Equilibrium Effects of Food Labeling Policies

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The war against obesity

- Obesity rates have **tripled** since 1975

- **Dietary factors** are a leading cause of obesity

- Governments are exploring policies to improve nutritional intake

- Increasingly popular policy is to implement **food labels**
Research questions

1. Do food labels improve nutritional intake and consumer welfare?
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2. How do supply-side responses affect the potential benefits of food labels?
Research questions

1. Do food labels improve nutritional intake and consumer welfare?

2. How do supply-side responses affect the potential benefits of food labels?
   - Affect \textit{prices} through product differentiation and market power
   - Induce the use of \textit{healthier ingredients} to avoid labels

$\Rightarrow$ \textit{Equilibrium effects} of food labels are ambiguous
Research questions

1. Do food labels improve nutritional intake and consumer welfare?

2. How do supply-side responses affect the potential benefits of food labels?

3. How do food labels compare to alternative policy instruments?
We study a national food labeling regulation passed in Chile in 2016:

- Mandates food labels on all processed foods that:
  surpass threshold in sugar, calorie, sodium, and saturated fat concentration
Overview of results

1. Reduction in sugar and calorie intake of 9% and 7% due to the policy
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2. Descriptive evidence from the cereal market
   - Consumers: Substitute from labeled to unlabeled products
     - Stronger effect for products mistakenly believed to be healthy
   - Firms: Change prices and reformulate their products
Overview of results

1. Reduction in *sugar* and *calorie* intake of 9% and 7% due to the policy

2. Descriptive evidence from the cereal market

3. Model of supply and demand for cereal
   - **Policy effects**: Increases in consumer welfare by 1.8% of total expenditure
   - **Decomposition**: Role of demand and supply
   - **Counterfactuals**: Compare food labels to sugar taxes
Related literature

1. Consumer choice in settings of imperfect information

   → Consumers beliefs are crucial for policy effectiveness
1. Consumer choice in settings of imperfect information

2. Quality disclosure and certification


   → Framework to study equilibrium effects of mandatory disclosure policies
Related literature

1. Consumer choice in settings of imperfect information

2. Quality disclosure and certification

3. Policies to improve consumers’ nutritional intake
   - **Information on Menus**: Elbel et al. (2009), Wisdom et al. (2010), Bollinger et al. (2011), Finkelstein et al. (2011)
   - **Advertising**: Ippolito and Mathios (1990,1995), Dubois et al. (2017a)
   - **Taxes**: Dubois et al. (2017b), Allcott et al. (2019), Aguilar et al. (2020)

→ (i) Equilibrium framework, (ii) Role of beliefs (iii) Policy counterfactuals
This Talk

- Data
- Descriptive evidence
- Model
- Estimation
- Results
Data

1. Prices and quantities
   - Walmart-Chile scanner data (2015-2018)
   - Panel of 524,000 consumers that shop at Walmart regularly

2. Nutritional content
   - Coverage: 90% of revenue of packaged products and 94% in the cereal market

3. Beliefs about nutritional content
   - We conducted an online survey in Argentina to 1,500 customers
This Talk

- Data

- Descriptive evidence
  - Overall changes in nutritional intake
  - Zoom in on the breakfast cereal market

- Model

- Estimation

- Results
Descriptive evidence: Overall changes in nutritional intake

- Sugar and calorie intake per dollar spent decreased 9% and 7% respectively
- **Channels:** 1. between-category subs., 2. within-category subs., 3. product reformulation

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(a) Sugar intake

(b) Caloric intake
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![Graphs showing changes in sugar and caloric intake](attachment:image.png)

(a) Sugar intake  
(b) Caloric intake
The breakfast cereal market
Descriptive evidence: Changes in equilibrium quantities

- Product: all bar codes with same name and brand (e.g. “Honey Nut Cheerios”)

- We estimate the following regression

\[
\log(q_{jst}) = \sum_{k} \beta_k L_j \mathbb{1}_{k=t} + \gamma \log(p_{jst}) + d_{js} + \delta_t + \epsilon_{jst}
\]

where
- \( q_{jst} \) are total grams of product \( j \) sold in supermarket \( s \) in period \( t \) (8 weeks long)
- \( L_j \) is defined as whether the product gets any label (as in 2018)
- Observations are weighted by pre-policy revenue
- Standard errors clustered at the product level
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- Observations are weighted by pre-policy revenue
- Standard errors clustered at the product level
Descriptive evidence: Changes in equilibrium quantities

