

Inequality in Expenditure in the Twentieth Century

(for now: 1984-2006)

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Motivation

Large literature documents recent increase in US income inequality

Average weekly wages by percentile %.

Juhn, Murphy, Pierce (1993).

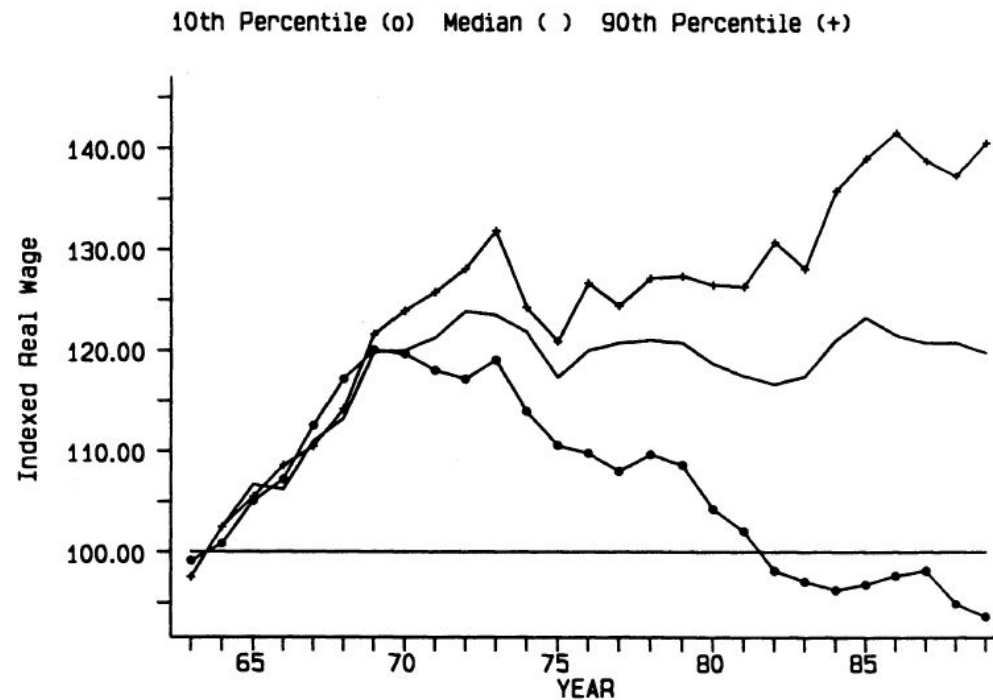
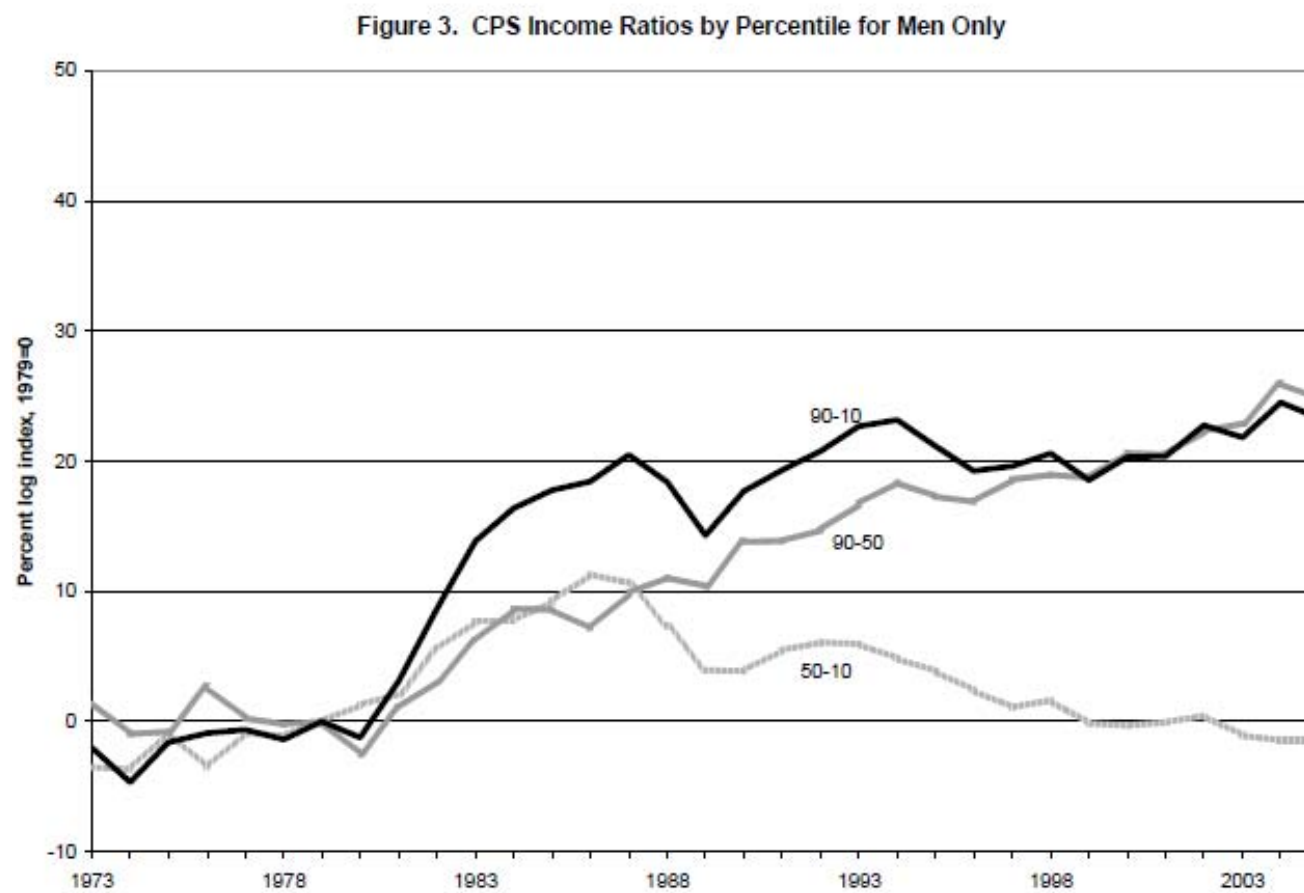


FIG. 1.—Indexed real weekly wages by percentile, 1963–89

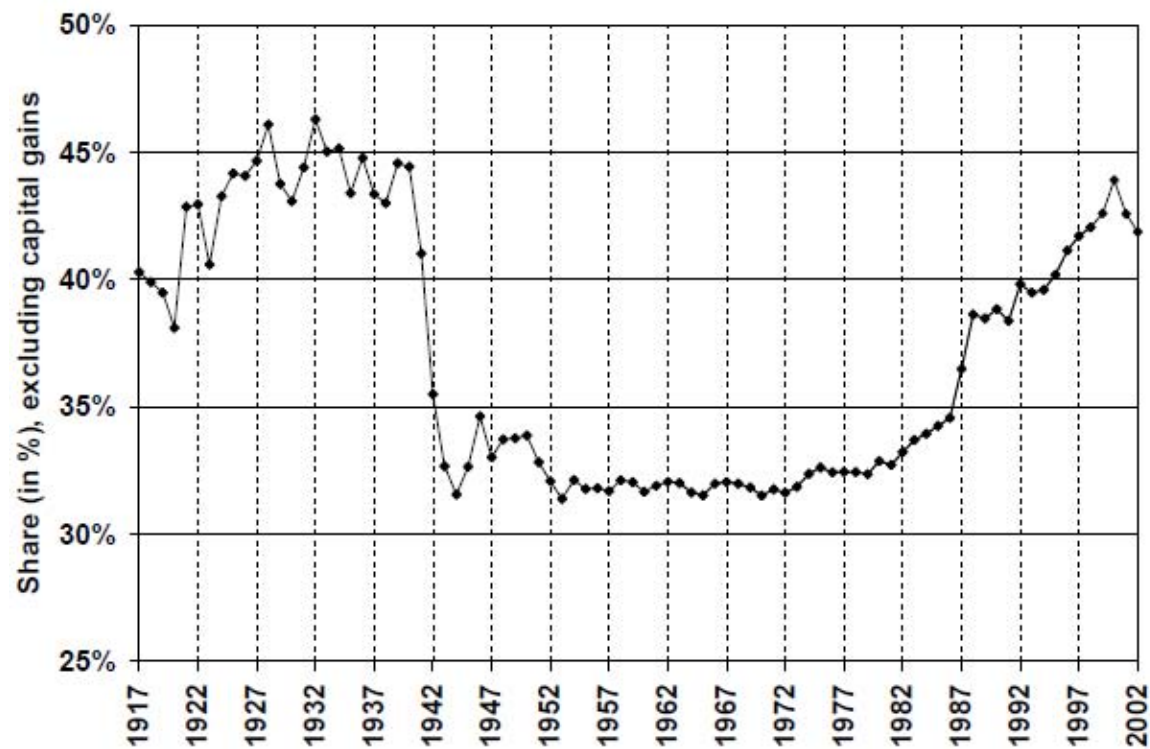
CPS income ratios for men.
Gordon (2008).



