# The Effects of Banning Advertising in Junk Food Markets

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# Introduction

# Background

Reducing consumption of junk foods is crucial in controlling obesity.

- Junk foods are high in calories, salt, sugar and fat and low in fibre, proteins, and vitamins.
  e.g. sugar, soda, potato chips
- Many junk food markets are dominated by **a small number of firms** that **sell multiple brands** and that **heavily advertise their products**.

Restriction on advertising of junk foods is a possible way.
Its effects depend on:

1. **market size effect:** whether advertising predominantly acts to expand the market size, or steal rival market share.
2. **consumer reaction:** what products consumers who substitute out of the market switch to instead.
3. **firm reaction:** how the firms in the market adapt their behaviour in response to a ban.

# Effect of advertising

The research contributes by looking into the effects of banning ads in the UK market for potato chips.

- the effects of advertising on product level demands are **various and heterogeneous** across consumers.
  - advertising of one brand **may steal market share** from some rival brands, **while boosting demand** of others;
  - advertising also acts to **tilt demand curves** and **change consumer willingness to pay for a more healthy product**.
- The paper **simulate** the effects of banning advertising on market equilibria.
  - **holding prices fixed**, the ban leads to a reduction in the quantity of potato chips sold of 15%.
  - banning advertising also **raises consumer sensitivity to price**. Therefore, the ban makes the **market more competitive** and firms respond to the ban by **lowering their prices**, **offsetting the decrease in demand**,
  - **in equilibrium**, the ban lowers the quantity of potato chips sold by 10%.

# Demand Switch

Another interest is where consumer switch to:

1. **within market:** healthier potato chips
   - The model allows ad to **shift the perceived weight** on the nutritional characteristics.
   - Advertising acts to lower willingness to pay for healthier products. Therefore, the ad ban **induces switching to relatively healthy potato chips**.
2. **outside the market:** other junk food, **OR** healthier non-junk food
   - The model includes the **BOTH** outside options.
   - Following the ban, consumers are **more likely to switch to another junk food market** than to a non-junk food, which partially offset any health gains from the policy.

# Identification Strategy

Identifying the causal impact of advertising on demand is challenging.

- To identify, this paper exploits variation in consumers' exposure to TV brand advertising.
- The authors exploit information on the precise **time and station of potato chip advertising** and link this to information on the **TV viewing behaviour of individual consumers**.
- The authors also have panel data on consumers' purchases.
- This strategy exploit **variation of exposure across consumers** to TV advertising driven by **(idiosyncratic) variation in viewing behaviour**.

# Demand model

Effect of ads across product can be complicated.

- **spillover effects:**
  - predatory: steal market share of rival products,
  - cooperative: increases demand for other products.
  - To capture the effect, the model includes both own brand and competitor advertising in consumer payoff functions.
- **mechanism of affecting consumer choice:**
  - persuasive: change consumer taste, or directly enter utility as a product characteristic.
  - informative: provide information about the products.
- This model is flexible and **captures the major mechanisms** of ads,
  - The paper models ad as a product characteristic and persuasion device.
  - Still, it omits some forms of informative advertising.

# Firm decisions

Firms play a dynamic game when choosing ad flows. However, we do not need full estimation of the game.

- Actual **ad level is observed**. Only **marginal costs** (determining supply) are unobserved and **needs estimation**.
- Such estimation requires only **price optimality conditions**, which are *static*, along with **observed values of advertising state**.
- To implement the counterfactual of advertising ban, only have to solve the **new price first-order conditions**. [There would be **no** ad decision anyway]
- In this way, the results are robust to the (unobserved) details of the dynamic games.

# Demand

# Consumer Choice Model

This paper uses a BLP random coefficient discrete choice model.

- Each consumer $i$ has a unit demand over potato chips $j = 1, ..., J$, two outside options $j = \underline{0}$ (junk food, "unhealthy outside option") and $j = \overline{0}$ (non-junk food "healthy outside option").
- Brands are indexed $b = 1, ..., B$. Each product belongs to one brand, $b(j)$. Products belonging to the same brand differ in terms of their pack size.
- Product characteristics: price, nutrient characteristics (both tastiness and health) [1], pack size, brand, and unobserved characteristics.
- Ad is for brand. Each brand may be shared by several product. Consumer $i$'s exposure to the advertising of brand $b(j)$ at time $t$ is $\mathfrak{a}_{ib(j)t}$. The set of advertising state variables is denoted by vector $\mathfrak{a}_{it} = (\mathfrak{a}_{i1t}, ..., \mathfrak{a}_{iBt})$.