- Relative decrease in demanded quantities for labeled products of 26.4% on average
Descriptive evidence: The role of beliefs

- The correlation between beliefs about sugar and true sugar content is 0.73
- The correlation between beliefs about calories and true calorie content is 0.28

(a) Beliefs about sugar

(b) Beliefs about calories
Descriptive evidence: The role of beliefs

- We divide product between labeled and unlabeled
- We split labeled products between above- and below-median in calorie beliefs

(a) Beliefs about sugar

(b) Beliefs about calories
Descriptive evidence: The role of beliefs

- Products perceived as healthy that received a label were more affected
Descriptive evidence: Supply side - product reformulation

- Firms reformulated products to avoid receiving labels
- 33% and 23% of “high-in” products in sugar and calories respectively crossed the threshold

(a) Sugar content - 2016

(b) Caloric content - 2016
Descriptive evidence: Supply side - product reformulation

- Firms reformulated products to avoid receiving labels
- 33% and 23% of “high-in” products in sugar and calories respectively crossed the threshold

(a) Sugar content - 2018

(b) Caloric content - 2018
Descriptive evidence: Supply side - changes in prices

- Unlabeled products increased price relative to labeled ones
- Mix between: responses to changes in demand + increase in production costs
Descriptive evidence: Takeaways

- Demand for unlabeled products increased 26% relative to labeled ones
  - Beliefs play a key role in shaping demand

- Firms reacted by changing prices and reformulating products
  - Average sugar and calorie concentration decreased in 12% and 3%
  - Average price of unlabeled products increased 5.5% relative to labeled ones
Descriptive evidence: Takeaways

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• We develop and estimate a model to:
  - Incorporate findings into an equilibrium framework
  - Disentangle the role of demand and supply
  - Study optimal policy design and compare to alternative policy instruments
This Talk

- Data
- Descriptive evidence

- Model
  - Demand
  - Supply

- Estimation

- Results
Model: Demand

- Utility obtained by individual $i$ when purchasing product $j$:

$$ u_{ijt} = \delta_{ijt} - \alpha_i p_{jt} - w_{jt} \phi_i $$

- $\delta_{ijt}$: experience/taste
- $\alpha_i p_{jt}$: price paid
- $w_{jt} \phi_i$: health consequences
Model: Demand

- Utility obtained by individual $i$ when purchasing product $j$:

$$u_{ijt} = \delta_{ijt} - \alpha_i p_{jt} - w_{jt} \phi_i$$

1. $\delta_{ijt}$: is immediately observed by the consumer
   - Includes taste, relief of hunger, social status, or any other short term benefit of consuming the good
Model: Demand

- Utility obtained by individual \( i \) when purchasing product \( j \):

\[
 u_{ijt} = \delta_{ijt} - \alpha_i p_{jt} - w_{jt} \phi_i 
\]

experience/taste \hspace{1cm} price paid \hspace{1cm} health consequences

2. \( \alpha_i p_{jt} \): disutility from paying price \( p_{jt} \)
   - \( \alpha_i \) is the parameter that governs the price elasticity
Model: Demand

- Utility obtained by individual $i$ when purchasing product $j$:

$$ u_{ijt} = \delta_{ijt} - \alpha_i p_{jt} - w_{jt} \phi_i $$

- Experience/taste
- Price paid
- Health consequences

3. $w_{jt} \phi_i$: long term damage from consuming unhealthy products

- $w_{jt}$ is a vector of the nutritional content of product $j$
- We assume that consumers know $\phi_i$ but only observe $E_i[w_{jt} | L_{jt}]$, where
  - $E_i$ is defined over $\pi_{ji}$, the distribution of prior beliefs of consumer $i$ over product $j$’s nutritional content
  - $L_{jt} \in \{pre, no, yes\}$ is the labeling status of product $j$ (pre policy, not labeled after policy, labeled after policy)
Model: Demand

• Taking expectation over $u_{ijt}$, the expected utility is

$$E_i[u_{ijt}] = \delta_{ijt} - \alpha_i p_{jt} - E_i[w_{jt}|L_{jt}] \phi_i$$

• The set of consumers buying product $j$ in market $t$ is given by:

$$\Theta_{jt} = \{i : E_i[u_{ijt}] \geq E_i[u_{ikt}] \forall k \in \{0, \ldots, J\}\}$$