This increase reverses the Great Compression in the 1940's

Income share of the top 10%.

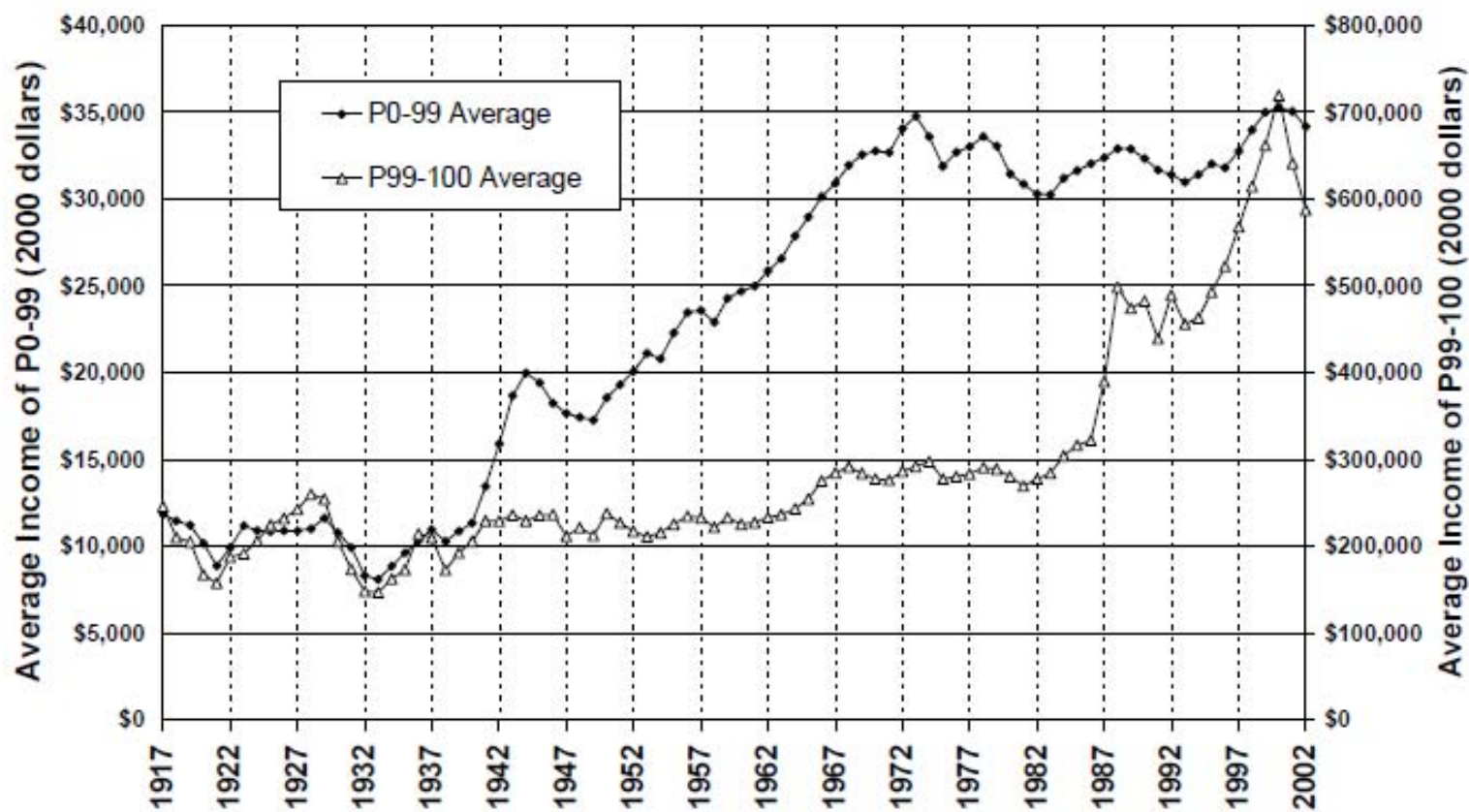
Piketty and Saez (2007). Income excludes capital gains.



and is most extreme at the very highest incomes

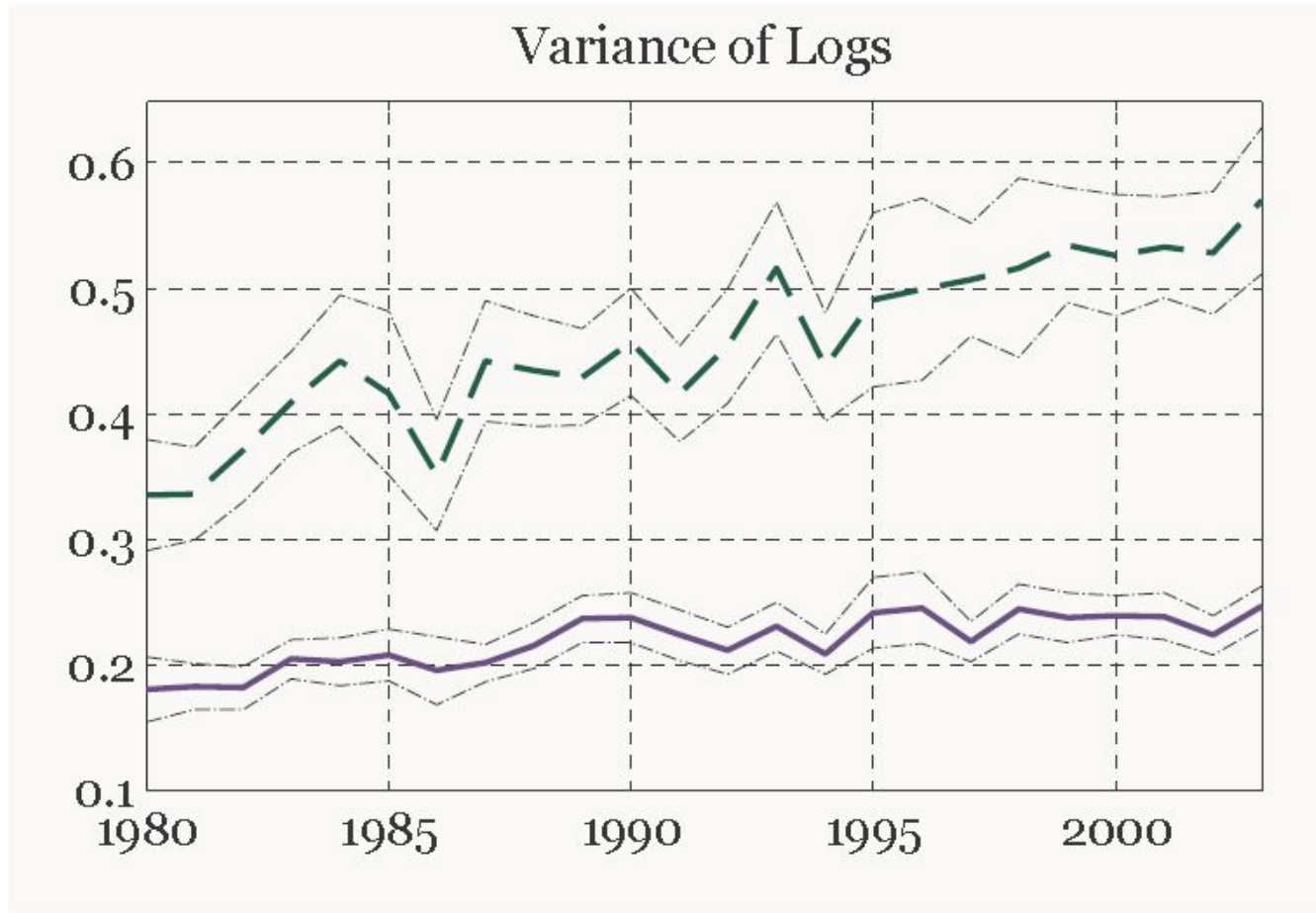
Average real income of bottom 99% and top 1%.

Piketty and Saez (2007). Income excludes capital gains.

