Global Income Dynamics Database Project: Argentina

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Income dynamics in a developing country: Argentina

Part I: Income Inequality and Income Dynamics

- Drop in inequality after 2002 devaluation
- Decade-long decline in dispersion of earnings changes
- Stable mobility patterns over time

Part I+: Data Validation and Formal vs. Informal Sectors

- Comparing first and second moments of levels and dynamics

Part II: Wage Setting under Low and High Inflation

- Changes in "regular wages" under different inflation regimes:
  - Frequency of positive changes increases with inflation
  - Low ($< 10\%$ p.a.) inflation: strongly asymmetric changes
  - High (10–40% p.a.) inflation: almost symmetric changes
- Heterogeneity in frequency of wage changes

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Data Sources

▸ Comparison

1. Sistema Integrado Previsional Argentino (SIPA)
   - Matched employer-employee monthly panel data
   - Covers all formal workers (private and public in national govt')
   - Period: 1996–2017
   - Data on 4.5 million people per year
   - Key variables: worker ID, gender, age, job start and end month, monthly earnings

2. Encuesta Permanente de Hogares (EPH)
   - Labor force survey rotating panel data
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Sample Selection

- Ages 25–55
- Earnings include salary, bonus, vacation, 13th salary
  - No top-coding in SIPA
  - Censored earnings in EPH labor force survey data
- Compute total annual earnings, y_{it}, for person i in year t
- Drop observations with incomes below threshold

$$y_{it} \leq \frac{1}{2} \times 48 \frac{\text{hours}}{\text{week}} \times 4.3 \frac{\text{weeks}}{\text{month}} \times 3\text{months} \times \text{National MW}_t$$

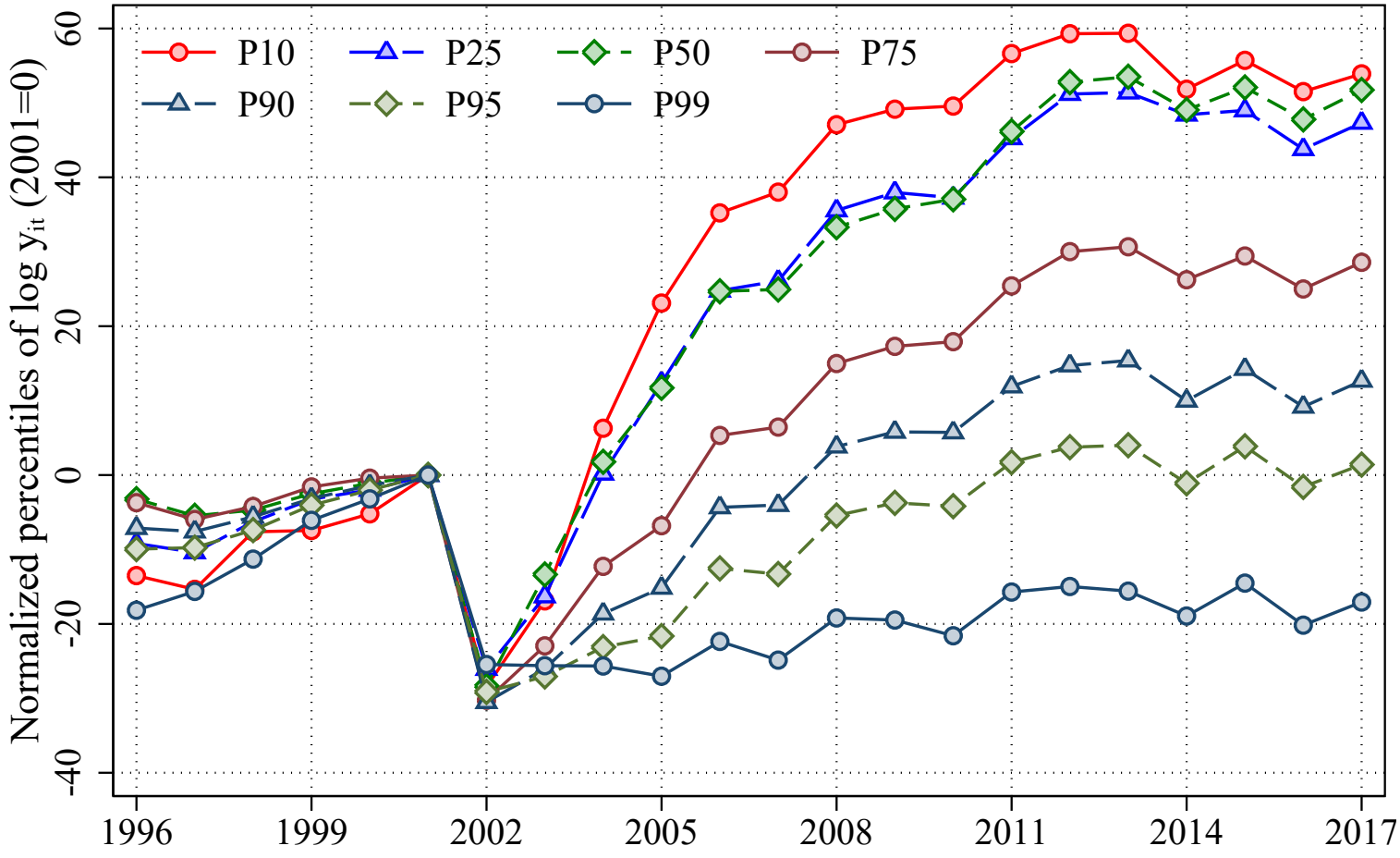
Part I.A:

Inequality and Concentration

Normalized Log Earnings Percentiles

▸ Permanent ▸ Residual

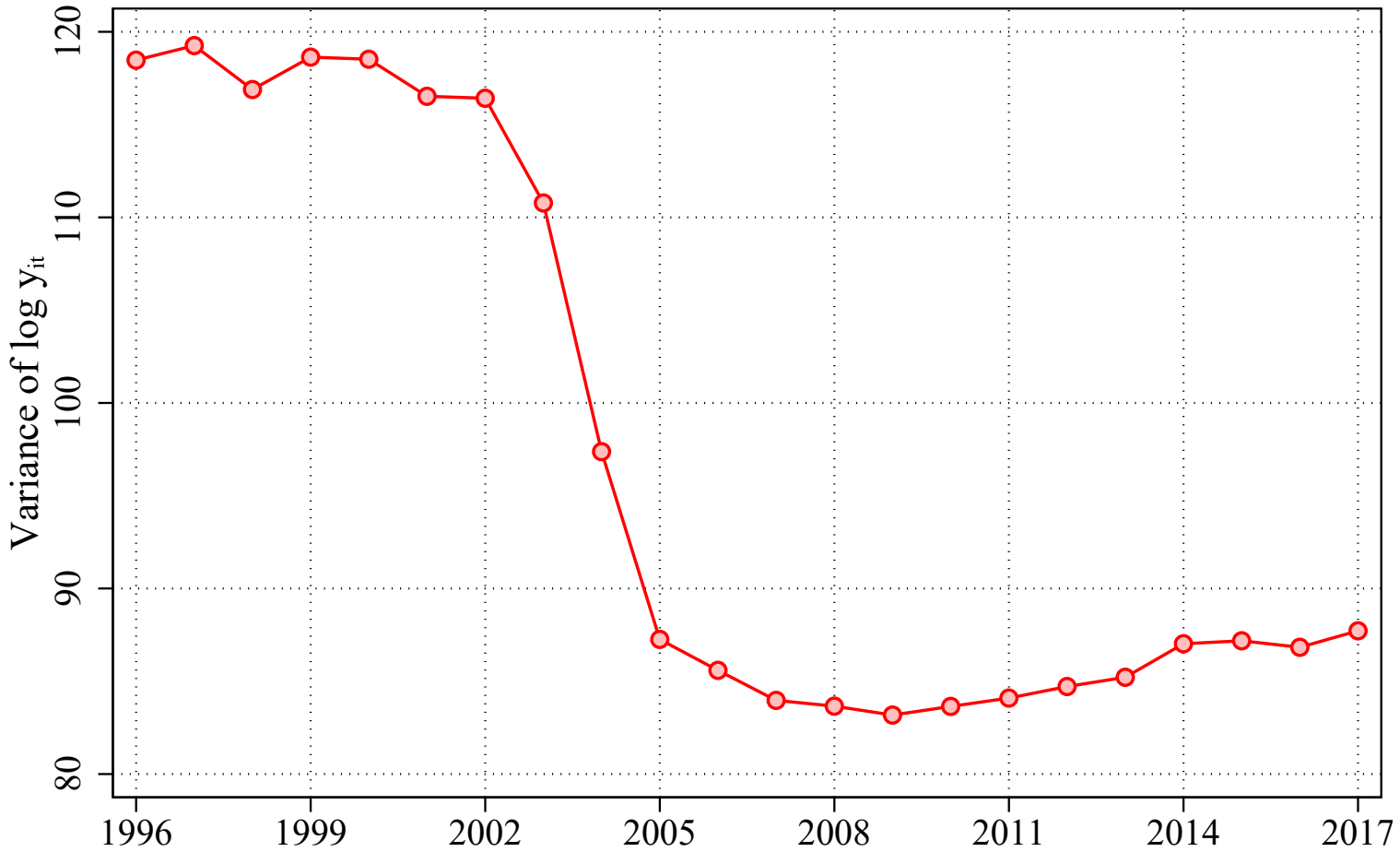
- Qualitatively, all percentiles track business cycle
  - 25% drop during 2002 devaluation and economic crisis
  - Rapid bottom-driven growth after 2002 devaluation



Variance of Log Earnings

Permanent Residual

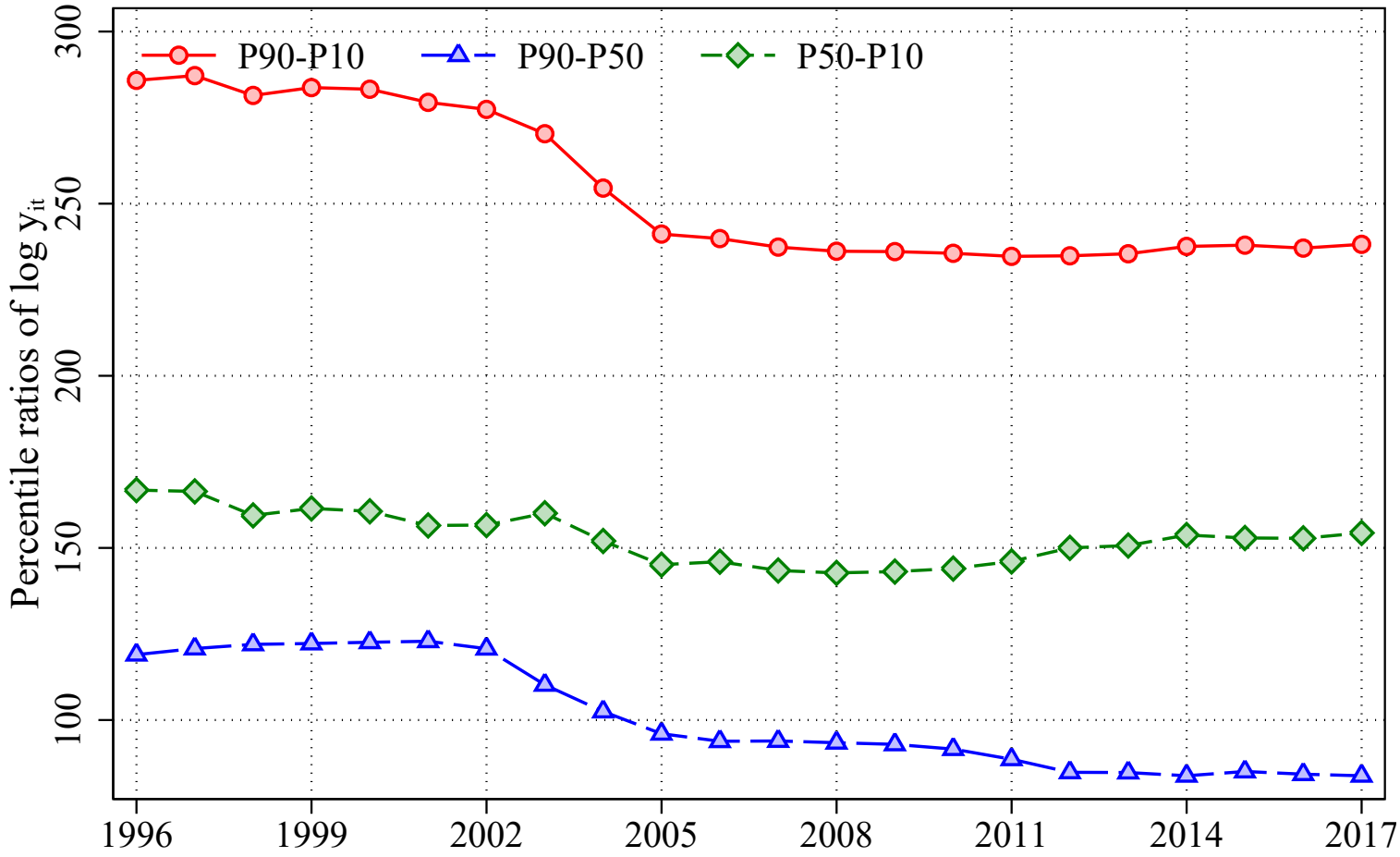
- Compression of income distribution coinciding with 2002 devaluation (Blanco, Drenik and Zaratiegui, '20)



Log Earnings Percentile Ratios

Permanent Residual

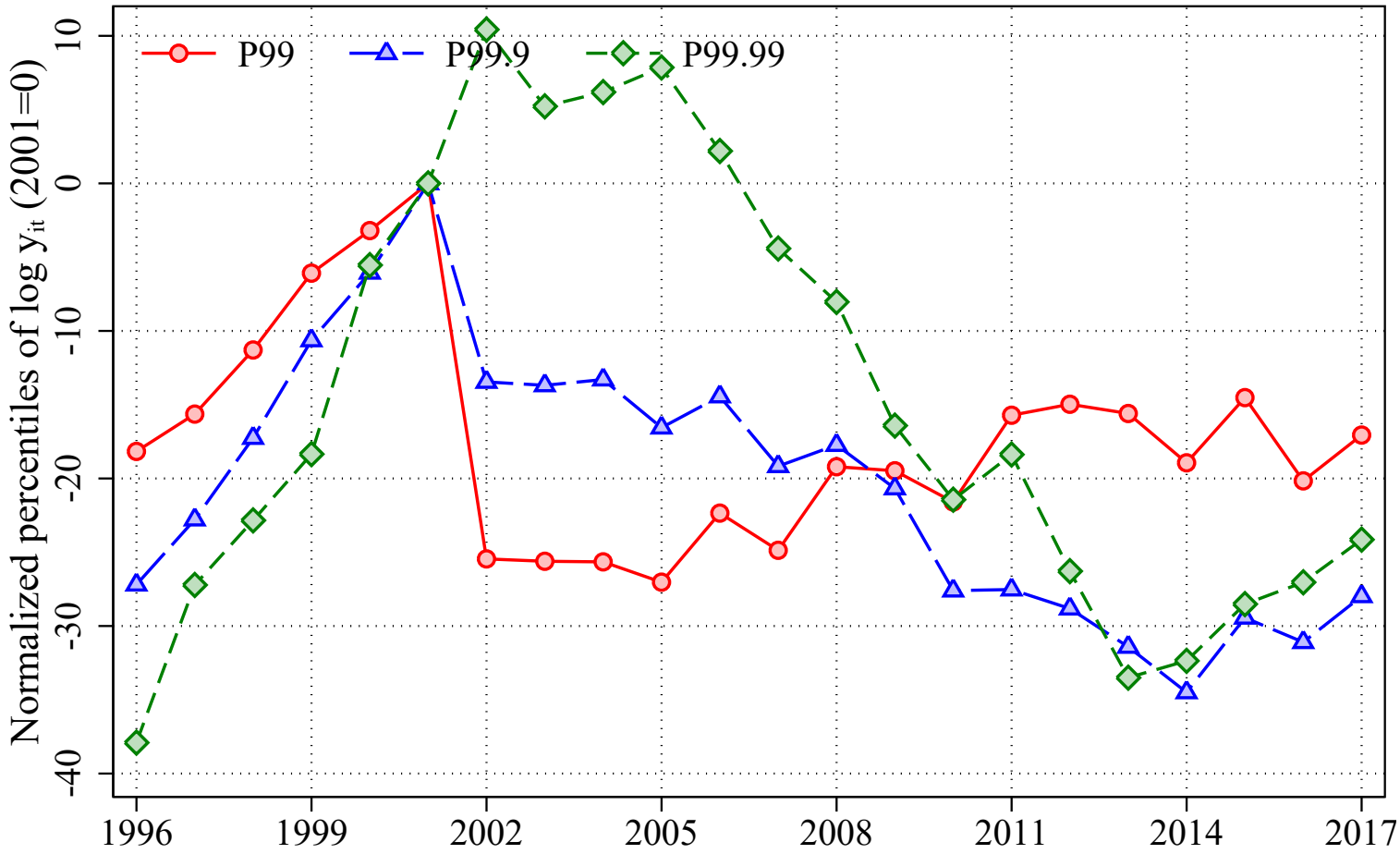
- Qualitatively, decline in overall inequality (P90-P10) due to decline in both bottom-inequality (P50-P10) and top-inequality (P90-P50)
- Quantitatively, driven especially by decline of P90-P50