[1] in the data, nutrient characteristics is measured by the **weighted sum of unhealthy nutrients**

# Consumer Choice Model (Contd.)

Denote $\bar{v}_{ijt} = \bar{v}_i(p_{jt}, \mathfrak{a}_{it}, \mathrm{x}_j, \xi_{ib(j)}, \tau^d_{b(j)t}, \epsilon_{ijt})$ as the payoff from product $j$.

- $p_{jt}$: product price
- $\mathrm{x}_j = (z_j, z_j^2, n_{b(j)})'$: other observed product characteristics.
  - $z_j$: pack size
  - $n_{b(j)}$: nutrient content
- $\xi_{ib(j)}$: unobserved brand effects (individuals)
- $\tau^d_{b(j)t}$: unobserved brand effects (time and observed demographics $d$)
- $\epsilon_{ijt}$: i.i.d. payoff shock

## Function Form

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

# Consumer Choice Model (Contd.)

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

The main focus is the terms on the square brackets, which capture the impact of advertising on the payoff function.

- advertising acts directly as a feature.
- advertising also affects consumer sensitivity to price and nutrient characteristics.
- competitor advertising also affects consumer payoff.

Outside options:

- **Unhealthy:** $\bar{v}_{i\underline{0}t} = v_{i\underline{0}t} + \epsilon_{i\underline{0}t} = \xi_{i\underline{0}j} + \psi_{1i} x_{\underline{0}} + \tau^d_{\underline{0}t} + \epsilon_{i\underline{0}t}$
- **Healthy:** Normalize the mean to zero, $\bar{v}_{i\bar{0}t} = \epsilon_{i\bar{0}t}$

# Consumer Choice Model (Contd.)

Consumer $i$ chooses product $j$ at time $t$ if

$$\bar{v}_{ijt} > \bar{v}_{ij't} \ \forall j' \neq j$$

Assume $\epsilon_{ijt}$ i.i.d. from type-I extreme value distribution, $\boldsymbol{\tau_t^d} = (\tau_{\underline{0}t}^d, \tau_{1t}^d, ...., \tau_{Bt}^d)$
The probability of consumer $i$ to choose product $j$ at time $t$ is

$$s_{ij}(\mathfrak{a}_{it}, \mathbf{p_t}, \boldsymbol{\tau_t^d}) = \frac{\exp(v_{ijt})}{1+\exp(v_{i\underline{0}t})+\sum_{j'=1}^{J}\exp(v_{ij't})}.$$

# Effect of Advertising

The marginal impact of a change in the advertising of one brand on the individual level choice probabilities is:

$$\frac{\partial s_{ijt}}{\partial \mathfrak{a}_{ib(j)t}} = \sum_{l \in \mathcal{J}_{b(j)}} s_{ijt} \left[ \tilde{\lambda}_{ijt} - \rho_i (1 - s_{i0t}) - (\tilde{\lambda}_{ilt} - \rho_i) s_{ilt} \right]$$

$$\frac{\partial s_{ij't}}{\partial \mathfrak{a}_{ib(j)t}} = \sum_{l \in \mathcal{J}_{b(j)}} s_{ij't} \left[ \rho_i s_{i0t} - (\tilde{\lambda}_{ilt} - \rho_i) s_{ilt} \right] \quad \text{for } j' \neq (\underline{0}, \bar{0}) \quad \text{and} \quad b(j) \neq b(j')$$

$$\frac{\partial s_{i0t}}{\partial \mathfrak{a}_{ib(j)t}} = \sum_{l \in \mathcal{J}_{b(j)}} -s_{i0t} \left[ \rho_i (1 - s_{i0t}) + (\tilde{\lambda}_{ilt} - \rho_i) s_{ilt} \right],$$

where $\tilde{\lambda}_{ijt} = \lambda_i + \alpha_{2i} p_{jt} + \psi_{2i} n_{b(j)}$ and $s_{i0t} = s_{i\bar{0}t} + s_{i\underline{0}t}$.
Consumer price elasticities are:

$$\frac{\partial \ln s_{ijt}}{\partial \ln p_{jt}} = (\alpha_{1i} + \alpha_{2i} \mathfrak{a}_{ib(j)t})(1 - s_{ijt}) p_{jt}$$

$$\frac{\partial \ln s_{ij't}}{\partial \ln p_{jt}} = -(\alpha_{1i} + \alpha_{2i} \mathfrak{a}_{ib(j)t}) s_{ijt} p_{jt} \quad \text{for } j' \neq j.$$

