



International Tobacco Control
Policy Evaluation Project

State-Level Cigarette Affordability Among Current US Smokers: Findings from the ITC US Survey, 2003-2015

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Disclosures

- K. Michael Cummings has received payment as a consultant to Pfizer, Inc., for service on an external advisory panel to assess ways to improve smoking cessation delivery in health care settings. He also has served as paid expert witness in litigation filed against the tobacco industry.
- All other authors have no conflicts of interest to declare.

Background

- Tax-induced cigarette price increases reduce demand for cigarettes
- Inflation undermines the effects of those increases
- Price alone is less important than price paid relative to smokers' incomes (affordability)
 - Cigarettes are generally more affordable for higher income smokers
 - Affordability measures enable comparison of tax policies over time and across jurisdictions
- Extant studies tend to rely on aggregate measures of affordability (e.g., state-level)

Cigarette Tax Policy in the United States

- On April 1, 2009, the federal tax on cigarettes was increased from \$0.39/pack to \$1.01/pack
- Cigarettes also taxed at state and local levels
 - Produces price differentials across states
 - Incomes vary by state
- Effect on affordability?
 - Aggregate measures of affordability varied widely across US in 2010 (Bandi et al., 2013)
- Prior research has not examined individual-level affordability nor longitudinal trends over time

Study Objectives

1. Estimate individual-level cigarette affordability within US states from 2003 to 2015
2. Test whether affordability changed significantly following the federal cigarette tax increase in 2009
3. Examine the effects of the US recession (2008-2009) on affordability, defined as relative income price (RIP)

RIP = the proportion of annual per capita household income smokers spend on 100 standard packs of 20 cigarettes (higher RIP = lower affordability)

Methods: The ITC US Survey

- N=7,046 current smokers participating in one/more waves of the ITC US Survey (Waves 2 through 9)
 - Nationally representative cohort survey (1,500 to 2,000 randomly sampled smokers per wave)
 - Stratified sampling design; respondents lost to attrition were replaced by newly sampled smokers
- Analysis restricted to smokers who last purchased cigarettes by the carton or pack
- For analysis, Wave 9 split into two parts by continuing cohort (2013-2014) or new recruits (2015)

Measures

- Primary outcome: relative income price

$$RIP = \frac{\textit{price of 100 standard packs of 20 cigarettes}}{\textit{annual per capita household income}}$$

- log(RIP) was outcome for linear mixed effects models
- Sociodemographic covariates:
 - sex (female vs. male),
 - age (25-39, 40-54, 55+ vs. 18-24),
 - education (\leq high school vs. greater),
 - race/ethnicity (black, Hispanic, other vs. white),
 - currently employed (vs. not)

Statistical Analysis: State-level Estimates

- Small area estimation (SAE) methods to estimate individual-level cigarette affordability within states
 - Wave-specific linear mixed effects models
 - Random intercept: US state
 - Fixed effects: sex, age group, race, education, employment status
 - Model parameters combined with auxiliary information (contemporaneous BRFSS survey) to estimate $\log(\text{RIP})$ within each state
- SAE models estimated using R (“sae” library Version 1.1 using R Version 3.4.3)