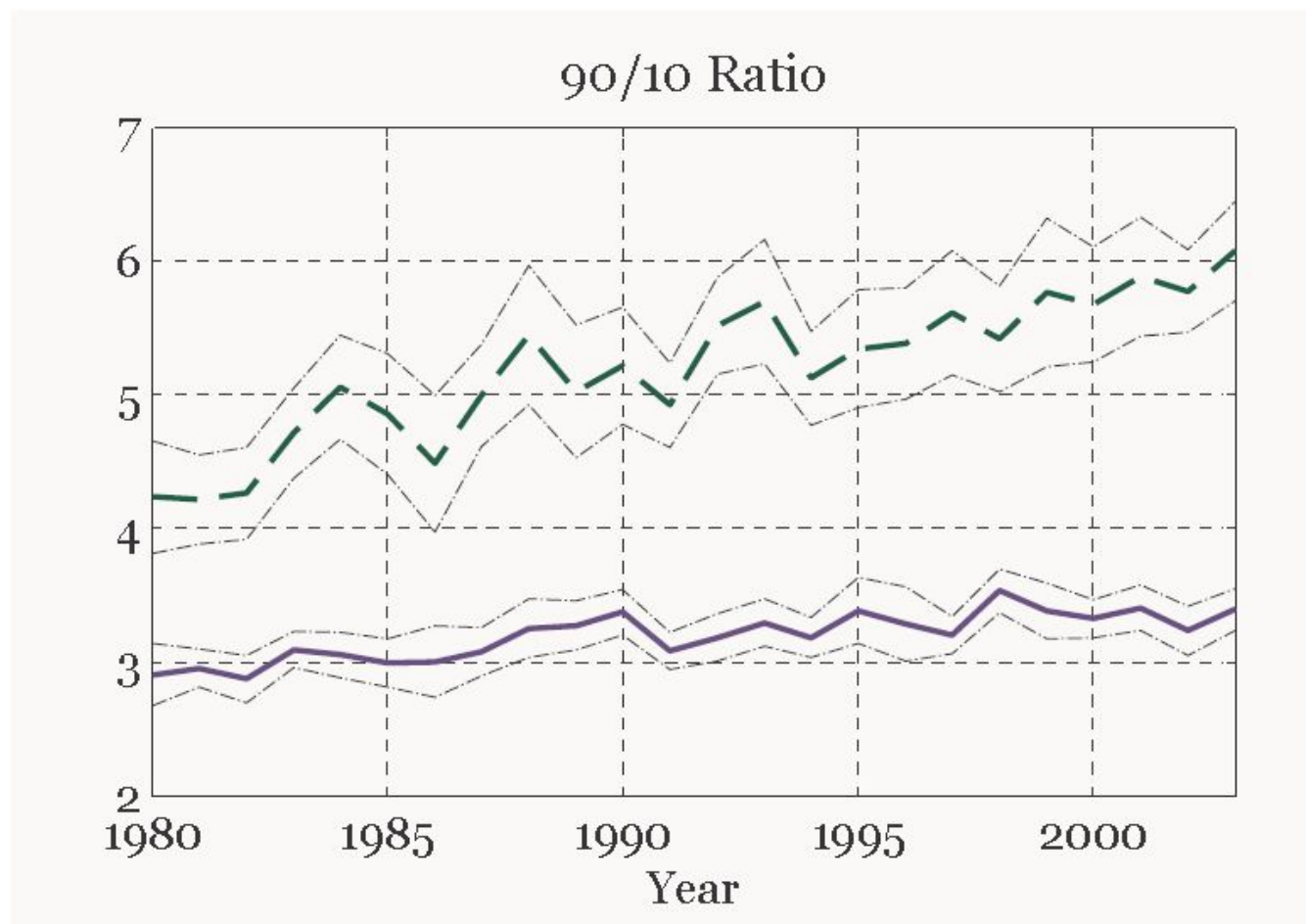


Consumption inequality seems to increase much less

Income and consumption inequality. Krueger and Perri (2003).



Income and consumption inequality. Krueger and Perri (2003).



Why did measured consumption inequality not increase much?

Possibilities:

1. Close to complete consumption insurance
2. Income shocks were mostly transitory and households smooth using credit markets (Krueger Perri)
3. Income shocks were permanent, but the changes were expected ahead of time by consumers (Primerici and van Rens)
4. Consumption inequality did go up, but the CEX does not pick it up

We will investigate the role of 4

Measurement an issue: Interview vs. diary survey. Attanasio, Battistin, and Ichimura (2004).

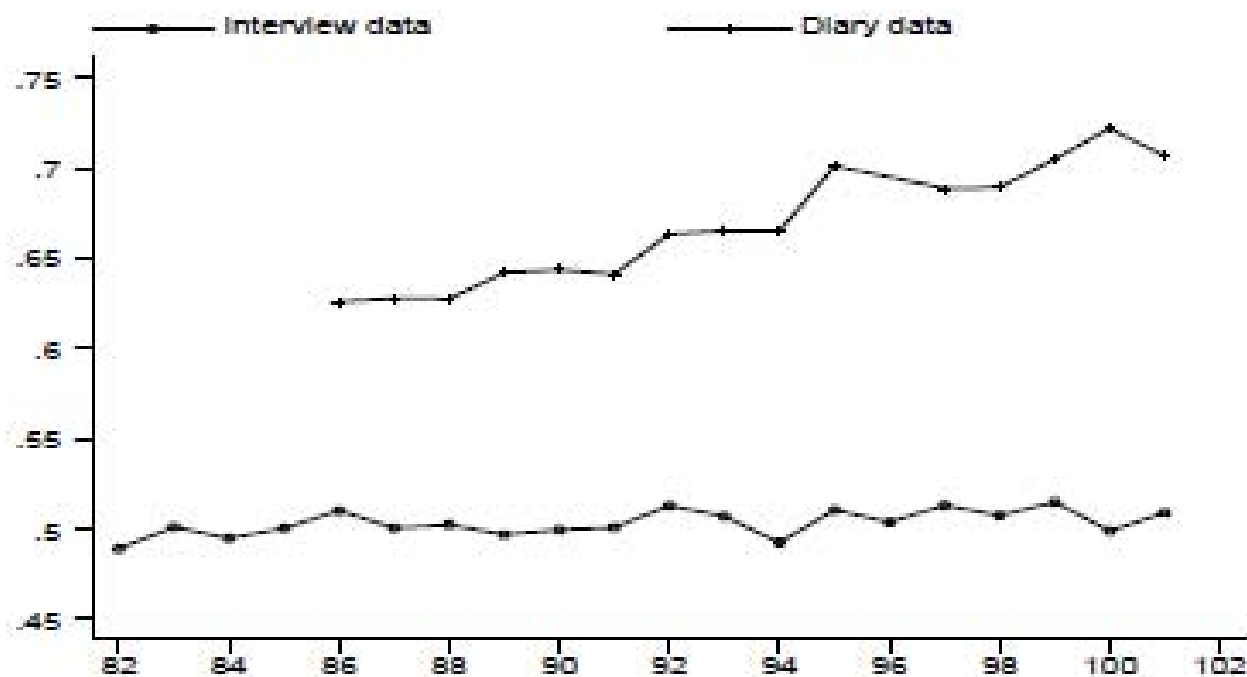


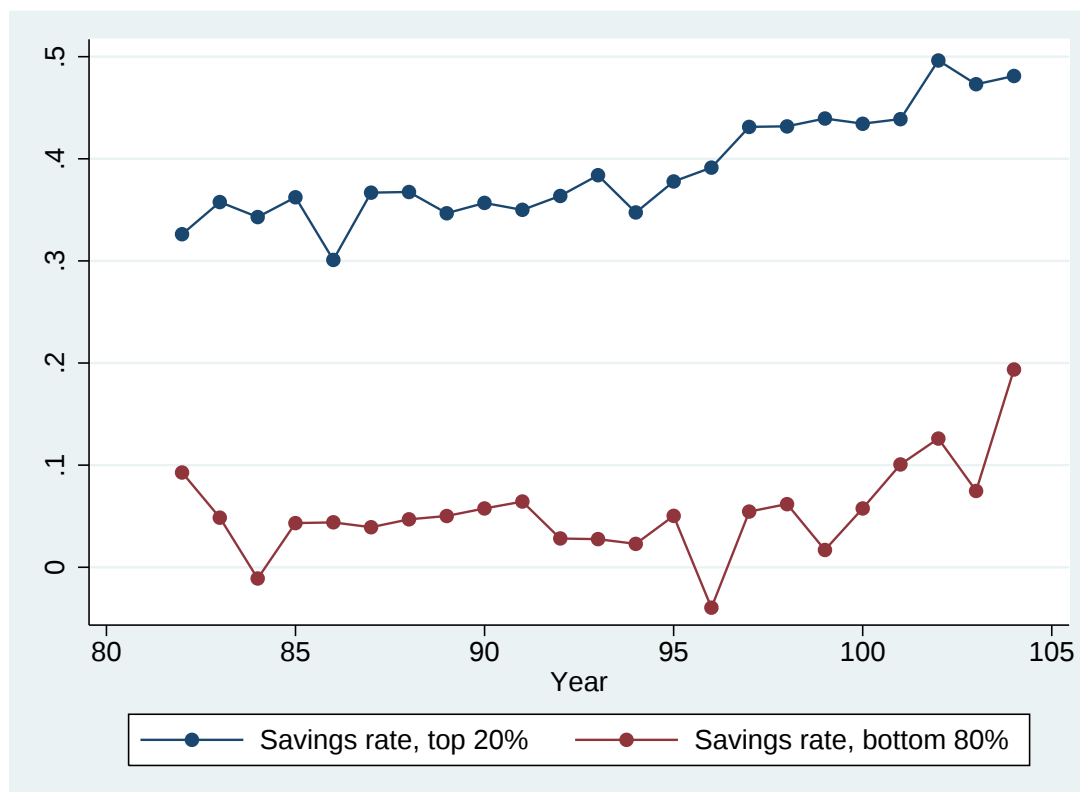
Figure plots stdev of log expenditures: IS (DS) implies about 0.01 (0.05) increase in variance 86-01

Our hypothesis: **CEX understatement of expenditures has gotten increasingly worse for high consumption households**

- Approach 0: compare CEX savings rates and “true” savings rates
- Approaches 1 and 2: Adjust CEX data using NIPA coverage ratios to improve measure of inequality
- Approach 3: Demand system estimated on micro data gives an implied inequality from NIPA data

A rough idea: compare CEX savings rates and “true” savings rates:

- **Measured savings rates** in the CEX (total consumption/after-tax income) *increase* over time for both the rich (by income) and the poor:



– The increase for the rich is from 33% to 48%.

