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## **The Unequal Distribution of Body Mass Index: Examining the Effect of State-Level Soft Drink Taxes on Obesity Inequality**

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# The Unequal Distribution of Body Mass Index: Examining the Effect of State-Level Soft Drink Taxes on Obesity Inequality



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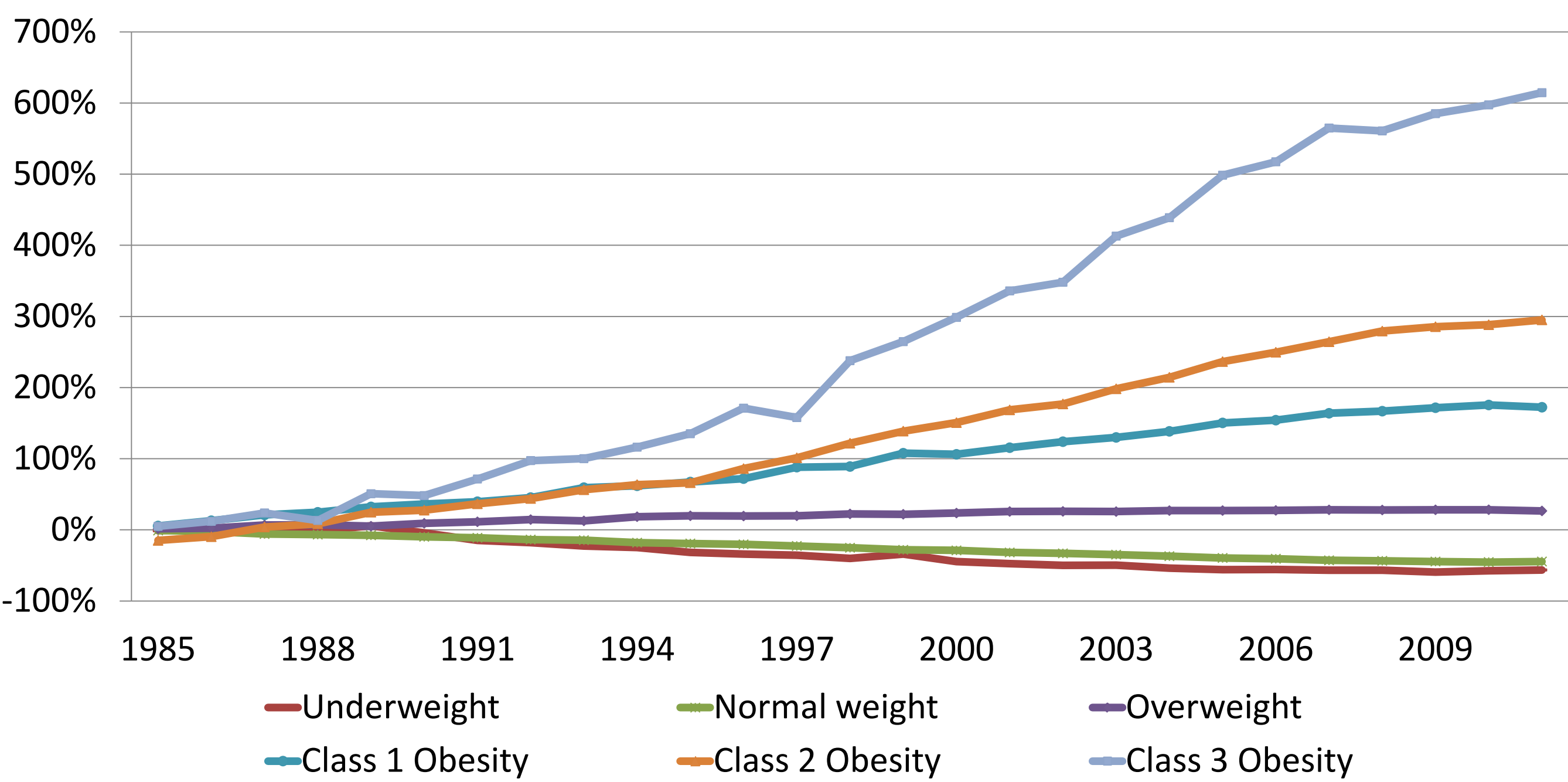
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## BMI Trends for US Adults, 1984-2010

