}(\mathbf{p_t}, \mathbf{a_t}, \zeta_t) =$

$$\frac{\exp[\alpha_i(\mathbf{a_{bt}}, p_{bst}) + \psi_i(\mathbf{a_{bt}}, x_b) + \gamma_{bi}(\mathbf{a_t}) + \eta_i(\mathbf{z_{bs}}, \xi_b)]}{\exp(\zeta_{d0t}) + \sum_{(b',s')\in\Omega_\kappa} \exp[\alpha_i(\mathbf{a_{b't}}, p_{b's't}) + \psi_i(\mathbf{a_{b't}}, x_{b'}) + \gamma_{bi}(\mathbf{a_t}) + \eta_i(\mathbf{z_{b's'}}, \xi_{b'})]}$$

- Aggregate demand is:

$$s_{bs}(\mathbf{p_t}, \mathbf{a_t}, \zeta_t) = \int s_{ibs}(\mathbf{p_t}, \mathbf{a_t}) dF(\upsilon_i, d_i)$$

Impact of advertising on demand is flexible

- Brand advertising can be (even at individual level):
  - predatory with respect to some products and cooperative with respect to others
  - market expanding or contracting

$$\frac{\partial s_{ibst}}{\partial a_{bt}} = s_{ibst}\left(\tilde{\lambda}_{ibst} - \rho_i(1 - s_{i00t}) - \sum_{s' \in K_b}(\tilde{\lambda}_{ibs't} - \rho_i)s_{ibs't}\right)$$

$$\frac{\partial s_{ibst}}{\partial a_{b't}} = s_{ibst}\left(\rho_i s_{i00t} - \sum_{s' \in K_{b'}}(\tilde{\lambda}_{ib's't} - \rho_i)s_{ib's't}\right)$$

$$\frac{\partial s_{i00t}}{\partial a_{b't}} = -\, s_{i00t}\left(\rho_i(1 - s_{i00t}) + \sum_{s' \in K_{b'}}(\tilde{\lambda}_{ib's't} - \rho_i)s_{ib's't}\right)$$

where

$$\tilde{\lambda}_{ibst} = \lambda_i + \alpha_{1i} p_{sbt} + \psi_{1i} x_b$$

Potential distortionary effects of advertising

- Willingness to pay for better nutrient quality is potentially affected by advertising

$$WTP_{ibt} = \frac{\partial \bar{v}_{ibst} / \partial x_b}{\partial \bar{v}_{ibst} / \partial p_{bst}} = \frac{\psi_{0i} + \psi_{1i} \mathbf{a_{bt}}}{\alpha_{0i} + \alpha_{1i} \mathbf{a_{bt}}}$$

- Increases or decreases with $\mathbf{a_{bt}}$ depending on the sign of

$$\psi_{1i}\alpha_{0i} - \psi_{0i}\alpha_{1i}$$

Supply overview

- Multi-product firms compete by setting simultaneously two strategic instruments to maximize profits
  - prices and advertising expenditures
- Firms' problem is dynamic because
  - advertising today affects future demand and hence profits
- However because we consider an advertising ban, we don't have to solve dynamic model

Profit

- Multi-product firm j chooses (p_{bst}, e_{bt}) to maximize intertemporal profit:

$$\sum_{t=0}^{\infty} \beta^t \left[\sum_{(b,s) \in N_j^{bs}} (p_{bst} - c_{bst}) \, s_{bs} (\mathbf{p}_t, \mathbf{a}_t, \zeta_t) \, M_t - \sum_{b \in N_j^b} e_{bt} \right]$$

where

$$\mathbf{a}_{bt} = f(e_{bt}, e_{bt-1}, e_{bt-2}, ..., e_{b0})$$

N_j^{bs}: set of products owned by firm j
N_j^b: set of brands owned by firm j
c_{bst}: constant marginal cost
M_t: size of the potential market
e_{bt}: advertising expenditure

