

# Obesity Rates of Cohorts in Middle Age: Increasing Burden, Increasing Educational Inequalities

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We have no commercial relationships to disclose.



## Motivation

Importance of investigating obesity as risk factor of adverse health, functional limitations and chronic conditions

Inequalities in BMI and obesity are well established

- SES-BMI gradients stronger in women, vary across racial/ethnicity groups 1970s-2008 (Grabner 2012)
- Stronger increases in obesity rates in women 2005-2014 (Flegal et al. 2016), some levelling off cautiously noted (Rokholm et al. 2012)

Cohort inequalities?

- Strong cohort component suspected but evidence is scarce
- Available age-period-cohort analyses have problematic assumptions (Bell & Jones 2014)
- Characteristics of cohorts entering older ages necessary for social and healthcare planning

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## Data and Method

- National Health Interview Surveys (cross-sectional, annual data collection)

### Age-Period-Cohort analysis

- 5-year periods 1976-2014 and five-year age groups 20-60
- Age-Period-Cohort Trended Lag Analysis (Chauvel & Schröder 2014; Bar-Haim, Chauvel, Hartung 2018) to detect fluctuations of prevalence of obesity across years
- Age-Period-Cohort Gap-Oaxaca Analysis to estimate the gradient related to education across age, period, cohort

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## Method Intro

The Lexis diagram to plot age against period to detect cohort change

Figure: Simulated (against empirical) data on suicide rates per 100,000 population taken from Chauvel, Leist & Ponomarenko (2016)

	1970	1975	1980	1985	1990	1995	2000	2005
20	-0.30	-0.16	0.03	0.15	0.17	0.12	0.05	-0.07
25	-0.31	-0.25	-0.11	0.06	0.18	0.20	0.15	0.08
30	-0.23	-0.25	-0.19	-0.06	0.10	0.21	0.23	0.19
35	-0.09	-0.18	-0.19	-0.15	-0.03	0.13	0.24	0.27
40	-0.01	-0.04	-0.12	-0.15	-0.12	0.00	0.16	0.28
45	0.08	0.03	0.01	-0.09	-0.13	-0.10	0.02	0.18
50	0.12	0.10	0.06	0.02	-0.08	-0.13	-0.10	0.02
55	0.14	0.12	0.10	0.04	-0.01	-0.11	-0.16	-0.12
60	0.20	0.11	0.09	0.06	-0.01	-0.06	-0.17	-0.21
65	0.21	0.15	0.07	0.03	-0.01	-0.08	-0.13	-0.23
70	0.24	0.16	0.10	0.00	-0.04	-0.09	-0.16	-0.21
75	-0.05	0.23	0.15	0.08	-0.03	-0.08	-0.12	-0.19

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## Method

### 0. Age-Period-Cohort model

- Unidentifiable w/o further constraints

$$y^{apc} = \mu + \alpha_a + \pi_p + \gamma_c (APC)$$

age a ( $\alpha_a$ ), period p ( $\pi_p$ ) and cohort membership c ( $\gamma_c$ )!

### 1. Age-Period-Cohort Detrended<sup>1</sup>

- Detects deviations from the linear trend of age, period and cohort
- Cannot identify actual linear trends
- Detects lucky/protected and unlucky/disadvantaged cohorts

$$\left\{ \begin{array}{l} y^{apc} = \alpha_a + \pi_p + \gamma_c + \alpha_0 \text{rescale}(a) + \gamma_0 \text{rescale}(c) + \beta_0 + \varepsilon_i \\ \sum \alpha_a = \sum \pi_p = \sum \gamma_c = 0 \\ \text{Slope}_a(\alpha_a) = \text{Slope}_p(\pi_p) = \text{Slope}_c(\gamma_c) = 0 \\ \min(c) < c < \max(c) \end{array} \right.$$

<sup>1</sup> Chauvel & Schröder 2014; Chauvel, Leist, Ponomarenko 2016; Stata: `ssc install apcd`

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## Method

### 2. Age-Period-Cohort Trended Lag<sup>1</sup>

- Constraints to identify social change via cohort vector
- Age linear trend constrained to average within-cohort age effect; sum of age and period vectors zero; period linear trend zero