- Maki and Palumbo (2001) estimate **“true” savings rates** by income quintile using income and wealth data from the SCF and FFA/NIPA:

Income Category	Net worth-income ratio			Saving rate		
	1992 (A)	2000 (B)	Difference (B) – (A)	1992 (C)	2000 (D)	Difference (D) - (C)
Total	468.6	612.7	144.1	5.9	1.3	-4.6
81% - 100%	639.5	869.2	229.7	8.5	-2.1	-10.6
61% - 80%	332.2	417.1	84.9	4.7	2.6	-2.1
41% - 60%	326.7	364.9	38.2	2.7	2.9	.2
21% - 40%	328.2	414.5	86.3	4.2	7.4	3.2
0% - 20%	411.3	512.3	101.0	3.8	7.1	3.3

- Dramatic *decrease* in savings rate for rich (9% to -2%)
Increase in savings rate for poor
Qualifier: time period and assumptions in assignment of returns

- Implications:

- CEX covers the poor's consumption about right
- CEX initially captures about $67/91=74\%$ of consumption of the rich
- Then coverage declines to about $52/102=51\%$ of consumption of the rich

⇓

- Initially $(\text{True } C_{rich}/C_{poor}) = \text{Measured } C_{rich}/C_{poor} \times \frac{1}{0.74}$
 $= \text{Measured } C_{rich}/C_{poor} \times 1.36.$
- At the end, $(\text{True ratio } C_{rich}/C_{poor}) = \text{Measured } C_{rich}/C_{poor} \times \frac{1}{0.51}$
 $= \text{Measured } C_{rich}/C_{poor} \times 1.96.$

So if there is roughly no measured inequality trend, **the true increase in inequality is $1.96/1.36-1=44\%$!**

- Piketty and Saez estimate that Y_{rich}/Y_{poor} increases by 58% from 1982-2004, using rich=top 10%, poor=bottom 90%.
- Qualifier: numbers not completely comparable (nor time period)

Goal: Use national accounts data to bring information on spending omitted from CE

Approaches 1, 2, and 3: Use NIPA data across goods to improve CEX-based estimates of recent evolution of inequality in expenditures across households

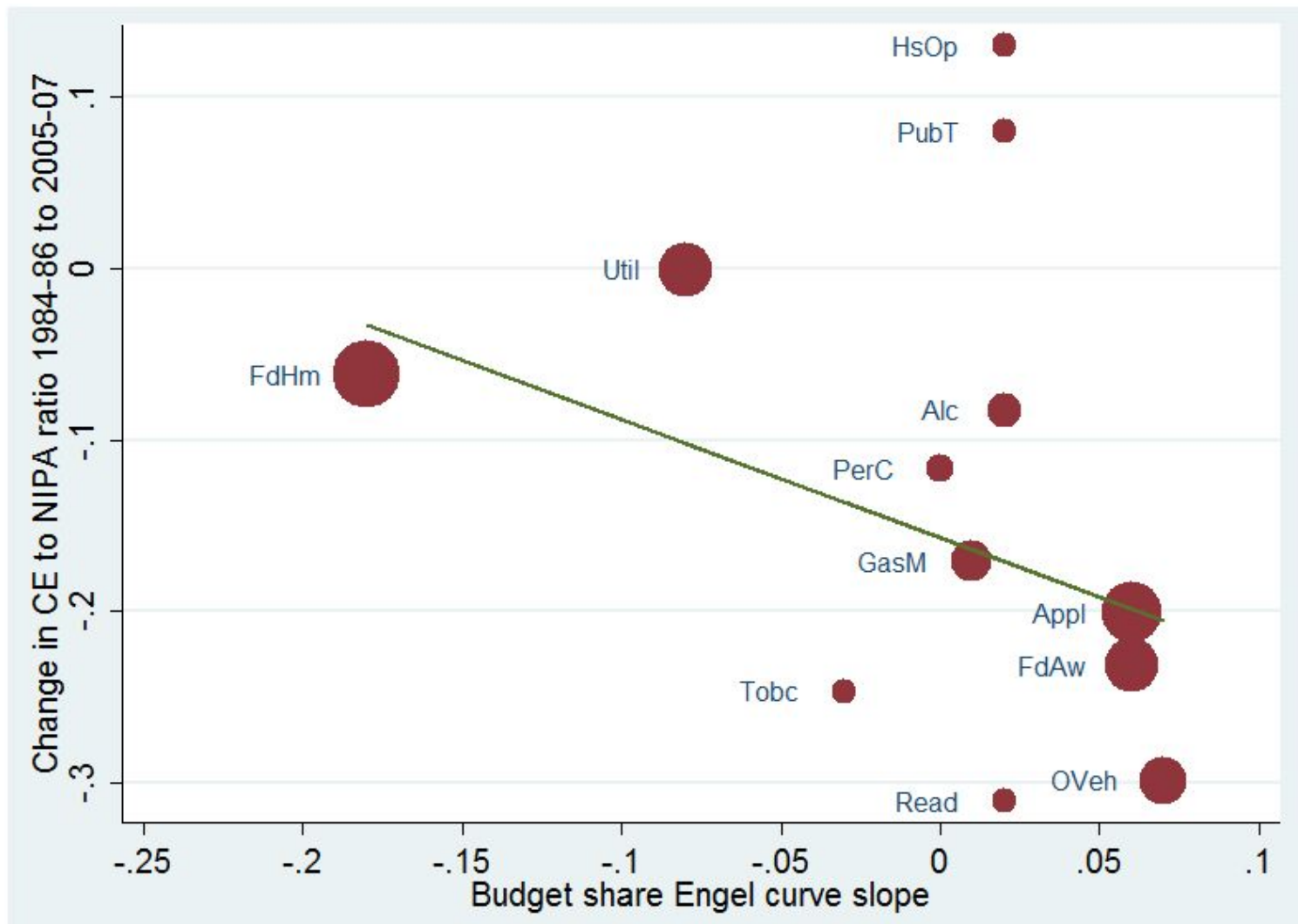
Approaches 1 and 2:

- Change in aggregated NIPA to aggregated CEX by good tells us what goods are worse covered
- Budgets shares can inform us about which households have under-measured expenditures

Approach 3:

- Demand system estimated on micro data gives an implied inequality from NIPA data

New fact: CEX/NIPA deteriorates more for luxuries



Weighted least squares (weight=budget share): **Slope=-0.69, t=-2.65.**

Implications for measuring inequality

- The CE is getting worse at measuring luxuries:
 - A larger fraction of the rich's consumption is luxuries
 - This disproportionately lowers rich's relative consumption, biasing down measured inequality over time
- The consumption of the rich is getting relatively worse measured:
 - Directly biases down measured inequality over time
 - Because the rich consume mostly luxuries, biases down CE-NIPA coverage of luxuries more over time

⇒ The trend in consumption inequality will be too small.

And the savings rate of the rich will trend upward relative to its true trend while the same will not be the case for the poor

Suppose that for household h , good i , period t , observed CEX consumption equals true consumption times a “coverage factor”

$$c_{h,i,t} = c_{h,i,t}^* f_{h,i,t}$$

Case 1: $f_{h,i,t} = f_{i,t}$

- The coverage factor differs by good and time period.
- The coverage factor does not differ across households (in a given period).

Case 2: $f_{h,i,t} = f_{h,t}$

- The coverage factor differs by household and time period.
- The coverage factor does not differ across goods for a given households (in a given period).

Either setting could lead to the stronger decline in CEX/NIPA for luxuries:

- In Case 1, it's driven by gradually worsening coverage of luxuries for everyone.
- In Case 2, it's driven by the greater under-measurement of expenditures of (or omission of) rich households over time

Either setting could lead to actual increases in inequality much greater than measured:

- In Case 1, rich households consume mostly luxuries, so consumption more understated over time
- In Case 2, rich households consumption more understated over time

Is this happening? Is it quantitatively important?

Methodology for Case 1:

- Estimate $f_{i,t}$ as (total CEX consumption for i, t)/(total NIPA consumption for i, t)
- Calculate coverage-adjusted consumption for each h, i, t as

$$c_{h,i,t}^* = \frac{c_{h,i,t}}{f_{i,t}}$$

- Using the new consumption values to estimate inequality.