Top Log Earnings Percentiles

▸ Permanent ▸ Residual ▸ Pareto Tail ▸ Gomez '19

- After 2002: Slow growth or decline in top incomes

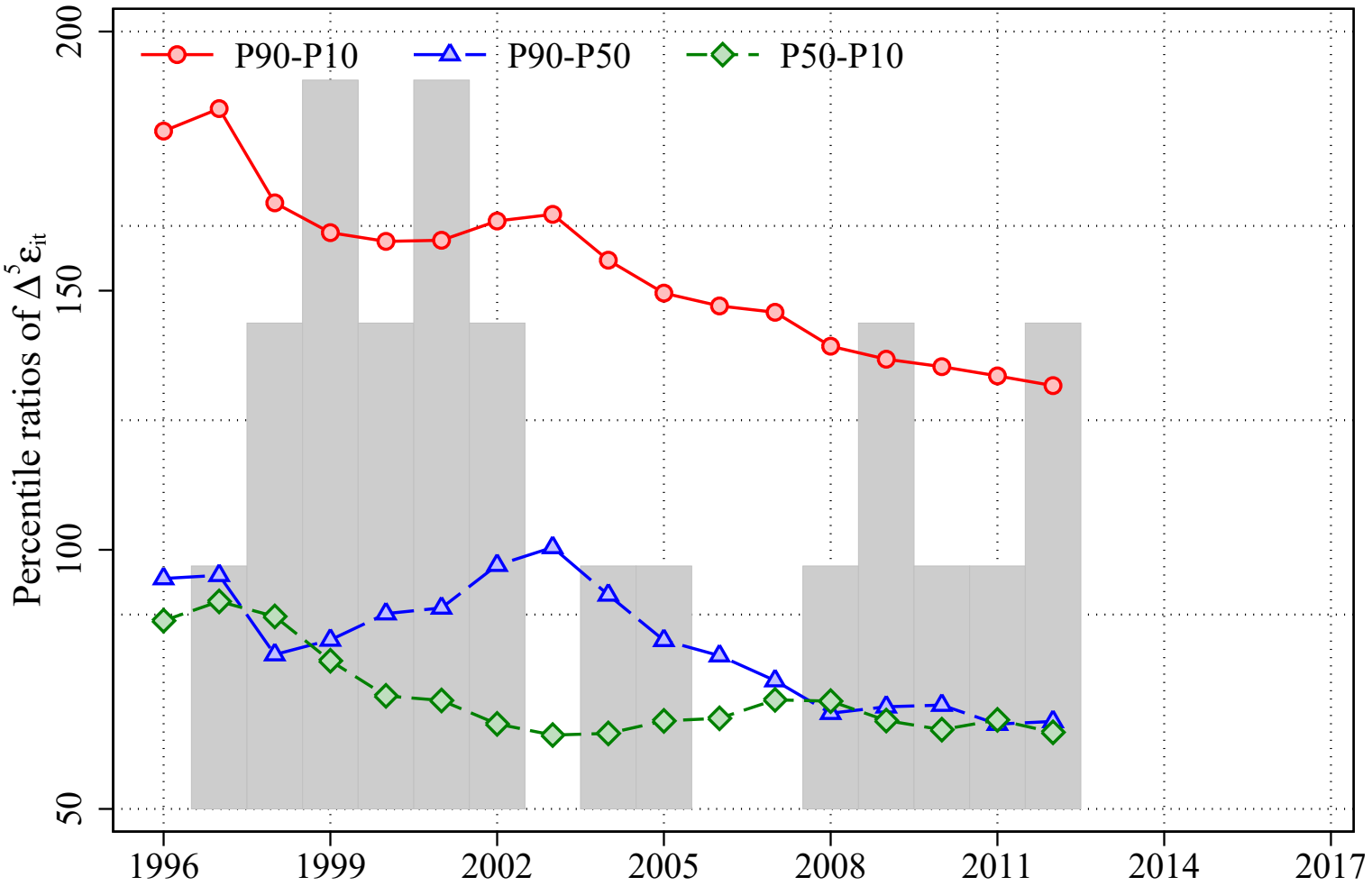


Part I.B:
Volatility and Higher-Order Moments

Log Perc. Ratios of 5-Year Resid. Earnings Change

Short-Term

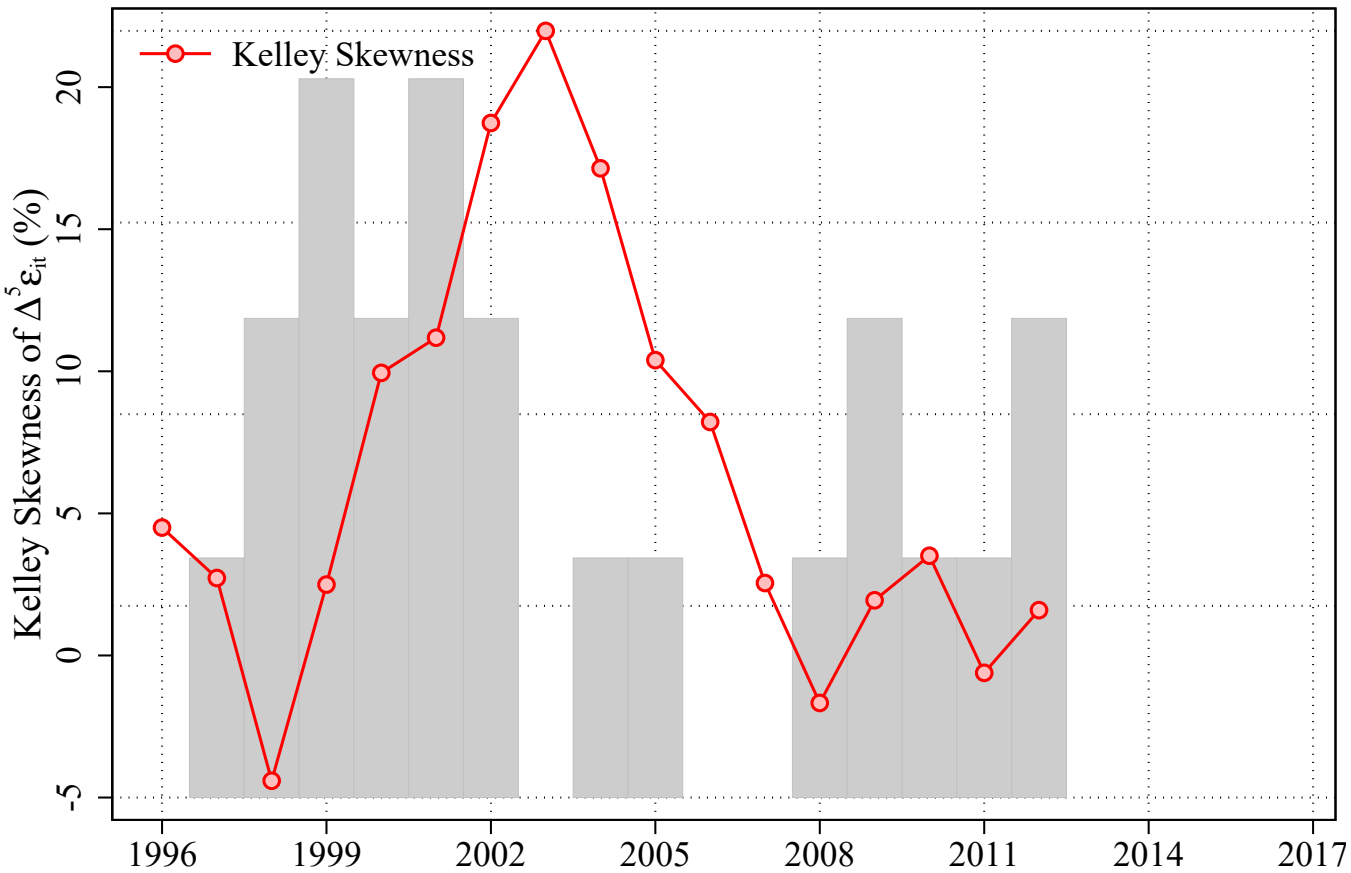
- Secular decline in income risk (P90-P10) from 1996–2012
- Counteracted by temporary increase in P90-P50 around 2002



Skewness of 5-Y. Resid. Earnings Change

▸ Short-Term ▸ Comparison

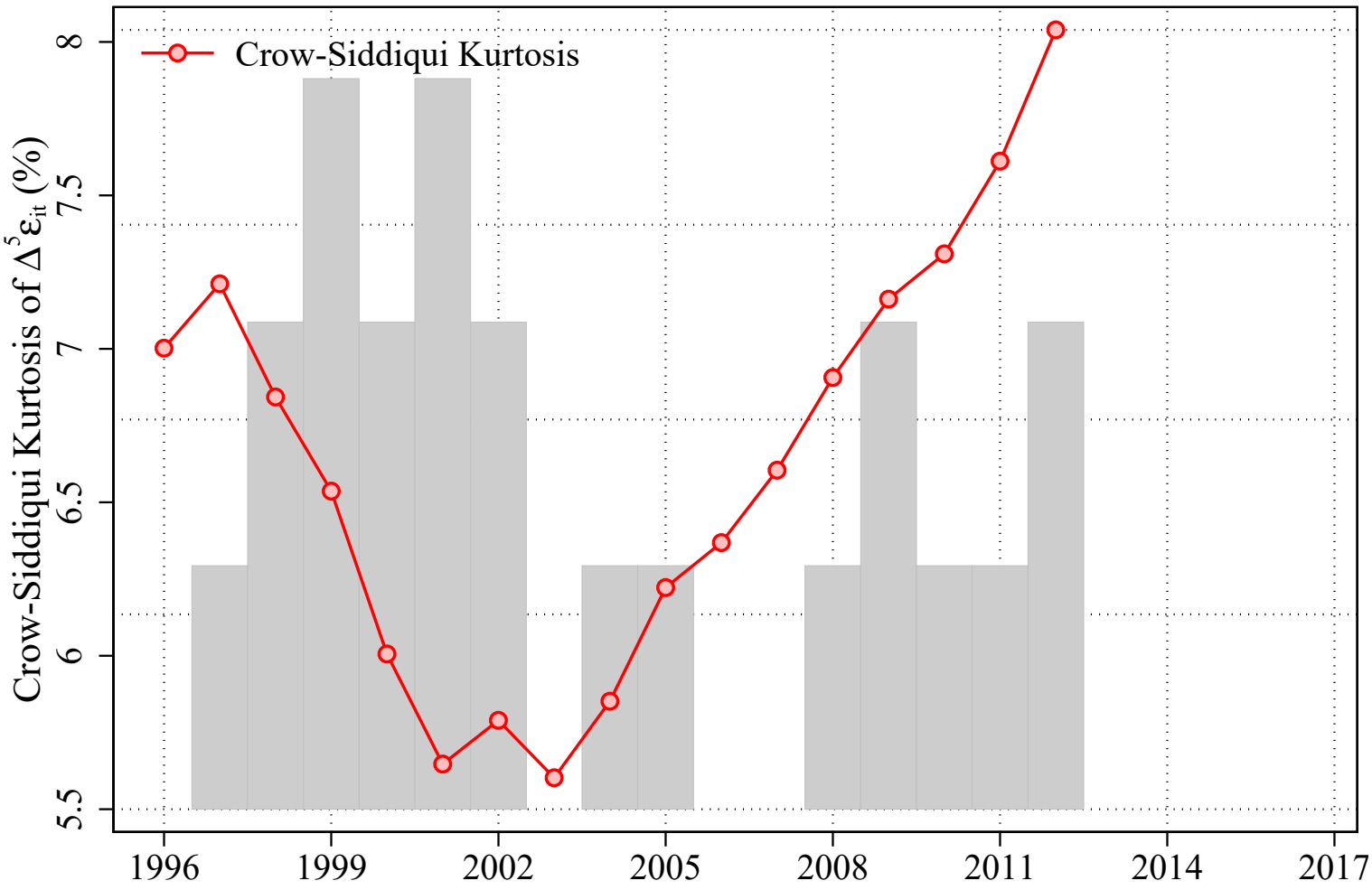
- Overall, countercyclical skewness (increases during recessions)



Kurtosis of 5-Y. Resid. Earnings Change

Short-Term Comparison

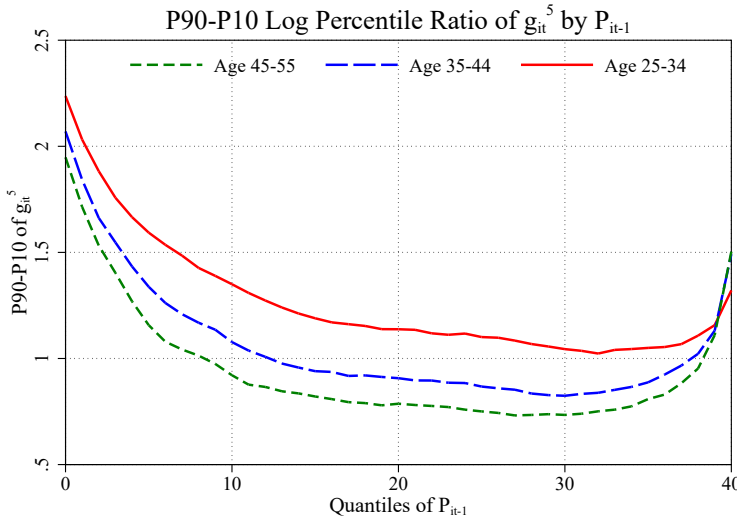
- Decline during 2001 recession, sharp reversal after 2002 devaluation

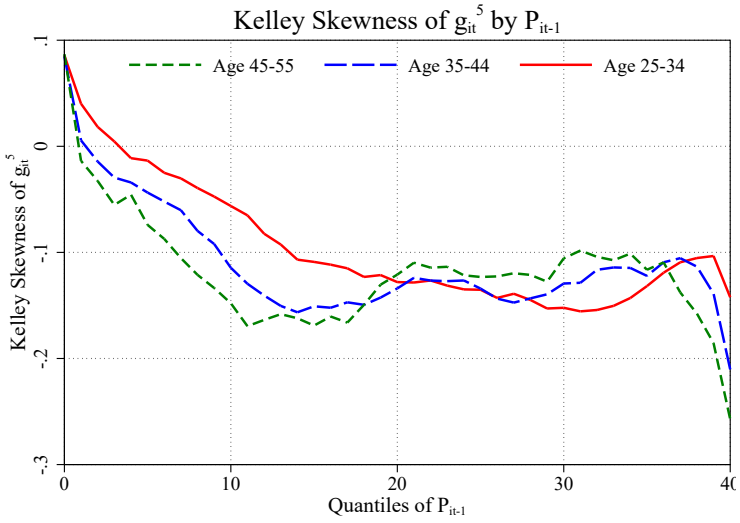


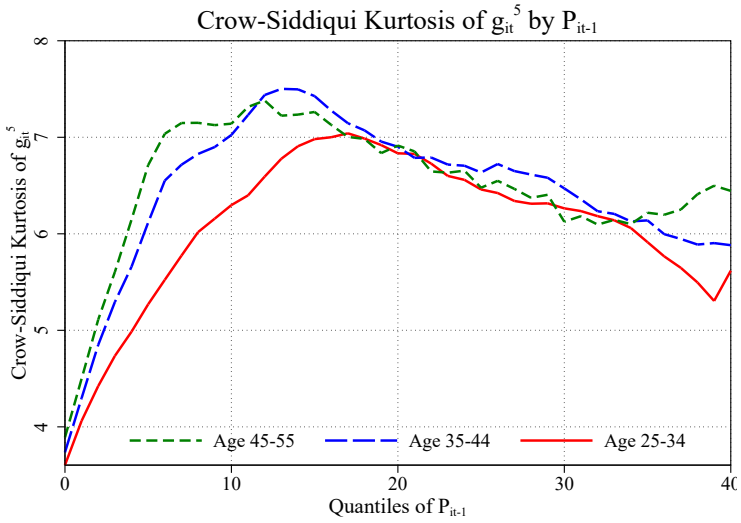
5-Y. Res. Earnings Changes, by Age & Perm. Inc.

Short-Term

- Volatility: decreasing in age & U-shape in permanent inc.







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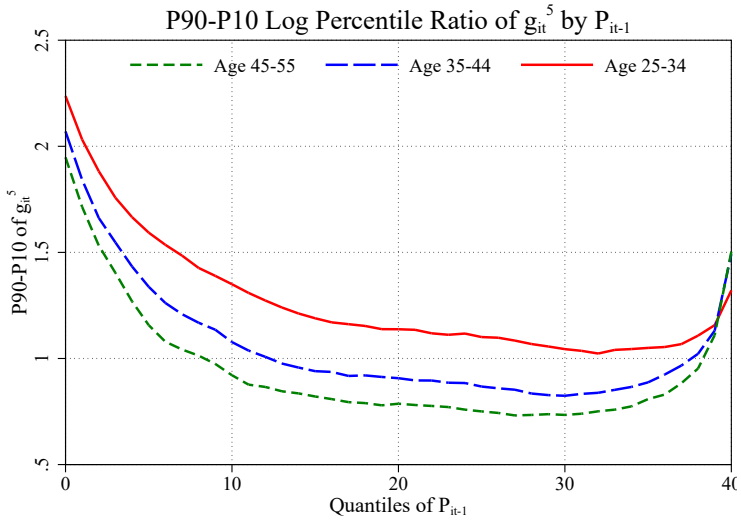
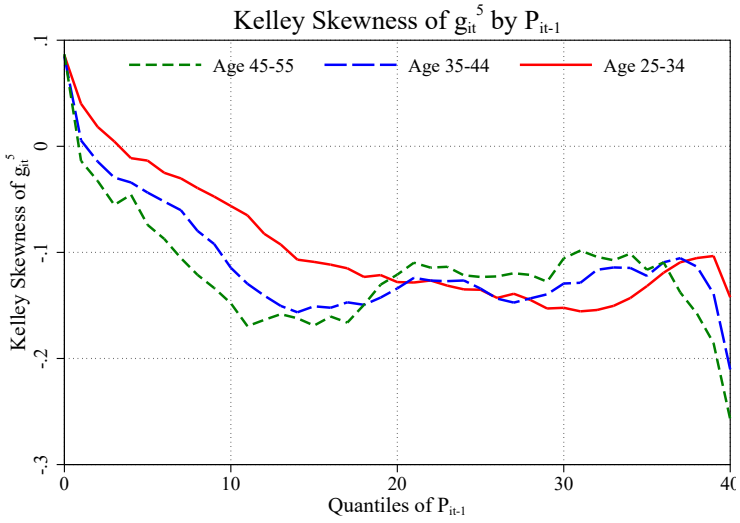
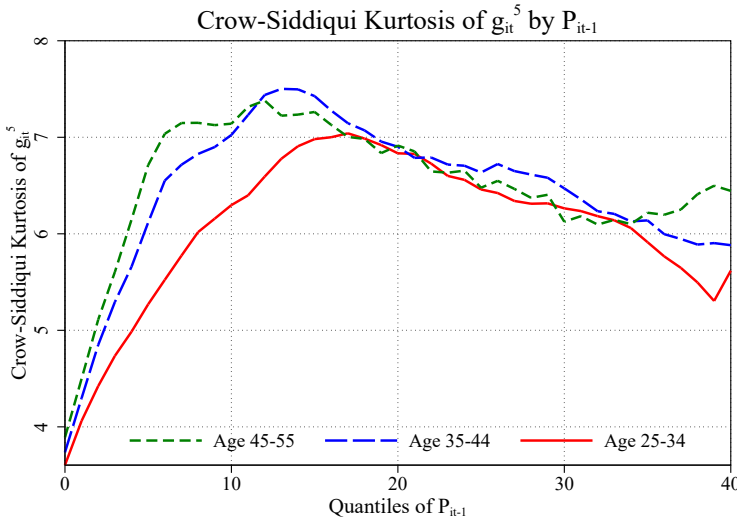
Short-Term

- Kelley skewness: decreasing in permanent income







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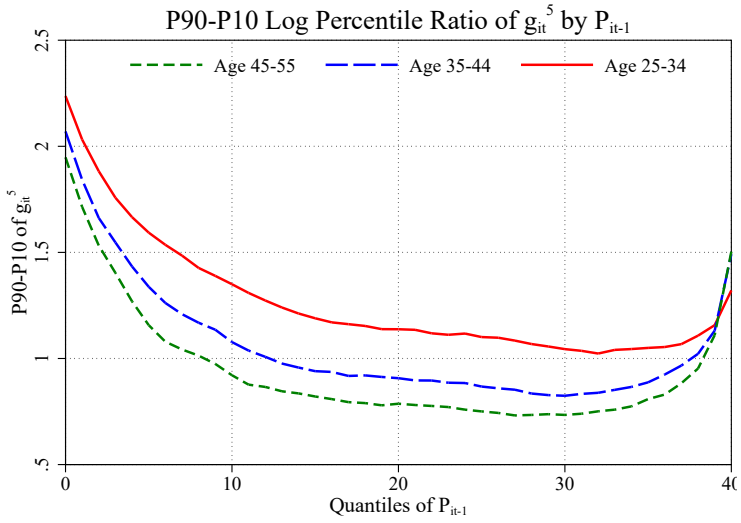
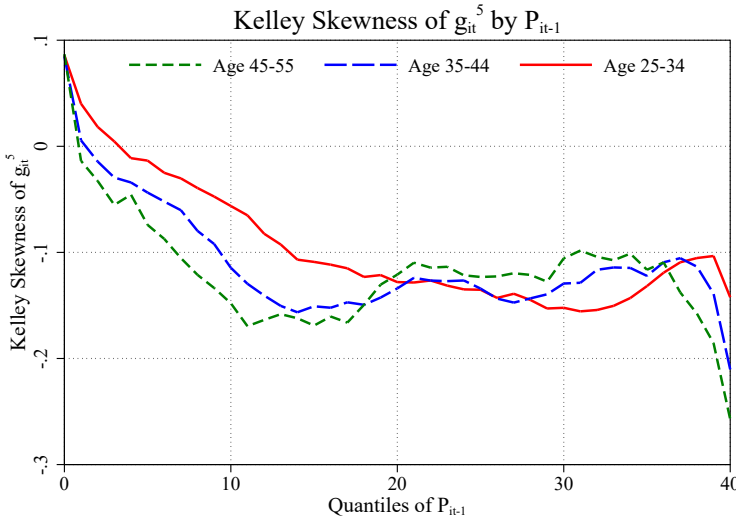
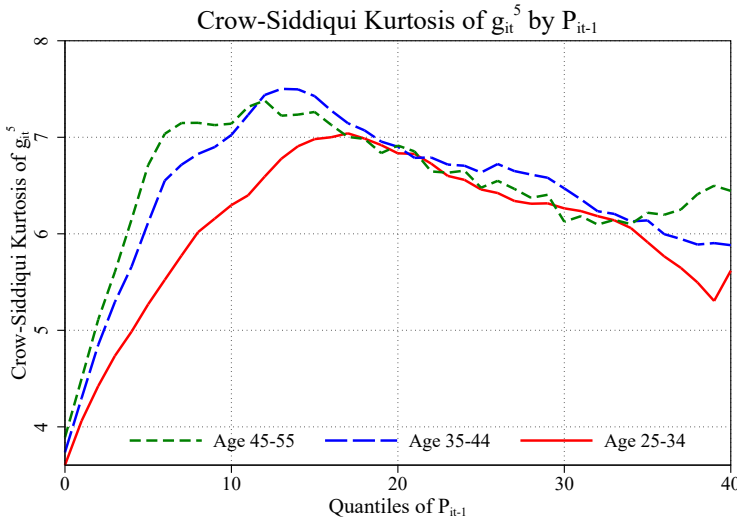
Short-Term