Markov perfect equilibrium

- Firm j makes an assumption on competitive strategy profile $\sigma_{-j} = (\sigma_1, ..., \sigma_{j-1}, \sigma_{j+1}, ..., \sigma_J)$ and chooses its own strategy σ_j
- Value function $\pi_j^*(.,.)$ from Bellman equation conditional on specific strategy profile σ_{-j} :

$$\pi_j^*(\mathbf{a}_{t-1}, \theta_t) = \max_{\sigma_j = (p_{bst}, e_{bt}) \in N_j^{bs}} \left\{ \sum_{(b,s) \in N_j^{bs}} (p_{bst} - c_{bst}) s_{bs}(\mathbf{p}_t, \mathbf{a}_t, \zeta_t) M_t - \sum_{b \in N_j^b} e_{bt} + \beta E[\pi_j^*(\mathbf{a}_t, \theta_{t+1})] \right\}$$

- A Markov perfect equilibrium is a list of strategies $\sigma^* = (\sigma_1^*, ..., \sigma_J^*)$ such that no firm has an incentive to deviate from the action prescribed by σ_j^* in the subgame that starts from the state $(\mathbf{a}_{t-1}, \theta_t)$

Markov perfect equilibrium

- Assume existence of a subgame perfect Markov equilibrium, and restrict attention to Markov Perfect Equilibrium in pure strategies (Maskin and Tirole, 2001)
- Ericson and Pakes (1995), Doraszelski and Satterthwaite (2003) give general conditions for the existence of equilibria in similar games
- Each solution of Bellman equation π_j^* corresponds to each MPE of dynamic game.
- Do not need to assume equilibrium is unique

Price first order conditions

- Price first order conditions depend on Markov perfect equilibrium only through observed goods and state vector $(\mathbf{p}_t, \mathbf{a}_t)$

$$s_{bs}\left(\mathbf{p}_t, \mathbf{a}_t, \zeta_t\right) + \sum_{(b',s') \in N_j} \left(p_{b's't} - c_{b's't}\right) \frac{\partial s_{b's'}\left(\mathbf{p}_t, \mathbf{a}_t, \zeta_t\right)}{\partial p_{bst}} = 0$$

- ... we can identify marginal costs without solving for the value function π_j^*
- Optimality conditions of entry, exit and advertising decisions not needed for identification of costs

Advertising Ban

- Simulate Counterfactual equilibrium with ban on advertising ($\mathbf{a}_t = 0$)
- New price equilibrium will be played and satisfy the following per period Bertrand-Nash conditions, for all (b, s)

$$s_{bs}\left(\mathbf{p}, \mathbf{0}, \zeta\right) + \sum_{(b',s') \in N_j} \left(p_{b's't} - c_{b's't}\right) \frac{\partial s_{b's'}\left(\mathbf{p}, \mathbf{0}, \zeta\right)}{\partial p_{bs}} = 0$$

  where

$$s_{bs}(\mathbf{p}, \mathbf{0}, \zeta) = \int s_{ibs}(\mathbf{p}, \mathbf{0}, \zeta) dF(\upsilon_i, d_i)$$

  is aggregate demand for product (b, s) when advertising is banned

- Can check exit decisions for all possible assortments

Purchase data

- From Kantar/TNS Worldpanel
- June 2009 - October 2010
- Use information on a panel where we observe purchases both at home and on the go
  - all groceries brought into home, 161,513 transactions
  - all snacks bought for consumption outside the home, 99,636 transactions
- Transaction (barcode) level quantities, prices, characteristics
- Household and individual demographics

Food at home - 26 products in total

Brand	Size	Purchase Share	Price (£)
Pringles:	150-300g	1.34%	1.10
	300g+	5.54%	2.63
Walkers Regular:	150-300g	1.77%	1.25
	300g+	23.98%	2.77
Walkers Sensations:	150-300g	0.43%	1.26
	300g+	1.81%	2.52
Walkers Doritos:	150-300g	1.30%	1.21
	300g+	3.29%	2.47
Walkers Other:	<150g	0.69%	1.24
	150-300g	3.73%	1.77
	300g+	8.66%	3.17
Golden Wonder:	<150g	0.10%	1.28
	150-300g	0.25%	1.35
	300g+	1.15%	2.70
...			