### 3. Age-Period-Cohort Gap/Oaxaca model<sup>1</sup>

- Blinder-Oaxaca decomposition in each cell of the Lexis table to derive differences between groups: Mean BMI of lower-educated minus mean BMI of higher-educated group
- APCT-lag to detect the intensity of the cohort gap (constant), its evolution over time and non-linear accelerations or decelerations in the cohort trend

$$\left\{ \begin{array}{l} y^{apc} = \alpha_a + \pi_p + \gamma_c + \varepsilon_i \\ \sum \alpha_a = \sum \pi_p = 0 \\ \text{Slope}(\pi_p) = 0 \\ \text{Slope}(\alpha_a) = \frac{\sum (y_{a+1,p+1,c} - y_{a,p,c})}{(p-1)(a-1)} \\ \min(c) < c < \max(c) \end{array} \right.$$

<sup>1</sup> Bar-Haim, Chauvel, Hartung, 2018; Bar-Haim et al. 2018; Stata: `ssc install apcgo`

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## Descriptives

- Total of 4,071,692 observations 1976-2014, age 20-60
- 2,054,190 observations do not have information on BMI
- 17,080 observations without information on education
- 2,000,422 observations with information on BMI and education
- Age-Period-Cohort analysis requires the omission of first and last five-year age group:
- Final sample: 1,257,802 observations
- Higher education = BA holders or higher, 299,986 observations (23.84 %)

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## Descriptives

	M (Std)	N (%)
Full sample	25.37 (4.87)	1,257,802 (100)
Obese (BMI $\geq$ 30)	34.00 (4.02)	211,249 (16.8)
Overweight (BMI $\geq$ 25)	27.01 (1.42)	421,385 (33.5)
Underweight (BMI $\leq$ 18)	17.21 (0.86)	20,029 (1.59)

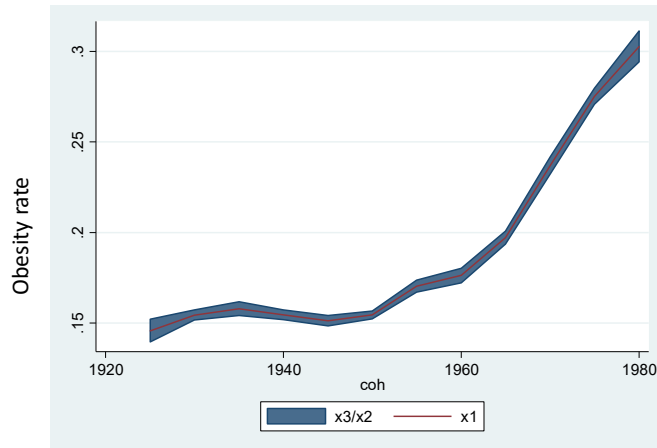
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## Strategy of Data Analysis

- Social trends with APC Trended Lag
- Educational gaps with APC Gap Oaxaca
- Stratified by gender (1)
- Stratified by gender; education; race/ethnicity (non-Hispanic White: non-Hispanic Black; Hispanic) (2)

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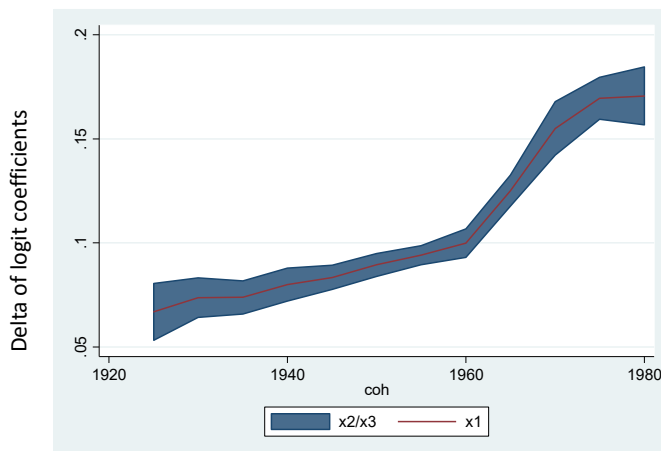
## 1a. Obesity Trends in Women (apctlag)



- Social change in obesity rates in women across the window of observation (1976-2014)
- Slope increases in steepness for cohorts born 1960+