Methodology for Case 2:

- Estimate $f_{h,t}$ as laid out below
- Calculate coverage-adjusted consumption for each h, i, t as

$$c_{h,i,t}^* = \frac{c_{h,i,t}}{f_{h,t}}$$

- Using the new consumption values to estimate inequality.

Estimating $f_{h,t}$ in case 2:

$$c_{h,i,t} = c_{h,i,t}^* f_{h,t}, \quad \text{with } f_{h,t} = \frac{1}{1 + s_t c_{h,t}^*} \simeq \frac{1}{1 + s_t c_{h,t}}$$

$$\begin{aligned} W_{i,t}^* &= \frac{C_{i,t}^*}{C_t^*} = \frac{\sum_h w_{h,i,t}^* c_{h,t}^*}{C_t^*} = \frac{\sum_h w_{h,i,t}^* \frac{1}{f_{h,t}} c_{h,t}}{C_t^*} = \frac{\sum_h w_{h,i,t}^* (1 + s_t c_{h,t}) c_{h,t}}{C_t^*} \\ &= \frac{\sum_h w_{h,i,t} c_{h,t}}{C_t^*} + \frac{\sum_h w_{h,i,t} s_t c_{h,t} c_{h,t}}{C_t^*} = \frac{C_{i,t}}{C_t} \frac{C_t}{C_t^*} + s_t \frac{\sum_h c_{h,i,t} c_{h,t}}{C_t} \frac{C_t}{C_t^*} \\ &= W_{i,t} \frac{C_t}{C_t^*} + s_t \frac{\sum_h c_{h,i,t} c_{h,t}}{C_t} \frac{C_t}{C_t^*} \quad \Rightarrow \quad s_t \end{aligned}$$

We include all luxuries in one big group and use that to get one s_t -series.

- $W_{i,t}^*$: NIPA budget share for good i in period t
- $W_{i,t}$: CEX budget share for good i in period t
- $\frac{C_t}{C_t^*}$: Ratio of CEX to NIPA total consumption in period t (for all goods)
- $\frac{\sum_h c_{h,i,t} c_{h,t}}{C_t}$: A quantity we calculate in the CEX.

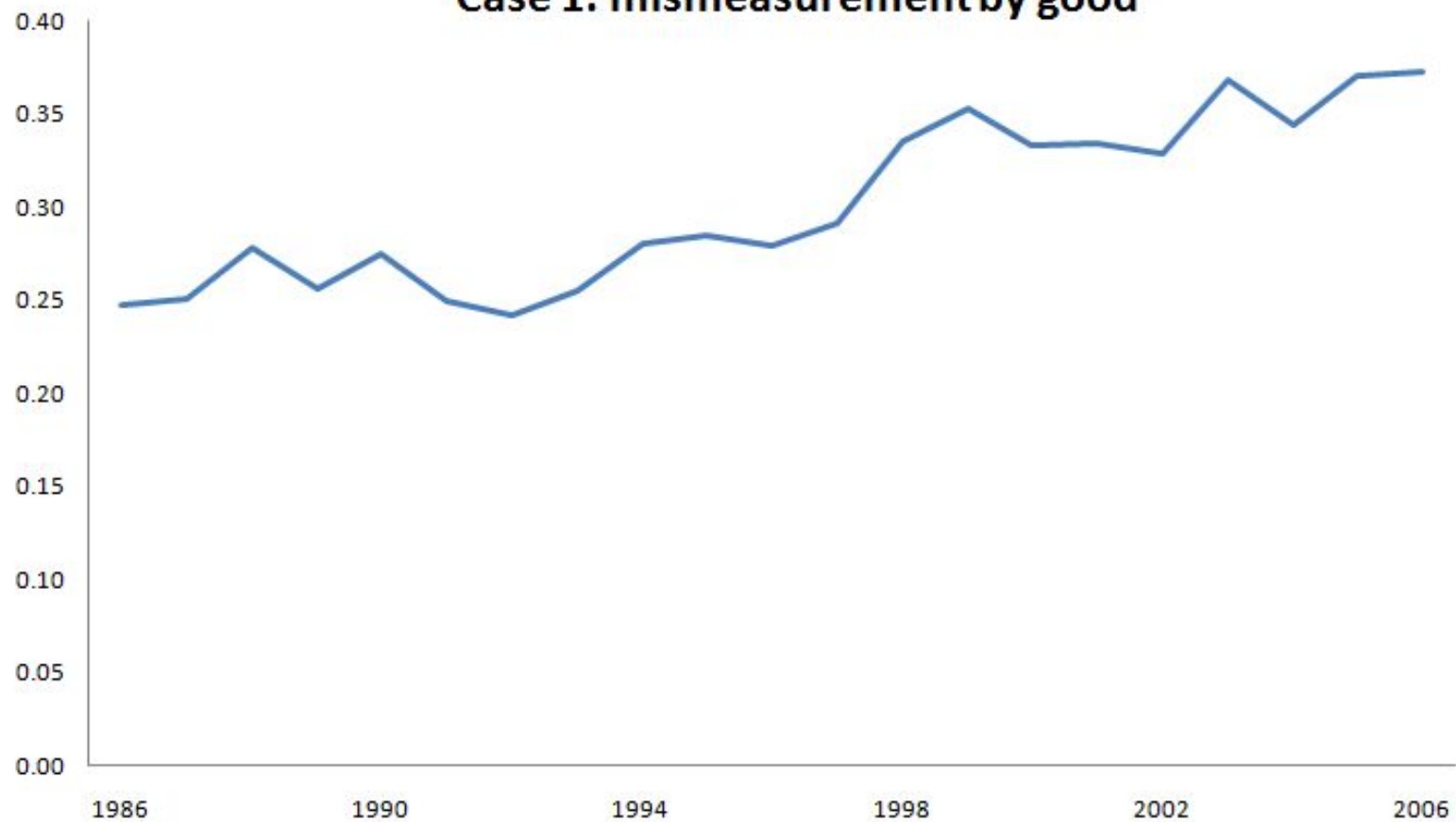
Data: Consumer Expenditures Surveys 1986-2006 and NIPA Table 2.5.5 and 2.5.4 and published CE tables

Map NIPA to 11 CE nondurable categories:

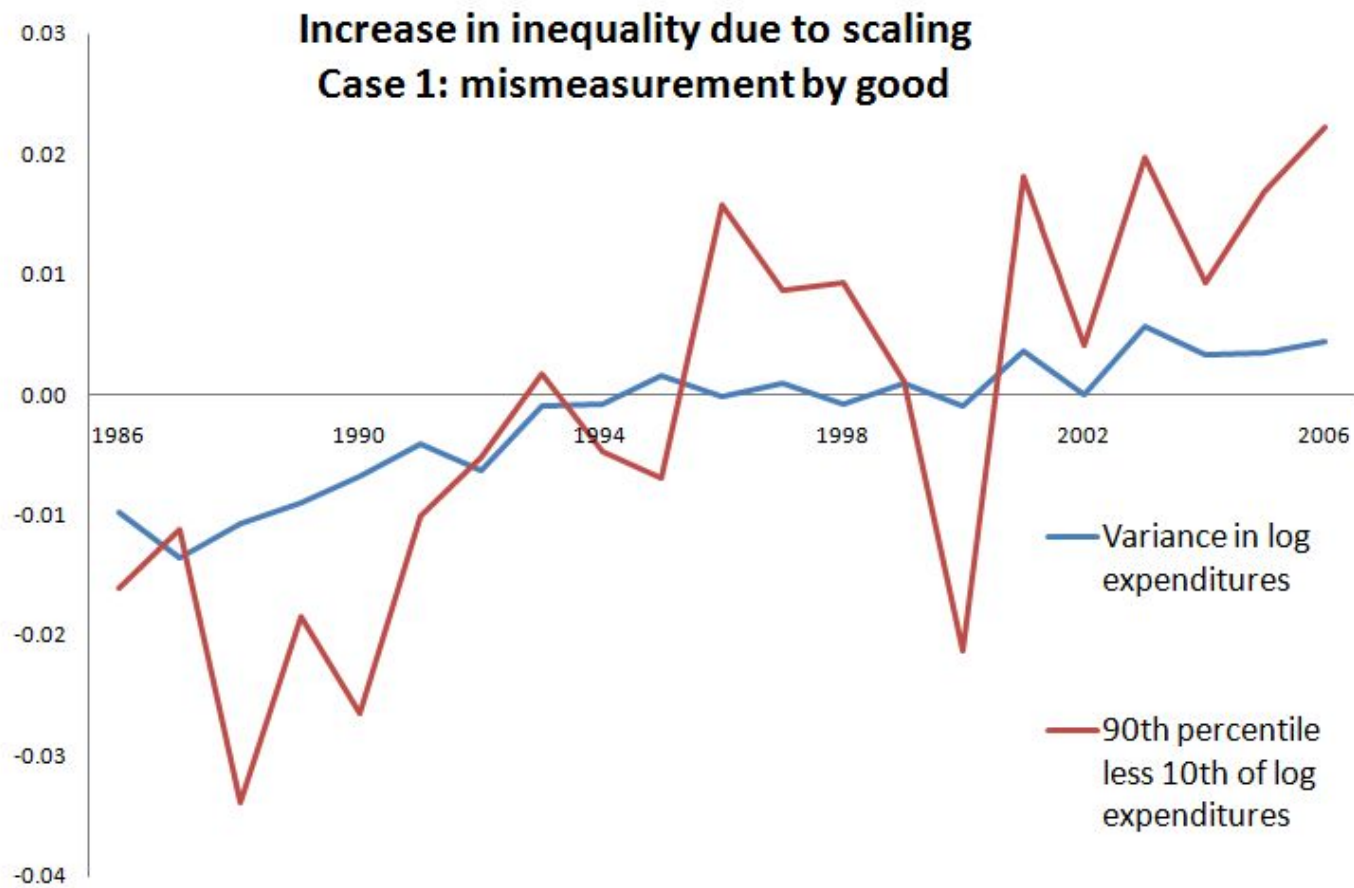
- Food away from home = apmbrc1 'Purchased meals and beverages (n.d.)' - bapmrc1 'Other alcoholic beverages (n.d.)' ;
- Alcohol = baoprc1 'Alcoholic beverages purchased for off-premise consumption (n.d.)' + bapmrc1 'Other alcoholic beverages (n.d.)';
- Utilities = a535rc1 'Household utilities' + btelrc1 'Telephone and telegraph (s.)';
- Other vehicle expenses = atbarc1 'Tires, tubes, accessories, and other parts (d.)' + breprc1 'Repair, greasing, washing, parking, storage rental, and leasing (s.)' + btolrc1 'Bridge, tunnel, ferry, and road tolls (s.)' + bainrc1 'Insurance (s.)';
- Also food at home, personal care, gas and motor oil, public transportation, household operations, apparel, reading tobacco, entertainment