# WTP for healthier foods

The willingness to pay (WTP) for a marginally more healthy brand (equal to the **marginal rate of substitution between price and the characteristic**) is given by:

$$WTP_{ijt}(\mathfrak{a}_{ib(j)t}) = \frac{\partial \bar{v}_{ijt}/\partial n_{b(j)}}{\partial \bar{v}_{ijt}/\partial p_{jt}} = \frac{\psi^n_{1i} + \psi_{2i}\mathfrak{a}_{ib(j)t}}{\alpha_{1i} + \alpha_{2i}\mathfrak{a}_{ib(j)t}}$$

Effect of advertising of $n_{b(j)}$ on WTP will depend on interactions between advertising with price and the nutrient characteristic;

$$\frac{\partial}{\partial \mathfrak{a}_{ib(j)t}} WTP_{ijt}(\mathfrak{a}_{ib(j)t}) = -\frac{\alpha_{2i}\psi^n_{1i} - \alpha_{1i}\psi_{2i}}{(\alpha_{1i} + \alpha_{2i}\mathfrak{a}_{ib(j)t})^2}$$

# Consumer Level Heterogeneity

The paper models the coefficients as random, varying by demographic groups.

- The groups are based on income, education, household composition, and purchase occasions (at home or on-the-go).

All the parameters are assumed to follow log-normal distribution:

$$\left(-\ln\alpha_{1i}, \psi_{1i}^{n}, \lambda_i, \rho_i, \xi_{iW}\right)' \Big| i \in \mathcal{D}_d \sim \mathcal{N}\left(\bar{\boldsymbol{\mu}}_d, \boldsymbol{\Sigma}_d\right)$$

**Table 4** *Household types*

| Composition | Skill | Income | Number of households | Number of individuals | Purchase occasions at home | Purchase occasions on-the-go |
|---|---|---|---|---|---|---|
| No children | High | High | 413 | 302 | 2,0747 | 1,4761 |
| | | Medium | 270 | 223 | 11,962 | 9,669 |
| | | Low | 245 | 225 | 11,800 | 10,147 |
| | Low | Med–high | 193 | 152 | 9,477 | 7,200 |
| | | Low | 289 | 234 | 14,369 | 10,488 |
| Pensioners | | | 242 | 134 | 13,273 | 6,683 |
| Children | High | High | 367 | 323 | 18,976 | 1,5368 |
| | | Medium | 276 | 244 | 12,923 | 1,0766 |
| | | Low | 147 | 126 | 6,448 | 5,315 |
| | Low | Med-high | 282 | 256 | 13,971 | 12,060 |
| | | low | 277 | 257 | 13,584 | 11,976 |
| Child purchase | | | | 95 | | 4,365 |
| Total | | | 2,496 | 2,112 | 147,530 | 118,798 |

Figure: Household groups

# Equilibrium

# Market Demand

Denote the set of random coefficients by $\pi_i$, the market share of product $j$ in market (at time) $t$:

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

# Firm Decisions

Index the firms as $f = 1, ..., F$, denote the set of firms $\mathcal{J}_f$, andd the set of brands offered by firm $f$, $\mathcal{B}_f$.

- **product pricing:** take **advertising state variables** $\mathfrak{a}_t$ **as given**, firm maximizes current profit

  $$\sum_{j\in\mathcal{J}_f}(p_{jt} - c_{jt})s_j(\mathfrak{a}_t, \mathbf{p_t}, \boldsymbol{\tau}_t)M_t - \sum_{b\in\mathcal{B}_f} e_{bt}$$

  in which $M_i$ denotes the total potential size of the market, $c_{jt}$ is the marginal cost of product $j$ at time $t$ and $\sum_{b\in\mathcal{B}_f} e_{bt}$ is the total advertising expenditure by firm $f$ during period $t$
  Price first-order conditions are then

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

- **advertising flows: not relevant to marginal cost identification**.
  Therefore, we only need to solve a static component of the game.

The system of equations, if invertible [2], solves marginal cost.