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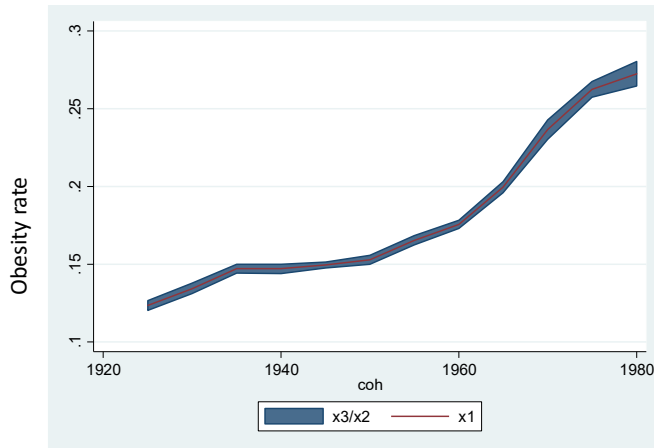
## 1b. Educational Gaps in Obesity Rates between Low- and High-educated Women (apcgo)



- BA holders versus non-BA holders
- Increasing inequalities = sharp change in steepness of the gradient for those cohorts born 1960+

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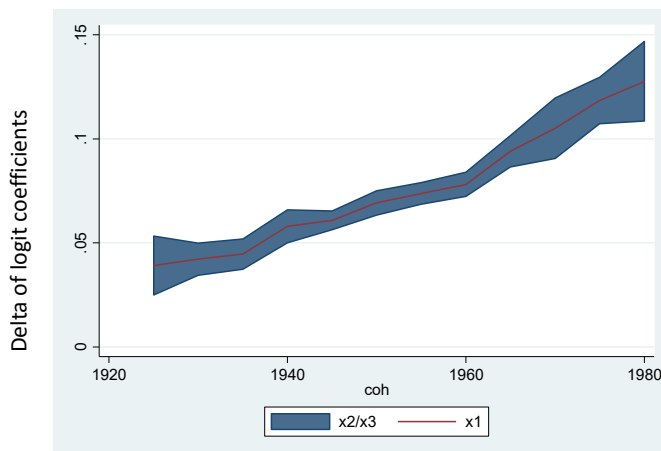
### 1c. Obesity Trends in Men (apctlag)



- Social change in obesity rates in men across the window of observation (1976-2014)
- Less steep increases for men

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### 1d. Educational Gaps in Obesity Rates between Low- and High-educated Men (apcgo)



- BA holders versus non-BA holders
- Increasing inequalities for those cohorts born before and after 1960 in men

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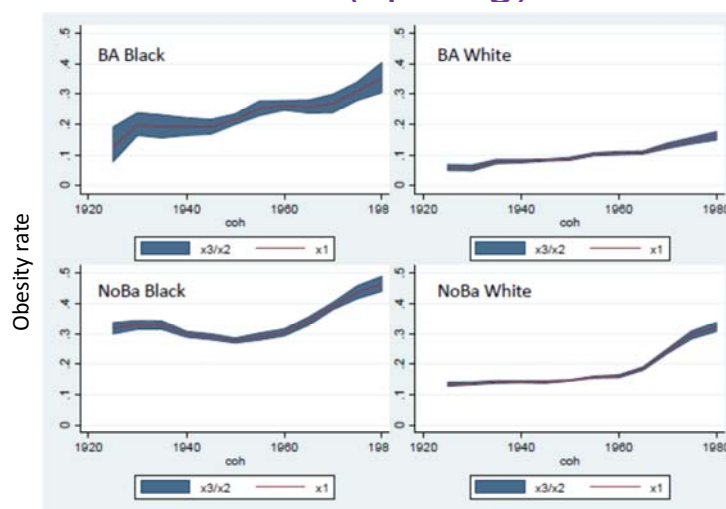
## Are there Race or Ethnicity Differences?