- Crow-Siddiqui kurtosis: inverted U-shape in permanent income





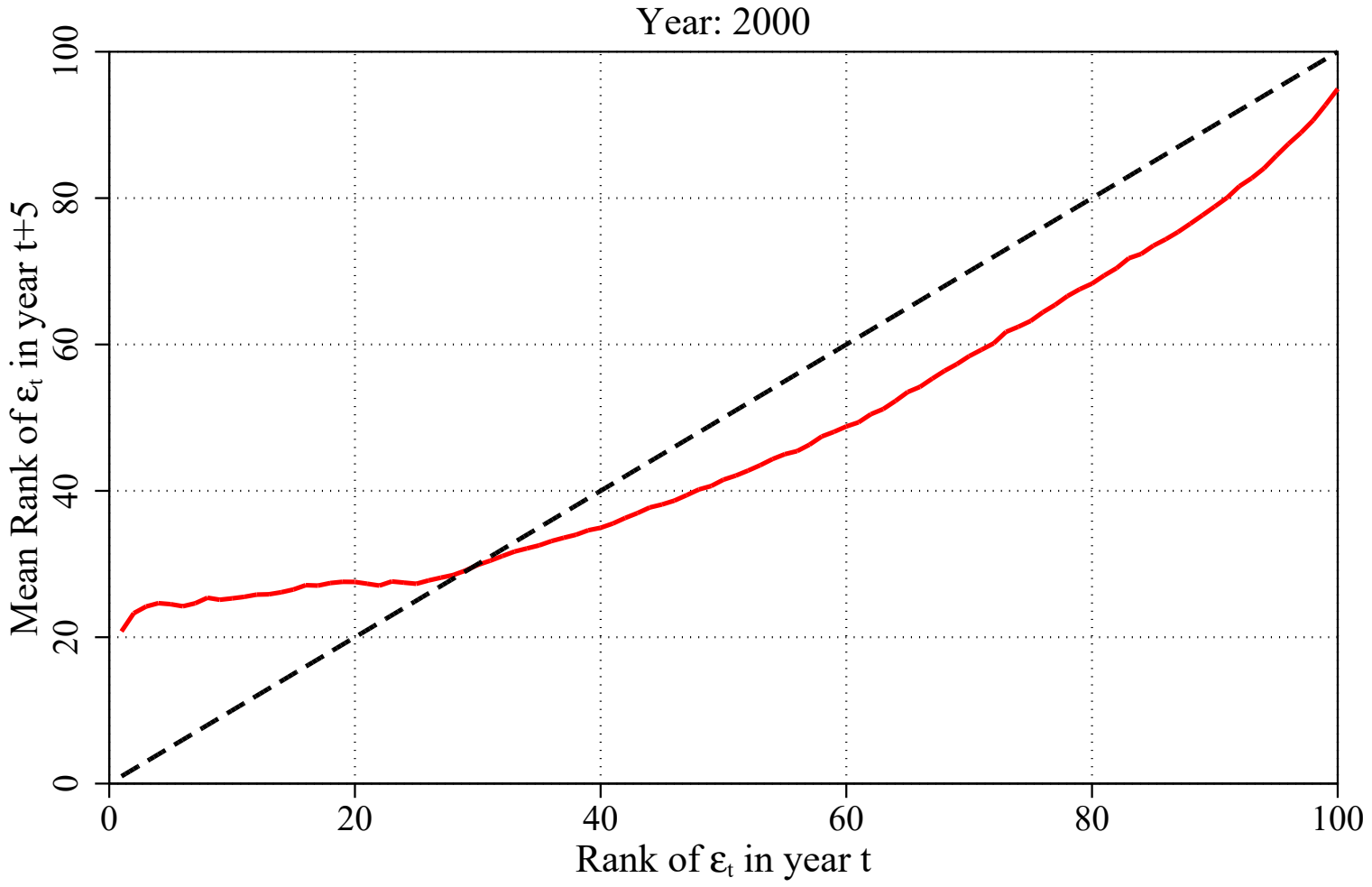


Part I.C: Mobility

Long-Term Mobility in Resid. Inc., 2000

▸ More Years ▸ Short-Term

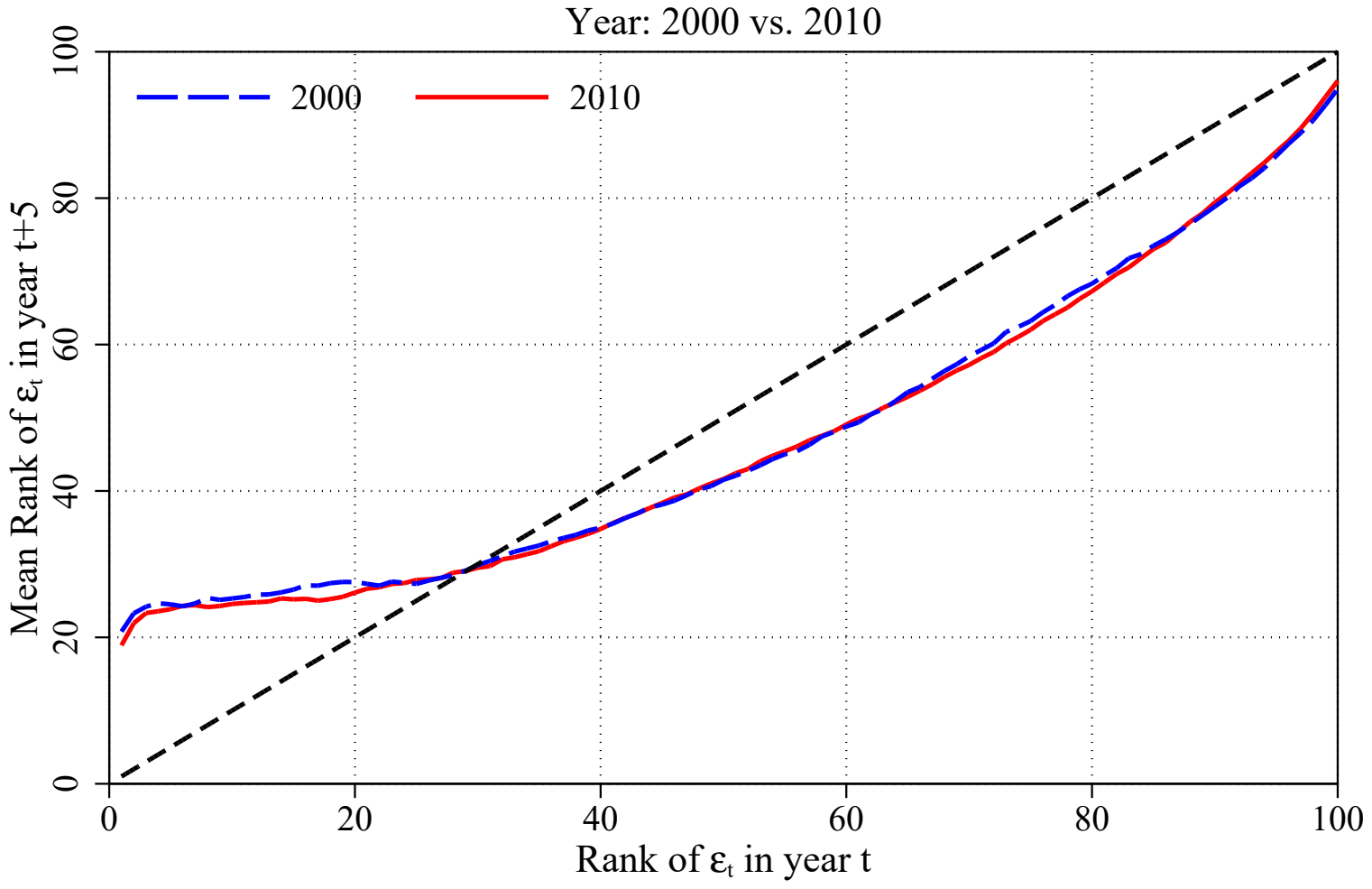
- Upward (downward) mobility below (above) 30th percentile



Long-Term Mobility in Res. Inc., 2000 vs. 2010

Short-Term

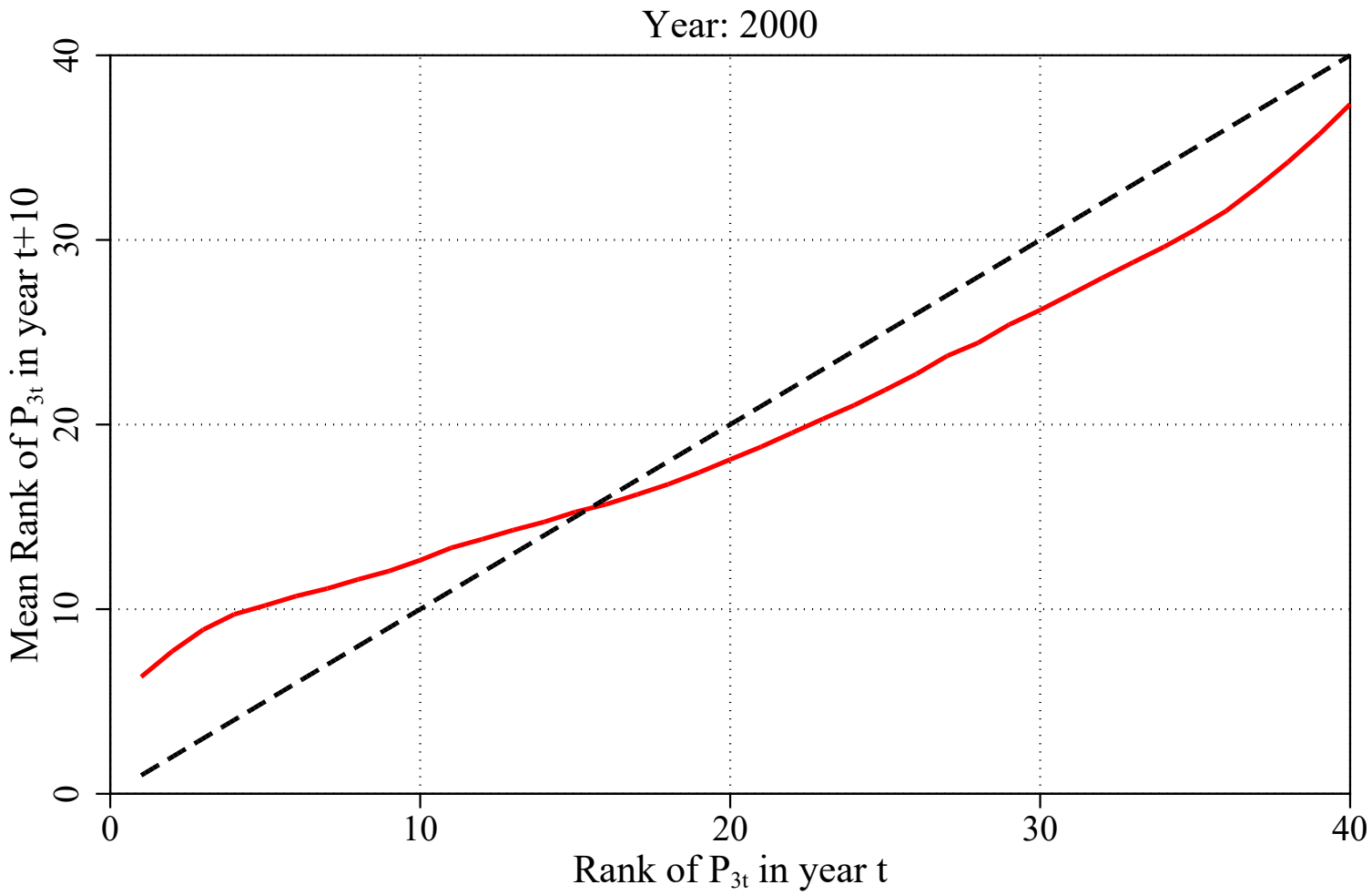
- Stable mobility patterns over time



Permanent Mobility in Resid. Inc., 2000

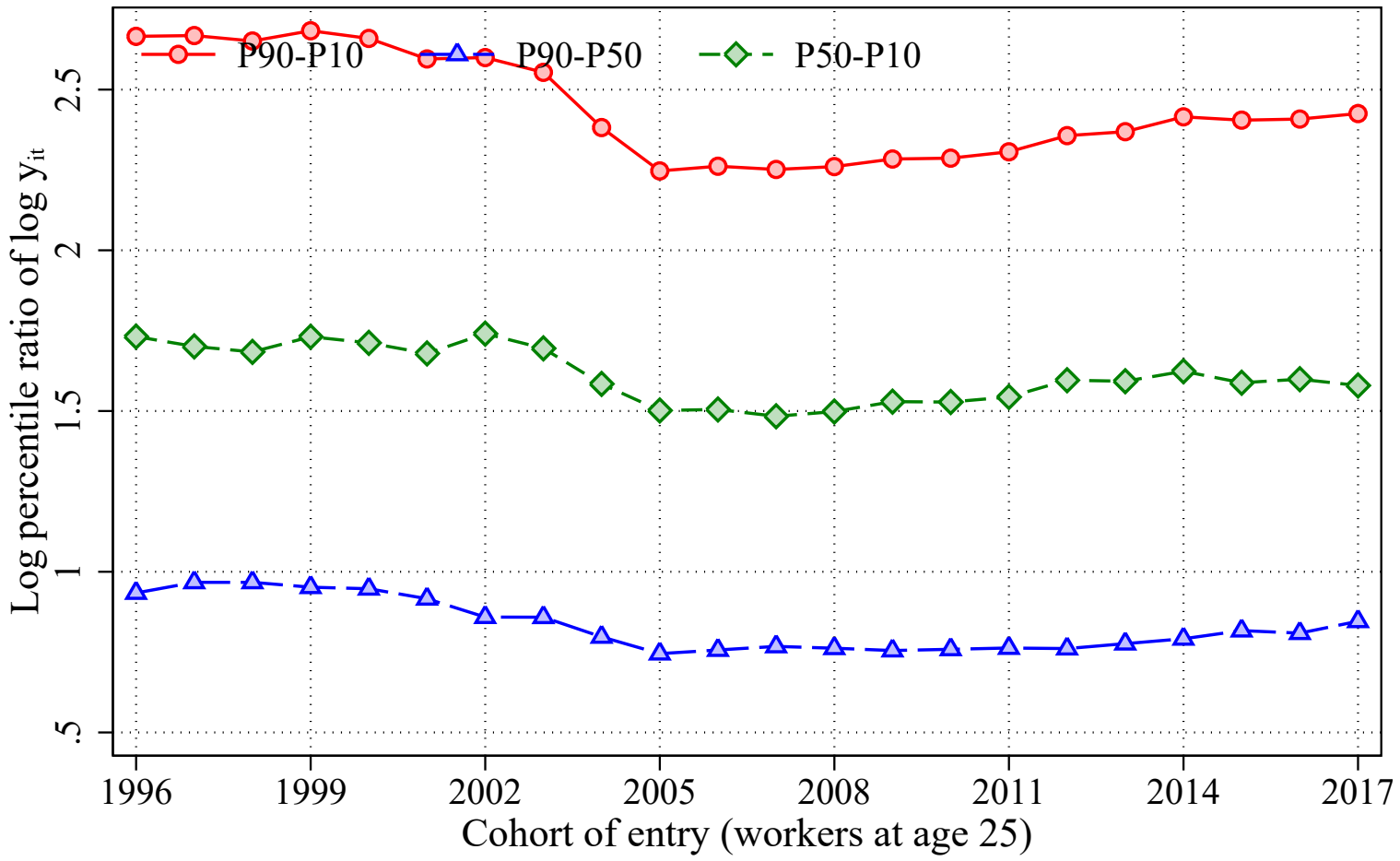
▸ More Years ▸ More Lengths

- Long-term mean reversion around percentile 40 ($= 16 \times \frac{100}{40}$)



Inequality at Age 25 by Cohort

- Qualitatively, compression in top & bottom of income distrib'n
- Quantitatively, similar contributions toward P90-P10 ratio



Part I+:

Data Validation

and

Formal vs. Informal Sectors

Road Map for Part I+

1. Administrative vs. Household Survey Data
2. Formal vs. Informal Sectors

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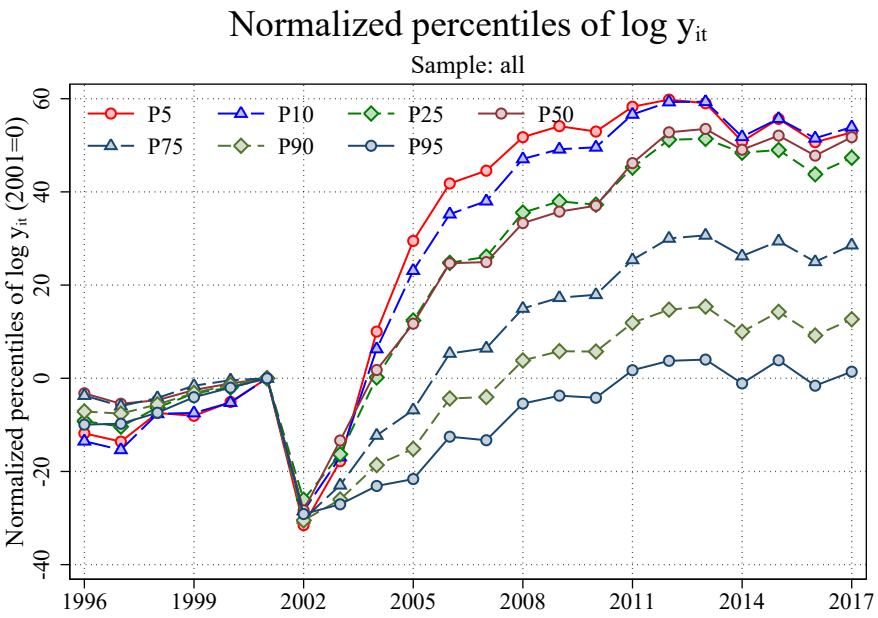
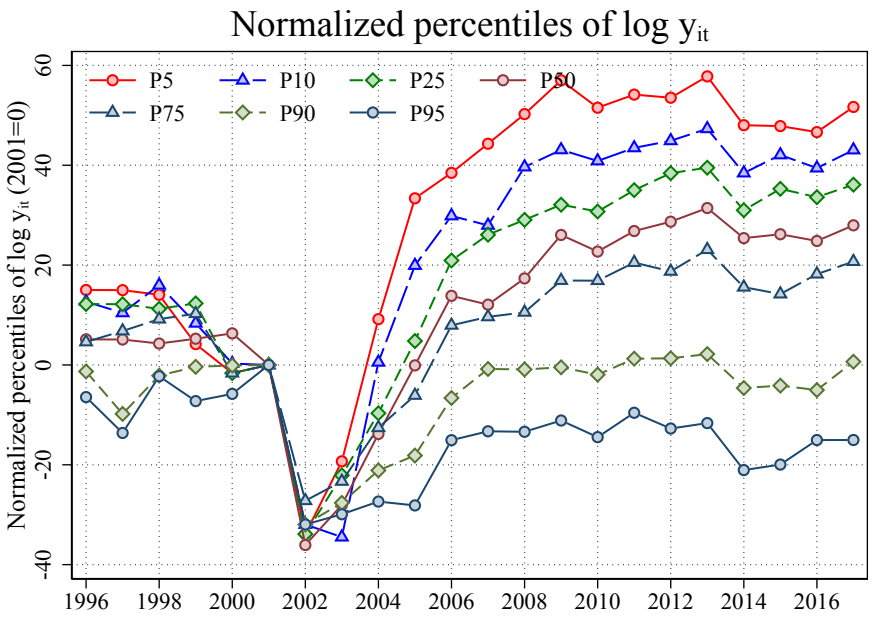
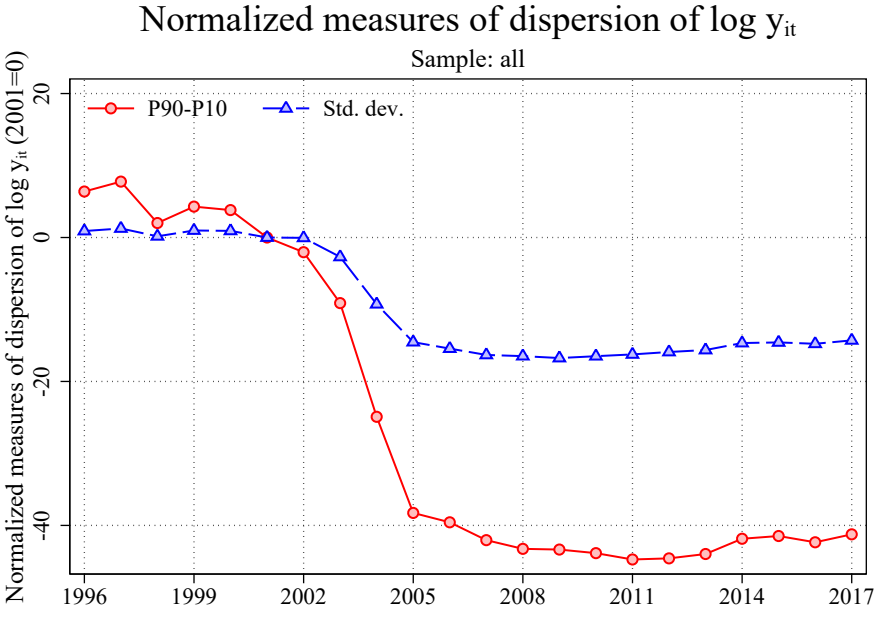
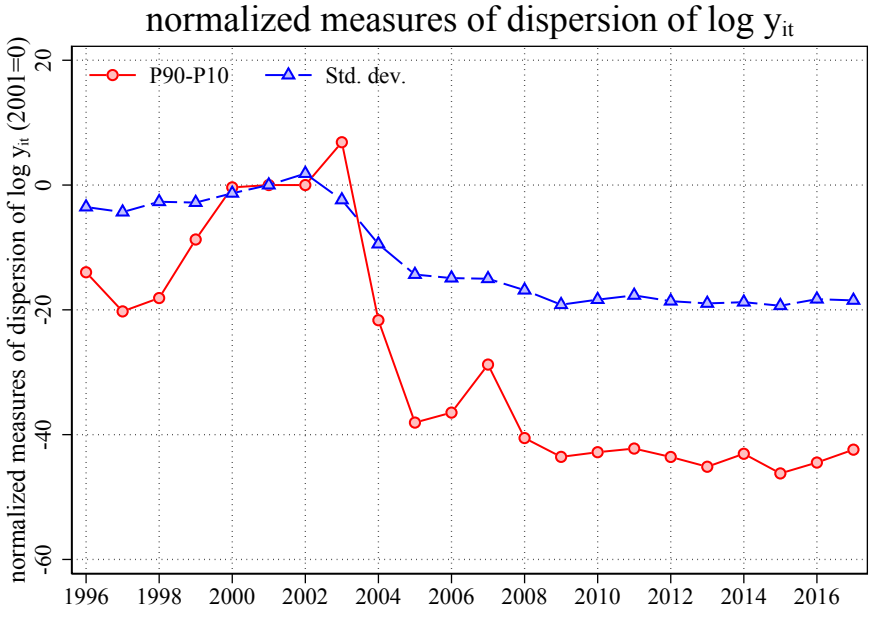
Inequality in Administrative vs. HH Survey Data

▸ w/o norm.