• Market share of product $j$ in market $t$ is given by $s_{jt}(p_t, E[w_t|L_t])$
Model: Supply

- **Key assumption**: Products are characterized by an invariant taste level
  - Achieved by combining critical nutrients $w_{jt}$ with other substitute inputs
  - We denote by $\nu_j$ the optimal amount of $w_{jt}$ to achieve taste at minimum cost

- In each period, firms choose prices and nutritional content to maximize profits
  \[
  \max_{\{p_{jt}, w_{jt}\}_{j \in \mathcal{J}}} \sum_{j \in \mathcal{J}} (p_{jt} - c_{jt}(w_{jt})) \cdot s_{jt}(p_t, \mathbb{E}[w_t|L_t])
  \]

  where $c_{jt}(w_{jt})$ is minimized at $\nu_j$
Model: Supply

- In the **absence of the policy**, firms solve:

\[
\max_{\{p_{jt}, w_{jt}\} j \in \mathcal{I}} \sum_{j \in \mathcal{I}} (p_{jt} - c_{jt}(w_{jt})) \cdot s_{jt}(\mathbf{p}_t, \mathbb{E}[\mathbf{w}_t])
\]

- From the first order conditions, we have:

\[
\begin{align*}
    w_{jt}^* &= \nu_j \\
    p_{jt}^* &= c_{jt}(w_{jt}^*) + \Delta_{(j, \cdot)}^{-1} s_t
\end{align*}
\]

where the \((j, k)\) element of \(\Delta\) is given by:

\[
\Delta_{jk} = \begin{cases} 
    \frac{-\partial s_k}{\partial p_j} & \text{if } k \in \mathcal{I}_j \\
    0 & \text{otherwise}
\end{cases}
\]
Model: Supply

- When we introduce labels, demand $s_{jt}(p_t, E[w_t | L_t])$ becomes discontinuous in $w_{jt}$
  - Previous first order conditions might not hold with equality

- Firms have incentives to bunch below the threshold to get rid of the labels
  - Firms closer to the threshold are more likely to bunch
This Talk

• Data

• Descriptive evidence

• Model

• Estimation
  - Demand
  - Supply

• Results
Demand estimation: Parametrization

- We split consumers into two consumer-type bins $b \in \{\text{low SES, high SES}\}$

- The expected utility is given by:
  $$E_b[u_{ijt}] = -\alpha_i p_{jt} - E_b[w_{jt}|L_{jt}]' \phi_i + \beta_i r_j + \delta_{jb} + \delta_{T(t)b} + \delta_{S(t)b} + \xi_{jtb} + \epsilon_{ijt}$$

  where $[\alpha_i \phi_i']' \sim \log \mathcal{N}([\alpha_b \phi_b'], \Sigma_{\alpha,\phi})$ and $\beta_i \sim \mathcal{N}(0, \Sigma_{\beta})$

  - $r_j$ is product $j$'s subcategory (e.g. plain, sugary, chocolate, oatmeal, granola)
  - $\epsilon_{ijt} \sim \text{GEV (nested logit)}$ with intra-nest correlation $\rho$ (inside vs outside goods)

- $E_b[\cdot]$ is defined over prior beliefs $\pi_{jb}$, that are given by a normal distribution $\mathcal{N}(\mu_{jb}, \Omega_{jb})$

- Bayesian consumers update posteriors taking the labels as a binary signal
Demand estimation: Identification

- $\alpha_b$: Instrument for prices ($\hat{\rho}_{jt}$)
  - We construct instruments using international commodity prices (corn, wheat, oat) interacted with the content of each commodity in product $j$

- $\phi_b$: Variation in labeling status across and within products
  - We interact a predictor for labeling status $\hat{L}_j$ with a post dummy
  - We construct $\hat{L}_j$ via random forest using $r_j$ and pre-policy nutritional content

- $(\rho, \Sigma_\alpha, \phi, \Sigma_\beta)$: Variation in other products’ demand shifters
  - $z_{t,1}^r = \text{mean}_{j \in r, t}\{\hat{\rho}_{jt}\}$, $z_{t,2}^r = \text{pctile}_{20,80}^{20,80}\{\hat{\rho}_{jt}\}$, $z_{t,3}^r = \sum_{j \in r, t} 1\{t \geq \tau_{jt}\}$

- $(\mu_{jb}, \Omega_{jb})$: Combination of beliefs’ survey with additional moment conditions
Demand estimation: Results