- Information on self-reported main racial background and Hispanic ethnicity

	N	BMI mean (std)	Obesity rate in %
Non-Hispanic White	912,544	25.32 (4.75)	14.8
Non-Hispanic Black	155,045	27.22 (5.59)	26.2
Hispanic	135,692	26.8 (4.92)	22.2

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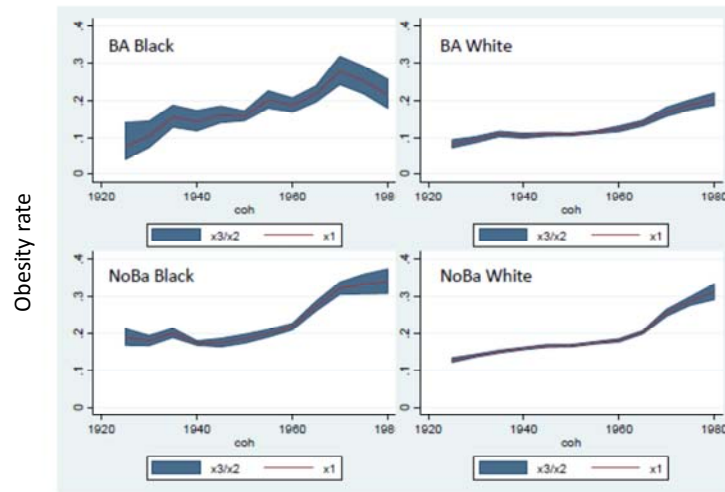
## 2a. Trends in Women (apctlag)



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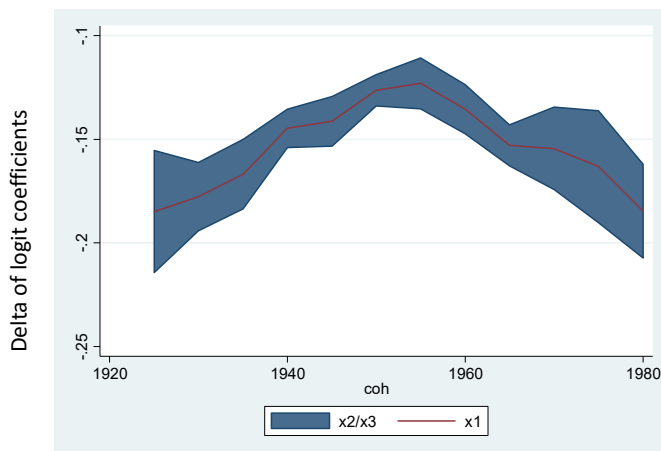


## 2b. Trends in Men (apctlag)



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## 2c. Gaps b/w White and Black Women for Low Educated (apcgo)



- Strong gaps for cohorts born 1925-1940
- Gradients smaller for cohorts 1945-1960, before widening again for cohorts born 1960+
- Situation for Black low-educated women will be worse than for White counterparts

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## Discussion

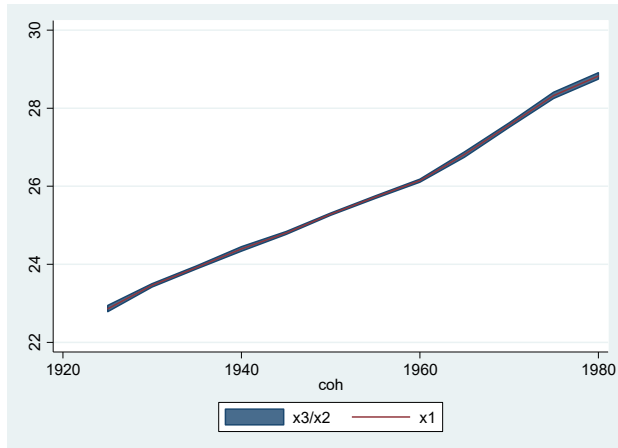
- Women of cohorts born 1960s and later entering old age in the next decade will present sharply increased obesity rates with associated challenges for social and healthcare systems
- In general similar patterns in increases of obesity rates for Black and White non-Hispanic men and women, and Hispanic men and women but different gap trajectories
- Possible explanations
  - Obesogenic environment; HFCS; sweetened beverages
  - Living conditions...