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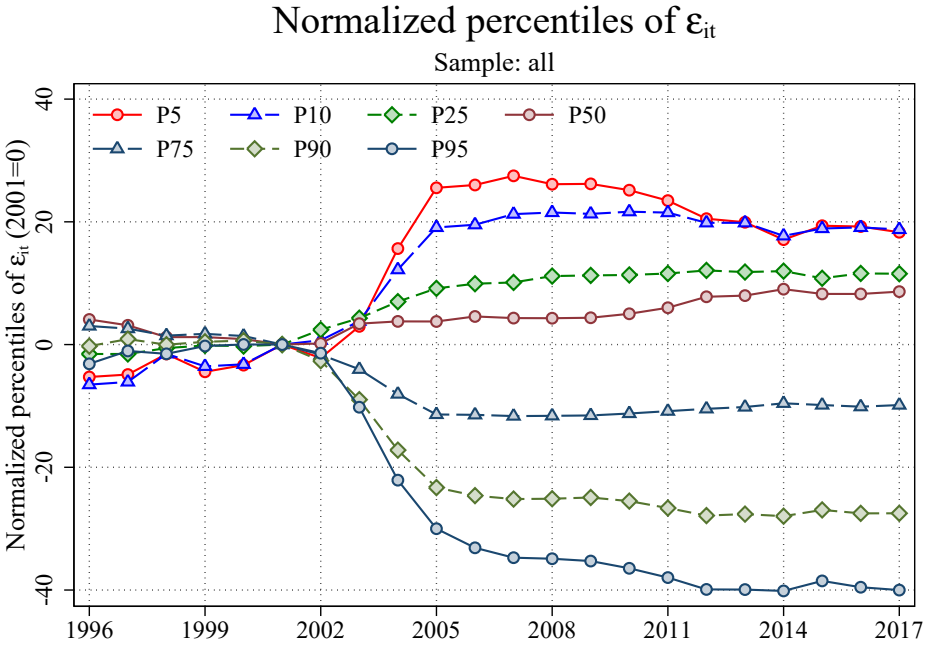

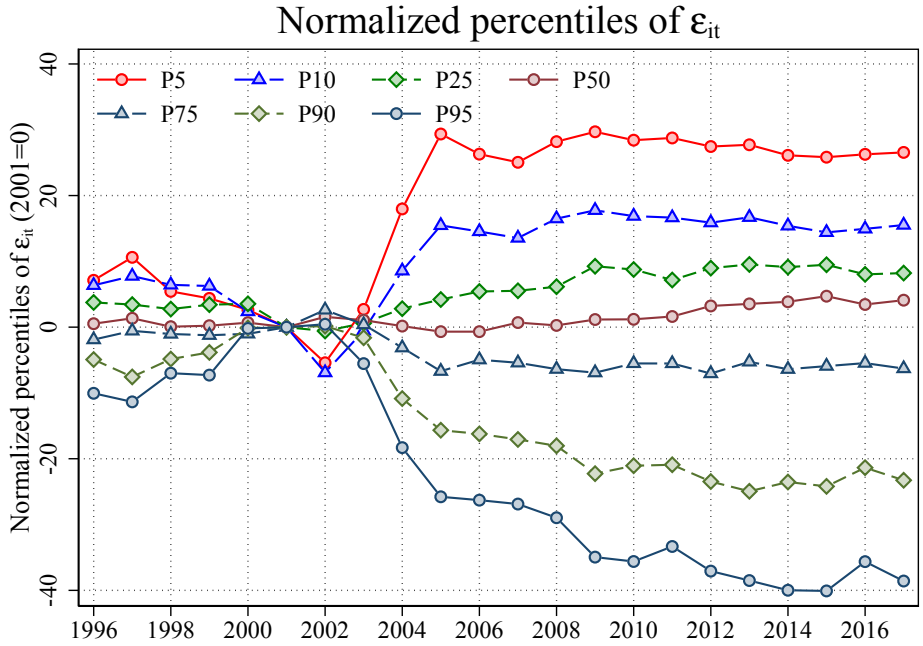

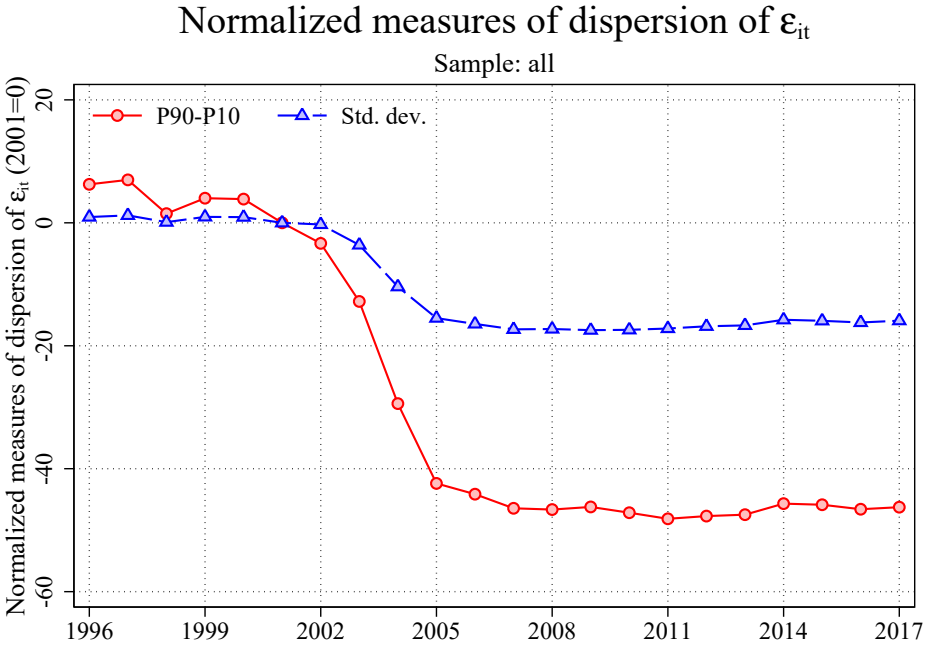

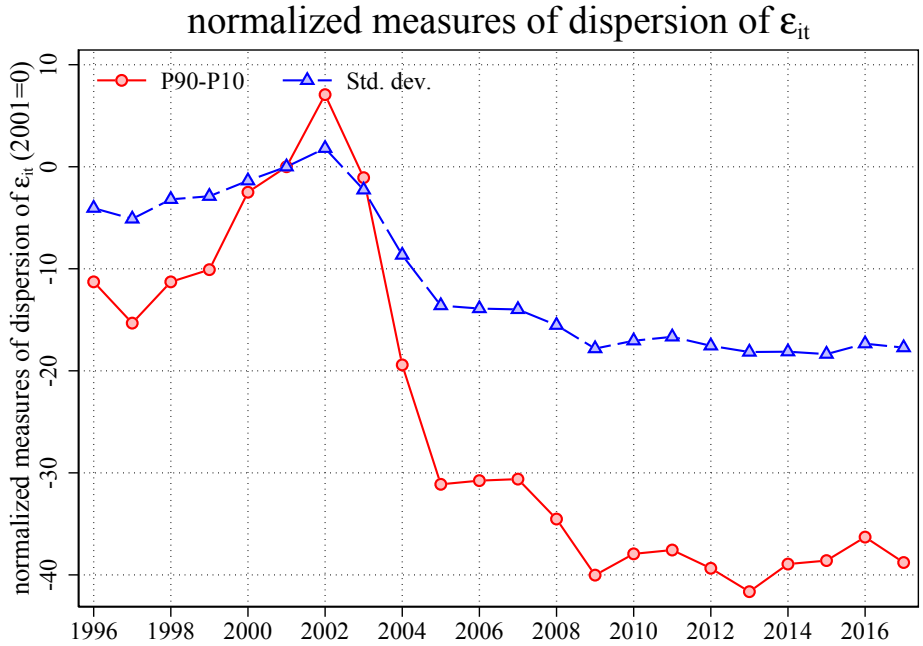

Dynamics in Administrative vs. HH Survey Data

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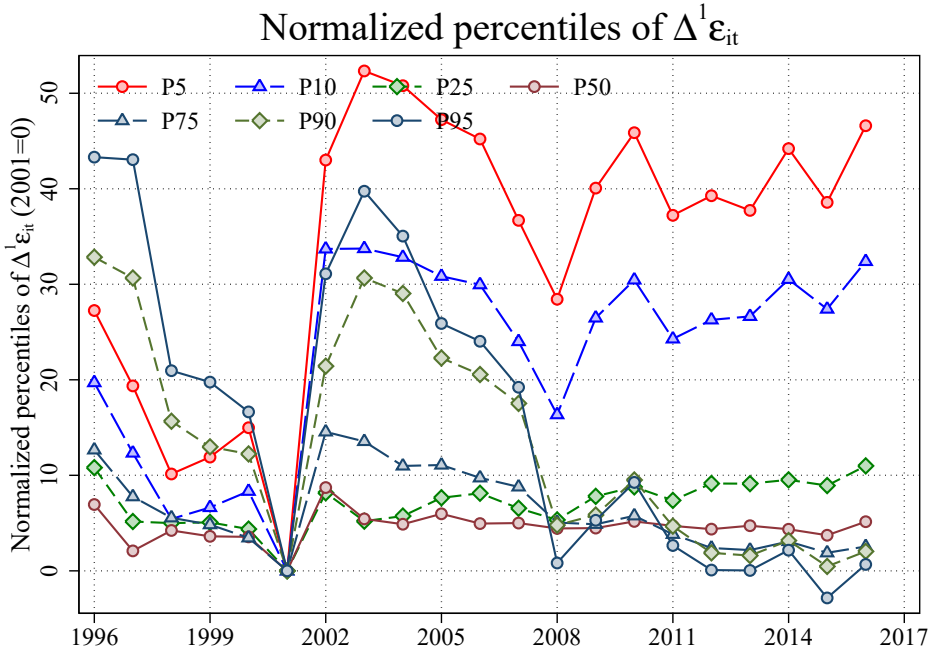

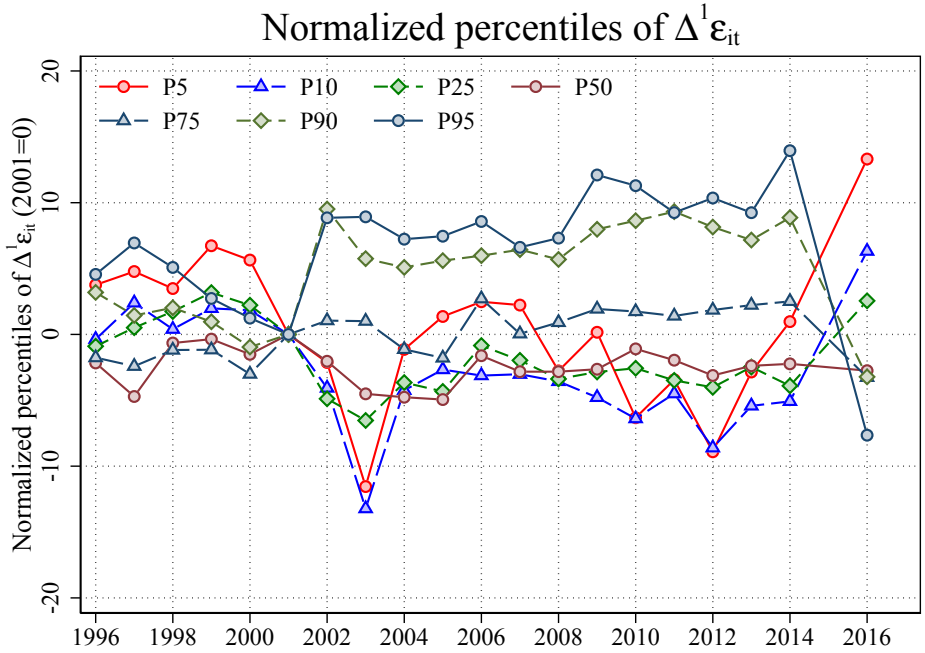

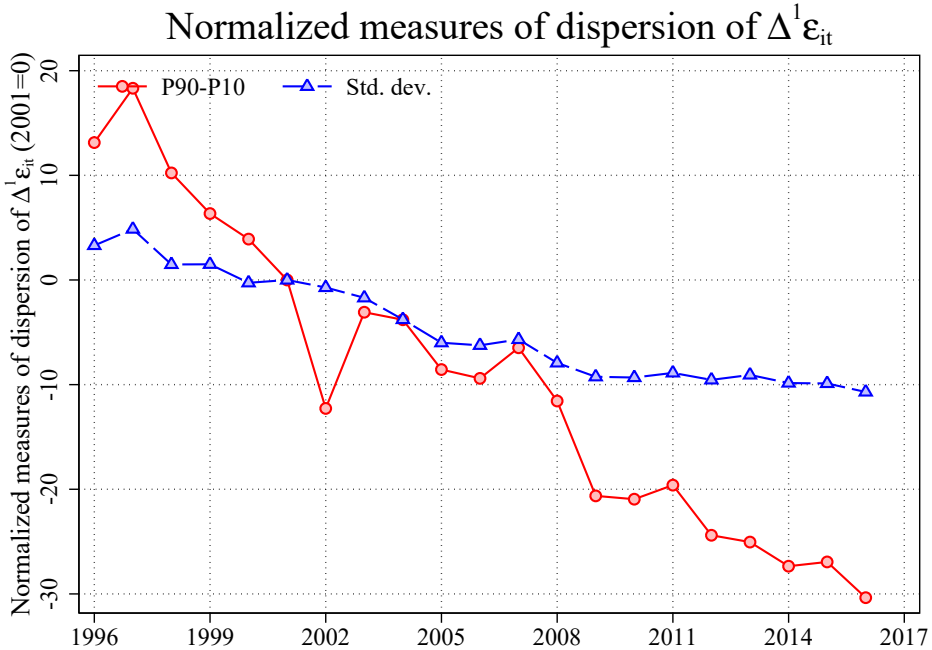

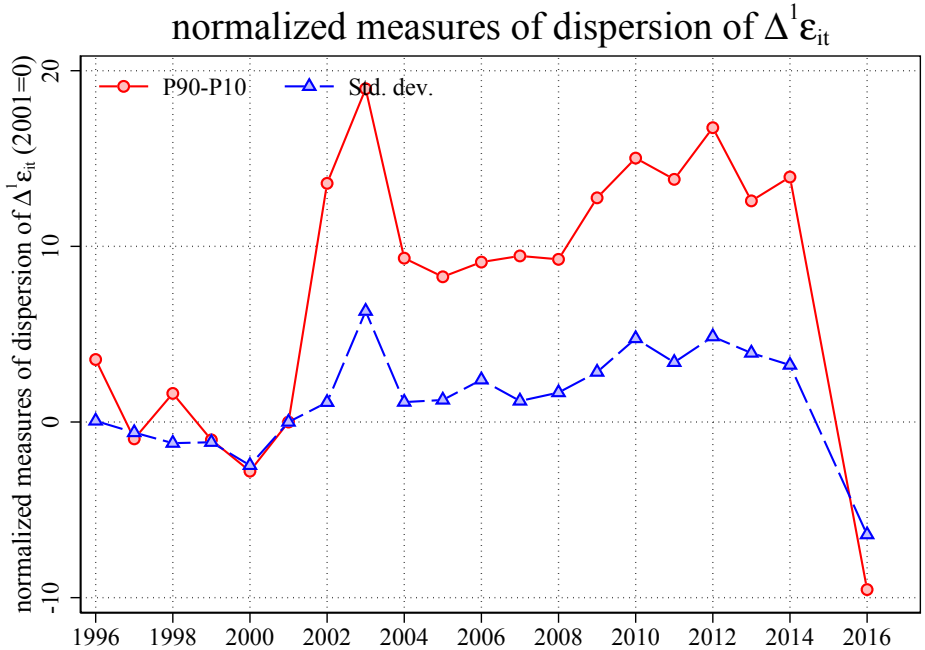

Road Map for Part I+

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Inequality in Formal vs. Informal Sectors

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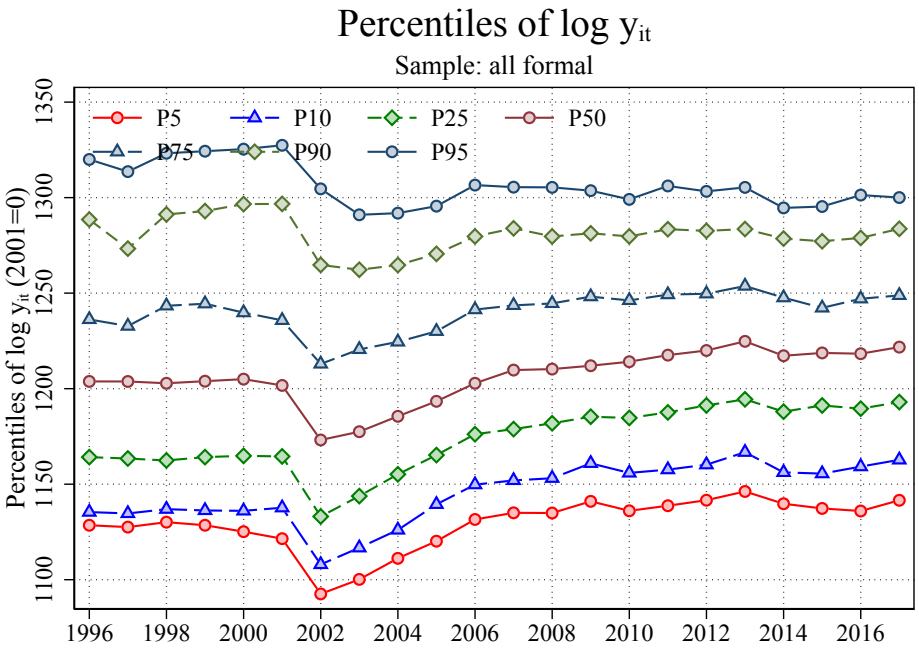