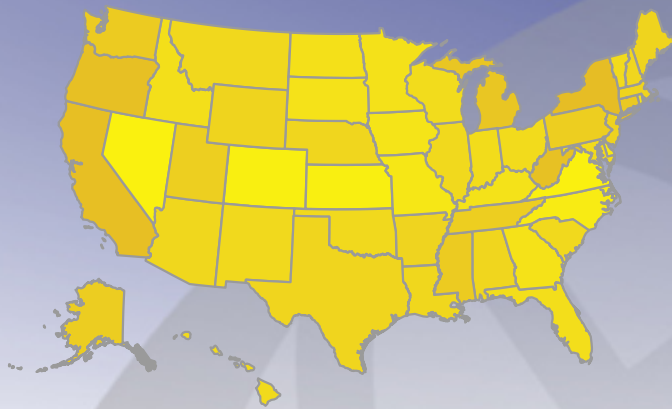
Temporal Effects

- Linear mixed effects models to model longitudinal trends in affordability from Wave 2 to Wave 9
 - Random intercepts for state and respondent
 - Individual-level sociodemographic factors
 - State-level cigarette excise taxes (in 2015 USD) and state-level labor force participation rate
 - Piecewise linear effects to model: (a) trend from 2003 to 2008 (pre-federal tax increase), (b) 2008 to 2010 (post-tax period), (c) 2010 to 2013 and (d) 2013 to 2015
- Model estimated using R (“lme4” V1.1-15)

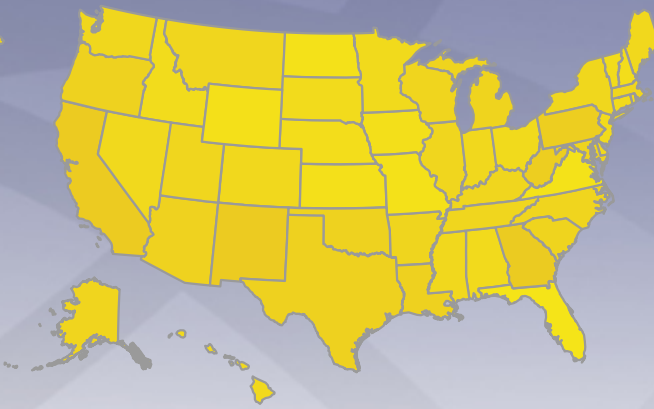
Results: Sample Characteristics

	<u>Wave of Recruitment</u>		
	2 (n = 655)	9 (n = 1540)	Overall (n = 7046)
Mean Time-in-sample (SD)	2.41 (1.91)	1.00 (0.00)	2.12 (1.66)
Male (%)	310 (47.3)	766 (49.7)	3220 (45.7)
Age group (%)			
18-24	94 (14.4)	92 (6.0)	614 (8.7)
25-39	171 (26.1)	346 (22.5)	1654 (23.5)
40-54	239 (36.5)	452 (29.4)	2551 (36.2)
55-max	151 (23.1)	650 (42.2)	2227 (31.6)
≤ High school education (%)	245 (37.4)	623 (40.5)	3103 (44.0)
% Low income (≤ \$30,000)	250 (38.2)	592 (38.4)	2577 (36.6)
Race/ethnicity (%)			
Black	77 (11.8)	168 (10.9)	689 (9.8)
Hispanic	36 (5.5)	135 (8.8)	360 (5.1)
Other	47 (7.2)	106 (6.9)	521 (7.4)
Employed (%)	414 (63.2)	771 (50.1)	3964 (56.3)
Daily smoker (%)	598 (91.3)	1280 (83.1)	6406 (90.9)
Mean cigarettes/day (SD)	17.89 (11.02)	12.91 (9.90)	16.96 (11.16)
Last purchased cigarette packs (%)	394 (60.2)	1091 (70.8)	4304 (61.1)