Increase in average log consumption per capita due to scaling

Case 1: mismeasurement by good



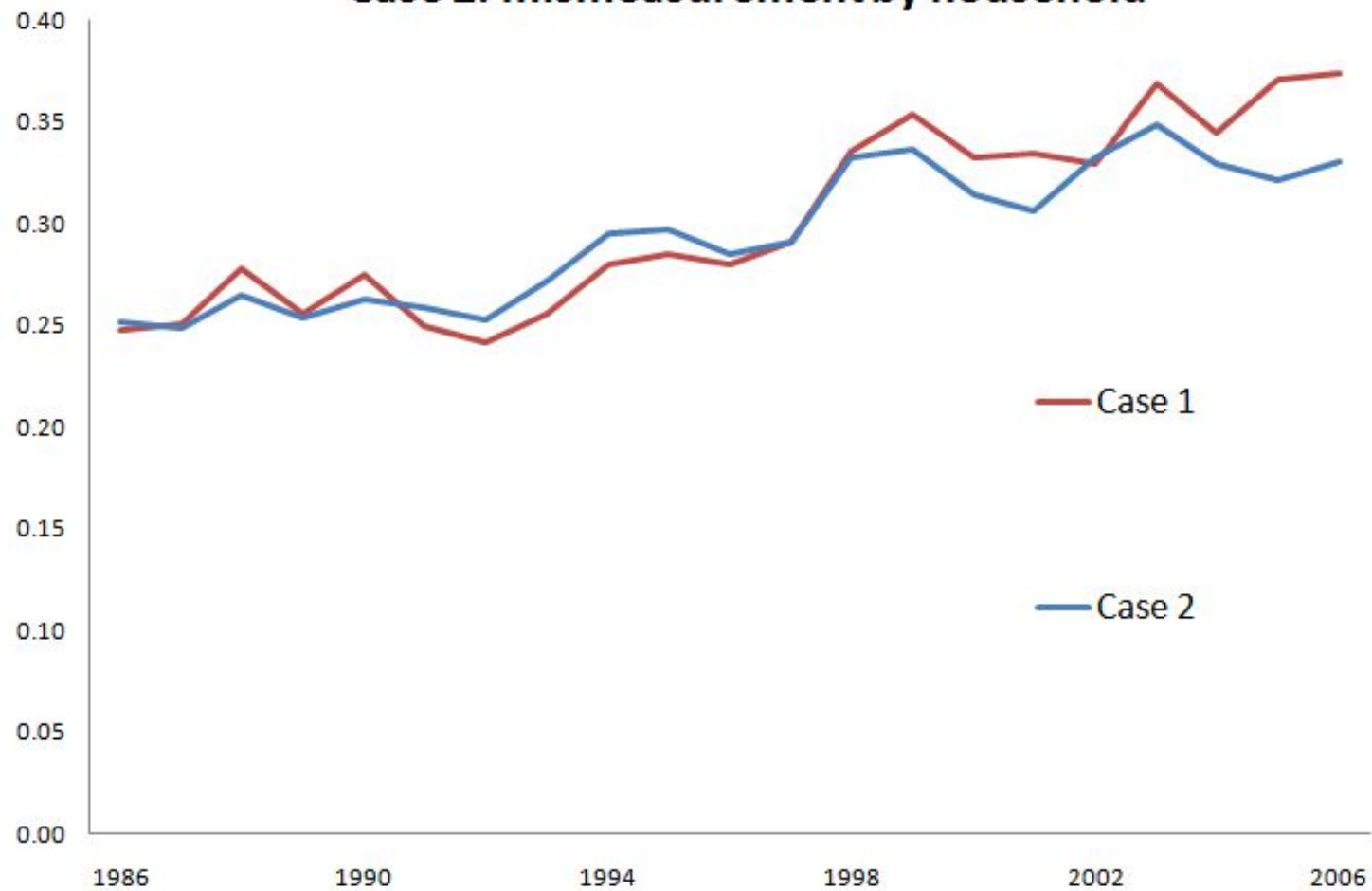
Results for Case 1: Small increase in inequality



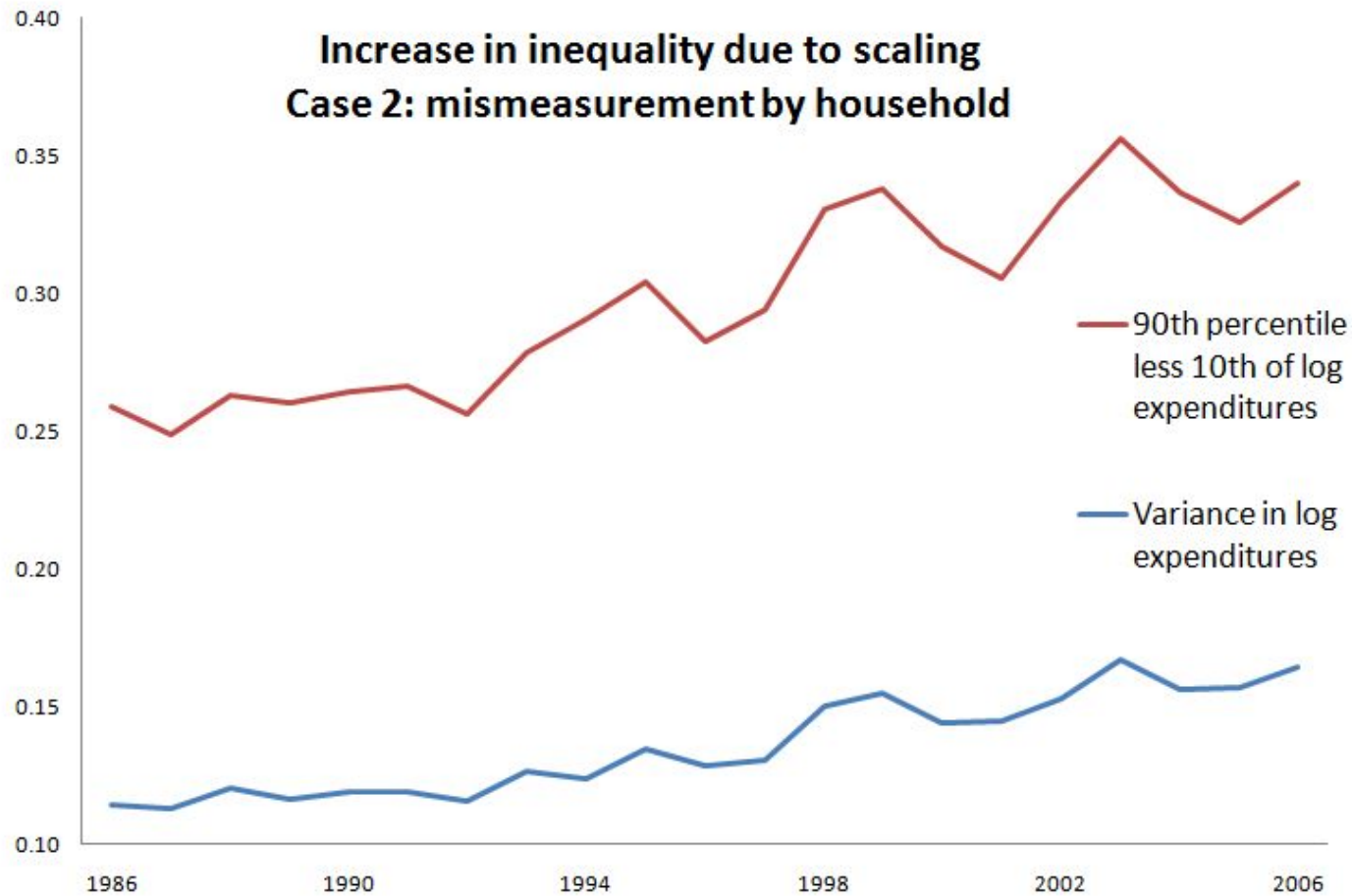
Baseline consumption increase:	90-10: 0.04	var: 0.04
Baseline income increase:	90-10: 0.18	var: 0.22