Food on the go - 11 products in total

Brand	Size	Purchase Share	Price (£)
Walkers Regular	34.5g	27.16%	0.45
	50g	7.19%	0.63
Walkers Sensations	35g	2.04%	0.61
Walkers Doritos	50g	4.70%	0.54
Walkers Other	<30g	4.34%	0.45
	30g+	8.94%	0.61
KP	35g	0.83%	0.57
Golden Wonder:	<40g	3.08%	0.39
	40g+	1.09%	0.73
Other	<40g	17.57%	0.48
	40g+	20.01%	0.59
...			

Advertising data from AC Nielsen

- Advertising expenditure by brand and month from 2001 to 2010
- Includes all potato chips advertising appearing on TV, in press, on radio, on outside posters and internet
- We compute the stock of advertising goodwill according to:

$$\mathbf{a}_t = \delta \mathbf{a}_{t-1} + \mathbf{e}_t$$

with $\delta = 0.75$

Advertising Expenditures

	Monthly expenditure (£100,000)			Total
	Mean	Min	Max	(06/09-10/10)
Pringles	4.50	0.00	10.14	76.54
Walkers Regular	4.97	0.00	18.29	84.47
Walkers Sensations	0.54	0.00	1.46	9.12
Walkers Doritos	1.75	0.00	8.25	29.67
Walkers Other	2.89	0.00	8.99	49.07
KP	2.09	0.00	8.49	35.60
Golden Wonder	0.08	0.00	0.80	1.34
Asda	0.01	0.00	0.23	0.23
Tesco	0.08	0.00	0.68	1.44
Other	1.58	0.00	5.74	26.83

Consumers Descriptive Statistics

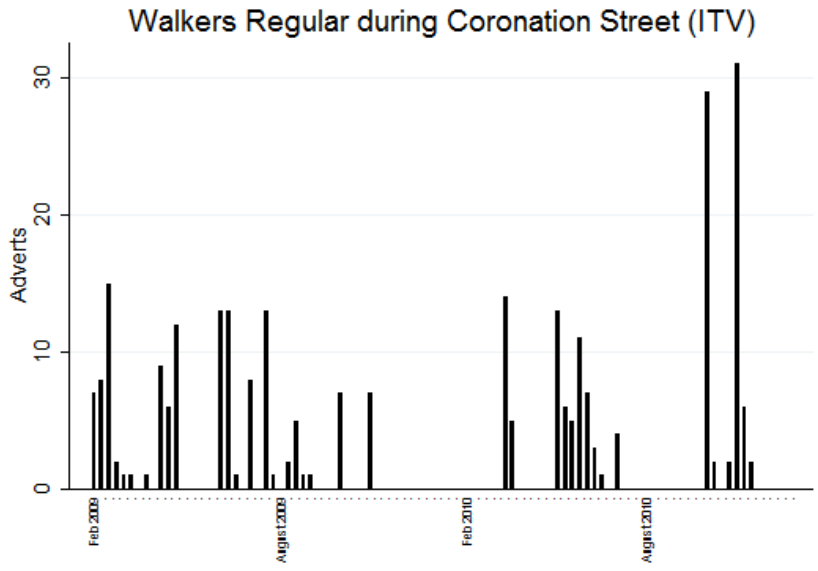
Demographic group			Number of purchase occasions	
			food at home	food on-the-go
Composition	skill level	income		
HH no children	high	high	22721	14371
		medium	13178	8376
		low	13341	8219
	low	medium-high	10187	6667
		low	16147	8559
Pensioners			14384	6016
HH children	high	high	20426	12786
		medium	14292	8502
		low	7091	4494
	low	medium-high	15349	9549
		low	14397	8932
Child purchase				3165