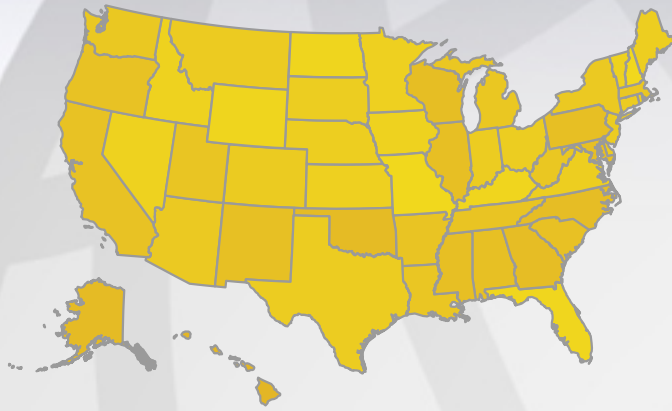
2003



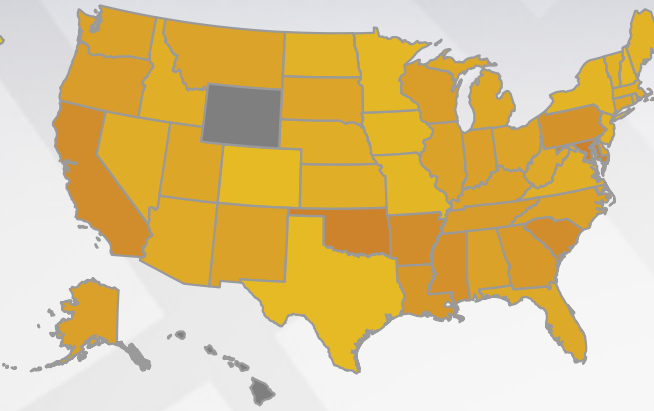
2007-2008



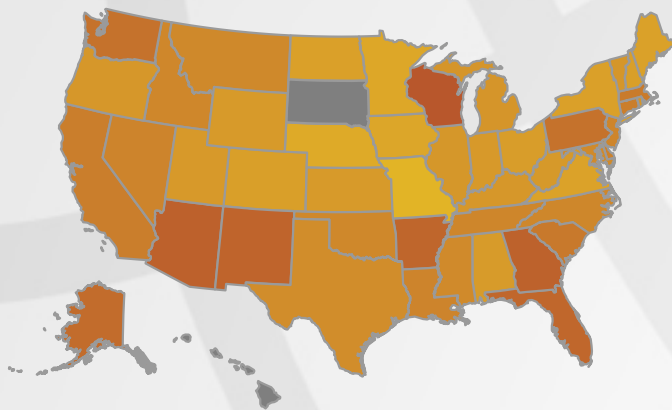
2008-2009



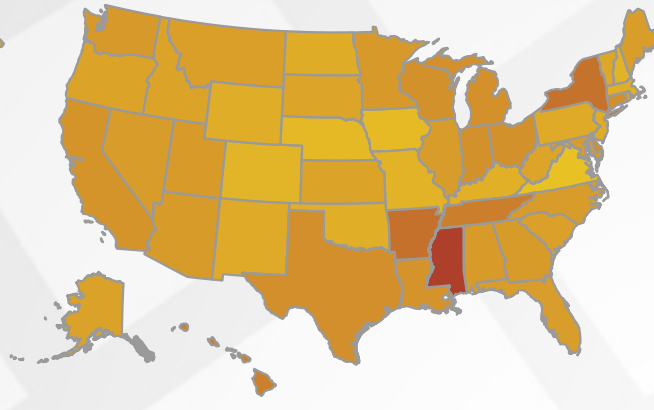
2010-2011



2013-2014



2015



Cigarettes were:

- less affordable following federal tax increase (2009) & economic recession (2008)
- became more affordable by 2015 with improving economic conditions

Small variation in affordability across states was apparent during this time period