[2] which will be the case if goods are "connected substitutes" as in Berry and Haile (2014)

# Advertisement Ban Counterfactual

Following the introduction of an advertising ban, equilibria will satisfy the per period Nash-Bertrand conditions of profit maximization.

- Irrelevant about firms' belief of duration of the ban (permanent or not)

Assume the Nash equilibrium is unique. Then, the new first-order conditions are

$$s_j\left(\mathbf{0}, \mathbf{p}_t^0, \boldsymbol{\tau}_t\right) + \sum_{j' \in \mathcal{J}_f} \left(p_{j't}^0 - c_{j't}\right) \frac{\partial s_{j'}(\mathbf{0}, \mathbf{p}_t^0, \boldsymbol{\tau}_t)}{\partial p_{jt}} = 0$$

where

$$s_j(\mathbf{0}, \mathbf{p}_t^0, \boldsymbol{\tau}_t) = \int s_{ij}(\mathbf{0}, \mathbf{p}_t^0, \boldsymbol{\tau}_t^d) f(\pi|d) f(d) \mathrm{d}\pi \mathrm{d}d$$

is the counterfactual market level demand. [3]

[3] **Notice:** because ad ban changes the demand shape, the price equilibrium under an advertising ban will be different from the observed one.

# Data

# Advertisement Exposure state $\mathfrak{a}_{i,t}$

- The author use a state variable (vector) to store the **consumer's memory** about all the brands $\mathfrak{a}_{it} = (\mathfrak{a}_{i1t}, \ldots, \mathfrak{a}_{iJt})$
- The memory is **diminishing**: $\mathfrak{a}_{i,t} = \delta \cdot \mathfrak{a}_{i,t-1} + a_{i,t}$
- $\delta = 0.9$: diminishing rate
- $a_{i,t} = (a_{i,1,t}, \ldots, a_{i,J,t})$ is the vector of new exposure to adverts.
- Use the current period discounted value: $\mathfrak{a}_{i,t} = \sum_{n=0}^{t-t_0} \delta^n a_{i,t-n}$

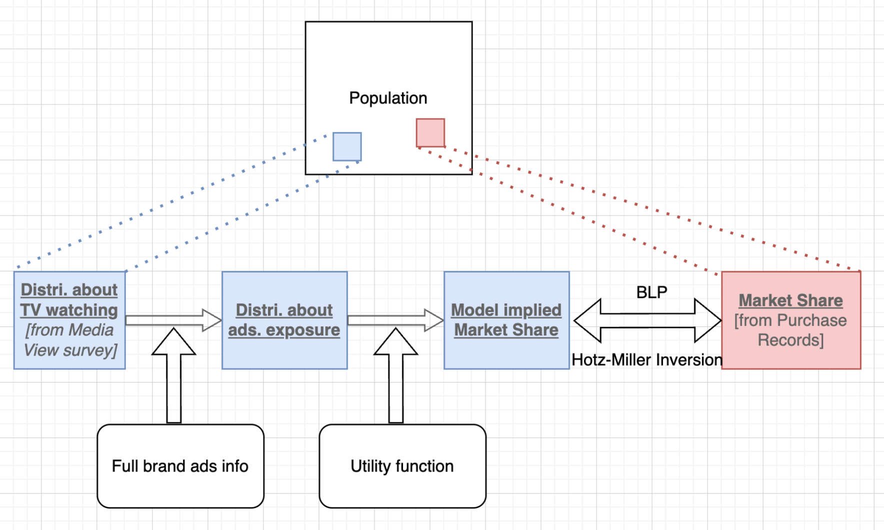
# New exposure $a_{i,t}$

- How to obtain the new exposure information?
- The author used the company's **Advertising data**.
- The author also used the **Media viewing survey data** from Kantar media survey.
- Advertising data reports which brand advertises at which channel, at what time
- Survey data reports the distribution of people's TV watching time
- From these two data sources we can obtain the distribution of people's advert exposure to each brands.

# Market share $s^{data}$

- Obtained also from purchase records from Kantar.
- Purchasing households information are included.
- Grouping information: Children? Pensioners? Income? Skill?
- We incorporate grouping information by giving each group a different brand preference term $\tau^d$.

# Data flow


Population
Distri. about TV watching [from Media View survey]
Distri. about ads. exposure
Model implied Market Share
BLP
Hotz-Miller Inversion
Market Share [from Purchase Records]
Full brand ads info
Utility function

# Empirical Results

# Estimates

This paper uses maximum likelihood estimate of the coefficients. Details of coefficients can be found in the appendix.