From 1984–2010 the percentage of US adults that are:

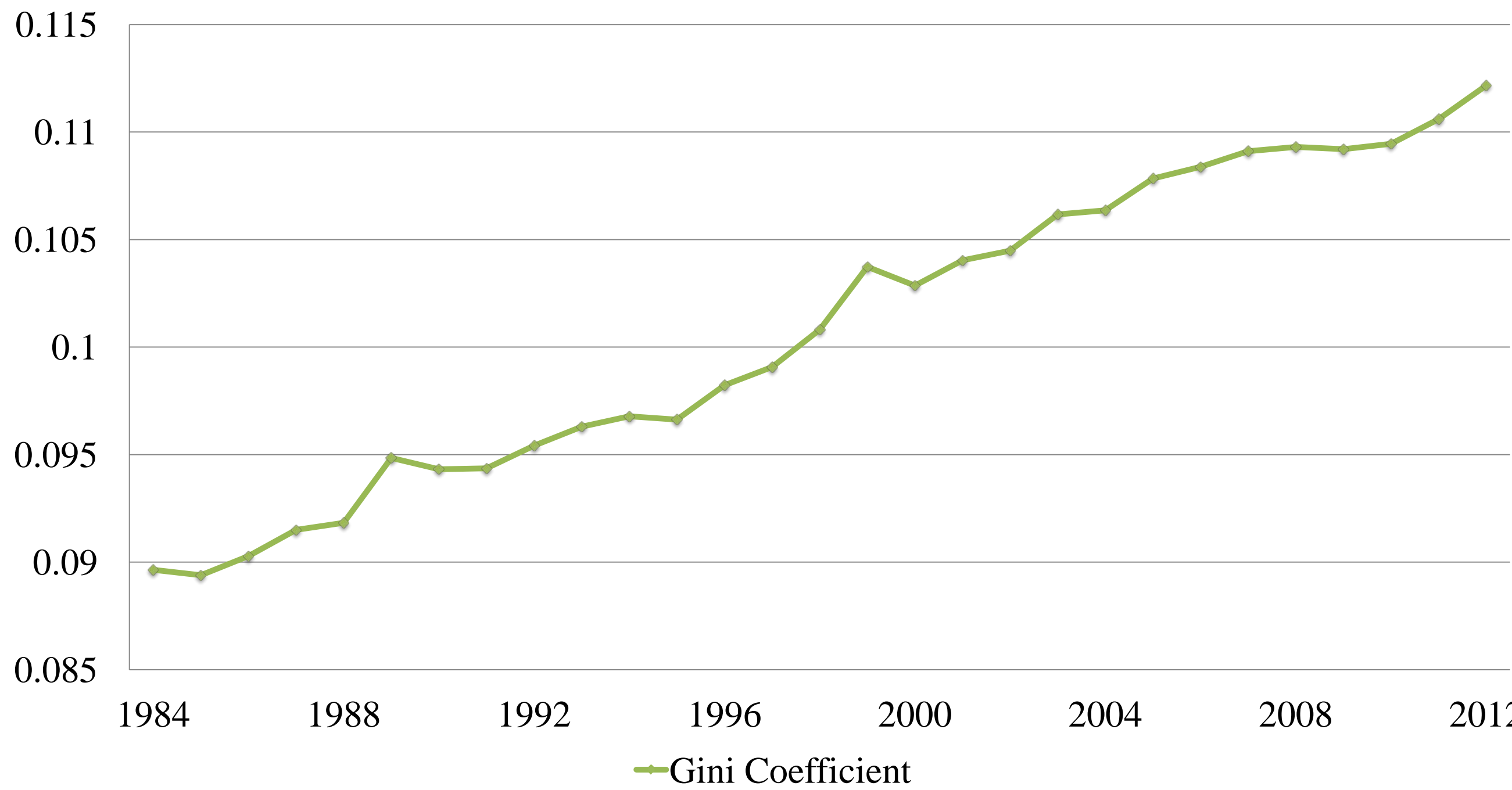
- Overweight or obese (BMI>25) increased by 74%
- Class 3 obese (BMI>40) increased by 614%
- Class 2 obese (35<BMI<40) increased by 295%
- Class 1 obese (30<BMI<35) increased by 172%



## Has There Been An Increase In Obesity Inequality?

We apply a Gini Coefficient to measure obesity inequality

$$Obesity\ Gini_t = 1 - \sum_{i=1}^N (x_{i,t} - x_{i-1,t})(BMI_{i,t} - BMI_{i-1,t})$$



## Research Questions

Are soda taxes:

1. Effective for reducing average obesity rates?
2. Relatively more effective reducing BMI among the morbidly obese?
3. Effective in reducing obesity inequality?