Relative Income Price



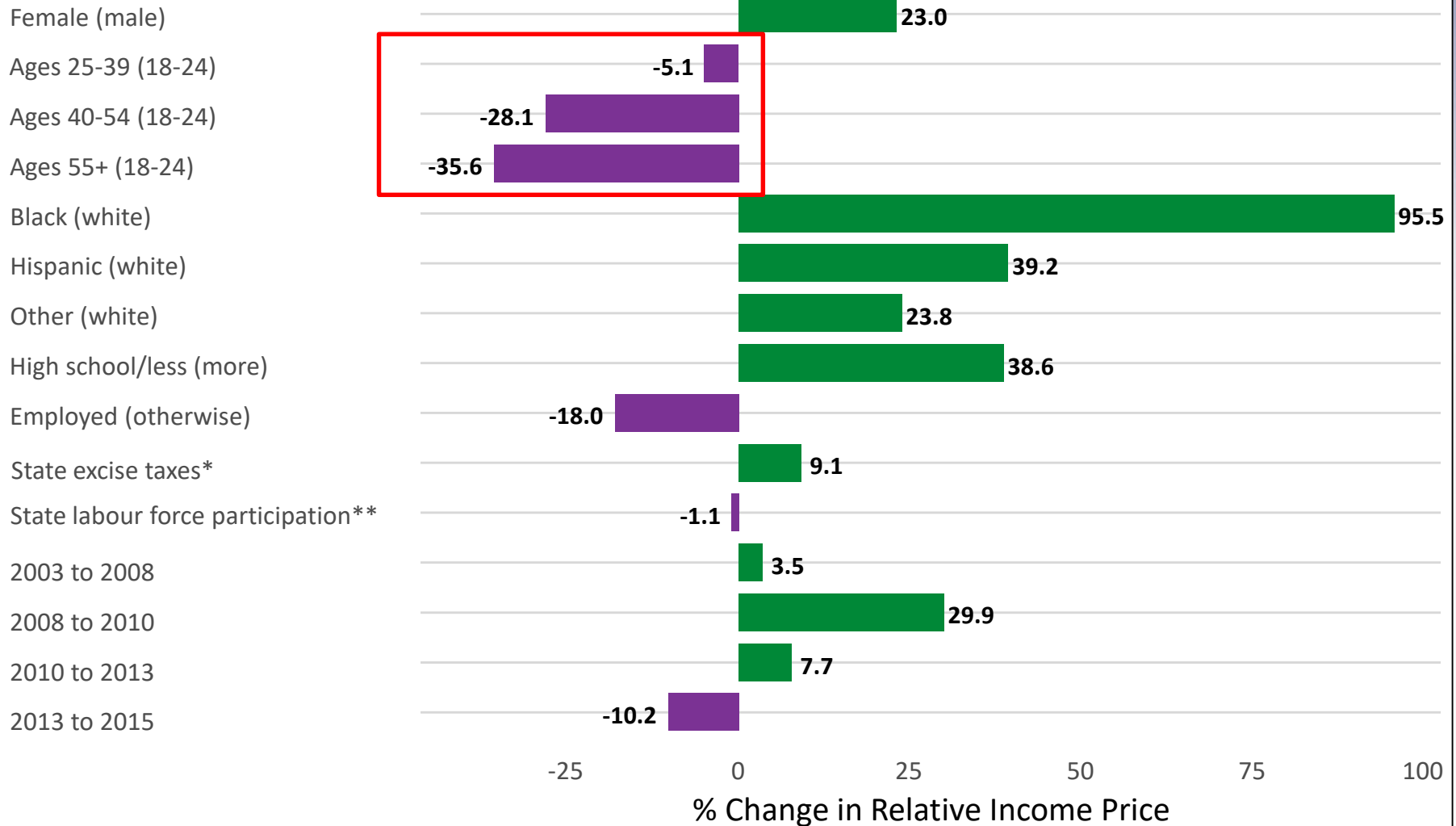
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Linear Mixed Effects Model Results

- Based on 12,445 observations from 6,694 smokers surveyed at least once from Wave 2 to Wave 9
- Random intercepts fit for state and individual smokers (to allow for repeated measures)

Random effect	Variance (StdDev)	Intracluster Correlation	Test (p-value)
State	0.0128 (0.1130)	0.0172	< 0.001
Individual	0.5892 (0.7676)	0.7923	< 0.001
Residual	0.1417 (0.3764)	—	—