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## Annex Slides

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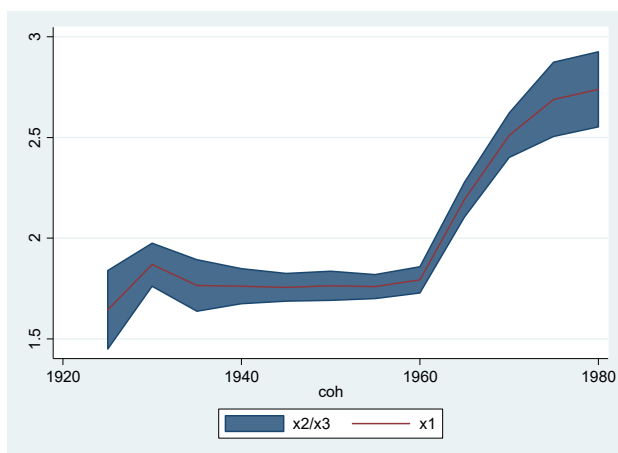
## Annex 1: BMI Trends in women (apctlag)



- Trends in BMI linear, capturing the increasing BMI across the weight/height distribution in the window of observation

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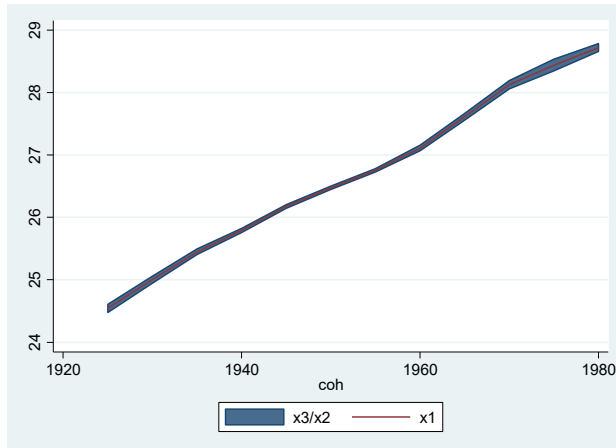
## Annex 2: Educational Gaps in BMI in Women (apcgo)



- Gap analysis for BMI more pronounced than for obesity for cohorts born after 1960

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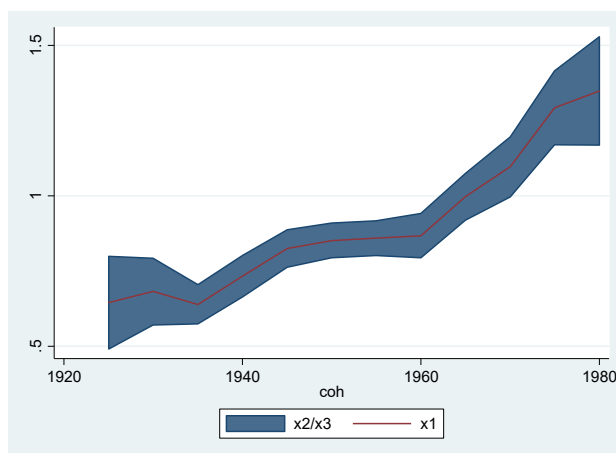
### Annex 3: BMI Trends in Men (apctlag)



- Linear increase

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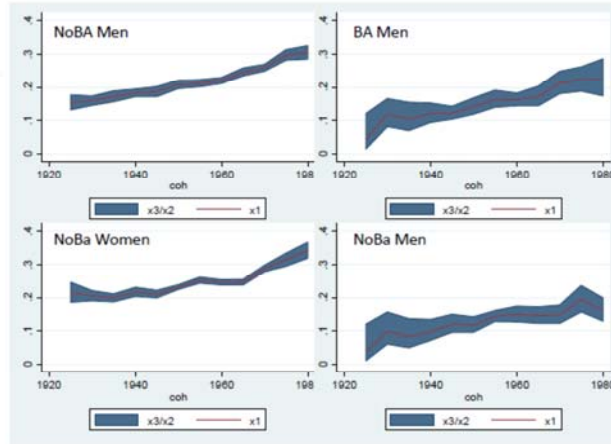
### Annex 4: Educational Gaps in BMI in Men (apcgo)



- No clear cohort trend

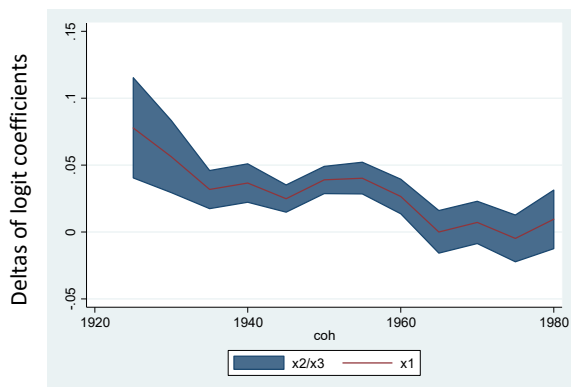
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## Annex 5. Trends in Hispanics (apctlag)