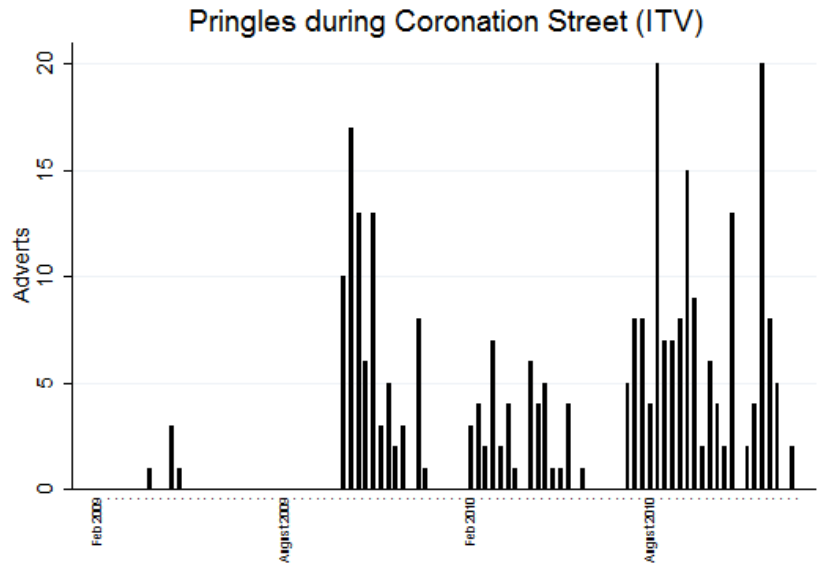
- All parameters are allowed to vary across these demographics

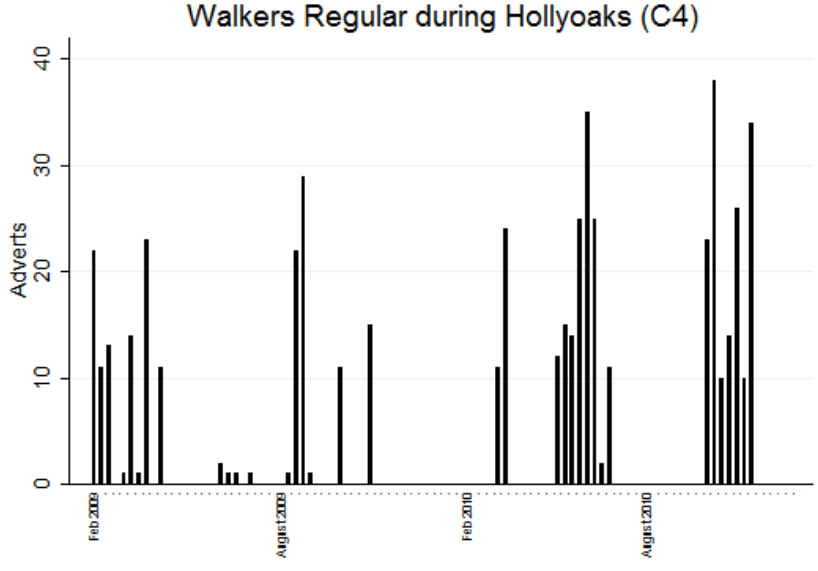
Identification: price and advertising variations

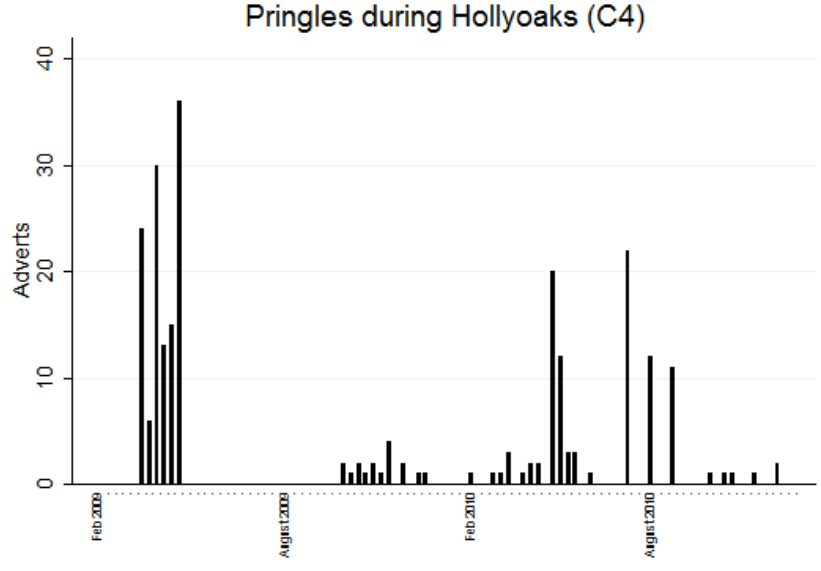
- Price variation
  - longitudinal data, we see consumers buying in different stores, where menu of prices differ, assume store choice exogenous (conditional on controls)
  - time series variation of prices within product due to promotions
- Advertising variation
  - exposure varies due to idiosyncractic TV viewing behaviours
  - use control function (Blundell and Powell, 2004 and Petrin and Train, 2010) with advertising expenditure on ready-meals interacted with brand fixed effects as instruments; because brand advertising flows may be correlated with unobserved individual demand shocks