Piecewise Linear Trend Model

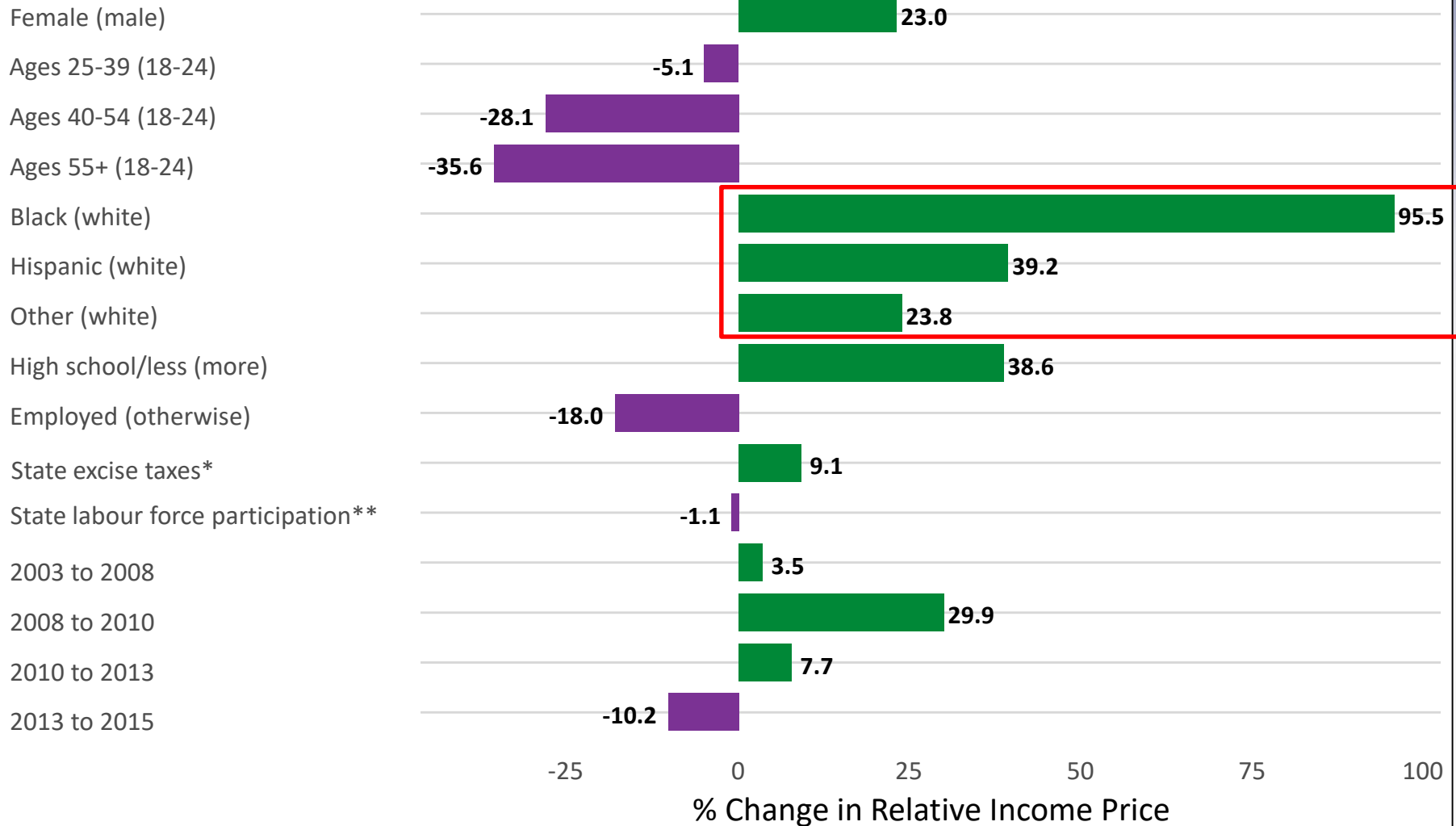


* \$1 increase in real excise taxes (2015 USD)