Increase in average log consumption per capita due to scaling

Case 2: mismeasurement by household



Results for Case 2: Larger increase in inequality



Baseline consumption: 90-10: 0.04

var: 0.04

Baseline income: 90-10: 0.18

var: 0.22

Summary:

Baseline consumption:	90-10: 0.04	var: 0.04
Baseline income:	90-10: 0.18	var: 0.22
Case 1 consumption:	90-10: +0.04	var: +0.02
Case 2 consumption:	90-10: +0.08	var: +0.05

Note that both approaches miss if very high income households omitted from the survey

Doing Case with both (identified)

Approach 3: Use household level demand system to infer inequality from NIPA

$$\begin{aligned}\frac{x_{i,t}}{x_t} &= a_i + \sum_j \gamma_{i,j} \ln p_{j,t} + \beta_i \ln c_t \\ \ln c_t &= \ln x_t - \ln P_t\end{aligned}$$

where

$$\ln P_t := \ln a(\mathbf{p}_t) := a_0 + \sum_{i=1}^I a_i \ln p_{i,t} + \frac{1}{2} \sum_{i=1}^I \sum_{j=1}^I \gamma_{i,j} \ln(p_{i,t}) \ln(p_{j,t})$$

and $\gamma_{i,j} = \frac{1}{2} (\gamma_{i,j}^* + \gamma_{j,i}^*)$.

The restrictions

$$\begin{aligned}\sum_{i=1}^I a_i &= 1 \\ \sum_{i=1}^I \beta_i &= 0 \\ \sum_{i=1}^I \gamma_{i,j} &= 0 \quad j = 1, \dots, I \\ \sum_{j=1}^I \gamma_{i,j} &= 0 \quad i = 1, \dots, I \\ \gamma_{i,j} &= \gamma_{j,i} \quad \forall i, j\end{aligned}$$

impose homogeneity of degree zero in prices, Slutsky symmetry, and budget shares sum to one across goods

Aggregation

Let $F_t(c)$ denote the distribution of $c_{h,t}$ across consumers

$$W_{i,t} = a_i + [\sum_j \gamma_{i,j} \ln p_{j,t}] + \beta_i \left[\ln \left(\frac{C_t}{N_t} \right) + T_t \right] \quad (1)$$

where

$$W_{i,t} := X_{i,t}/X_t \quad (2)$$

and

$$T_t := \frac{\int c \ln c dF_t(c)}{C_t/N_t} - \ln \left(\frac{C_t}{N_t} \right) \quad (3)$$

. Under the assumption of log-normality,

$$T_t = \frac{1}{2} \sigma_t^2 \quad (4)$$

Goal: estimate AIDS system on CEX and recover T_t with NIPA

Whether CE coverage complete or not irrelevant for consistent T_t

Estimation

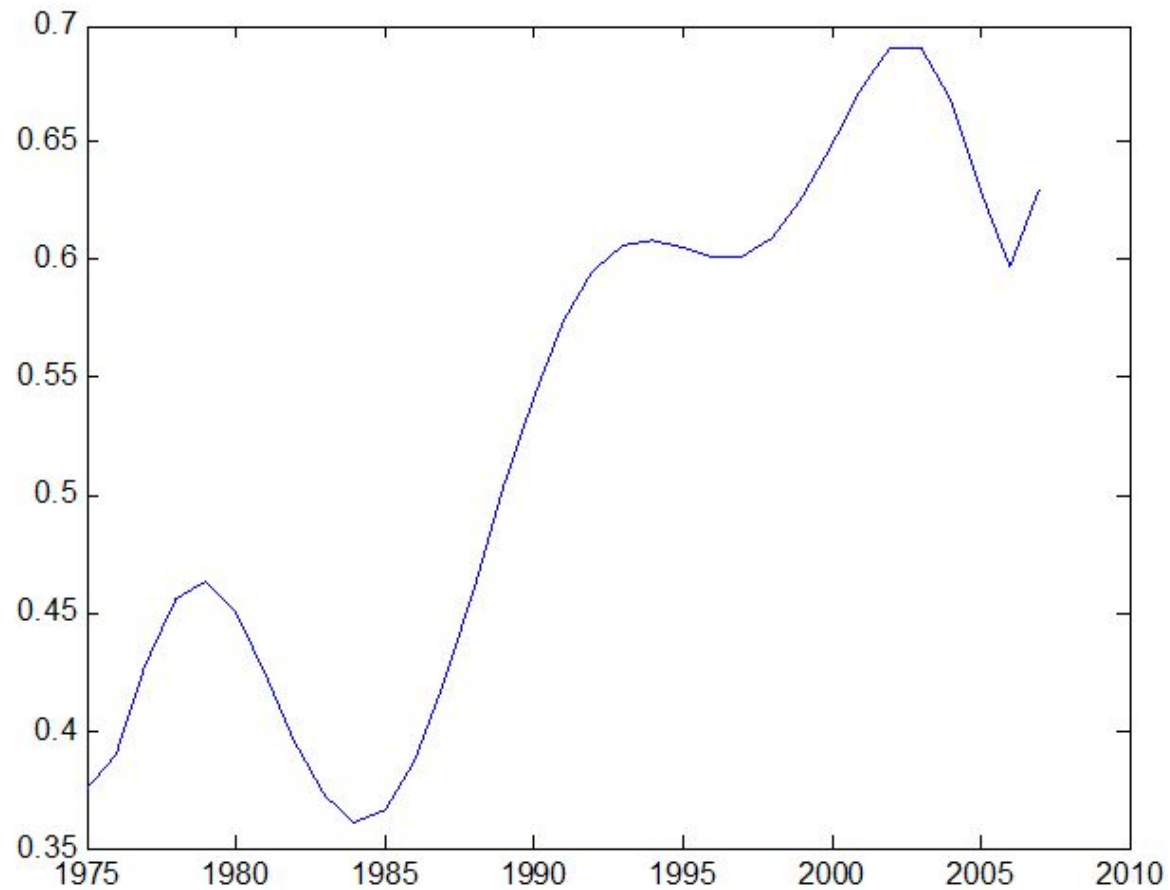
1. In CEX, estimate AIDS by maximum likelihood (on scaled up data, approach 1)
2. Use estimates of parameters as priors in estimation of T_t in multi-equation estimation in NIPA data

$$W_{i,t} = a_i + [\sum_j \gamma_{i,j} \ln p_{j,t}] + \beta_i \left[\ln \left(\frac{C_t}{N_t} \right) + T_t \right] \quad (5)$$

