

# **bridging the gap**

Research Informing Policies & Practices  
for Healthy Youth

# Soda Taxes, Consumption and Weight Outcomes

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# Presentation Outline

## 1. Overview of Studies

- Objectives
- Individual-level and Tax Data
- Models

## 2. Empirical Evidence

- A.C. Nielsen Homescan
- Early Childhood Longitudinal Study
- Monitoring the Future Study
- National Longitudinal Survey of Youth

## 3. Policy Implications

# Overview of Studies

Objectives, Data and Models

## Objectives

- Empirical findings on association of state-level soda taxes with consumption and weight outcomes, using national data sets including:
  - A.C. Nielsen Homescan Data
  - Early Childhood Longitudinal Study-Kindergarten Cohort (ECLS-K)
  - Monitoring the Future (MTF)
  - National Longitudinal Survey of Youth 1997 (NLSY97)

# Tax Data

- State level soda taxes from Bridging the Gap (BTG)
- Linked by state FIPS codes and year
- Measures used:
  - State-level soda tax rate
  - Categorical indicators for state-level soda tax rates:
    - a. Zero tax
    - b.  $0 < \text{soda tax rate} \leq 4\%$
    - c.  $4\% < \text{soda tax rate} \leq 5\%$
    - d.  $5\% < \text{soda tax rate} \leq 6\%$
    - e. Soda tax rate  $> 6\%$
  - Disfavored tax rate (soda tax rate – general food tax rate)
  - Disfavored dichotomous indicator (indicator if disfavored tax rate  $> 0$ )

# Models

## Cross-Sectional Model:

$$\text{Consumption/Weight}_{ist} = \beta_0 + \beta_1 \text{Tax}_{st} + \beta_2 \text{OC}_{st} + \beta_3 X_{it} + \beta_4 D_{it} + \varepsilon_{ist}$$

## Longitudinal Model:

$$\text{Consumption/Weight}_{ist} = \beta_0 + \beta_1 \text{Tax}_{st} + \beta_2 \text{OC}_{st} + \beta_3 X_{it} + \beta_4 D_{it} + v_i + w_{ist}$$

❖ Random Effects Models: Assumes  $v_i$  and independent variables are not correlated

❖ Fixed Effects Models: Difference out the constant individual-specific residual  $v_i$  and provide within person effects

# Soda Taxes and Consumption

A.C. Nielsen Homescan Data



## Objective

- To examine the association of soda taxes with household soda purchases

## Data Description

- Cross-section of household purchase information based on scanner data from a variety of stores, 2<sup>nd</sup> Q 2007
- Household demographic data
- Final sample includes 66,211 non-military households
- Outcome variable: soda volume in ounces of carbonated beverages purchased per household over the sample period (m=566 ounces ~ 2 cases of 12 oz cans)
- Control variables: household income, size, race, educational attainment, presence of children/age, female head of household employment status, and census regions

## Preliminary Results

### OLS Regression Results: Soda Volume

	All Households	Households with Children	Households without Children
Disfavored Soda Tax Amount	-9.352**	-10.983**	-8.417**
Disfavored Soda Tax Status	-42.247	-49.247	-38.417

Source: Loudermilk, Powell, Chriqui, and Chaloupka, *in progress*, 2010

## Preliminary Results

### OLS Regression Results: Soda Volume

	All Households	Households with Children	Households without Children
Disfavored Soda Tax Amount	-9.352**	-10.983**	-8.417**
<b>Elasticities</b>	<b>-0.052</b>	<b>-0.044</b>	<b>-0.052</b>
Disfavored Soda Tax Status	-42.247	-49.247	-38.417

Source: Loudermilk, Powell, Chriqui, and Chaloupka, *in progress*, 2010

# Soda Taxes, Children's Consumption, and Weight

Early Childhood Longitudinal Study-Kindergarten Cohort

## Objective

- To examine association between soda taxes, consumption and weight of children

## Data Description

- Nationally representative panel of elementary school students.
- Food consumption 5<sup>th</sup> grade; measured height and weight
- Final sample: 7,414 children who reported their food consumption and 7,300 children for which height and weight information exists
- Outcome variables: soda consumption in last week (m=6), soda purchases at school (m=0.4), and weight change 3<sup>rd</sup> to 5<sup>th</sup> grade (m=1.9)
- Control variables: age in months, race/ethnicity, family income, mother's education level, physical activity, TV watching, parent-child interactions.