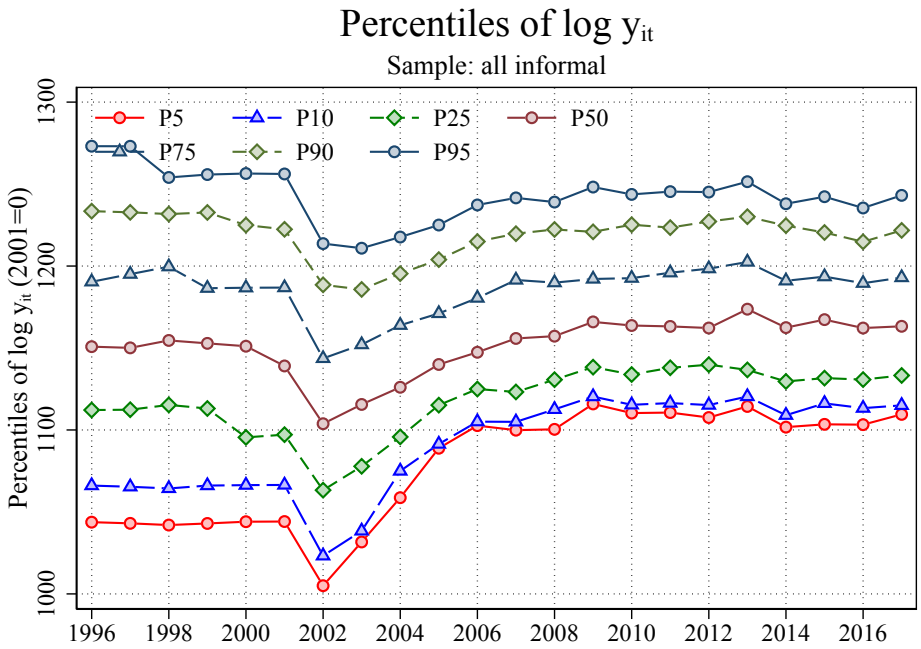

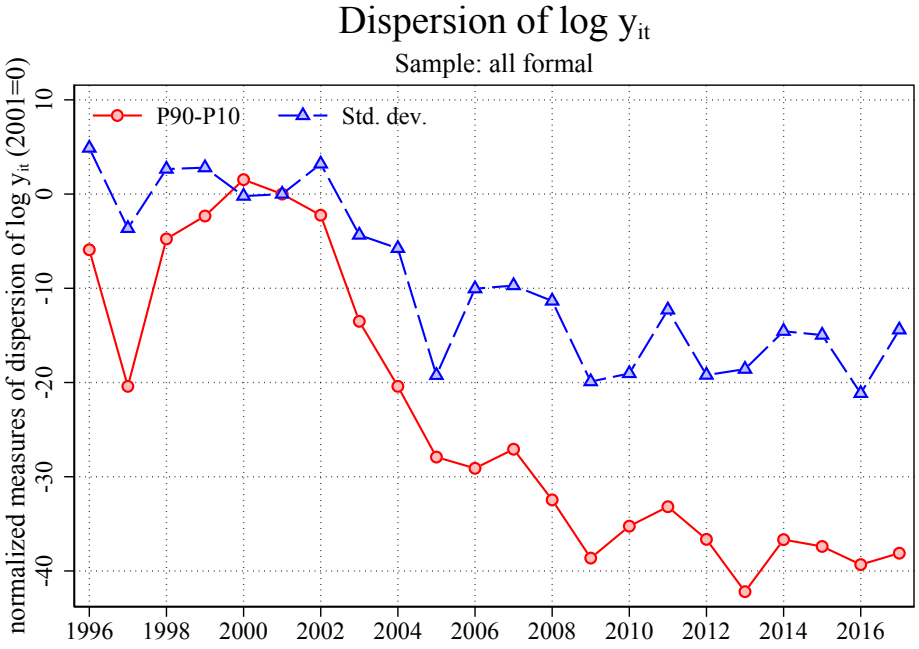

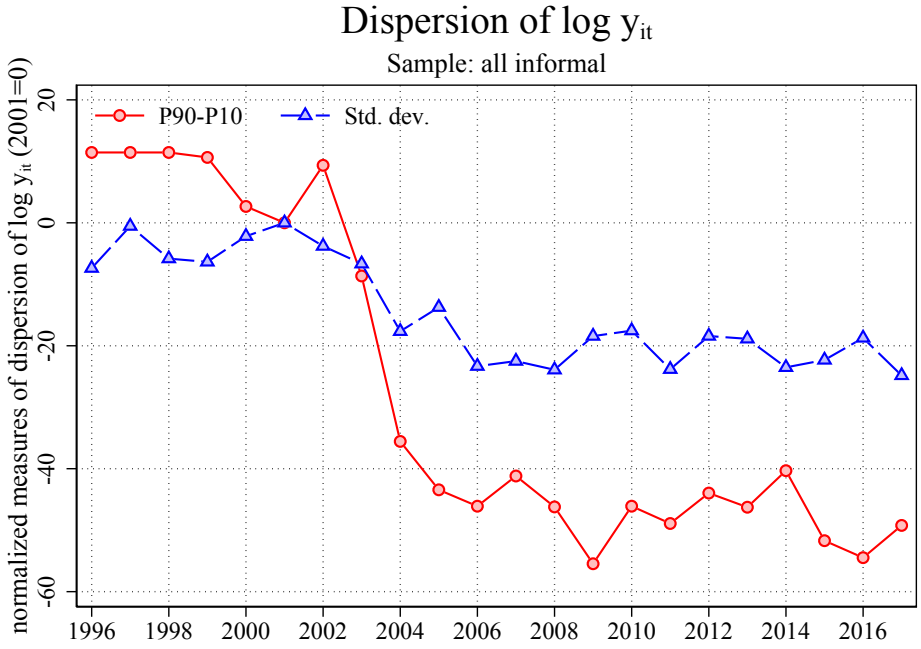

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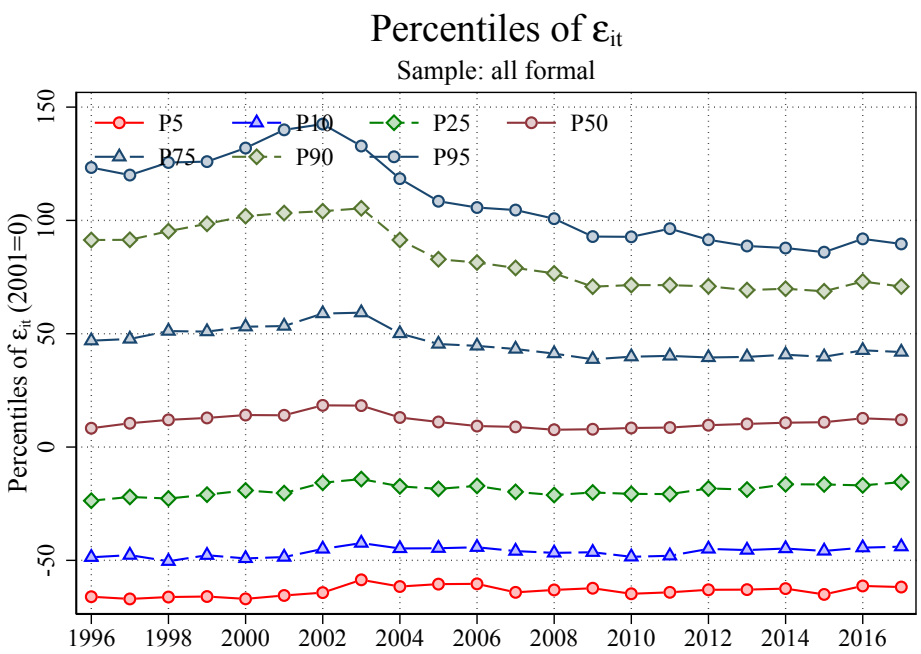
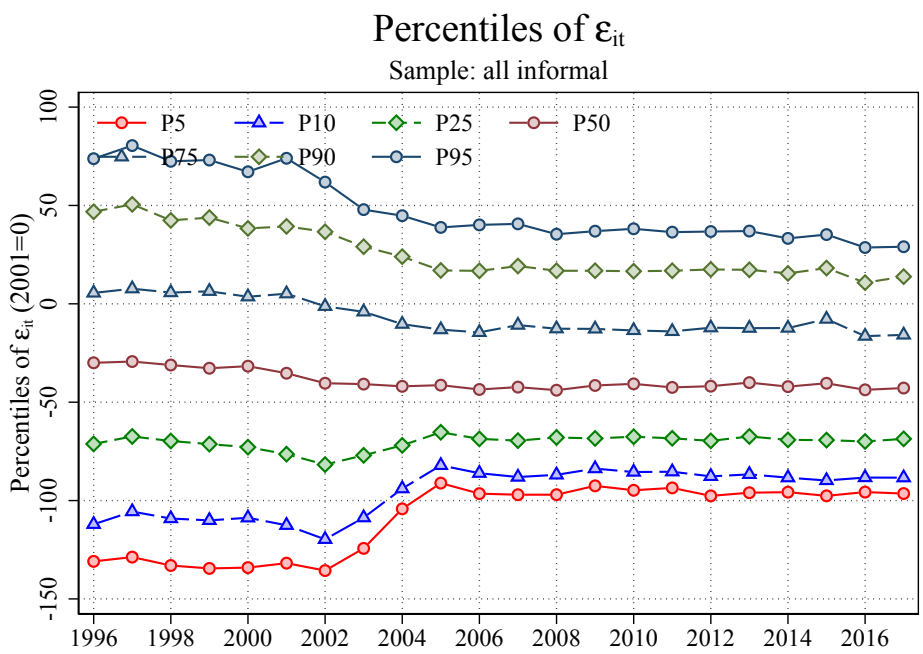
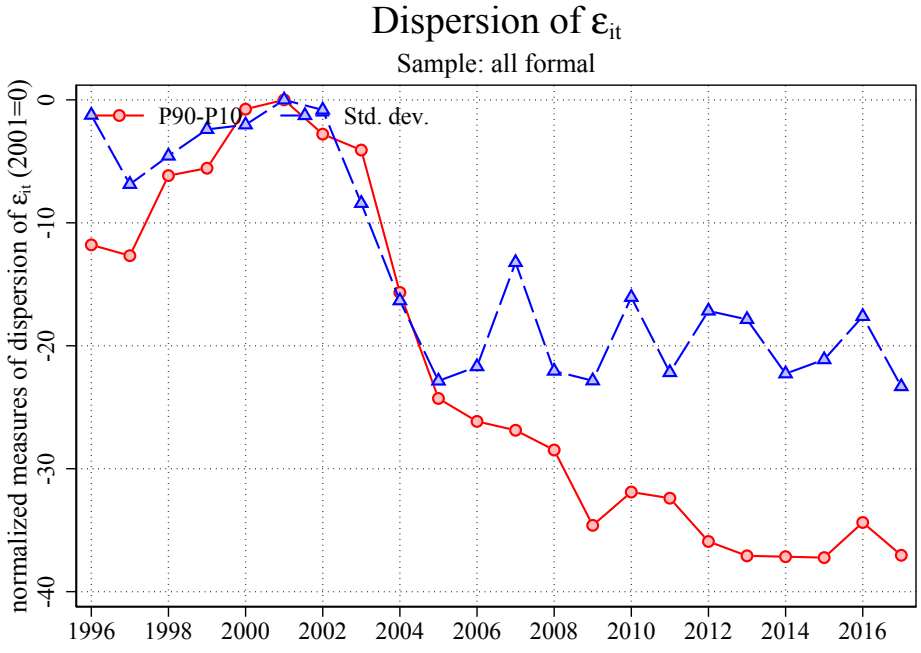
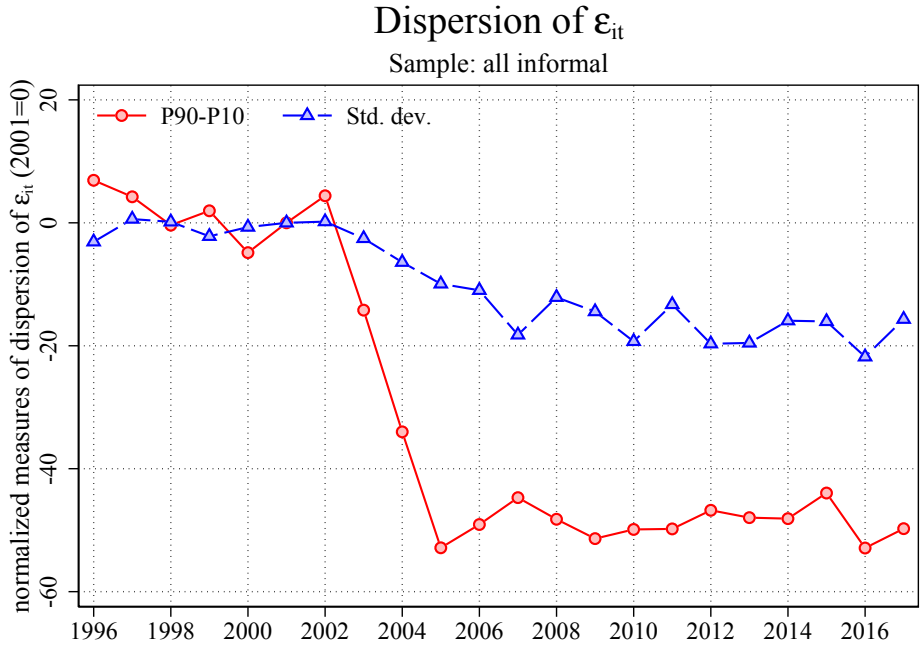


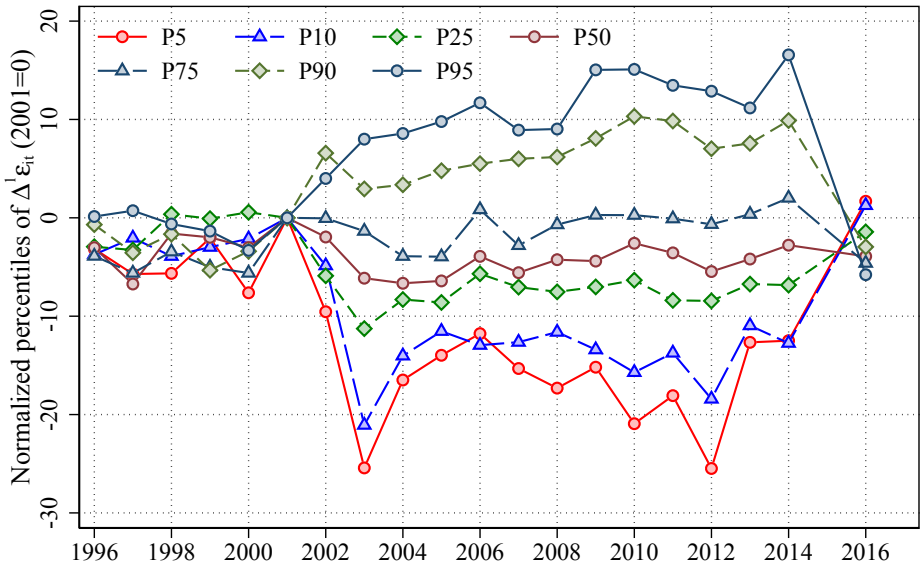


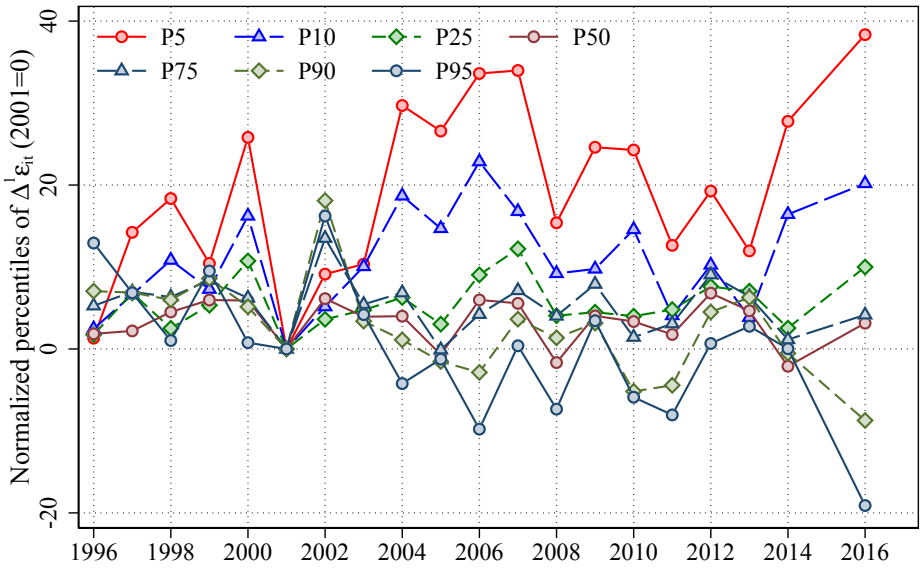


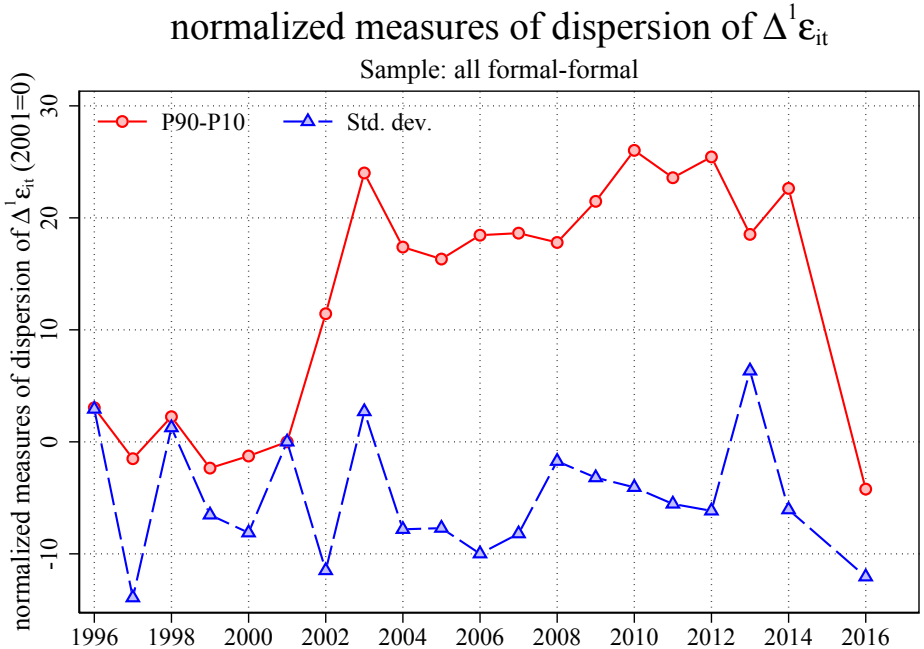


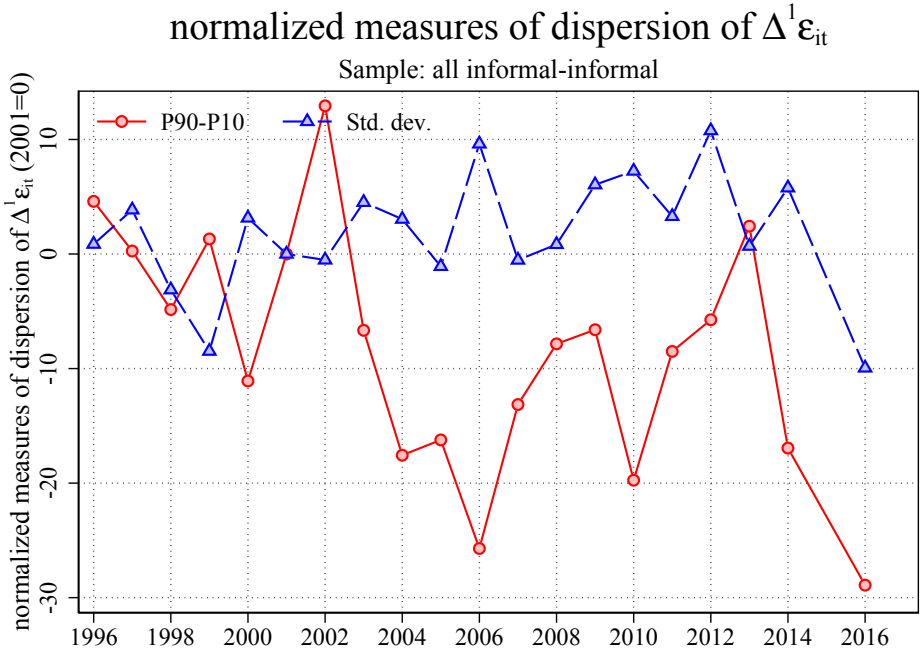
Dynamics in Formal vs. Informal Sectors

▸ w/o norm.









Part II:

Wage Setting under Low and High Inflation

Research Question

- Wage rigidity is the core mechanism in many macro models
  - Effect of a monetary shock (Christiano-Eichenbaum-Evans, '05)
  - Optimal monetary policy (Levin et. al., '05)
  - Cyclicality of unemployment (Shimer, '05)
  - Recovery after sudden stops (Schmitt Grohé-Uribe, '16)
- Measurement of wage rigidity still scarce, requires to:
  - minimize measurement error $\longrightarrow$ administrative data
  - avoid time aggregation bias $\longrightarrow$ high-frequency data

$\Longrightarrow$ Additional measurement can help discipline macro models!

Research question: How does the frequency of wage changes vary with aggregate inflation and across workers?

Research Design Overview

1. Construct regular wage
2. Present facts under different inflation regimes
3. Present facts across different workers

Construct regular wage: Overview

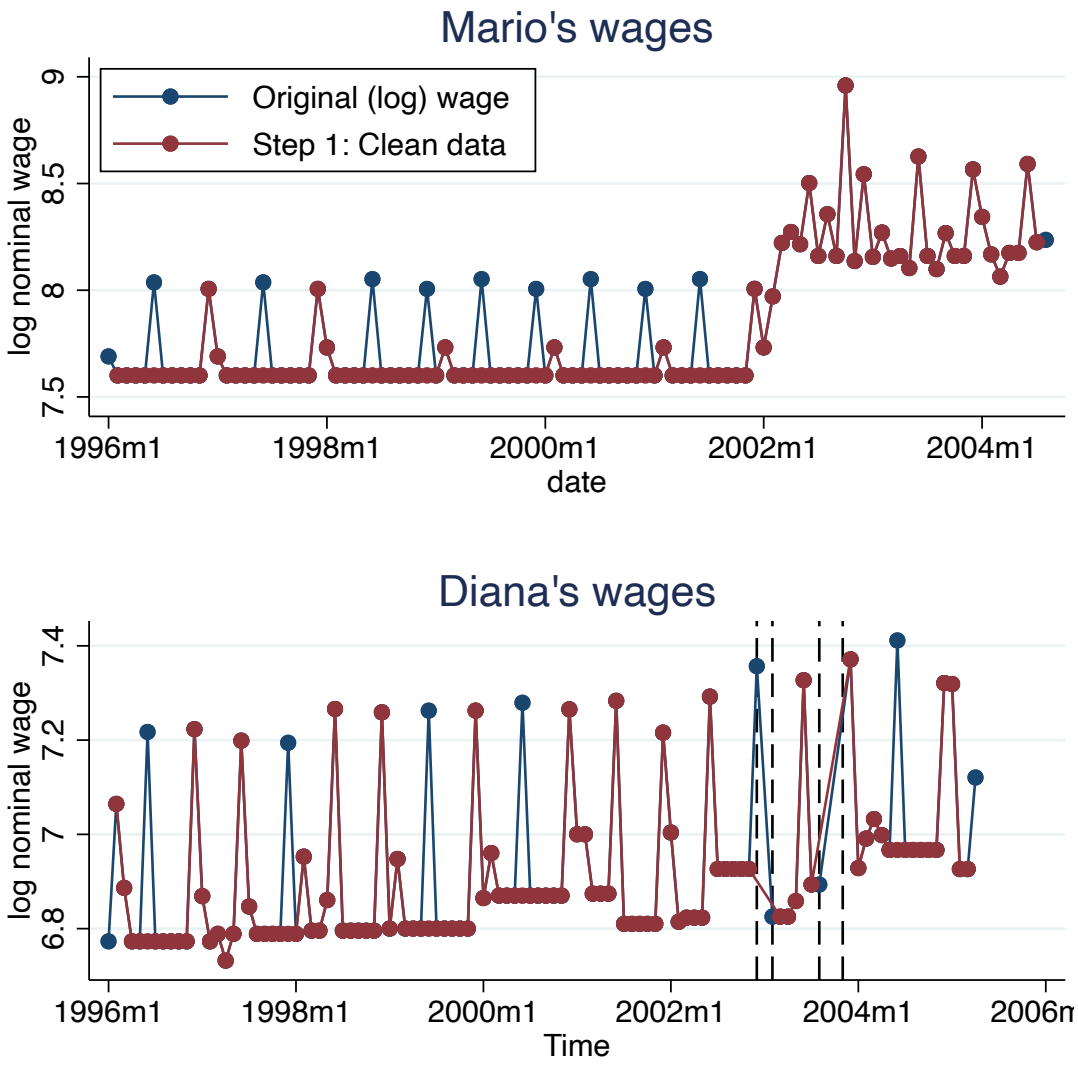
1. Clean data
   - Remove first and last wage by job
   - Remove wages < 0.5 minimum wage
   - Replace wage in June/Dec by average in annexed months if equal

2. Construct regular wage (w^r) using filters from pricing literature
   - i) Kolmogorov-Smirnov test ▸ Stevens, '19, Barattieri et al., 14'
   - ii) Remove wages preceded & followed by same wage ▸ Blanco, '20
   - iii) Remove v-shapes in wage dynamics ▸ Nakamura-Steinsson, '08
   - iv) Use modal wage ▸ Kehoe-Midrigan, '14