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

Figure: effect on WTP for an increase in healthiness

- For both food at home and food on-the-go higher exposure to advertising lowers consumers' willingness to pay for a more healthy product.

# Estimates (Contd.)

| | 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] |

Figure: Effect on brand demand

1. **diagonal blocks:** advertisement lowers consumer elasticity to prices
2. **other blocks:** advertisement can be cooperative for many brands

# Counterfactual Analysis

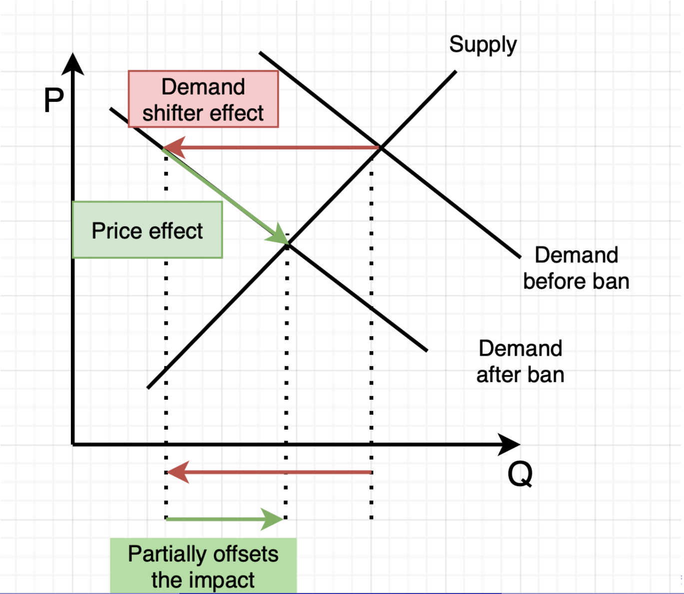
Now we assume the advert ban policy is implemented for one year. By the memory setting, the advertising state $\mathfrak{a}^{cf} = \delta^{54}\mathfrak{a}^{eq} = 0.004\mathfrak{a}^{eq}$

- Basics: What will be the new equilibrium?
- How will price change?
- How will quantity and expense change?
- How will nutrient consumption change?
- How will people substitute?
- Consumer surplus?

# What do adverts change?

- By utility function specification, adverts surely shift the demand function.
- Does adverts ban change the production function?
- Yes and no. In principle companies change their advertising expenses in order to maximize their profit.
- But advertising expenses can not change weekly. [Usually in a quartely or yearly basis]. Rather, companies adjust their product price very fast.
- At least we can say that in the short run advertising expense does not respond to price.

# Effect Decomposition



# Effect Decomposition

Normal market parameter for (ads state, price) is $(\mathfrak{a}^{eq}, \mathbf{p}^{eq})$
We decomposite our analysis into two steps:

- Firstly fix the price before the advert ban, but change the ads exposure state to $\mathfrak{a} = 0.4\%\mathfrak{a}^{eq}$: $(\mathfrak{a}^{ban}, \mathbf{p}^{eq})$
  Then use the utility function to generate 1st step market share.
  $s^{step1}(\mathfrak{a}^{ban}, \mathbf{p}^{eq})$
- Secondly we use company's response to generate new price equilibrium $(\mathfrak{a}^{ban}, \mathbf{p}^{ban})$
  Solve again the company FOC,

$$s_j(\mathfrak{a}^{ban}, \mathbf{p}, \tau) + \sum_{r \in \mathcal{F}_f} (\mathbf{p}_r - mc_r) \frac{\partial s_r(\mathfrak{a}^{ban}, \mathbf{p}, \tau)}{\partial p_r} = 0$$

  get company's best response, then solve the Nash equilibrium to get the new equilibrium price $\mathbf{p}^{ban}$

# How will Price Change?

TABLE 9
*Effect of advertising ban on equilibrium prices*

| | Walkers Regular | | Pringles | | KP | |
|---|---|---|---|---|---|---|
| | Pre ban | Advertising banned | Pre ban | Advertising banned | Pre ban | Advertising banned |
| <150 g | | | | | 0.86 | 0.82 [0.81, 0.84] |
| 150 g–300 g | 1.26 | 1.11 [1.09, 1.13] | 1.11 | 1.05 [1.03, 1.08] | 1.19 | 1.14 [1.13, 1.16] |
| 300 g+ | 2.79 | 2.62 [2.58, 2.64] | 2.60 | 2.50 [2.47, 2.52] | 2.38 | 2.31 [2.30, 2.33] |

*Notes:* Numbers show the mean price across markets in £s. "Pre ban" refers to the prices observed in the data; "Advertising banned" refers to counterfactual prices when advertising is banned. The 95% confidence intervals are given in square brackets.