Identification: advertising variations









Advertising effects on brand demand

% change in demand if advertising expenditure set to zero (ceteris paribus)

	Walkers Regular	Pringles	KP
Adv exp (£m)	0.497	0.450	0.209
Walkers Regular	-2.77	1.39	0.63
	[-4.30, -1.44]	[1.06, 1.72]	[0.50, 0.76]
Pringles	3.43	-19.53	0.25
	[2.78, 4.10]	[-21.54, -17.97]	[0.11, 0.39]
KP	-0.35	0.03	-2.63
	[-0.81, 0.11]	[-0.35, 0.39]	[-3.36, -1.99]
...	...	...	...
	-1.15	-1.10	-0.42
	[-1.46, -0.85]	[-1.41, -0.79]	[-0.53, -0.31]

Numbers are means across markets (i.e. months).

Effect of advertising on own price elasticities

	Walkers Regular		Pringles		KP	
	Obs. advert. exp.	Zero advert. exp.	Obs. advert. exp.	Zero advert. exp.	Obs. advert. exp.	Zero advert. exp.
<150g					-1.33	-1.37
					[-1.38, -1.29]	[-1.42, -1.32]
150-300g	-1.49	-1.62	-1.40	-1.53	-1.68	-1.74
	[-1.57, -1.44]	[-1.69, -1.57]	[-1.46, -1.35]	[-1.60, -1.49]	[-1.75, -1.63]	[-1.80, -1.68]
300g+	-2.20	-2.54	-2.37	-2.74	-2.77	-2.88
	[-2.32, -2.10]	[-2.67, -2.44]	[-2.51, -2.26]	[-2.88, -2.64]	[-2.89, -2.67]	[-3.01, -2.79]

Willingness to pay for one point reduction in nutrient score

Advertising:	None	Medium	High
Food at home			
Willingness to pay in pence	5.3	3.5	0.6
	[4.7, 5.8]	[3.0, 3.9]	[-0.4, 1.6]
% of mean price	2.5	1.7	0.3
	[2.3, 2.8]	[1.5, 1.9]	[-0.2, 0.8]
Food on-the-go			
Willingness to pay in pence	0.9	0.0	-0.8
	[0.7, 1.1]	[-0.2, 0.1]	[-0.9, -0.5]
% of mean price	1.7	-0.1	-1.5
	[1.3, 2.1]	[-0.4, 0.3]	[-1.8, -1.0]

Numbers are median willingness to pay in pence.

Counterfactual

- Estimate marginal costs using supply model
- Simulate counterfactuals
  - no pricing response
  - with pricing response
  - check deviations of Nash equilibrium in product exits

Advertising ban: pricing response

- Banning advertising leads to toughening price competition
- The average price in the market falls by 9%
- Pricing response differs across firms and over products
  - The big advertisers (e.g. Walkers and Pringles) lower prices
  - For instance, Walkers reduces price of its most popular brand by the most, 34p (or 28%) reduction for the 150-300g pack, and 56p (or 20%) for the 300g+ pack
- Besides advertising ban, no products exit the market (keeping all products is a Nash equilibrium)