   Warning: Filters were designed for different models and data

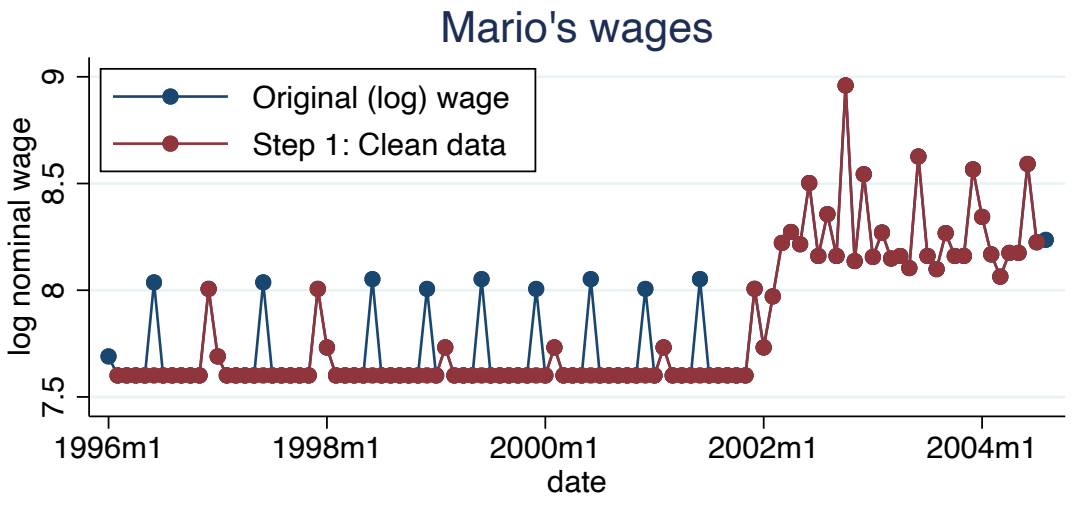
3. Today: explain and justify Kolmogorov-Smirnov test only

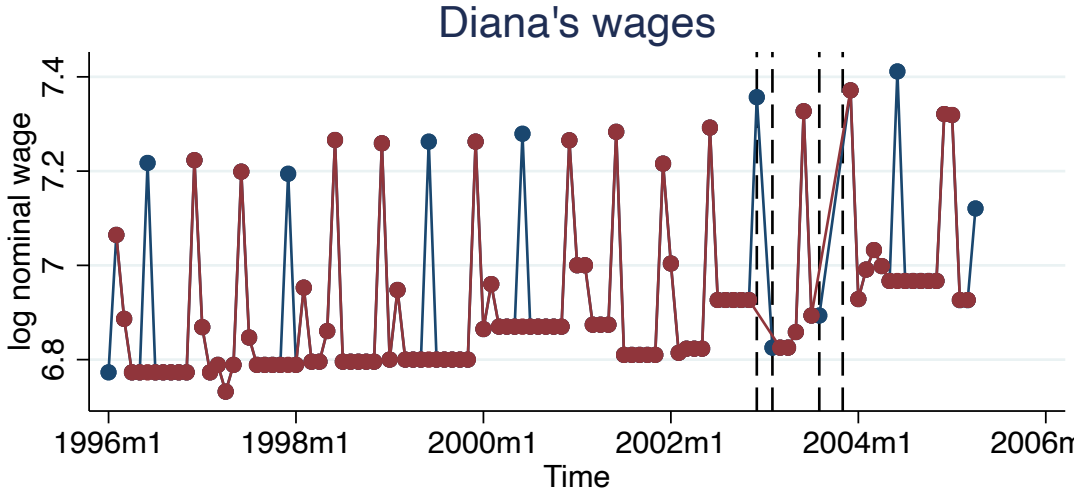
Step 1: Clean data



Sample of log monthly wages (black dotted line = job change)

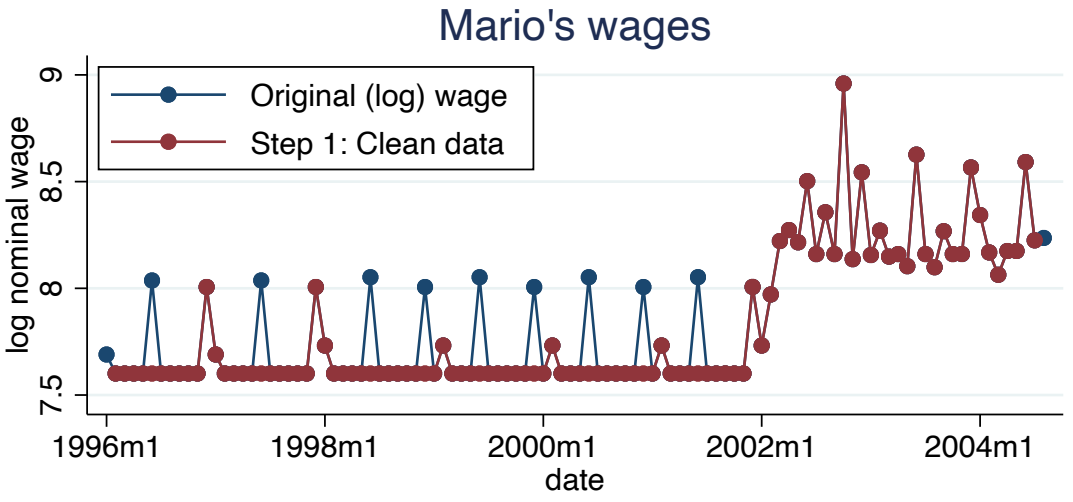
Step 1: Clean data

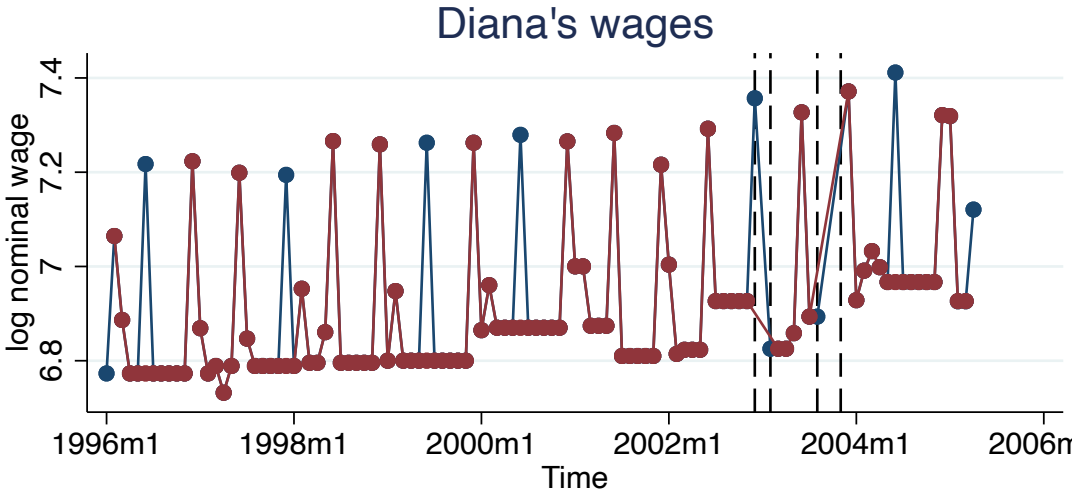




Remove first/last wage within job spell

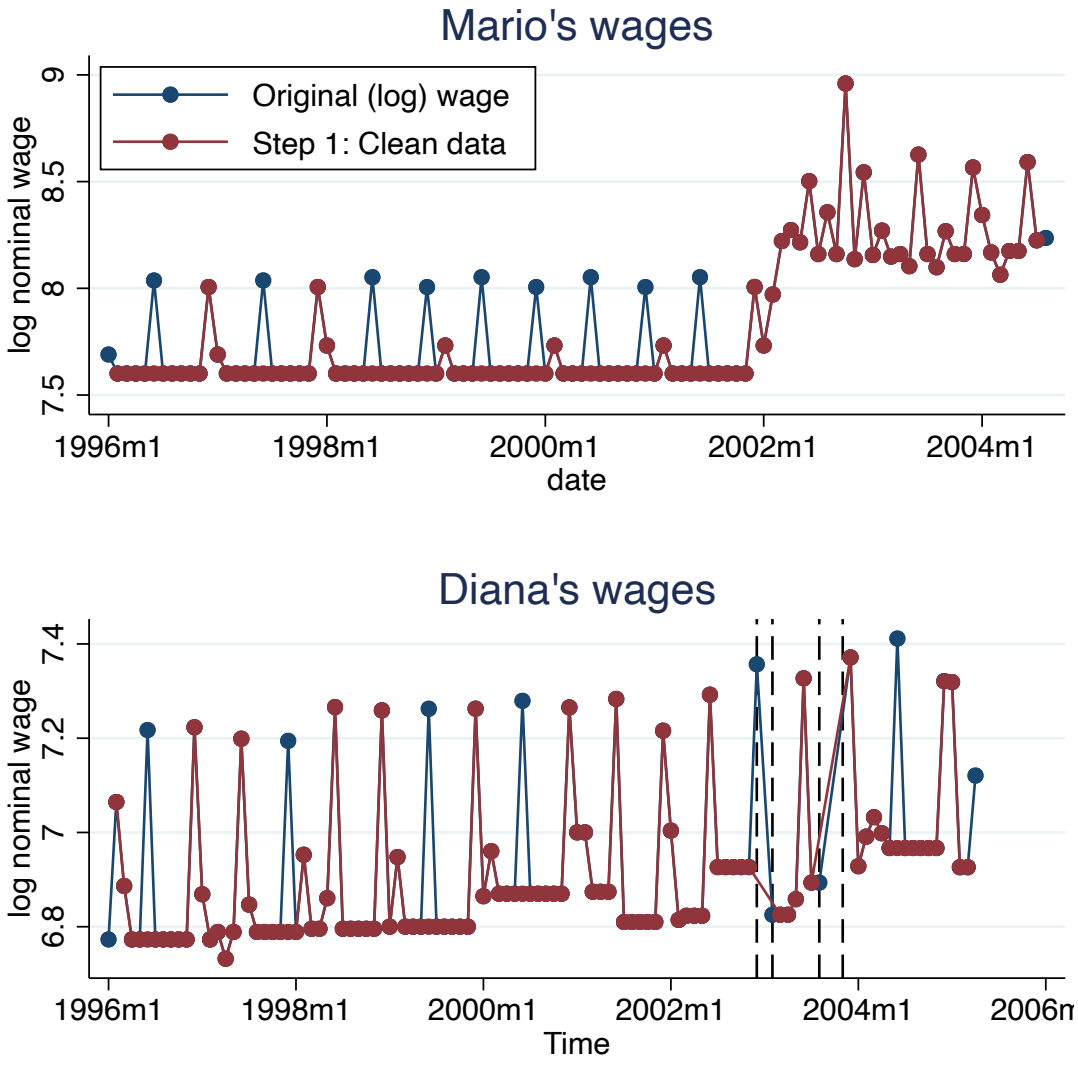
Step 1: Clean data





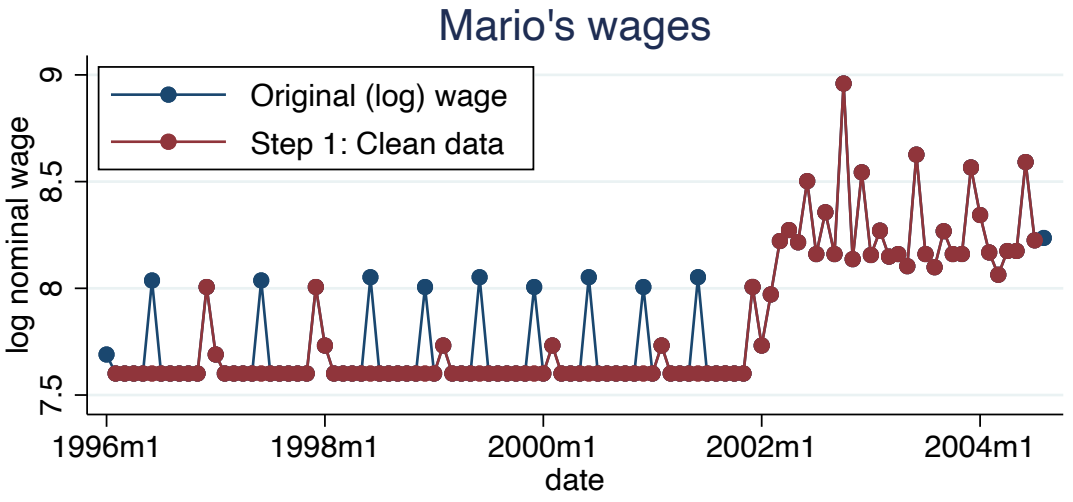
First wage suffers from time aggregation