- The average consumer buys 5.2kg of cereal, spending $25 a year

- The average own-price elasticity is -3.09

- Keeping taste constant, an average consumer is willing to pay:
  - 10% extra ($2.5 a year) to reduce sugar content in 1sd
  - 7.6% extra ($1.9 a year) to reduce calorie content in 1sd

- Original Cheerios have 2sd less sugar than Honey Nut Cheerios
Supply estimation

- Marginal cost is given by $c_{jt}(w)$, where $\nabla c_{jt}(\nu_j) = 0$

- We use a second order Taylor approximation around $\nu_j$

  $$c_{jt}(w) = \bar{c}_{jt} + (w - \nu_j)\Lambda_j(w - \nu_j)$$

- From the first order conditions we can recover $c_{jt}(w_{jt})$ and $\nu_j = w_{j,pre}$

- From equilibrium, we find cost at which firms are indifferent between bunching and not

- Assuming $\Lambda_j = \begin{bmatrix} \lambda_{jc} & 0 \\ 0 & \lambda_{js} \end{bmatrix}$ and that $\lambda_{jk} \sim \log\mathcal{N}(\mu_{\lambda_k}, \sigma_{\lambda_k})$, we can estimate $(\mu_{\lambda_k}, \sigma_{\lambda_k})$ via GMM: $\mathbb{E}_{\Lambda}[B_j - Pr(c_{jt}(\bar{w}) < c_{j,ind}^{ind})|\nu_j] = 0$, where $B_j$ indicates whether the product bunched and $c_{j,ind}^{ind}$ is the cost at which the firm is indifferent between bunching or not.
Supply estimation: Results

- Products bunching in sugar decreased sugar content in 0.6sd (8gr/100gr)
  - Marginal cost increased 8.8% on average (4.4% of final price)

- Products bunching in calories decreased calorie content 1sd (25kcal/100gr)
  - Marginal cost increased 8.7% on average (3.9% of final price)
This Talk

- Data
- Descriptive evidence
- Model
- Estimation
- Results
  - Policy decomposition
  - Policy counterfactuals
Policy decomposition

• We run counterfactuals to answer:
  - What are the effects of labels in the absence of supply-side responses?
  - How does product differentiation and market power affect final prices?
  - How product reformulation can
    → amplify the positive effects on nutritional intake
    → increase consumer prices as a result of increased production costs

• Study policy design by changing regulatory thresholds

• Compare food labels to sugar taxes
Policy decomposition: Normative assumptions

- Our model can accommodate **additional market imperfections**
  - **Externalities**: Financial health-care costs, moral hazard
  - **Internalities**: Lack of self-control, time-inconsistency, misinformation about $\phi_i$

- We add them to our model by having the following setup

  **Expected utility** : $\mathbb{E}_b[u_{ijt}] = \delta_{ijt} - \alpha_i p_{jt} - \mathbb{E}_b[w_{jt}|L_{jt}]'\phi_i$

  **Social planner utility** : $u_{ijt} = \delta_{ijt} - \alpha_i p_{jt} - w_{jt}'\phi_i \lambda$

- We focus on the case where $\lambda = 1$ (i.e. no additional market imperfections)
Policy decomposition: Counterfactuals

- We estimate outcomes under four scenarios:

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- We measure average yearly consumer welfare in dollars using the social planner utility

\[
CW = \frac{1}{I} \sum_i \frac{1}{\alpha_i} \sum_j \left\{ \int_{\Theta_{jt}} \left( \delta_{ijt} - \alpha_i p_{jt} - w'_{jt} \phi_i \lambda \right) dP(\epsilon) \right\}
\]

where \( \Theta_{bijt} = \{i \in b : j \geq i, k, \forall k\} \)
Policy decomposition: Counterfactuals

- We study the effects of the policy under four scenarios:

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- We can calculate \(\Delta CW = CW - CW(0)\) and decompose it into:

\[
\Delta CW = \frac{1}{I} \sum_i \frac{1}{\alpha_i} \sum_j \int_{\Delta\Theta_{jt}} \delta_{ij} dP(\epsilon) - (\alpha_i p_{jt} + w'_{jt} \phi_i \lambda) \Delta s_{ijt} - (\alpha_i \Delta p_{jt} + \Delta w'_{jt} \phi_i \lambda) s_{ijt}^{(0)}
\]