Advertising ban

	Pre ban	Post ban	
		No firm response	With firm response
Expenditure (£m)	220.86	206.82	212.19
	[217.17, 222.99]	[195.79, 216.42]	[201.23, 220.38]
% change		-6.35	-3.92
		[-10.88, -1.82]	[-8.13, 0.41]
Quantity (mKg)	32.14	29.18	34.95
	[31.62, 32.47]	[27.62, 30.65]	[33.18, 36.28]
% change		-9.21	8.73
		[-13.60, -4.29]	[3.39, 13.53]
Probability of selecting	0.37	0.37	0.38
potato chips	[0.36, 0.37]	[0.35, 0.39]	[0.35, 0.39]
% change		0.22	1.79
		[-5.33, 6.16]	[-4.02, 7.11]
Mean pack size	0.17	0.15	0.18
condi. on purchase	[0.17, 0.17]	[0.15, 0.16]	[0.17, 0.19]
% change		-9.43	6.63
		[-13.18, -5.65]	[2.23, 10.83]

Advertising ban

	Observed equilibrium	Advertising banned	
		no price response	with price response
Saturates (1000 kg)	1264.91	1086.79	1258.06
	[1244.03, 1279.87]	[1026.40, 1142.62]	[1191.95, 1313.92]
% change		-14.08	-0.54
		[-18.38, -9.31]	[-5.53, 4.26]
Salt (1000 kg)	575.20	515.34	601.74
	[565.94, 581.14]	[487.81, 540.07]	[571.33, 625.24]
% change		-10.41	4.61
		[-14.79, -5.56]	[-0.42, 9.15]
Nutrient score	13.80	13.33	13.05
	[13.77, 13.83]	[13.25, 13.42]	[12.97, 13.15]
% change		-3.36	-5.41
		[-3.96, -2.75]	[-5.95, -4.66]
Saturates intensity (g/100g)	3.94	3.73	3.61
	[3.92, 3.95]	[3.69, 3.76]	[3.58, 3.66]
% change		-5.34	-8.28
		[-6.17, -4.41]	[-9.08, -7.09]
Salt intensity (g/100g)	1.79	1.77	1.73
	[1.79, 1.79]	[1.76, 1.77]	[1.72, 1.73]
% change		-1.32	-3.61
		[-1.67, -0.93]	[-3.95, -3.07]

Consumer welfare

- What impact on welfare?
- How we measure welfare depends on whether we view advertising as:
  - Informative about prices/characteristics (Stigler, 1961; Nelson, 1995)
  - A characteristic that consumers value (Stigler and Becker, 1977)
  - Persuasive (Marshall, 1921; Robinson, 1933; Kaldor, 1950)

Consumer welfare: advertising as a characteristic

- If advertising is a characteristic, the payoff function represents the consumer's (indirect) utility function; the consumer makes decisions to maximize utility (standard revealed preference approach)
- Expected utility is given by:

$$W_{it}(\mathbf{p}_t, \mathbf{a}_t) = E\left[\max_{(b,s)\in\Omega_\kappa} \bar{v}_{ibst}\right]$$

$$= \ln\left[\sum_{(b,s)\in\Omega_\kappa} \exp\left[\alpha_i\left(\mathbf{a_{bt}}, p_{bst}\right) + \psi_i\left(\mathbf{a_{bt}}, x_b\right) + \gamma_{bi}(\mathbf{a_t}) + \eta_i(\mathbf{z_{bs}}, \xi_b)\right]\right]$$

Consumer welfare: advertising distorts decisions

- If advertising is distorting, then consumer's ("experience") utility (Kahneman et al. 1997) should be evaluated in the absence of advertising :

$$\widehat{v}_{ibst} = \alpha_i\left(\mathbf{0}, p_{bst}\right) + \psi_i\left(\mathbf{0}, x_b\right) + \gamma_{bi}(\mathbf{0}) + \eta_i(\mathbf{z_{bs}}, \xi_b) + \epsilon_{ibst}$$

- Expected "experience" utility from the choice made with different "decision" utility is:

$$\widehat{W}_i\left(\mathbf{a_t}, \mathbf{p_t}\right) = E\left[\widehat{v}_{\underset{(b,s)\in\Omega_\kappa}{\arg\max}\{\bar{v}_{ibst}\}}\right]$$