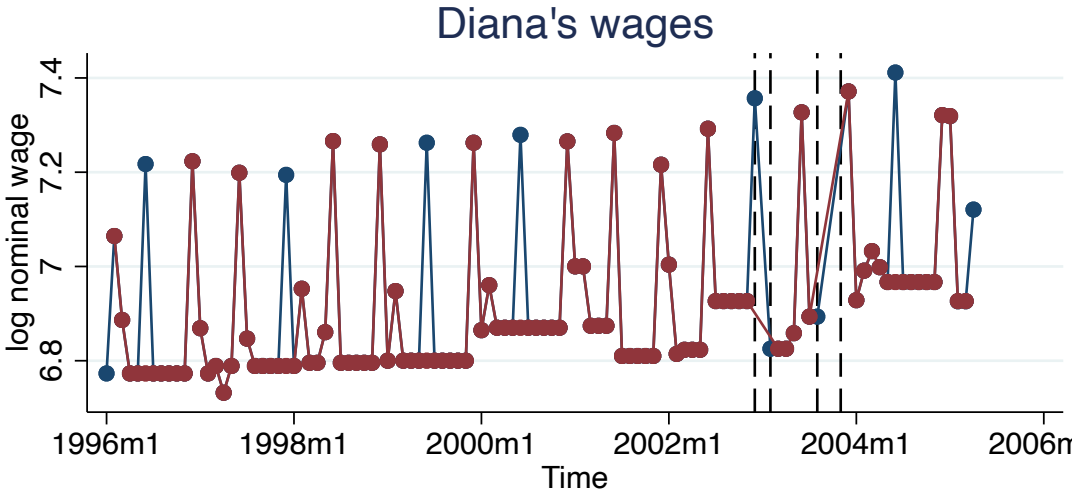
Step 1: Clean data



Last wage suffers from time aggregation and includes severance payment

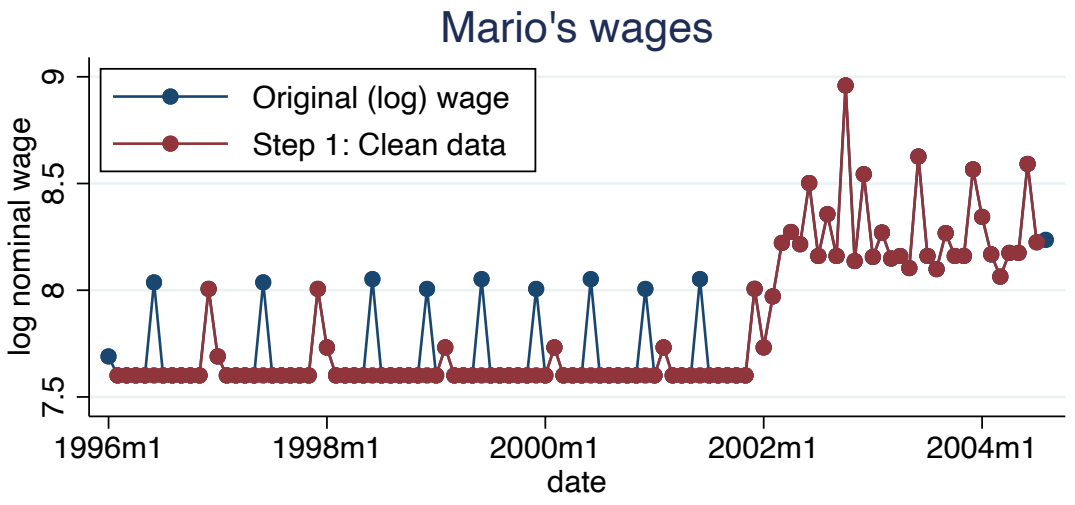
Step 1: Clean data

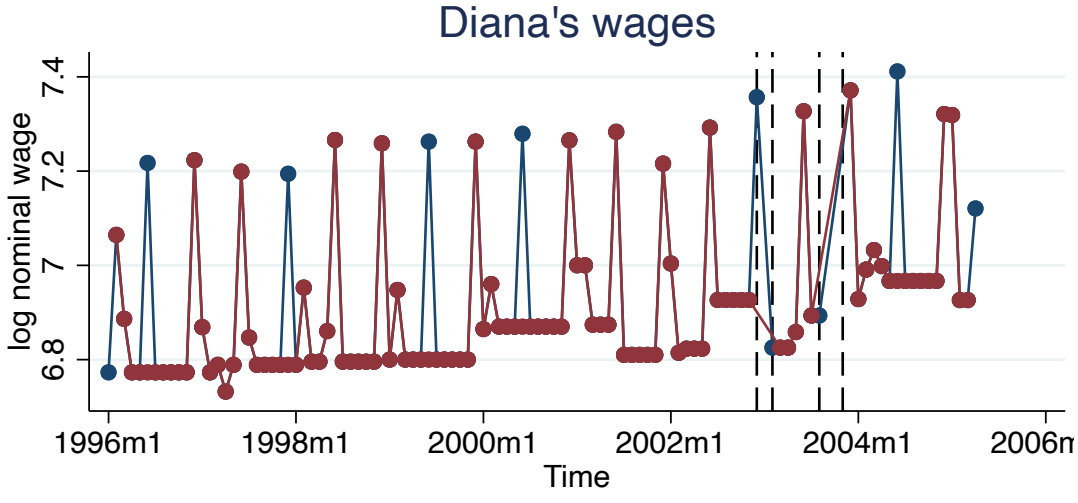




Remove wages below 0.5 minimum wage

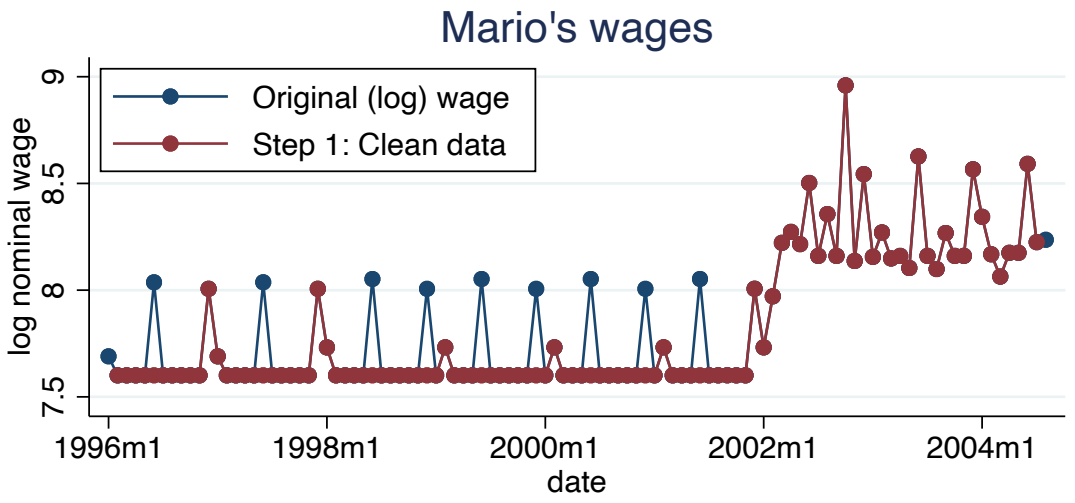
Step 1: Clean data

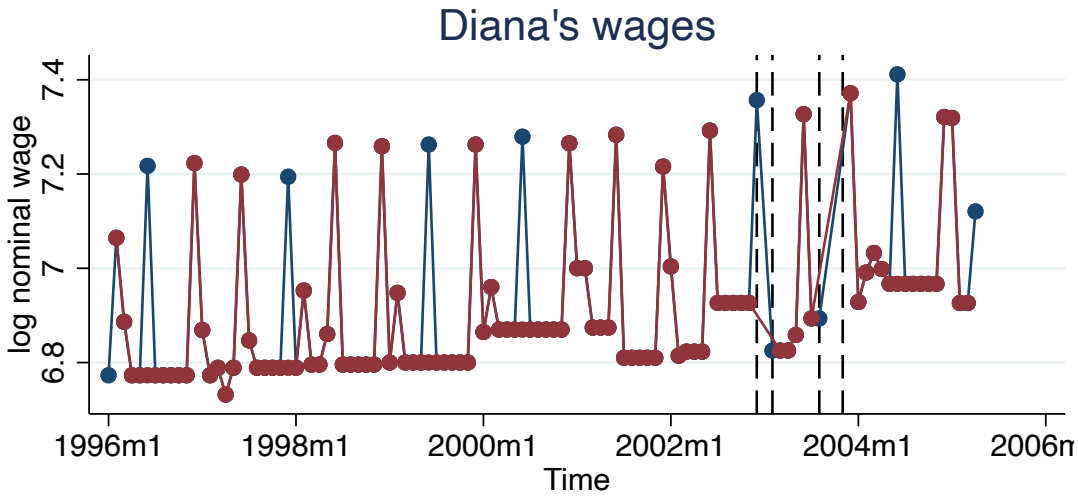




Remove 13th salary paid in June (1/2) and December (1/2) by law

Step 1: Clean data



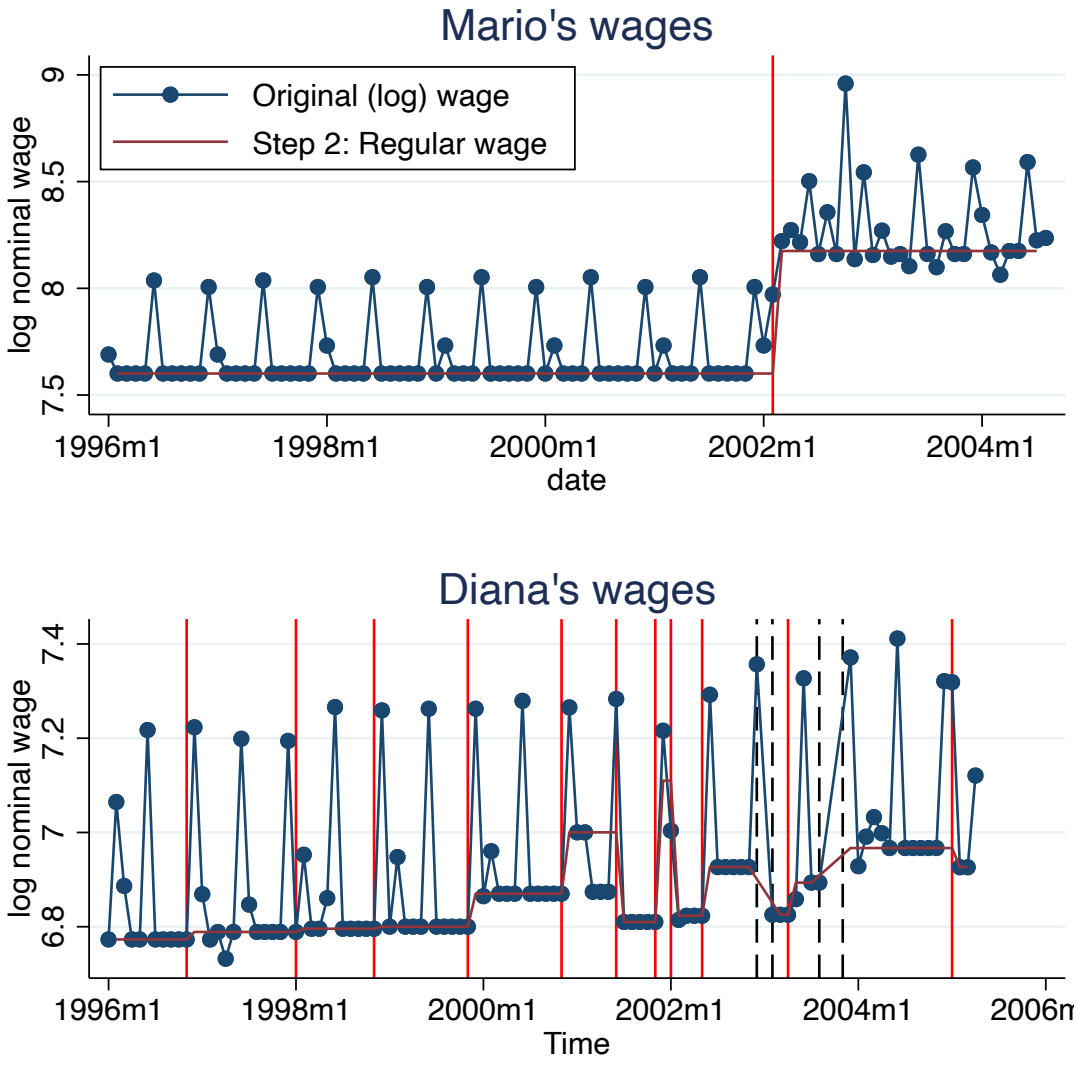


Remove 13th salary: Replace June's wage with wage paid in July if preceding and following wages are the same

Step 2: Construct regular wage

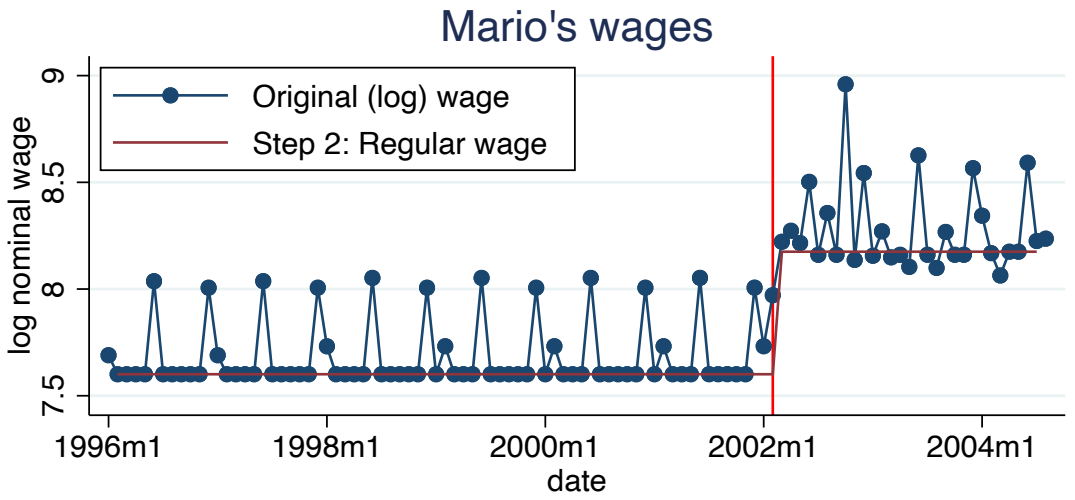
- Challenges in measuring wage stickness
  - 13-th wage (wage changes near these months)
  - Transitory wage changes that come back to same wage
  - Lack of a modal wage
- Solution: Kolmogorov-Smirnov test
  - Intuition: add breaks when wage series are different
  - Regular wage is median between breaks
  - Main parameter: K measures cutoff value of differences in subsamples
- Show data and calibration of K with sticky wage model

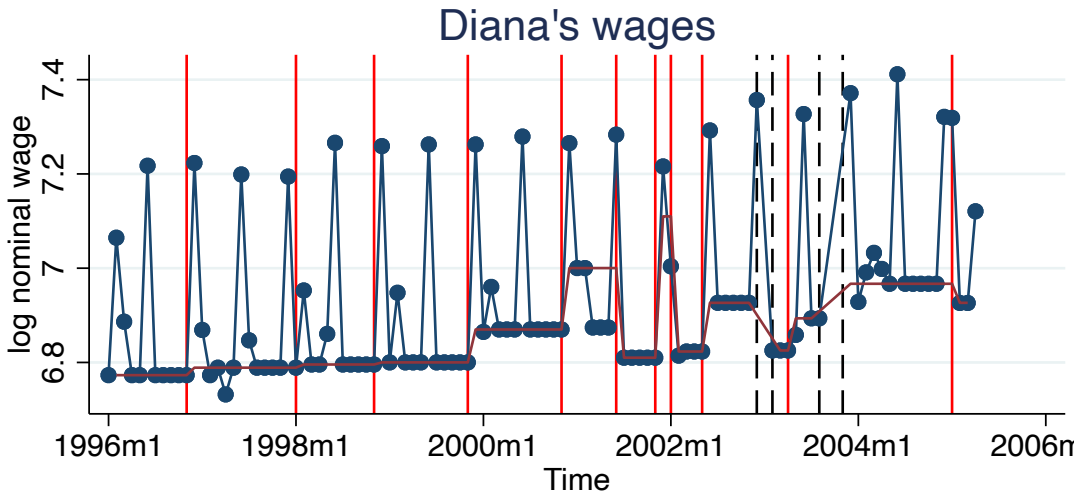
Step 2: Construct regular wage



Regular wage does not incorporate inverse v-shape wage changes

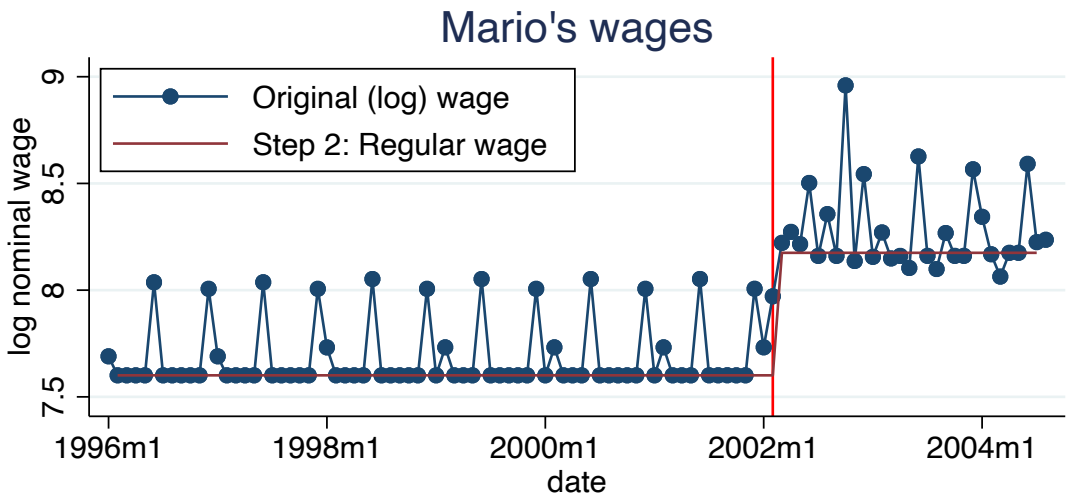
Step 2: Construct regular wage

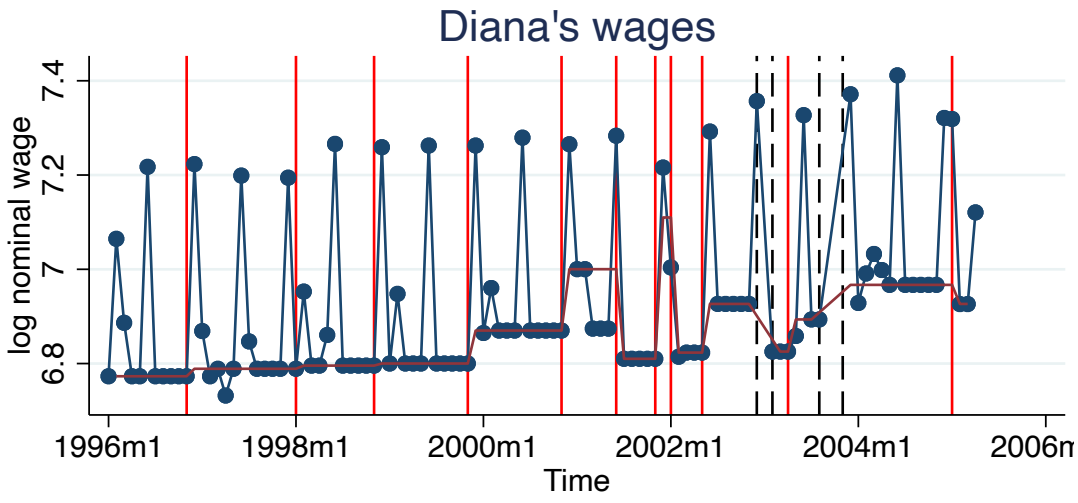




Regular wage does not incorporate sequence of wage changes near June/December or permanent

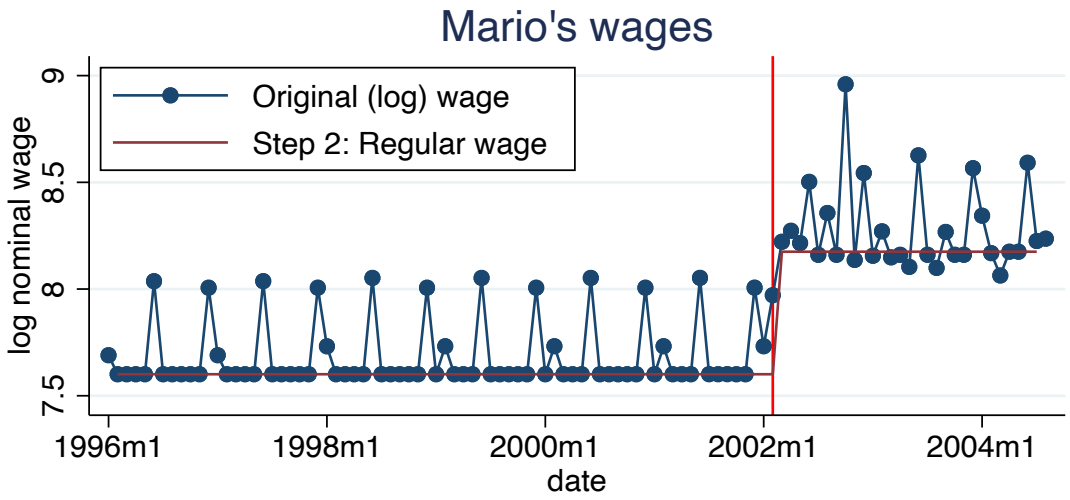
Step 2: Construct regular wage

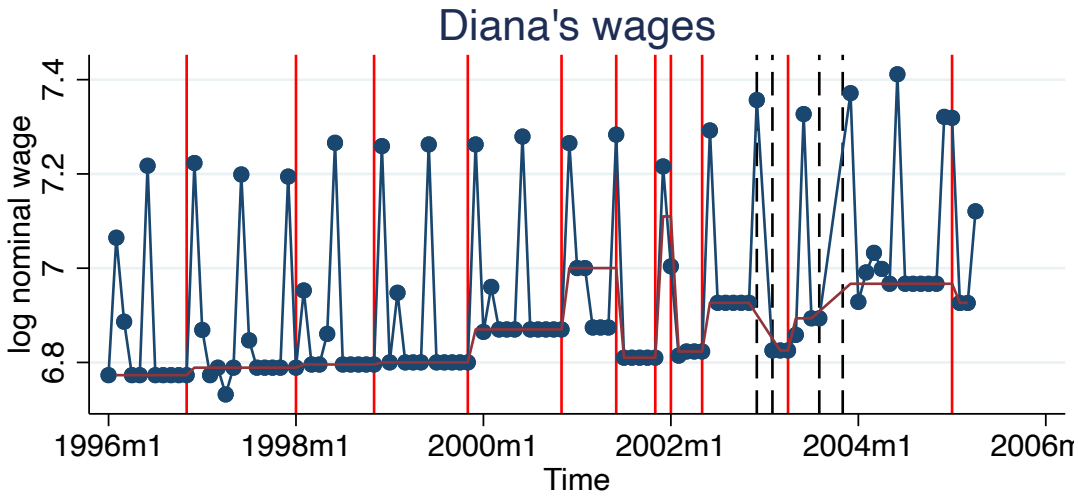




Regular wage does not incorporate sequence of wage changes close to a "target" value

Step 2: Construct regular wage





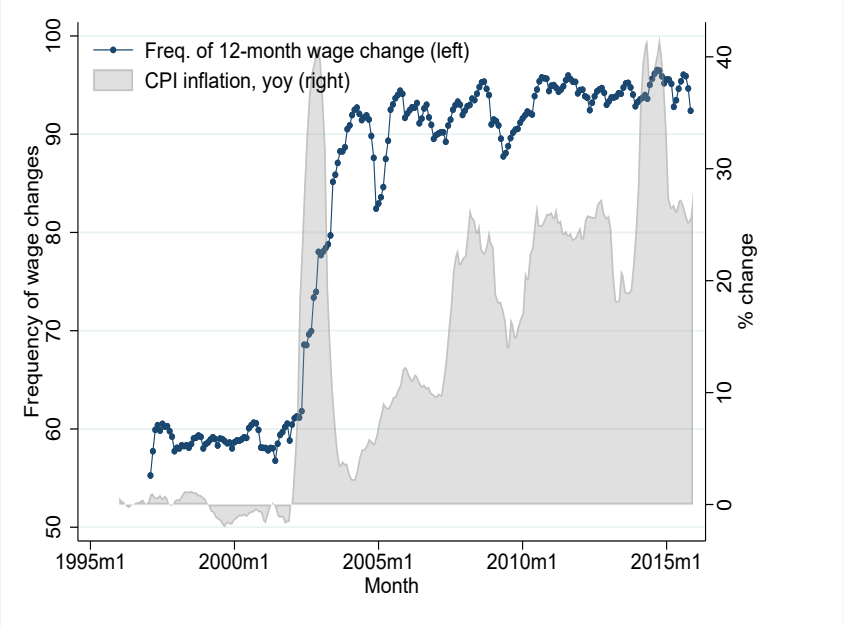
We need to calibrate K
(maximum distance across wage series that defines a break)

Calibration of K

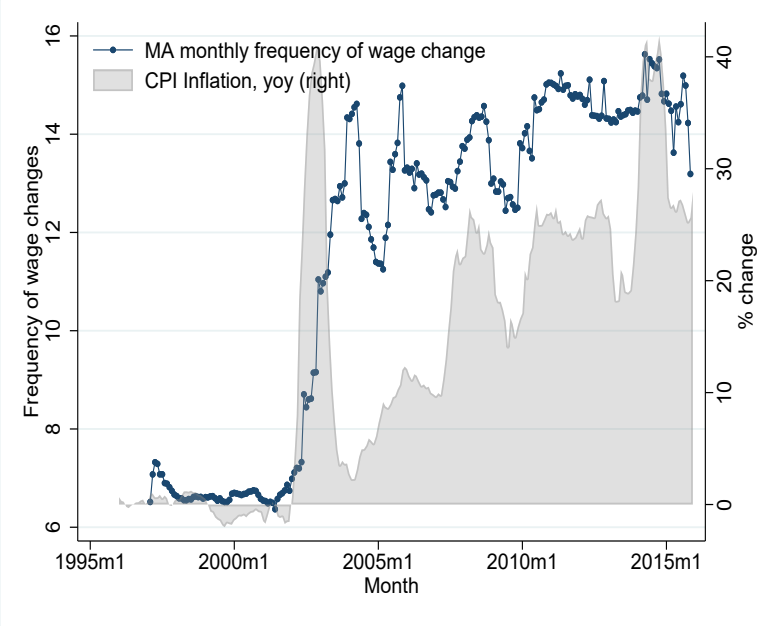
- Model overview ▸ Model
  - Taylor-Ss model of wage adjustment with idiosyncratic shocks
    - Taylor: wage change after T dates
    - Ss: wage change if accumulated shocks are large enough
  - Transitory shocks
    1. Gaussian shock in June and December
    2. Mixed normal distribution
- Estimate model using observed statistics ▸ Targets
- Calibrate $K = 0.51$ ▸ Cross-validation
  - Replicates the model's frequency of wage changes
  - $Pr(break|\Delta w^r = 0) = 0.07$
  - $Pr(no\ break\ btw\ t-2\ \&\ t+2|\Delta w^r \neq 0) = 0.25$

Frequency of wage changes

(a) 12-month changes



(b) Monthly changes

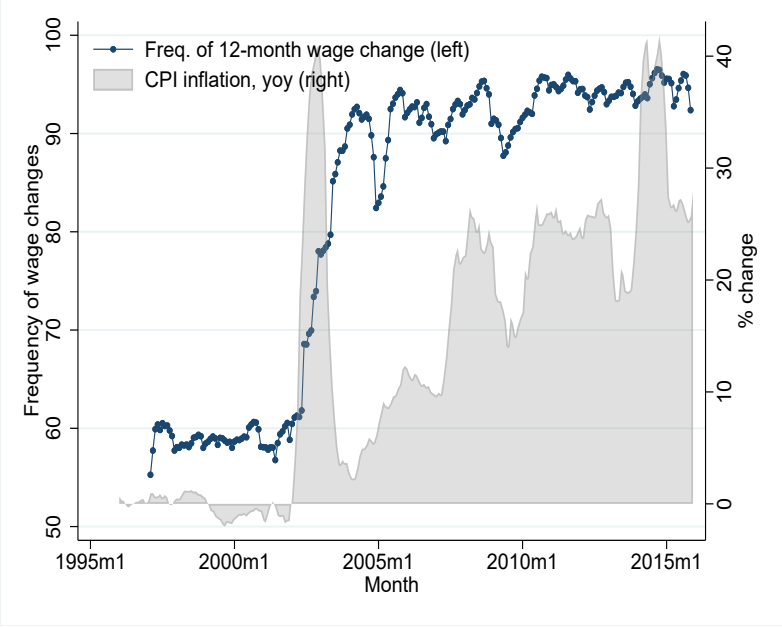


Low inflation period (pre-2002): avg. annual frequency of 58%
(avg. of 65% in the US, Grigsby, et. al., 2020)

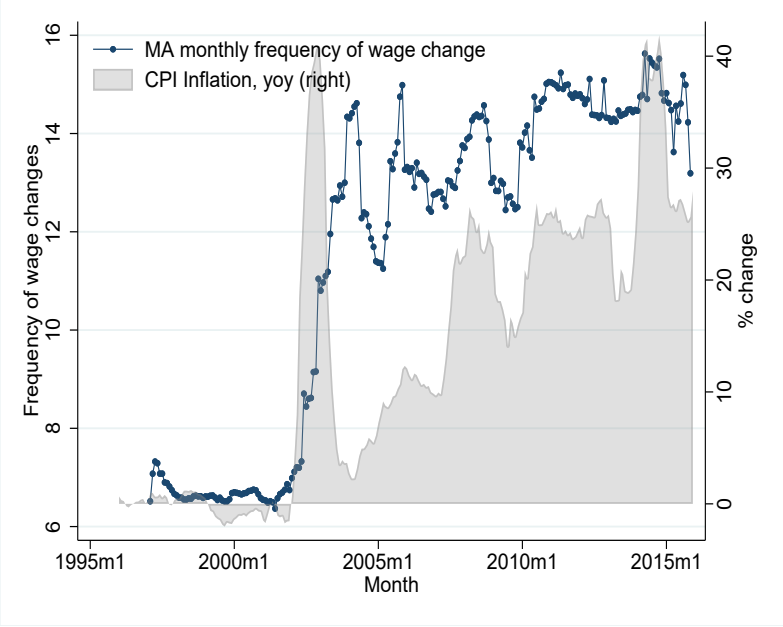
High inflation period (post-2002): avg. annual frequency of 90%