** 1 percentage point increase in state labor force participation

Lower Higher

Piecewise Linear Trend Model

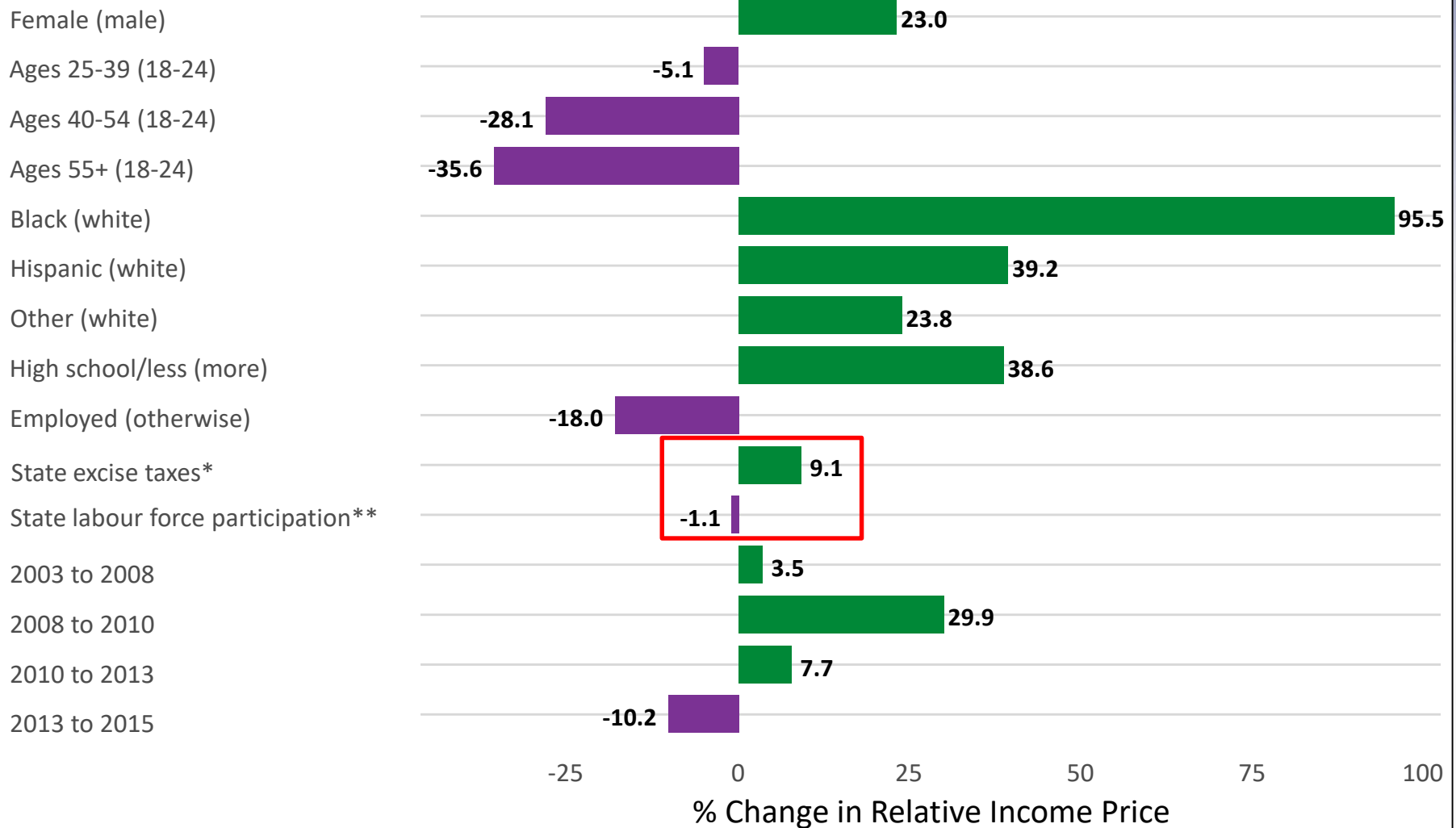


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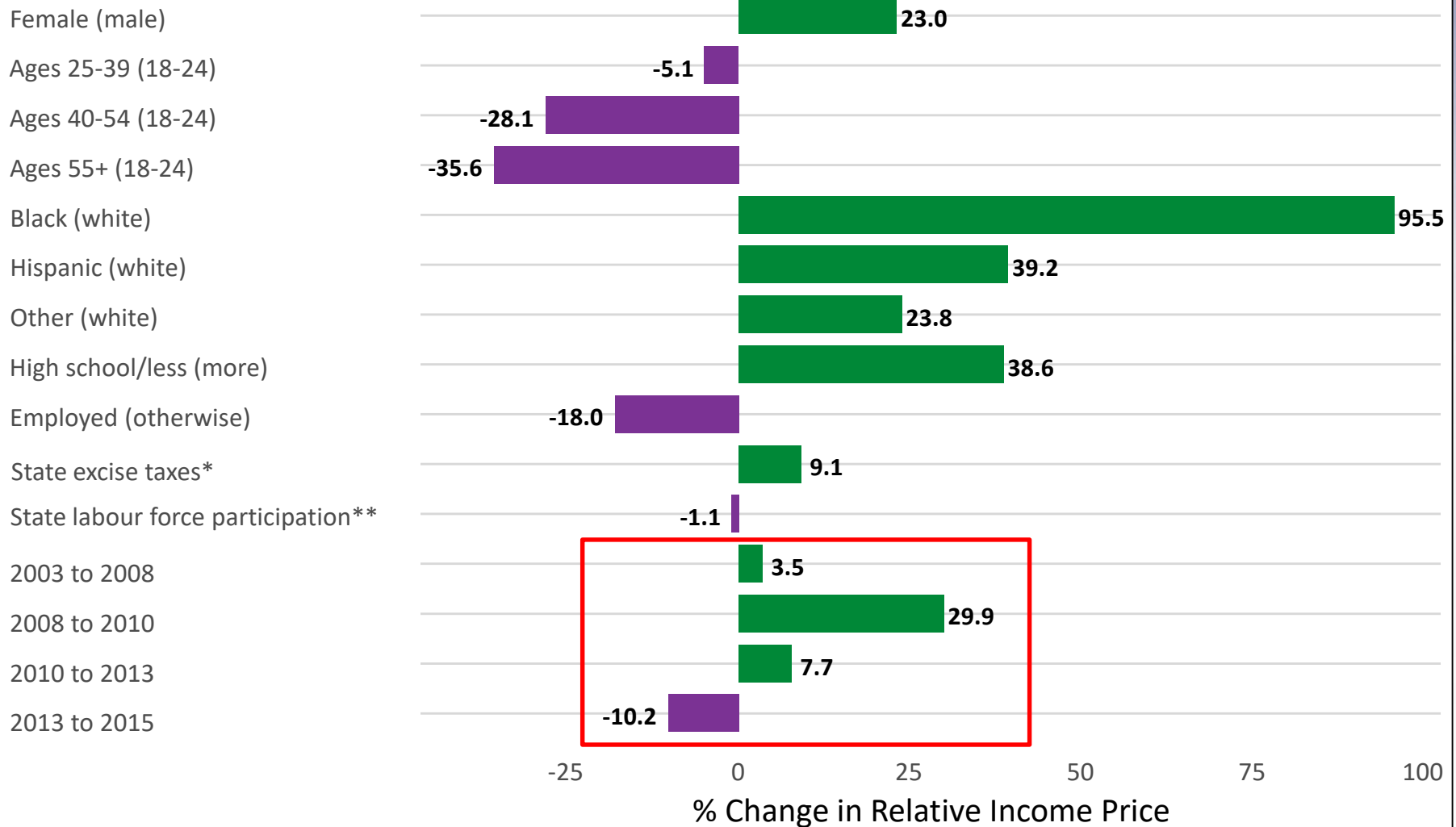


