United States Department of Agriculture

The impact of taxing sugary soft beverages in México: A censored QUAI demand system approach

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The Casales family

Figure: The Casales family of Cuernavaca. Food expenditure for one week is $93 dollars and about $12 is spent on Sugary Soft Beverages (SSB). Stated preferences: pizza, pasta, and chicken. Revealed preferences: SSB.

Sugary Soft Beverages consumption in México

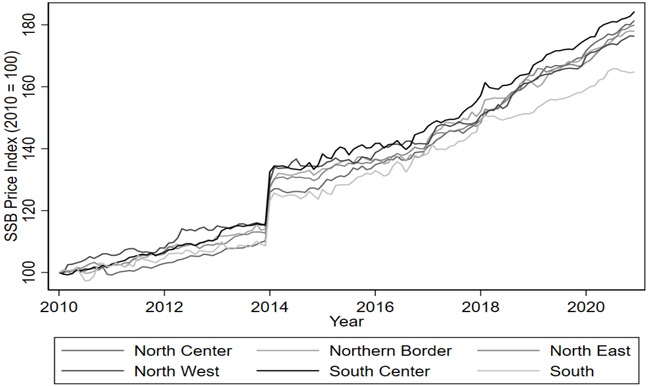


Figure: Sugary Soft Beverages (SSB) price index across all the economic regions in México over the last decade. A one peso per litter of SSB was proposed in 2012 and was successully implemented on the first day of 2014.

Non-demand estimation approaches to study the impact of the Sugary Soft Beverages

- Passed-through effect:
  - Colchero *et al.*, (2015b): **Tax was almost completely absorbed by consumers**.
  - Campos-Vázquez and Medina-Cortina (2019): After accounting for competition at the supermarket level, the consumer experienced price changes **between 24% and 152% pesos** of the tax value.
- SSB sales effect:
  - Colchero *et al.*, (2016): **7.3% decrease** in per capital sales of SSB.
- Caloric intake decrease:
  - Aguilar, Gutierrez, and Seira (2021): **2.7% decrease** in caloric intake.

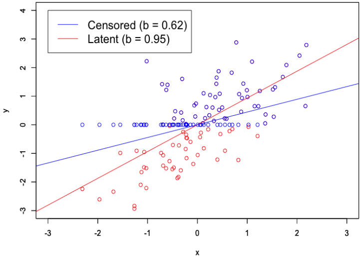
Caveats:

- Passed-through and sales studies suggest a clear decline in the consumption of SSB;
  - However, **substitution could take place** for caloric-intensive goods.
- Causal impact of the tax on caloric intake suggests a decline on obesity;
  - However, we do not understand the **mechanisms** (unintended consequences):
    - Budget effect.
    - Substitution and complementarity effects.

Demand estimation approaches in Latin America

- In México, Colchero, Salgado, and Unar-Munguía (2015a): Own-price elasticity at -**1.11**.
- In Colombia, Caro *et al.*, (2017): Own-price elasticity at -**1.61**.
- In Chile, Guerrero-López, Unar-Munguía, and Colchero (2017): Own-price elasticity at -**1.37**.
- All SSB demand estimation studies in Latin-america have at least two of the following empirical shortcomings:
  1. **Unit-value endogeneity** (Deaton, 1998; Cox and Wohlgenant, 1986).
  2. **Expediture endogeneity** (LeFrance, 1993).
  3. **Corner solutions treatment** (Dong, Gould, and Kaiser, 2004; Enríquez and Echevarría, 2016).

A Corner solution (censorship) problem



Our Amemiya-Tobin correction starts by:

$$S_i^* \in \mathbb{R}^1 \mapsto S_i^* \in [0,1]$$

where S_i^* is the latent share and S_i is the observed share.
Wales and Woodland (1983):

$$S_i = \begin{cases} \frac{S_i^*}{\sum_{j\in\Psi} S_j^*}, & S_i^* > 0, \\ 0, & S_i^* \leq 0 \end{cases} \quad i = 1, ..., 4$$

where Ψ is the set of all positive latent shares.

Preview of results

- Own-price elasticity with respect to SSB is:
  - **-0.83** for the year of 2014,
  - **-0.98** for the year of 2016,
  - **-0.95** for the year of 2018.
- Failure to account for unit-value endogeneity carries upward bias for own-price elasticities.
- Milk is a substitute good for SSB, and juice is a complement good for SSB.
- Education is a major determinant to reduce the consumption of SSB.

Banks, Blundell and Lewbel (1997)'s QUAI Demand System

$$U_1 = \alpha_1 + \theta_1' \mathbf{z} + \sum_{j=1}^{M} \gamma_{1j} \ln p_j + \beta_1 \ln\left\{\frac{w}{a(\mathbf{p})}\right\} + \frac{\lambda_1}{b(\mathbf{p})}\left[\ln\left\{\frac{w}{a(\mathbf{p})}\right\}\right]^2,$$

$$\vdots$$

$$U_M = \underbrace{\alpha_M + \theta_\mathbf{M}' \mathbf{z} + \sum_{j=1}^{M} \gamma_{Mj} \ln p_j + \beta_M \ln\left\{\frac{w}{a(\mathbf{p})}\right\}}_{\text{AID system}} + \underbrace{\frac{\lambda_M}{b(\mathbf{p})}\left[\ln\left\{\frac{w}{a(\mathbf{p})}\right\}\right]^2.}_{\text{QUAID system}}$$

where:

- $\mathbf{z}$ and w are a vector of demographic characteristics and a total budget, respectively.
- $a(\mathbf{p})$ and $b(\mathbf{p})$ are priced aggregators.
- p_i is a vector of prices $\forall i$.
- The dependent variable is defined as $U_i = \frac{p_i q_i}{w}$ $\forall i$ where q_i is quantity .
- The coefficients are restricted such that: $\sum_{i=1}^{M} \alpha_i = 1$, $\sum_{i=1}^{M} \beta_i = 0$, $\sum_{j=1}^{M} \gamma_{ij} = 0$, $\sum_{i=1}^{M} \lambda_i = 0$, $\sum_{i=1}^{M} \theta_i = 0$, and $\gamma_{ij} = \gamma_{ji}$ $\forall i, j$.

Cournot and Engel aggregations

The budget restriction is given by:

$$p_1 q_1 + \ldots + p_M q_M = w$$

The Cournot aggregation is given by:

$$U_1 \eta_{1j} + \ldots + U_M \eta_{Mj} = -U_j$$

The Engel aggregation is given by:

$$U_1 \eta_1 + \ldots + U_M \eta_M = 1$$

where:

- η_i is a budget elasticity.
- η_{mj} is a price elasticity.

The Slutsky Equation

Slutsky equation:

$$\frac{\partial h_i}{\partial p_j} = \frac{\partial x_i}{\partial p_j} + \frac{\partial x_i}{\partial w} x_j$$

Slutsky equation in elasticities:

$$\eta_{ij}^{c} = \eta_{ij} + \eta_i U_j$$

where:

- h_i is the Hicksian demand.
- η_{ij}^{c} is the Hicksian elasticity.

Thanks!