- substitution effects
- supply effects

where \(\Delta x = x - x^{(0)}\) and \(\Delta\Theta_{jt} = \{i \in b : j \succeq_i k, \forall k \cap i : \exists k | j \not\succeq_i k\}\)
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\text{substitution effects}
\]

\[
\text{supply effects}
\]

where $\Delta x = x - x^{(0)}$ and $\Delta \Theta_{jt} = \{ i \in b : j \geq_i k, \forall k \cap i : \exists k | j \neq_i k \}$
Policy decomposition: Counterfactuals

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where $\Delta x = x - x^{(0)}$ and $\Delta \Theta_{jt} = \{i \in b : j \geq_i k, \forall k \cap i : \exists k | j \neq^{(0)}_i k\}$
Policy decomposition: (0) No intervention
Policy decomposition: (1) Demand only

- Consumers substitute towards healthier products
Policy decomposition: (1) Demand only

- Healthier products are cheaper and of lower taste
Policy decomposition: (1) Demand only

- Net increase in consumer welfare of 1.1% of total expenditure
Policy decomposition: (2) Price response

- Firms respond by increasing (decreasing) prices of unlabeled (labeled) products
Policy decomposition: (2) Price response

- Gains in consumer welfare are lower with respect to (1)
Policy decomposition: (3) Equilibrium

- Firms respond by reducing the concentration of regulated nutrients
Policy decomposition: (3) Equilibrium

- Reformulation comes with higher production costs that translate to higher prices
Policy decomposition: (3) Equilibrium

- Gains in consumer welfare are 70% larger than in (1)
Policy counterfactuals

- We then use the model to:
  - Study optimal policy design by varying the regulatory thresholds
  - Compare food labels to sugar taxes

- We focus on the case where calorie content is perfectly observed and only sugar content is regulated
Policy counterfactuals: Optimal threshold

- Optimal threshold without supplier responses: maximize labels informativeness
- Taking supply responses into account: optimal threshold pushed to the left
Policy counterfactuals: Optimal threshold

- Optimal threshold without supplier responses: maximize labels informativeness
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Policy counterfactuals: Optimal threshold

- Optimal threshold without supplier responses: maximize labels informativeness
- Taking supply responses into account: optimal threshold pushed to the left
Policy counterfactuals: Sugar tax

- We compare the food labeling policy to alternative sugar taxes.

- Firm’s problem is now given by:

\[
\max_{\{p_{jt}, w_{jt}\}_{j \in \mathcal{J}}} \sum_{j \in \mathcal{J}} (p_{jt} - c_{jt}(w_{jt}) - \tau w_{jt}) \cdot s_{jt}(p_t, \mathbb{E}[w_t])
\]

- From the first order conditions, we have:

\[
\begin{align*}
    w_{jt}^* &= \nu_j - (2\Lambda)^{-1}\tau \\
    p_{jt}^* &= c_{jt}(w_{jt}^*) + \tau w_{jt}^* + \Delta_{(j, t)}^{-1}s_t
\end{align*}
\]

- We denote by $\psi$ the marginal value of public funds, and assume $\psi = 1$. 
Policy counterfactuals: Sugar tax

- Soda sugar taxes in the US are equivalent to 0.3¢ per gram of sugar
Policy counterfactuals: Comparative statics

- The effectiveness of food labels and sugar taxes depend on
  - The presence of non-informational market imperfections ($\lambda$)
  - The marginal value of public funds ($\psi$)

$CW(Labels) > CW(Tax)$

$CW(Labels) < CW(Tax)$

Benchmark Values in the literature
Policy counterfactuals: Distributional consequences

- The progressivity of a policy depends on how the **benefits** and the **costs** vary across the income distribution

- Two key parameters:
  - **Sugar-income gradient**: when low-SES consumers prefer sugary products more, they are charged disproportionately higher taxes
  - **Misinformation-income gradient**: when low-SES consumers are more misinformed, the effects of food labels are better targeted towards them

- Food labels present distributional advantages when these gradients are positive
Beyond Cereal

• Our model sheds light on the effects of food labels on other categories

• Determinants of demand-side response:
  - Close substitutes goods (+)
  - Informativeness of labels (+)

• Determinants of supply-side response:
  - Expected demand-side responses (+)
  - Distance to policy threshold (−)
  - Cost of reformulation (−)