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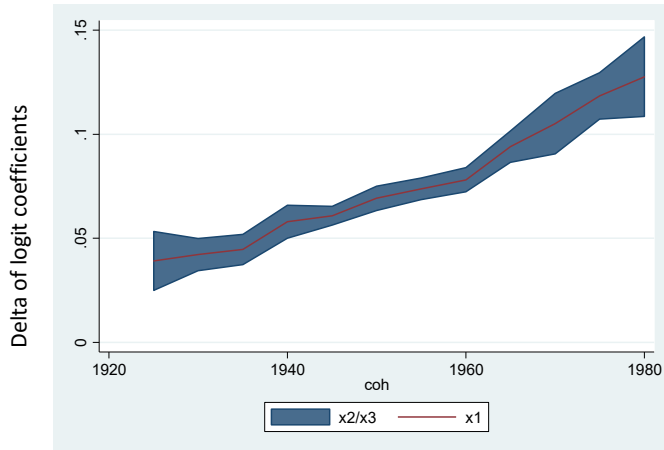
## Annex 6. Gaps in Obesity Rates between Low-educated Hispanic and non-Hispanic Women (apcgo)



- Gaps between Hispanic and non-Hispanic women with low education are closing across the window of observation and are zero for cohorts born 1965+

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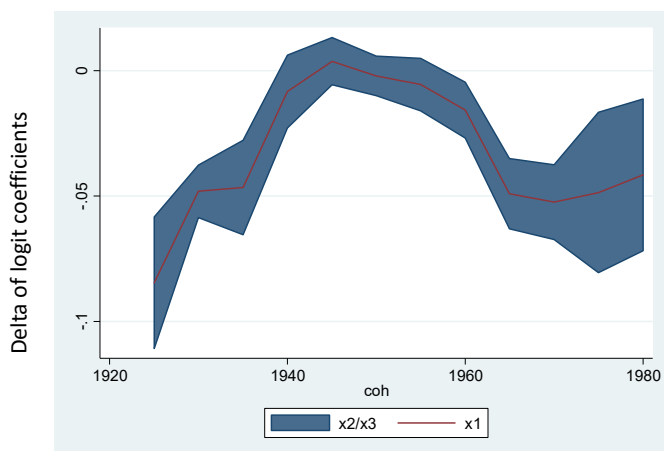
## Annex 7. Educational Gaps in Obesity Rates between Hispanic and non-Hispanic Men (apcgo)



- BA holders versus non-BA holders
- Stable inequalities for those cohorts born before and after 1960 in men

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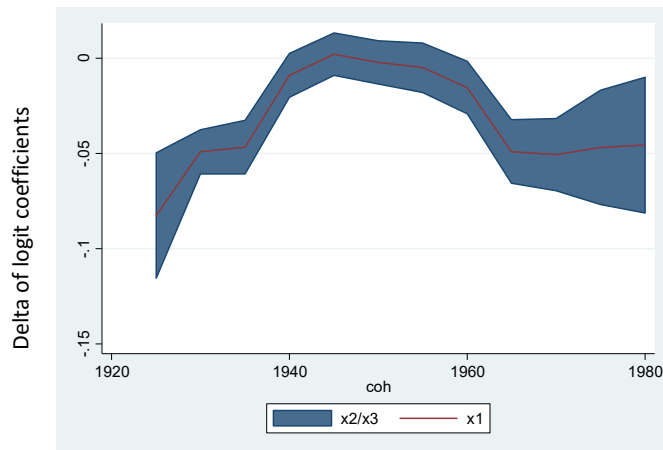
## Annex 8. Gaps b/w White and Black Men for Low-educated (apcgo)



- Smaller gaps in obesity rates
- Wide confidence intervals
- Gap closed for cohort born 1940 but widening again for cohorts 1960+

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## Annex 9. Gaps b/w White and Black Men for High-educated (apcgo)



- Wide confidence intervals
- Smaller gaps in obesity rates
- Cohorts born 1925 to 1940 close gap b/w White and Black men
- Cohorts born 1960+ widening again but w/wide CIs