Soda Taxes and the Price of Sodas: Evidence from Mexico

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The issue: widespread obesity

- Americans are heavy
  - Adults
    - 69% are overweight (BMI>25)
    - 36% are obese (BMI>30)
  - Children
    - 32% are overweight
    - 17% are obese
Why is obesity an issue?

- **Linked to chronic disease**
  - Diabetes
  - High blood pressure
  - Heart disease
  - Some forms of cancer

- **Obesity is costly**
  - Accounted for $147 billion of US health expenditures in 2008
  - Roughly 5% of total health spending
Obesity is not just an issue in the US

Prevalence of obesity*, ages 20+, age standardized
Both sexes, 2008

The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
Map Production: Public Health Information and Geographic Information Systems (GIS) World Health Organization

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Focus on Mexico

■ Mexicans are very heavy
  – 73 percent of Mexican adults are overweight
  – 33 percent are obese

■ Obesity is costly
  – Accounted for 13 percent of Mexican health expenditures in 2008
  – Costs projected to double by 2017
  – Much diabetes is uncontrolled
Causes of obesity

- In general, too many calories consumed and not enough expended

- Strong link to sugar consumption

- Drinks with added sugar a major problem
Drinks with added sugar

- High in calories
- Low in satiety
- Result: calories consumed via sugary drinks don’t displace other calories, just add to the total consumed
Mexicans love drinks with added sugar*

- 2013 consumption
  - Sodas: 139 liters/person/year
  - >1 can/person/day
  - Account for ~20% of adult energy intake

* so do Americans, Argentinians, and Chileans
Mexico’s policy solution

- National Strategy to Prevent and Control Overweight, Obesity, and Diabetes
  - Calls for numerous measures including:
  - restrictions on advertising oriented toward kids
  - taxes on junk food, drinks with added sugar
Mexico’s tax on drinks with added sugar

- Took effect January 1, 2014
- Imposed tax of 1 peso/liter
  - Applies to:
    - Regular sodas
    - Fruit juice drinks
    - Water drinks with added sugar
  - Does not apply to:
    - Milk
    - Pure juices
Theory

- Tax raises prices
- Higher prices reduce consumption
- Lower consumption means lower weight, less chronic disease
Two key questions not addressed by theory

- How much do prices rise?
- What happens if consumers substitute other caloric drinks for sodas?
Key questions

- How much do prices rise?
  - The more the tax is passed through to prices, the greater the decrease in consumption
  - Pass-through depends on market structure, shape of demand curve
  - Price could rise by less, the same, or more than the tax

- Pass-through is a key parameter
Key questions

- What do consumers drink instead of taxed beverages?
  - If non-caloric drinks, favorable prospects for weight loss
  - If caloric drinks, weight loss less likely

- How would we know?
  - Increased demand for substitute drinks should cause those drinks’ prices to rise

- Substitution patterns may be revealed by price changes
Research goals

- Estimate pass-through for sodas
- Estimate pass-through for potential substitute products
- Provide rough estimates of effect of tax on weight
The evaluation problem

- The tax took effect throughout the country all at the same time
- No control group in customary sense
The solution

- Compare changes in prices of taxed goods to changes in prices of untaxed comparison goods
The data

- From Mexican Consumer Price Index survey
  - Ongoing survey
  - 283 product categories
  - Price data for 235,000 items each month from 46 cities nationwide
The data

- Public use data
  - Average price of each product in each city each month
  - Standardized units (e.g., price per kg, per liter)
  - Quite detailed: liter price of Coca Cola purchased in six pack of 355 mL cans in Mexico City in January 2015 was 22.77 pesos
The data: a first look

Figure 1: National price index for sodas
The data

- Product categories
  - Original four: soft drinks, bottled water, juices and juice drinks, and milk
  - Categories included mix of taxed and untaxed products, so I recombined them
  - Ultimate five: regular sodas, diet sodas, water drinks w/o sugar, milk, pure juice
Two empirical approaches