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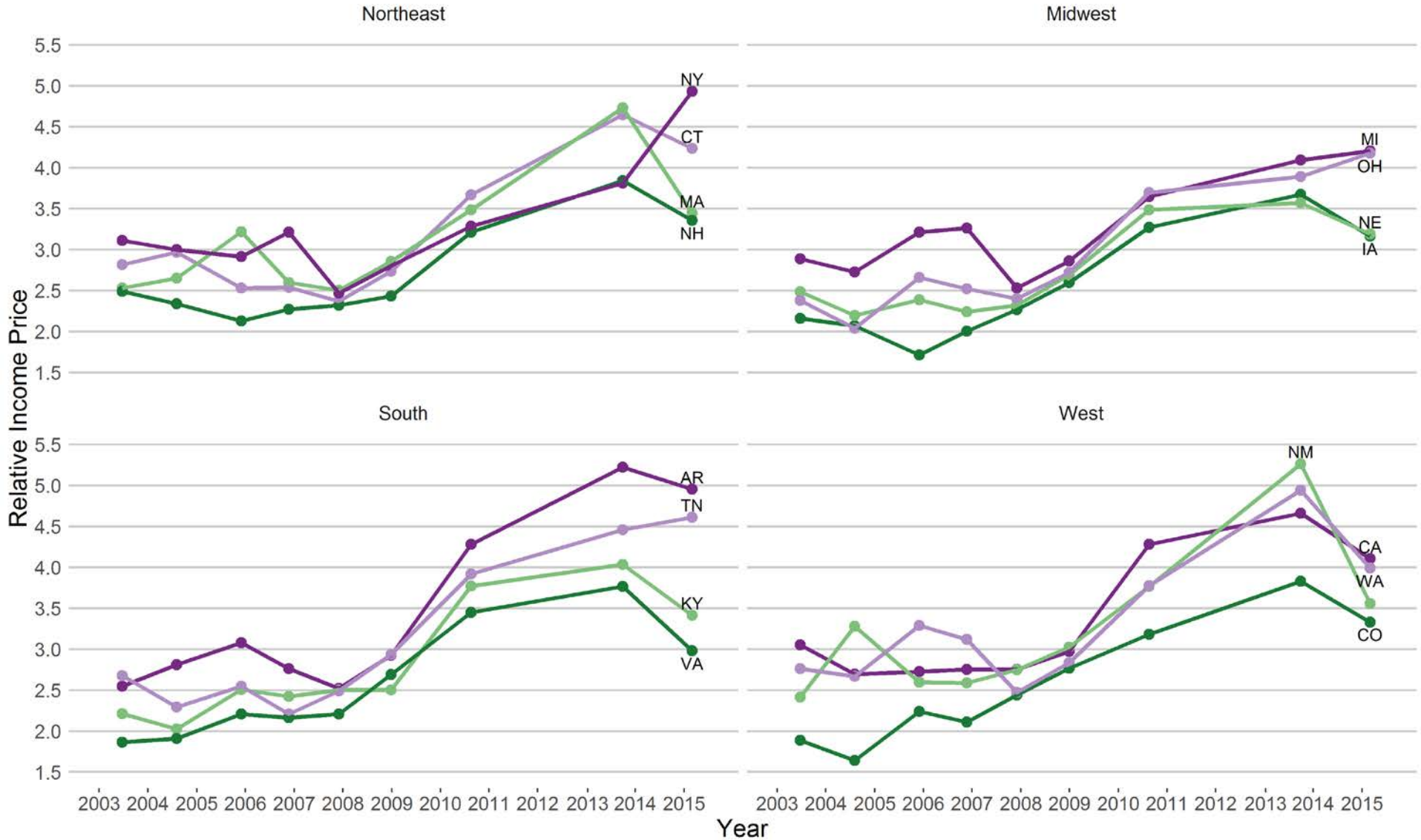


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Lower Higher

Temporal Trends



Conclusions

- Smokers faced changing policy and economic conditions that influenced their ability to pay for cigarettes
 - Greatest decline in affordability occurred from 2008 to 2010 following the federal tax increase on April 1, 2009 (confounded with the economic recession)
 - As the economy recovered, by 2015, cigarettes had become more affordable
- Tax increases must keep pace with inflation **and** improved economic conditions

ITC Project Research Organizations



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