## Data and Methods

### State Level Fixed-Effects Model of the Relationship Between Soda Taxes and Individuals' BMI

$$W_{ijmt} = \alpha + \beta X_{ijmt} + \phi Z_{jt} + \lambda T_{jt} + \mu_j + \sigma_m + \delta_t + \varepsilon_{ijt}$$

$W_{ijmt}$  BMI of individual  $i$  in state  $j$  at month-of year  $m$  in year  $t$

$X_{ijmt}$  Individual-level covariates (age, sex, income, etc.)

Source: Behavioral Risk Factor Surveillance System (BRFSS) by the Centers for Disease Control and Prevention (CDC). N=3,151,285 individual observations from 50 states (plus DC) from 1991–2010.

$Z_{jt}$  State-level controls (per capita number of autos, state funding for public transit, annual vehicle miles traveled, operating expenditures, violent crime, fast food restaurants, etc.). Various sources.

$T_{jt}$  State-level “pure” soft drink tax, or “incremental” soft tax (= soft drink tax – food tax) from Bridging The Gap, Book of States, and All States Tax Handbook.

$\mu_j, \sigma_m, \delta_t$  State, month-of year, and year fixed effects.

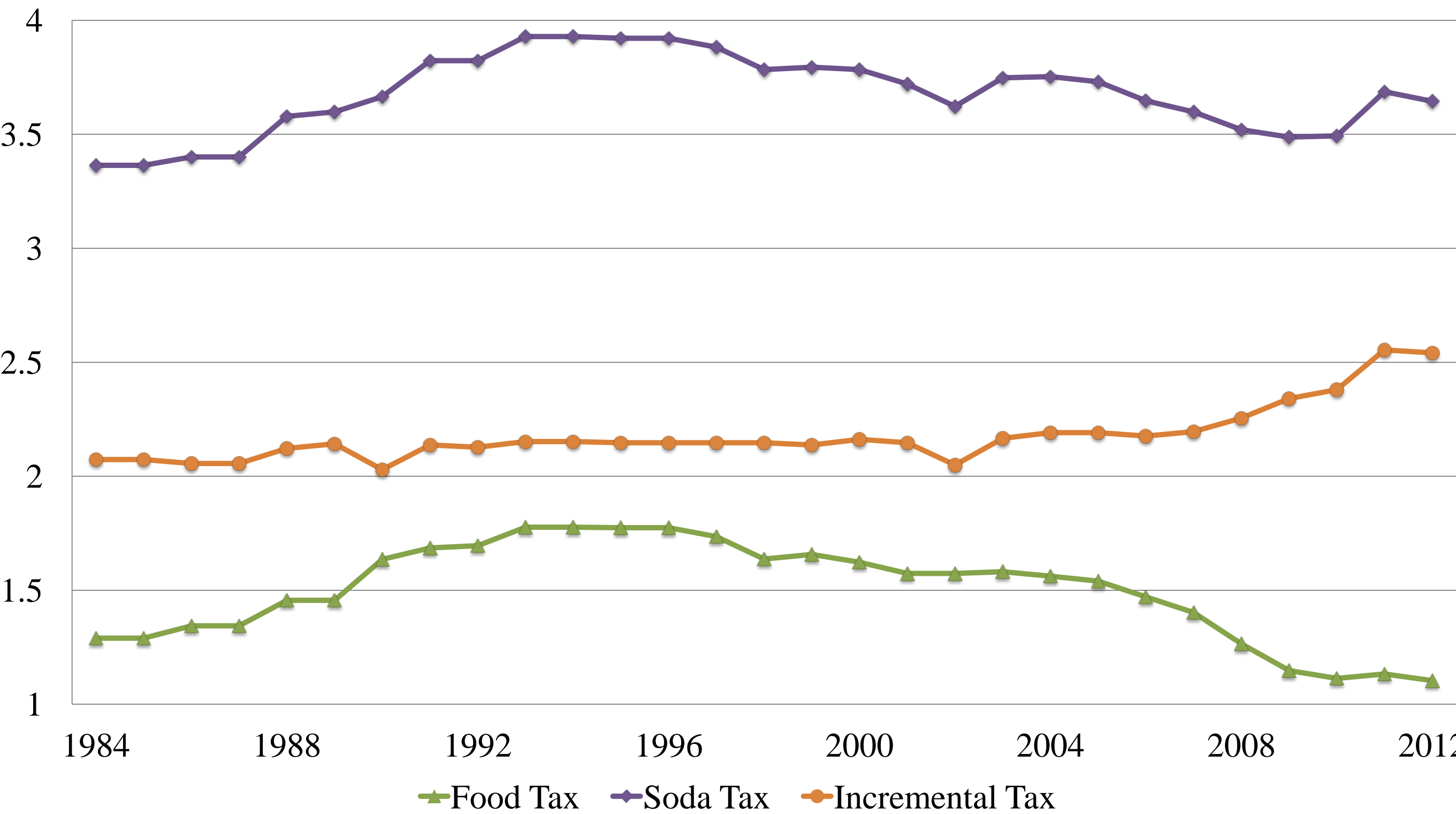
### State Level Fixed-Effects Model of the Relationship Between Soda Taxes and Obesity Inequality