- **Synthetic cohort approach**
  - Construct synthetic comparison product from universe of untaxed product that most closely tracks pre-tax behavior of soda prices
  - Use forecasts based on synthetic comparison product to estimate effect of tax

- **Intervention analysis/Interrupted time series**
  - Fit time series (ARIMA) model to pre-tax data
  - Estimate level shift that occurred beginning January 2014

- Use permutation methods for inference
### Magnitude of pass-through as percentage of December 2013 price

<table>
<thead>
<tr>
<th>Product</th>
<th>Synthetic cohort approach</th>
<th>ARIMA approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular sodas</td>
<td>14.09</td>
<td>12.09</td>
</tr>
<tr>
<td></td>
<td>[0.97]</td>
<td>[0.98]</td>
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<tr>
<td>Diet sodas</td>
<td>2.12</td>
<td>1.22</td>
</tr>
<tr>
<td></td>
<td>[0.70]</td>
<td>[0.73]</td>
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<tr>
<td>Water drinks</td>
<td>-0.30</td>
<td>0.07</td>
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<tr>
<td></td>
<td>[0.43]</td>
<td>[0.62]</td>
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<tr>
<td>Milk</td>
<td>0.64</td>
<td>0.02</td>
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<tr>
<td></td>
<td>[0.59]</td>
<td>[0.50]</td>
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<tr>
<td>Pure juices</td>
<td>0.43</td>
<td>-0.73</td>
</tr>
<tr>
<td></td>
<td>[0.56]</td>
<td>[0.36]</td>
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</table>
Summary

- Tax raised price of regular sodas
  - Tax increase was 9%; pass-through was 12-14%
  - Consistent with theory of incidence in imperfectly competitive industry
  - Corresponds to price increase of 1.32-1.54 pesos/liter

- Other drinks
  - No price increases
  - No evidence that consumers substituted toward other caloric drinks
From prices to consumption and weight

- Aggregate and micro consumption data disagree
- Use estimated pass-through, prior estimates of demand elasticity to estimate consumption response
- Use caloric content of sodas, standard energy calculations to estimate effect on weight
Elasticities, consumption, and calories

- Prior estimates of demand elasticity: -1 to -1.3
- Consumption of sodas
  - 139.4 in 2013 (Euromonitor)
  - 162.7 in 2014 (Mexican Finance Ministry)
- Energy content of sodas: 400 calories/liter
- Calories to gain 1 pound: 3500
## Estimated change in consumption/capita

### Change in liters consumed/year due to a 1 peso/liter tax

<table>
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<td></td>
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<tr>
<td>-1</td>
<td>-16.1</td>
<td>-18.8</td>
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<tr>
<td>-1.3</td>
<td>-21.0</td>
<td>-24.5</td>
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<td>-24.5</td>
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(Based on base price of 11.41 pesos/liter)
# Estimated change in weight

**Change in weight due to a 1 peso/liter tax (pounds)**

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<td>-1.8</td>
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Based on 400 calories/liter and 3500 calories/pound
How should we think about losing 1.8 to 3.3 pounds?

- Not nearly enough to eliminate obesity
- Eliminating obesity may be too high a bar
- Recent study by Trust for America’s Health suggests much smaller reductions may be medically, economically meaningful
Consequences of 5% reduction in mean BMI (US data)

- 21 percent fewer new cases of type II diabetes
- 8 percent fewer new cases of hypertension
- 8 percent fewer new cases of coronary heart disease and stroke
Question: How much weight would each Mexican have to lose to reduce mean BMI by 5%?

Answer: 7.9 pounds
# Estimated change in weight, as share of 7.9 pound target

## As share of 7.9 pound weight reduction target (=5% reduction of BMI)

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<td>0.35</td>
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Conclusions

- Tax raised prices of regular sodas
- Prices of substitute goods did not rise
- Soda tax may achieve 20-40 percent of target 5% reduction in BMI
END