# How will Quantity and Expense change?

TABLE 10
*Effect of advertising ban on purchases*

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

*Notes:* Percentage changes are shown below variables. "No price response" refers to the situation where advertising is banned and prices are held at their pre ban level; "with price response" refers to the situation where advertising is banned and firms reoptimize their prices. Expenditure refers to total expenditure on potato chip and quantity refers to the total amount of potato chips sold. Numbers are means across markets. The 95% confidence intervals are given in square brackets.

# How will nutrient consumption change?

TABLE 11
*Effect of advertising ban on nutrient purchases*

| | Pre ban | Advertising banned | |
|---|---|---|---|
| | | No price response | With price response |
| Energy | 313.70 | 265.94 | 283.23 |
| | [310.22, 316.37] | [256.46, 274.18] | [274.70, 290.29] |
| *% change* | | −15.23 | −9.71 |
| | | [−17.33, −12.55] | [−11.45, −7.18] |
| Saturates | 584.79 | 489.78 | 515.24 |
| | [576.73, 589.84] | [472.66, 506.86] | [498.46, 528.92] |
| *% change* | | −16.25 | −11.89 |
| | | [−18.05, −13.56] | [−13.57, −9.66] |
| Salt | 264.94 | 224.18 | 237.67 |
| | [261.89, 266.95] | [216.29, 231.02] | [230.45, 243.13] |
| *% change* | | −15.38 | −10.29 |
| | | [−17.41, −12.78] | [−12.01, −7.84] |
| Nutrient score | 13.78 | 13.72 | 13.62 |
| | [13.74, 13.80] | [13.66, 13.74] | [13.56, 13.65] |
| *% change* | | −0.46 | −1.19 |
| | | [−0.83, −0.13] | [−1.55, −0.92] |
| Saturates intensity | 3.95 | 3.90 | 3.85 |
| | [3.93, 3.97] | [3.87, 3.92] | [3.83, 3.87] |
| *% change* | | −1.19 | −2.41 |
| | | [−1.73, −0.72] | [−2.90, −2.03] |
| Salt intensity | 1.79 | 1.79 | 1.78 |
| | [1.79, 1.79] | [1.78, 1.79] | [1.77, 1.78] |
| *% change* | | −0.17 | −0.63 |
| | | [−0.37, 0.01] | [−0.83, −0.48] |

# How will people substitute?

TABLE 12
*Substitution to alternatives*

| Probability of selecting | Pre ban | Advertising banned: no price response | Advertising banned: 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] |

*Notes:* Numbers are the predicted market shares. The 95% confidence intervals are given in square brackets. Number below the confidence intervals is percentage point change. "No price response" refers to the situation where advertising is banned and prices are held at their pre ban level; "price response" refers to the situation where advertising is banned and firms reoptimise their prices. Numbers are means across markets.

# Consumer Surplus?

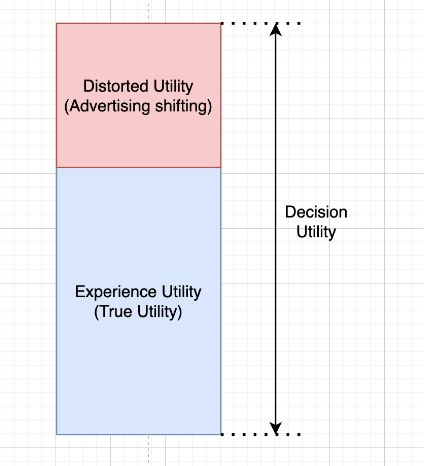
- Comparing the utility in the real equilibrium $W_i(\mathfrak{a}_i, \mathbf{p}^{eq})$ and utility in the banned counterfactual equilibrium $\hat{W}_i(\mathbf{0}, \mathbf{p}^{ban})$
- Calculate the individual difference in utility expectation, and then integrate them by demographics.