## Associations by Sub-populations

Outcome Variable	Total Consumption		School Consumption		BMI Change	
	Higher Soda Tax Amount	Higher Soda Tax Indicator	Higher Soda Tax Amount	Higher Soda Tax Indicator	Higher Soda Tax Amount	Higher Soda Tax Indicator
Full Sample	-0.004	-0.006	-0.010	-0.064*	-0.013*	-0.085**
At Risk of Overweight	-0.026	-0.078	-0.011	-0.067	-0.033**	-0.222**
Low-Income	-0.142*	-0.811	-0.039**	-0.239**	-0.000	-0.005
African American	-0.125	-0.767	-0.103**	-0.585**	0.029	0.086
9+ Hrs TV	-0.073	-0.376	-0.029**	-0.178**	-0.014	-0.091

Source: Sturm, Powell, Chriqui, and Chaloupka, *Health Affairs*, 2010

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# Soda Taxes and Adolescents' Weight

Monitoring the Future

## Objective

- To examine association of soda taxes with youths' BMI

## Data Description

- Cross-section individual-level data for 8th, 10th, and 12th grade students, 1997-2006
- Estimation sample includes 153,673 observations
- Outcome variable: body mass index (BMI)
- Control variables: gender, age, grade, race, ethnicity, student's hours work and income, parents' education, work, marital status
- Neighborhood controls: Food store and restaurant availability and per capita income

## Associations between Taxes and BMI: Full Sample and by Sub-populations

	Grocery Store Soda Tax Rate	Presence of Grocery Store Tax	Disfavored Grocery Soda Tax Status	Disfavored Grocery Soda Tax Amount	Vending Machine Soda Tax Rate	Presence of Soda Vending Machine Tax
<b>Full Model</b>	<b>0.0131</b>	<b>0.0638</b>	<b>0.0735</b>	<b>0.0124</b>	<b>0.0110</b>	<b>0.0514</b>
<b>By Weight Status</b>						
<b>At Risk of Overweight</b>	<b>-0.0058</b>	<b>-0.0252</b>	<b>-0.0337</b>	<b>-0.0054</b>	<b>-0.0060*</b>	<b>-0.0210</b>
<b>Not at Risk</b>	<b>0.0165</b>	<b>0.0809</b>	<b>0.0993</b>	<b>0.0166</b>	<b>0.0142</b>	<b>0.0665</b>
<b>By Grade</b>						
<b>8<sup>th</sup> Grade</b>	<b>0.0031</b>	<b>0.0429</b>	<b>0.0373</b>	<b>0.0043</b>	<b>0.0070</b>	<b>0.0590</b>
<b>10<sup>th</sup> Grade</b>	<b>0.0241</b>	<b>0.0997</b>	<b>0.1117</b>	<b>0.0212</b>	<b>0.0216</b>	<b>0.0873</b>
<b>12<sup>th</sup> Grade</b>	<b>0.0075</b>	<b>0.0400</b>	<b>0.0342</b>	<b>0.0043</b>	<b>-0.0101</b>	<b>-0.0478</b>
<b>By Parents' Education</b>						
<b>Some College</b>	<b>0.0160</b>	<b>0.0948</b>	<b>0.0985</b>	<b>0.0156</b>	<b>0.0146</b>	<b>0.0845</b>
<b>Less than College</b>	<b>0.0067</b>	<b>-0.0134</b>	<b>0.0003</b>	<b>0.0033</b>	<b>0.0017</b>	<b>-0.0354</b>

Source: Powell, Chiqui, and Chaloupka, *Journal of Adolescent Health*, 2009

## Associations between Taxes and BMI: Full Sample and by Sub-populations

	Grocery Store Soda Tax Rate	Presence of Grocery Store Tax	Disfavored Grocery Soda Tax Status	Disfavored Grocery Soda Tax Amount	Vending Machine Soda Tax Rate	Presence of Soda Vending Machine Tax
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Source: Powell, Chiqui, and Chaloupka, *Journal of Adolescent Health*, 2009

# Soda Taxes and Adolescents' Weight

National Longitudinal Survey of Youth 97

## Objective

- To examine association of soda taxes with youths' BMI using cross-sectional *and* longitudinal models

## Data Description

- Nationally representative longitudinal data on youth aged 12 to 17 in 1997; 4 waves of including 1997, 1998, 1999 and 2000
- Estimation sample includes 11,900 person-year observations living at home
- Information on parental characteristics available from parental questionnaire and annual household roster data
- Outcome variable: weight status: BMI and overweight prevalence
- Control variables: age, gender, race, ethnicity, income, mother's education, mother's employment status
- Neighborhood controls: median household income