Consumer welfare: advertising distorts decisions

- Expected "experience" utility from the choice made with different "decision" utility:

$$
\begin{aligned}
\widehat{W}_i\left(\mathbf{a_t}, \mathbf{p_t}\right) =& E\left[\widehat{v}_{\underset{(b,s)\in\Omega_\kappa}{\arg\max\{\bar{v}_{ibst}\}}}\right] \\
=& W_{it}(\mathbf{p}_t, \mathbf{a}_t) \\
& - \sum_{(b,s)\in\Omega_\kappa} s_{ibst}\left[\left(\alpha_i(\mathbf{a_{bt}}, p_{bst}) - \alpha_i(\mathbf{0}, p_{bst})\right)\right. \\
& \left. + \left(\psi_i(\mathbf{a_{bt}}, x_b) - \psi_i(\mathbf{0}, x_b)\right) + \left(\gamma_{bi}(\mathbf{a_t}) - \gamma_{bi}(\mathbf{0})\right)\right]
\end{aligned}
$$

Consumer welfare: advertising distorts decisions

- When advertising distorts decision making, welfare impact of advertising evaluated under preferences in absence of advertising
- Denote $\mathbf{p}^0$ a counterfactual price equilibrium with no advertising
- Welfare difference between the post and pre advertising ban is:

$$
\begin{aligned}
& W_i\left(\mathbf{0}, \mathbf{p_t^0}\right) - \widehat{W}_i\left(\mathbf{a_t}, \mathbf{p_t}\right) \\
= & W_i\left(\mathbf{0}, \mathbf{p_t}\right) - \widehat{W}_i\left(\mathbf{a_t}, \mathbf{p_t}\right) \quad \text{(choice distortion effect)} \\
+ & W_i\left(\mathbf{0}, \mathbf{p_t^0}\right) - W_i\left(\mathbf{0}, \mathbf{p_t}\right) \quad \text{(price competition effect)}
\end{aligned}
$$

where we use $\widehat{W}_i\left(\mathbf{0}, \mathbf{p}\right) = W_i\left(\mathbf{0}, \mathbf{p}\right)$

Consumer welfare: advertising distorts decisions

	Advertising banned	
	No price resp.	With price resp.
Choice distortion effect (£m)	35.9	35.9
	[34.7, 40.5]	[34.7, 40.5]
Price competition effect (£m)	0.0	19.2
		[15.9, 21.6]
Total compensating variation (£m)	35.9	55.1
	[34.7, 40.5]	[52.8, 60.1]
Change in profits (£m)	0.2	0.2
	[-4.9, 5.9]	[-4.8, 5.3]
Total change in welfare (£m)	36.1	55.3
	[32.2, 43.7]	[49.9, 62.6]

Consumer welfare: characteristic view

	Advertising banned	
	No price resp.	With price resp.
Characteristics effect (£m)	-30.6	-30.6
	[-38.6, -20.4]	[-38.6, -20.4]
Price competition effect (£m)	0.0	19.2
		[15.9, 21.6]
Total compensating variation (£m)	-30.6	-11.4
	[-38.6, -20.4]	[-20.4, -1.3]
Change in profits (£m)	0.2	0.2
	[-4.9, 5.9]	[-4.8, 5.3]
Total change in welfare (£m)	-30.4	-11.2
	[-43.6, -14.8]	[-25.2, 3.0]

Aggregate impact of ban

We find that in response to introduction of an advertising ban in potato chips markets:

- Advertising ban leads to substitution to healthier products (higher WTP)
- At constant prices, quantity of potato chips purchased would decrease
- But stronger price competition leads to lower prices and thus increase in quantity consumed and total calories but not significant changes in salt or saturated fat
- Lack of advertising isn't enough to deter bad products
- Profitability in the market is almost unchanged
- If advertising is viewed as distorting prices, total welfare would rise
- Welfare would decrease if advertising as a characteristic (assuming advertising affects only inside goods)