• We zoom out to other product categories to test these hypotheses
  - Soft drinks vs. cereal
  - Liquids vs. solids
Concluding remarks

1. Food labels can be an **effective** way to improve diet quality and combat obesity

2. **Equilibrium forces** are important
   - Price responses can undermine/augment the benefits
   - Reformulation increases healthiness at the expense of higher prices

3. Compared to sugar taxes, labels present **advantages** and **disadvantages**
   - More progessive and better targeted
   - Less effective against non-informational market imperfections

4. We should see more food labeling policies implemented in the future
Appendix: Regulatory thresholds

- The regulation is gradually tightened in three phases: June 2016, June 2018, June 2019

<table>
<thead>
<tr>
<th>Stage</th>
<th>Solids</th>
<th>Liquids</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$S_1$</td>
<td>$S_2$</td>
</tr>
<tr>
<td>Energy (kcal/100g)</td>
<td>350</td>
<td>300</td>
</tr>
<tr>
<td>Sodium (mg/100g)</td>
<td>800</td>
<td>500</td>
</tr>
<tr>
<td>Total Sugars (g/100g)</td>
<td>22.5</td>
<td>15</td>
</tr>
<tr>
<td>Saturated fats (g/100g)</td>
<td>6</td>
<td>5</td>
</tr>
</tbody>
</table>

- Some examples as reference:

<table>
<thead>
<tr>
<th>per 100 gr</th>
<th>Energy (kcal)</th>
<th>Sodium (mg)</th>
<th>Sugar (gr)</th>
<th>Fat (gr)</th>
<th># of labels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frosted Flakes</td>
<td>369</td>
<td>468</td>
<td>35</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>Cheetos</td>
<td>468</td>
<td>904</td>
<td>0.8</td>
<td>4.8</td>
<td>2</td>
</tr>
<tr>
<td>Snickers</td>
<td>488</td>
<td>189</td>
<td>47</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Coca-Cola</td>
<td>44</td>
<td>10</td>
<td>10.5</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
Appendix: Change in total revenue

- Large substitution from labeled to unlabeled cereals
Appendix: Beliefs Survey

- We asked consumers to insert cereal products between these reference products:
  - Calories:
    - Bajo en calorías (200 kcal cada 100g)
      - Pan Integral
    - Árroz Blanco
    - Galletas Oreo
    - Maní
    - Alto en calorías (600 kcal cada 100g)
      - Bajo en azúcar (0g cada 100g)
        - Papas Fritas
        - Manzana
        - Uvas
        - Muffin de Arándanos
        - Galletas Oreo
        - Dulce de Leche

- Sugar:
Appendix: Identification of $\mu_{jb}$

- Change in beliefs when $\mu = \mu_1$

(a) Change in beliefs for product $h$

(b) Change in beliefs for product $k$
Appendix: Identification of $\mu_{jb}$

- Change in beliefs when $\mu = \mu_2 < \mu_1$

(a) Change in beliefs for product $h$

(b) Change in beliefs for product $k$
Appendix: Identification of $\mu_{jb}$

- Model gives different predictions for different values of $\mu$:

$$\Delta E_{b}[u_{j}(\cdot)|L]$$

$$\hat{\mu}_{kb} \quad \hat{\mu}_{hb} \quad \hat{\mu}_{jb}$$

$$\Delta E_{b}[w_{h}|L_{h}] \phi_{b}$$

$$\phi_{b}$$

$\mu = \mu_{1}$ $\mu = \mu_{2}$
Appendix: Sugar-income gradient

- If low-SES consumers prefer high-in-sugar products more, taxes will disproportionally charge them more
Appendix: Misinformation-income gradient

- If low-SES consumers are less informed, food labels will be better targeted

(a) Food labels

(b) Sugar taxes
Appendix: Soft drinks vs. cereal

(a) Soft drinks

(b) Cereal
Appendix: Liquids vs. solids

Notes: 600 unique UPCs and 290 nutritional formulas. Weighted by pre-policy revenue.

(a) Juice (2016)

Notes: 300 unique UPCs and 244 nutritional formulas. Weighted by pre-policy revenue.

(b) Cookies (2016)
Appendix: Liquids vs. solids

Notes: 600 unique UPCs and 290 nutritional formulas. Weighed by pre-policy revenue.

(a) Juice (2018)

Notes: 300 unique UPCs and 244 nutritional formulas. Weighed by pre-policy revenue.

(b) Cookies (2018)