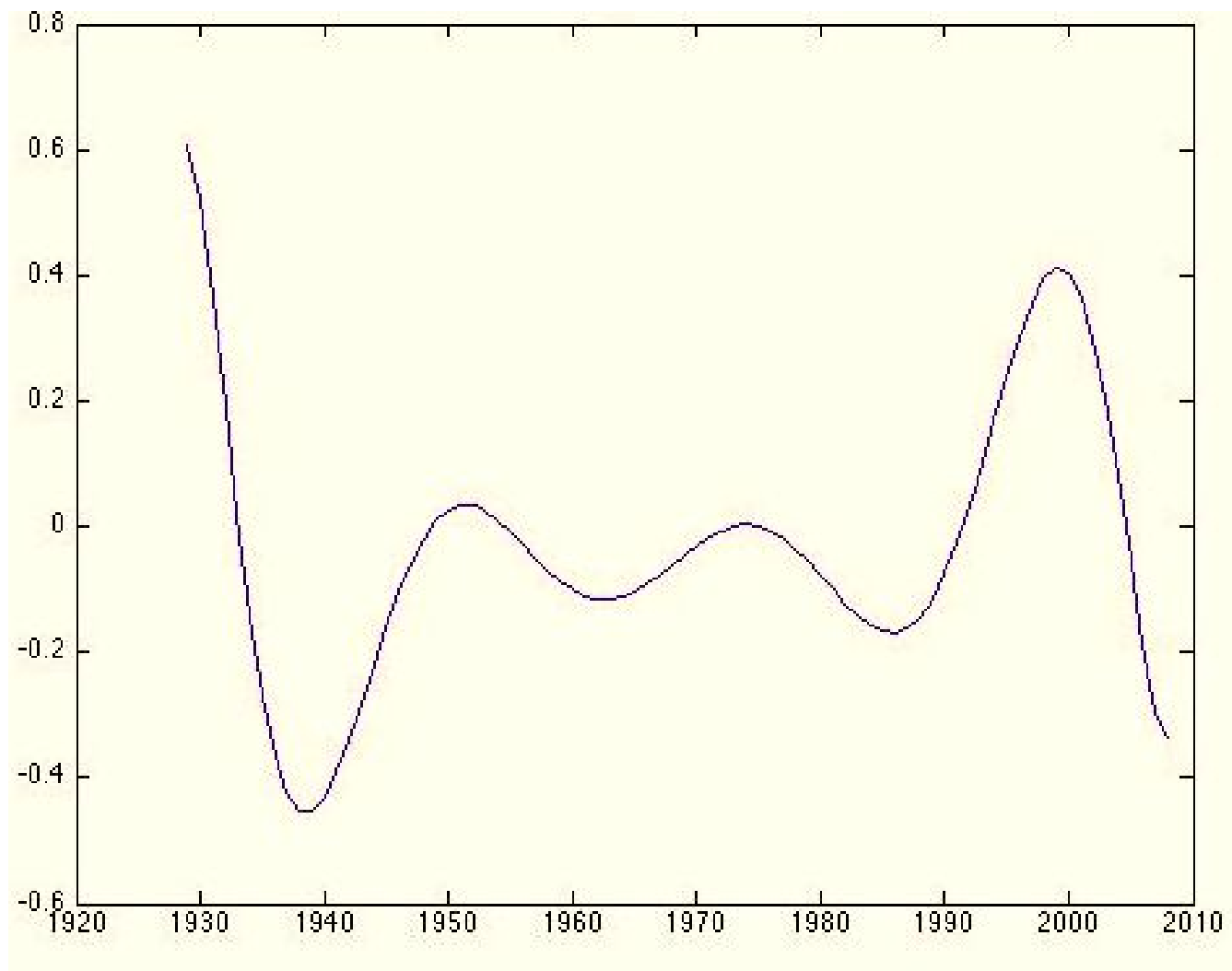
3. T_t smoothed using Chebychev polynomials
4. Note identification of T_t and do not carry forward/impose a_i (since betas and gammas will be roughly correct even with CE coverage problems)

Example result for recent inequality:

Two composite bundles – one of luxuries, one of necessities

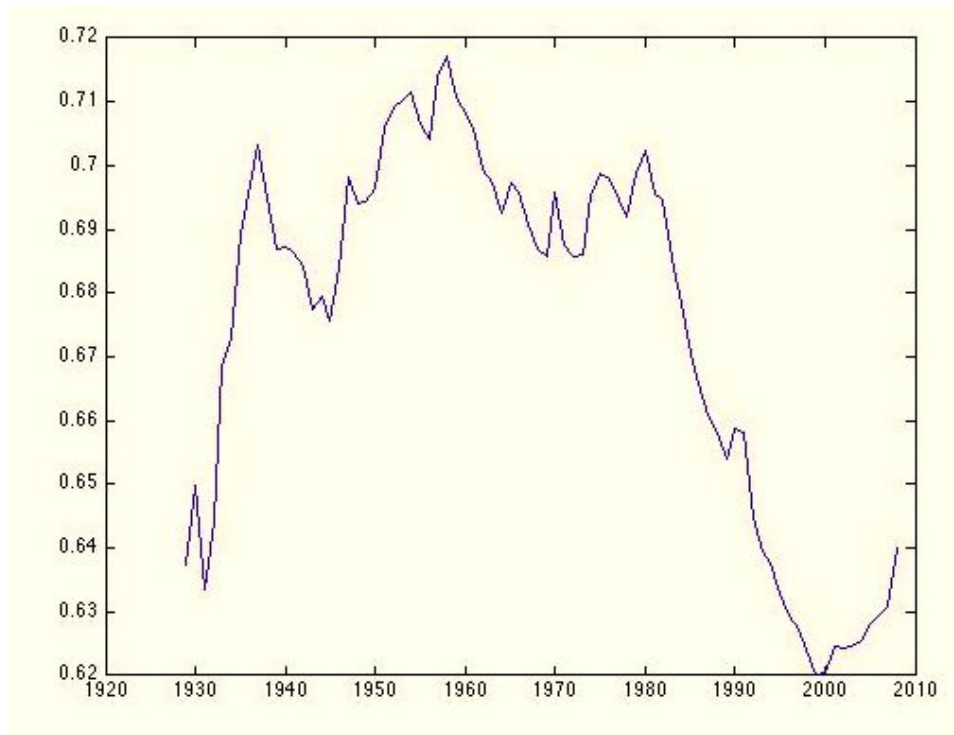


Example result: Inequality over the 20th century, three goods

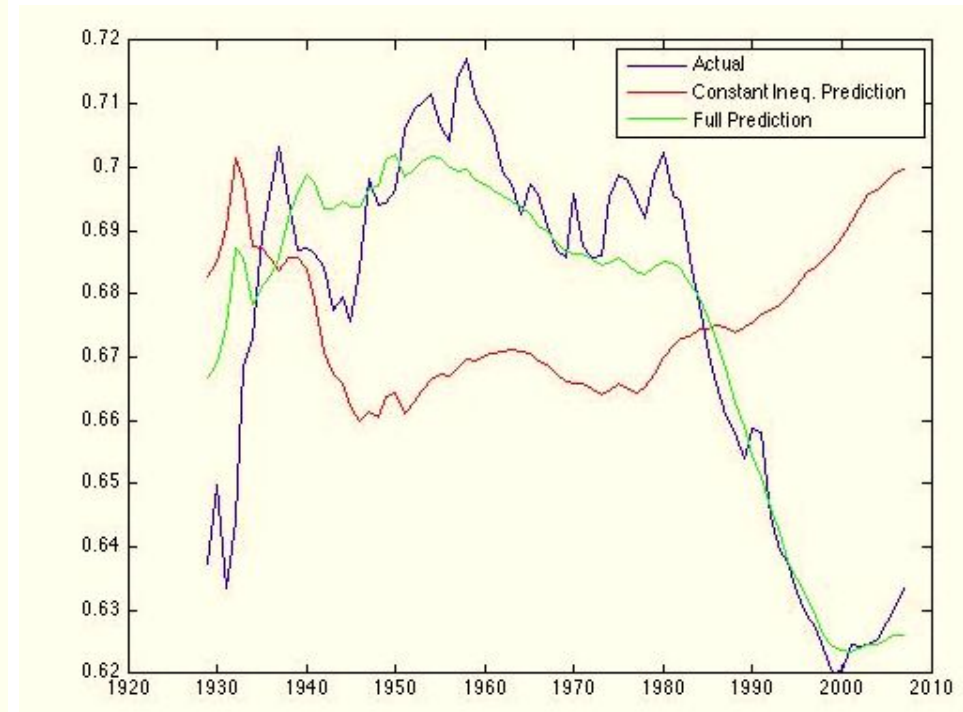


Central feature of raw data

Food share



Alternative scenarios



Consumption inequality from 1936 from Cheng and Parker (2009)

Table 4: Log premium across education groups

	High school degree premium	Some college less high school degree	College degree less high school degree
	<u>Total expenditures less health and education</u>		
<u>Change</u>			
1935-36 to 1960-61	-0.23	-0.08	-0.16
1960-61 to 1972-73	-0.04	0.00	-0.01
1935-36 to 1972-73	-0.27	-0.08	-0.17
<u>Survey years</u>	<u>Consistent nondurable expenditures</u>		
<u>Change</u>			
1935-36 to 1960-61	-0.21	-0.05	-0.14
1960-61 to 1972-73	-0.04	-0.02	-0.02
1935-36 to 1972-73	-0.25	-0.07	-0.16
<u>Survey years</u>	<u>Pre-tax family income</u>		
<u>Change</u>			
1935-36 to 1960-61	-0.07	-0.10	-0.12
1960-61 to 1972-73	-0.03	-0.01	-0.05
1935-36 to 1972-73	-0.11	-0.11	-0.17
<u>Survey years</u>	<u>Average weekly wages (male workers)</u>		
<u>Change</u>			
1935-36 to 1972-73	-0.07	-0.03	-0.02

Conclusion

The deterioration in CEX consumption relative to NIPA is greater for luxury goods

This implies that total expenditure is greater than measured for the high-expenditure households either because they consume more (undercounted) luxuries or because their spending is undercounted

Scaling up expenditures (in case 1 and case 2) leads to modest increase in consumption inequality – still not as large as income inequality

Using NIPA data and an estimated demand system, can lead to much larger estimated movements in inequality, but as yet highly unstable for different choices of goods