## Preliminary Regressions Results-Cross Sectional Analysis

	Female		Male	
	BMI	Overweight	BMI	Overweight
<b>Full Sample</b>				
0<tax≤4%	0.0552	0.0019	-0.0337	-0.0055
4%<tax≤5%	0.1339	0.0017	-0.1457	-0.0160
5%<tax≤6%	-0.0797	-0.0105	0.2203	0.1010
tax>6%	-0.0548	-0.0053	0.5410*	0.0257
<b>Low Income</b>				
0<tax≤4%	-0.5963	-0.0371*	-0.5030	-0.0556**
4%<tax≤5%	0.2401	-0.0094	-0.2245	-0.0073
5%<tax≤6%	-0.3359	-0.0436**	-0.1683	-0.0470**
tax>6%	-0.4483	-0.0369*	-0.4099	-0.0435**

## Preliminary Regressions Results-Cross Sectional Analysis

	Female		Male	
	BMI	Overweight	BMI	Overweight
Full Sample				
0<tax≤4%	0.0552	0.0019	-0.0337	-0.0055
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tax>6%	-0.4483	-0.0369*	-0.4099	-0.0435**

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## Preliminary Regressions Results-Longitudinal Analysis (FE)

	Female		Male	
	BMI	Overweight	BMI	Overweight
<b>Full Sample</b>				
0<tax≤4%	-0.7805**	-0.0078	-0.4054***	-0.0503
4%<tax≤5%	-0.7938**	-0.0153	-0.0942	-0.0369
5%<tax≤6%	-0.2033	0.0308*	-0.2297	-0.0591
tax>6%	-0.5647	0.0667*	0.4693	-0.0212
<b>Low Income</b>				
0<tax≤4%	-2.1950***	-0.0628***	-1.0196***	-0.0922***
4%<tax≤5%	-2.3600***	-0.0737**	-0.5907*	-0.0732***
5%<tax≤6%	-1.1818	-0.0162	-1.5229***	-0.0879***
tax>6%	-0.2139	0.0847	0.5069	-0.0969**

Source: Powell et al., *in progress*, 2010

## Preliminary Regressions Results-Longitudinal Analysis (FE)

	Female		Male	
	BMI	Overweight	BMI	Overweight
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0<tax≤4%	-0.7805**	-0.0078	-0.4054***	-0.0503
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5%<tax≤6%	-1.1818	-0.0162	<b>-1.5229***</b>	<b>-0.0879***</b>
tax>6%	-0.2139	0.0847	0.5069	<b>-0.0969**</b>

Source: Powell et al., *in progress*, 2010

# Policy Implications

# Policy Simulation Examples

## Household Soda Purchases:

- Study results imply very small tax elasticities for purchases of 0.052, 0.044, and 0.052 for all households, households with children, and households without children, respectively.
  - If tax rate went up 1 percentage point from its current average, soda purchases would be expected to fall by about 29 liquid ounces per household per quarter.
- However, if we assume a linear extrapolation for a large tax increase such as the one recently proposed in NY (soda tax of 18%) then rates would increase 14 points from the mean with an implied decrease in soda volume of 406 liquid ounces, 72% of mean purchases, for the average household.

## Children's Weight Outcomes:

- Again assuming a linear extrapolation, an 18% differential soda tax would correspond to a -0.23 BMI units in the change in BMI between 3<sup>rd</sup> and 5<sup>th</sup> grade, or a 20% reduction in the excess BMI gain.

# Policy Implications of Results

- Generally very small associations between soda taxes and consumption or weight outcomes based on the existing low tax rates which range up to just 7%. Consistent with previous findings by others researchers such as Fletcher, Frisvold and Tefft.
- Larger associations for populations at greater risk for obesity.
- *Substantial* increases in soda tax rates may have some measureable effects on outcomes and even greater effects at the population level.

## Future Research and Tax Policy Design Implications

- Evidence as we go ... jurisdictions that adopt higher taxes on sugar sweetened beverages will provide natural experiments for researchers to examine the effectiveness of these efforts in promoting healthier dietary intake and curbing the obesity epidemic.
- Tax Policy Design: Implications for Potential Impact on Health Outcomes
  - ❖ Issues of applicability to food stamp purchases
  - ❖ Excise tax rather than a sales tax
    - Incorporated at shelf price
    - Applicable regardless of where items are sold
    - Applied on a per unit basis rather than a function of price so that quantity discounts are still taxed.