$$CV_i(\mathfrak{a}_i, \mathbf{p}^{ban}, \mathbf{p}^{eq}) = \frac{1}{\alpha_{0,i}}[W_i(\mathbf{0}, \mathbf{p}^{ban}) - \hat{W}_i(\mathfrak{a}_i, \mathbf{p}^{eq})]$$

$$CV(\mathfrak{a}, \mathbf{p}^{ban}, \mathbf{p}^{eq}) = \int CV_i(\mathfrak{a}_i, \mathbf{p}^{ban}, \mathbf{p}^{eq}) f(\pi|d) f(d) d\pi dd$$

- However, does the shifted utility represent consumer's true utility?
- From the persuasive view, NO, advertising "persuades" consumer to deviate from their normal sensitivity to price and to nutrients.
  - We should remove all the demand shifting effect from the utility function
- From the characteristics view, YES, advertising contributes to consumer's true utility.
  - We only need to integrate the differences in the utility expectation

# Utility Distortion



# Utility function revisited

$$\bar{v}_{ij} = (\alpha_{1,i} \underbrace{+\alpha_{2,i}\mathfrak{a}_{i,j}}_{\text{price effect shifter}})p_j + (\xi_{i,j} \underbrace{+\lambda_i \mathfrak{a}_{i,j}}_{\text{brand effect shifter}} + \underbrace{\rho_i(\sum_{l \neq b(j)} \mathfrak{a}_{il})}_{\text{brand competitive effect}})$$

$$+ (\psi_{1,i}\mathsf{x}_j \underbrace{+\psi_{2,i}\mathfrak{a}_{i,j}}_{\text{nutrient effect shifter}} n_j) + \tau_j^d + \epsilon_{i,j}$$

- From persuasive view, the true utility function is experience function without any advertising effect:

$$\hat{v}_{i,j} = \alpha_{1,i}p_j + \psi_{1,i}\mathsf{x}_j + \xi_{i,j} + \tau_j^d + \epsilon_{i,j}$$

- And then the change in utility expectation is:

$$\begin{aligned} CV_i(\mathfrak{a}_i, \mathbf{p}^{ban}, \mathbf{p}^{eq}) = & \frac{1}{\alpha_{0,i}}[W_i(\mathbf{0}, \mathbf{p}^{ban}) - \hat{W}_i(\mathfrak{a}_i, \mathbf{p}^{eq}) && \text{choice distortion effect} \\ & + W_i(\mathbf{0}, \mathbf{p}^{ban}) - W_i(\mathbf{0}, \mathbf{p}^{eq})] && \text{price competition effect} \end{aligned}$$

# Consumer Surplus

TABLE 13
*Effect of advertising ban on welfare*

| | Persuasive view | Characteristic view |
|---|---|---|
| Choice distortion effect (£m) | 15.0<br>[14.2, 16.1] | |
| Characteristic effect (£m) | | −23.2<br>[−25.4, −20.4] |
| Price competition effect (£m) | 3.7<br>[3.1, 4.3] | 3.7<br>[3.1, 4.3] |
| *Total compensating variation (£m)* | 18.7<br>[17.7, 20.4] | −19.5<br>[−21.3, −16.7] |
| *Change in profits (£m)* | −5.1<br>[−6.0, −3.7] | −5.1<br>[−6.0, −3.7] |
| **Total change in welfare (£m)** | 13.6<br>[12.7, 15.1] | −24.6<br>[−27.0, −20.4] |

*Notes:* Total compensating variation is equal to the sum of the choice distortion effect or characteristic effect and the price competition effect. Total change in welfare is equal to the sum of total compensating variation and change in profits. Profits are inclusive of savings from no advertising expenditure. Numbers are means across markets. The 95% confidence intervals are given in square brackets.

# Summary

# Summary

- The article develops a model of advertising influences demand, and estimates the model using the U.K. potato chip market.
    - The paper finds that advertising is, at least in part, cooperative, it acts to lower consumer sensitivity to price and it lowers consumers' willingness to pay for more healthy products. It also acts to attract new consumers into the market and to trade up to larger pack sizes.
    - Simulating an advertising ban shows a decrease in potato chip demand, but some firms lower prices offsetting the decrease, and consumers switch to less healthy alternatives.
    - Considering advertising as persuasive, banning advertisement leads to less distorted decisions and higher consumer welfare.
- The study suggests that banning advertising could have varying effects on different markets.
- Future research could explore other counterfactuals, *e.g.* how firms would adjust pricing and advertising strategies in response to a tax, using the framework in this paper.

# Thank you!