$$I_{jt} = \alpha + \beta S_{jt} + \phi Z_{jt} + \lambda T_{jt} + \mu_j + \delta_t + \varepsilon_{ijt}$$

$I_{jt}$  Obesity Gini Coefficient of state  $j$  at time  $t$

$S_{jt}$  Aggregated individual characteristics

### State Average Food and Soda Tax Rates



## Abbreviated Regression Estimates

### Fixed Effects Regression of Total Soft Drink Tax on Individual BMI by Selected Obesity Categories

Variables	Class 3 obese	Class 2 obese	Class 1 obese	Normal
Individual controls	Yes	Yes	Yes	Yes
State-level controls	Yes	Yes	Yes	Yes
<b>Total soft drink tax</b>	<b>-0.0469 (0.0325)</b>	<b>-0.0002 (0.0041)</b>	<b>-0.0017 (0.0024)</b>	<b>-0.0014 (0.0028)</b>
# of Observations	85479	184330	501134	2339916
R-squared	0.0507	0.0075	0.0150	0.0761

### Fixed Effects Regression of Incremental Soft Drink Tax on Individual BMI by Selected Obesity Categories

Variables	Class 3 obese	Class 2 obese	Class 1 obese	Normal
Individual controls	Yes	Yes	Yes	Yes
State-level controls	Yes	Yes	Yes	Yes
<b>Incremental soft drink tax</b>	<b>-0.0709* (0.0382)</b>	<b>-0.0015 (0.0045)</b>	<b>-0.0031 (0.0038)</b>	<b>-0.0028 (0.0058)</b>
# of Observations	85479	184330	501134	2339916
R-squared	0.0484	0.0074	0.0149	0.0760

### Fixed Effects Regression of Incremental Soft Drink Tax on Obesity Inequality Index: Gini Coefficient

Variables	Dependent Variable: BMI			
	Model (1)	Model (2)	Model (3)	Model (4)
Individual controls	No	Yes	Yes	Yes
State-level controls	No	No	Yes	Yes
<b>Incremental Soft drink tax</b>	<b>-0.0001 (0.0002)</b>	<b>-0.0002 (0.0002)</b>	<b>-0.0002 (0.0002)</b>	<b>-0.0001 (0.0002)</b>
Number of Observations	845	845	845	663
R-squared	0.6092	0.6785	0.6949	0.7399

## Conclusions

Results of the study indicate that:

- Soda taxes do not have a significant effect on individual BMI
- Soda taxes are slightly effective for reducing the BMI of the morbidly obese
- Soda taxes are not an effective policy instrument for reducing obesity inequality