Frequency of wage changes

(c) 12-month changes

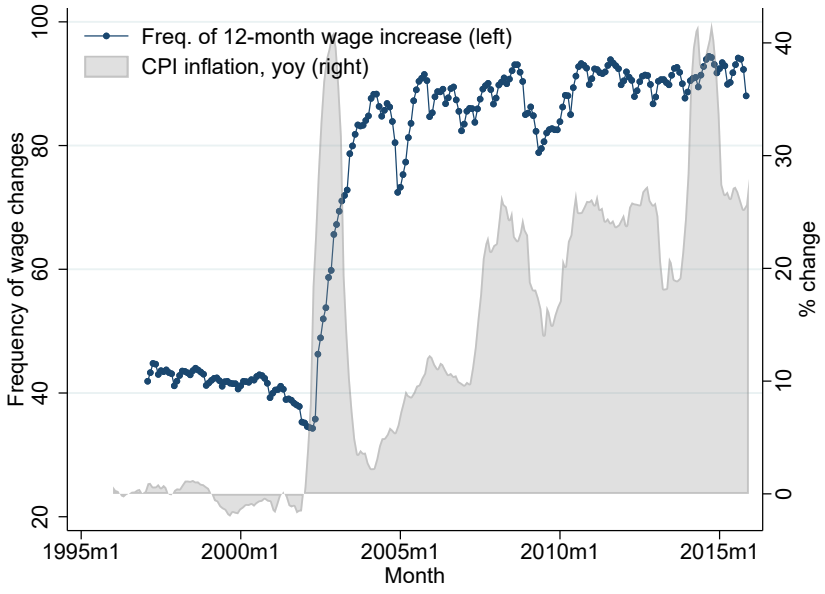


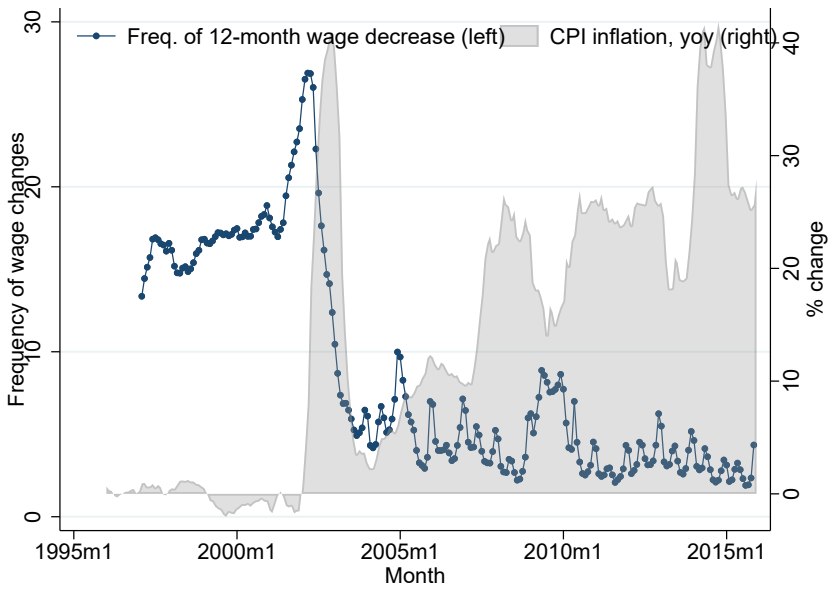
(d) Monthly changes



The frequency of wage changes increases with inflation and is procyclical

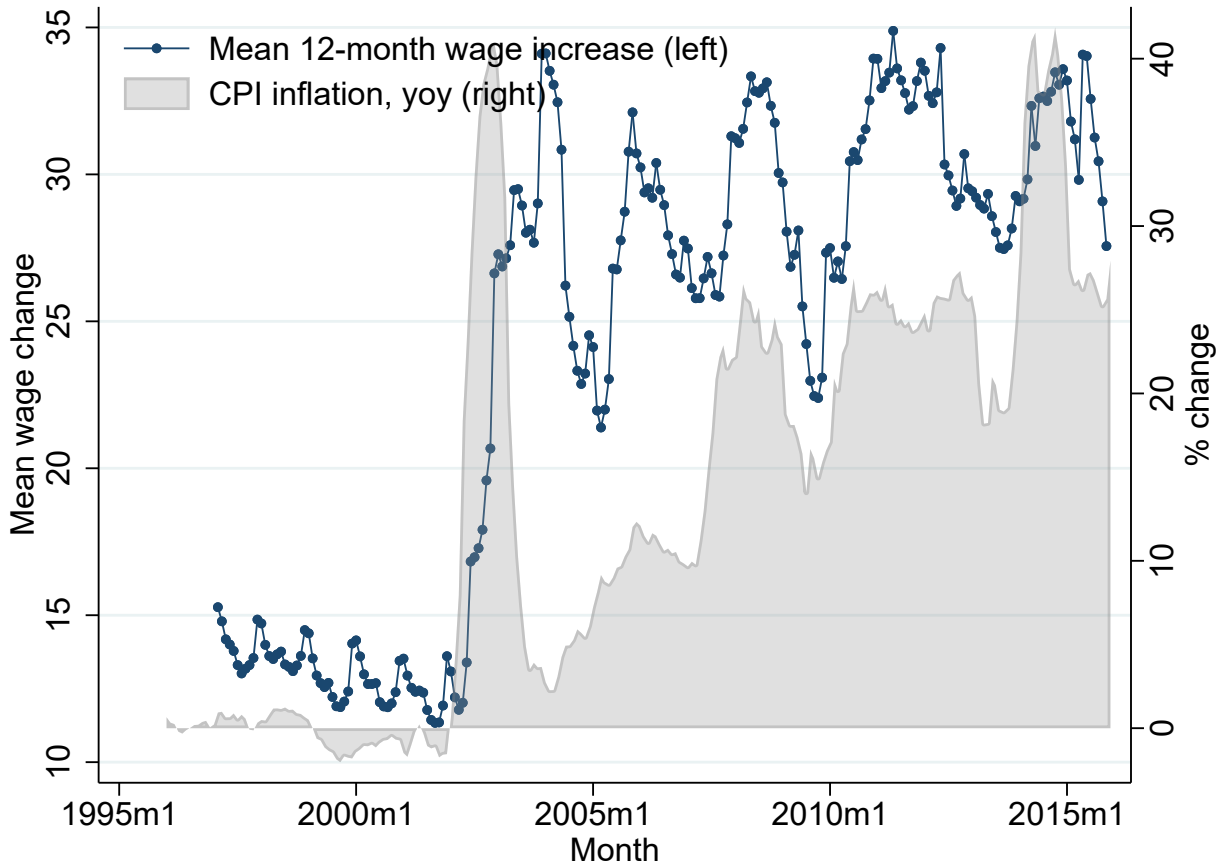
Frequency of 12-month upward and downward wage changes





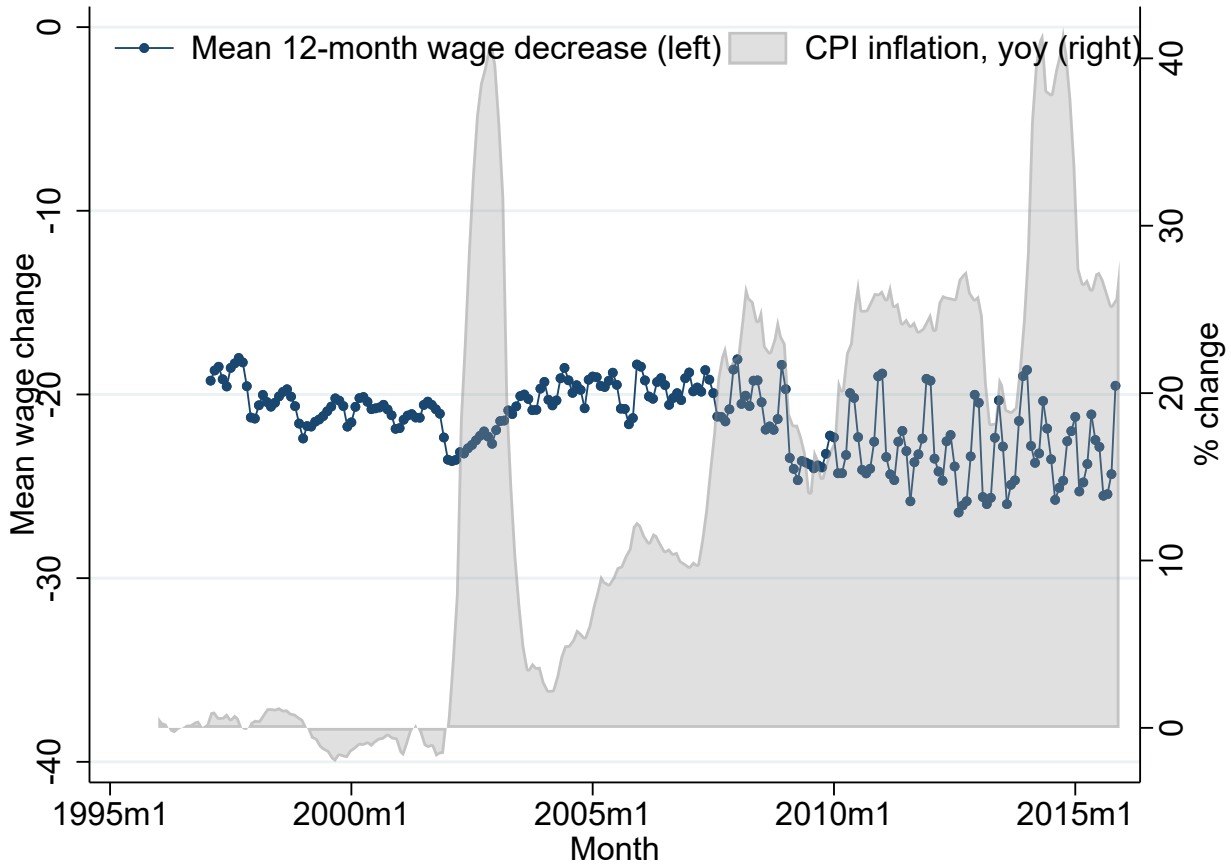
The frequency of upward (downward) wage changes significantly increases (falls) with inflation

Mean 12-month wage changes conditional on upward change



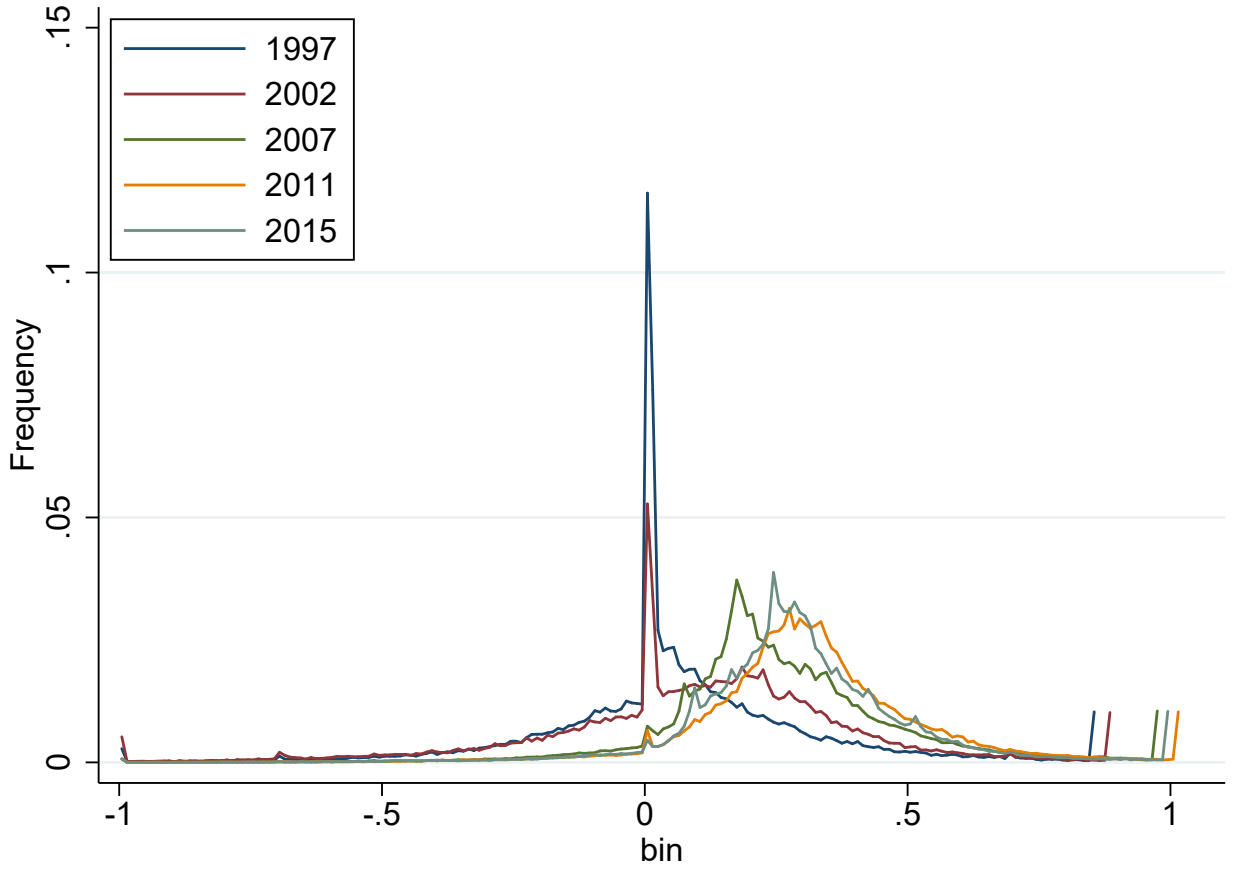
Average wage increases grow with inflation and are highly procyclical

Mean 12-month wage changes conditional on downward change



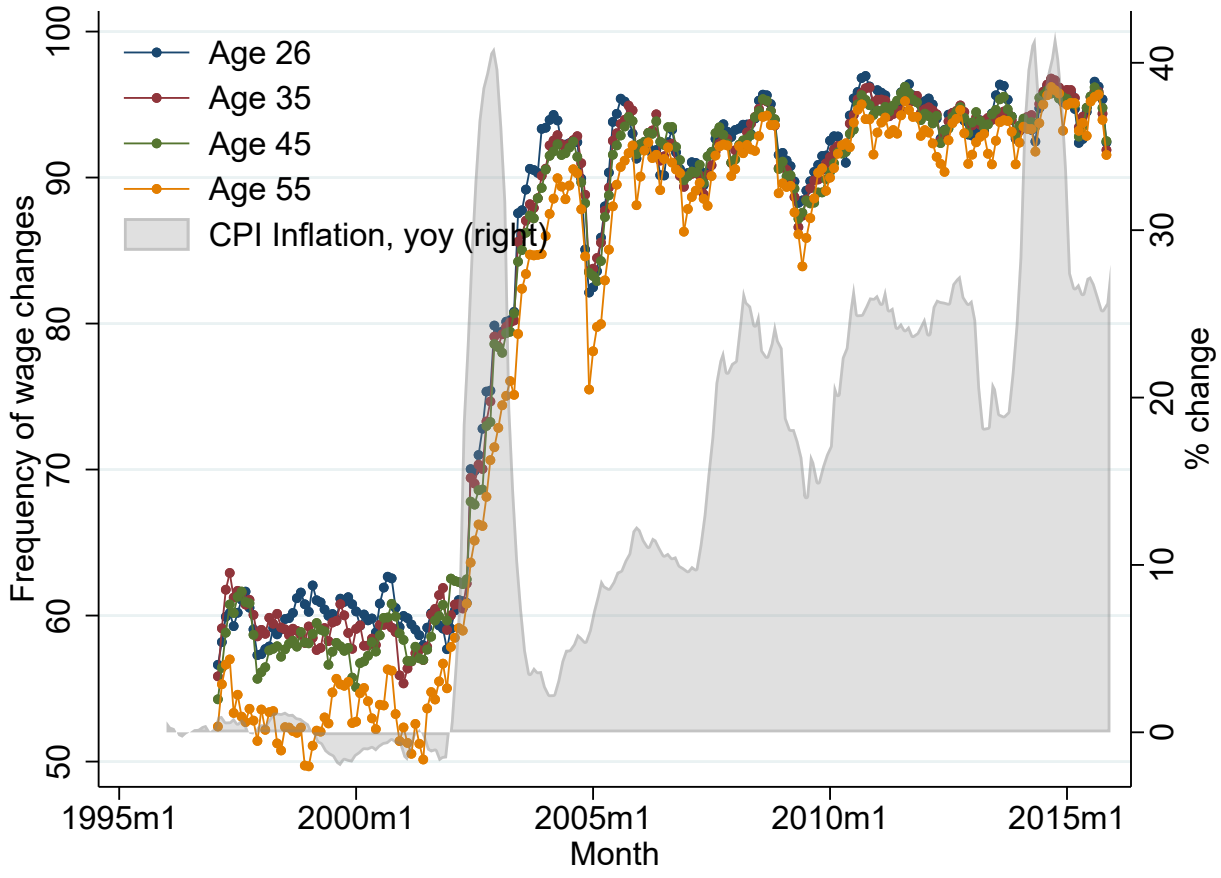
Average wage decreases fairly stable, though higher volatility and even lower levels than with deflation

Distribution of 12-month wage changes over time



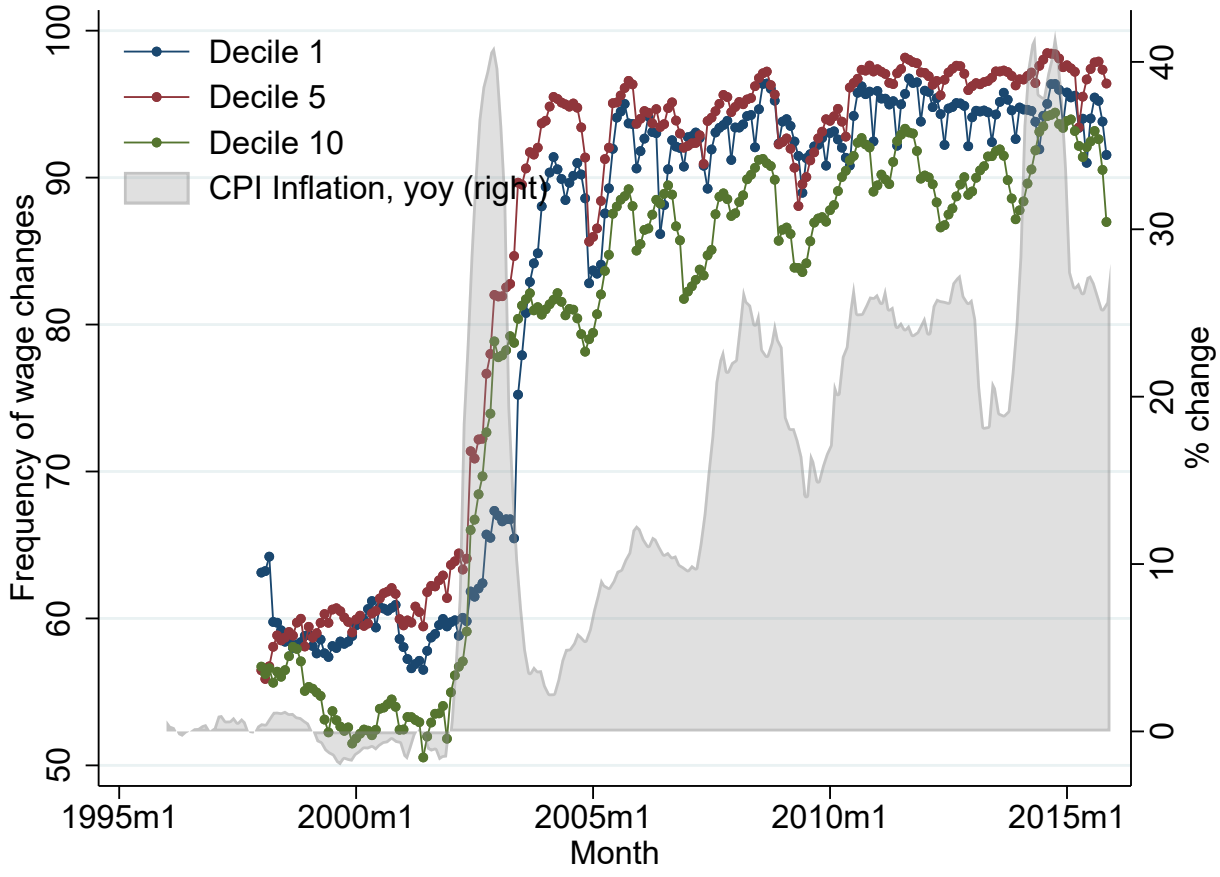
Distribution of wage changes evolves from asymmetric to symmetric with high-inflation

Frequency of 12-month wage changes: age groups



Frequency of wage changes falls monotonically with age

Frequency of 12-month wage changes: income groups



Frequency of wage changes decreases in income across workers under low- and high-inflation periods

Conclusion

- Advantage of studying Argentina: large macro variation that facilitates measurement
- Persistent decline in inequality after 2002 devaluation
- Significant variation of frequency of wage changes across inflation regimes
  - document variation over time, but also across workers
- Future work: study agg. implications of heterogeneous frequencies of wage changes

Comparison of Datasets

Back

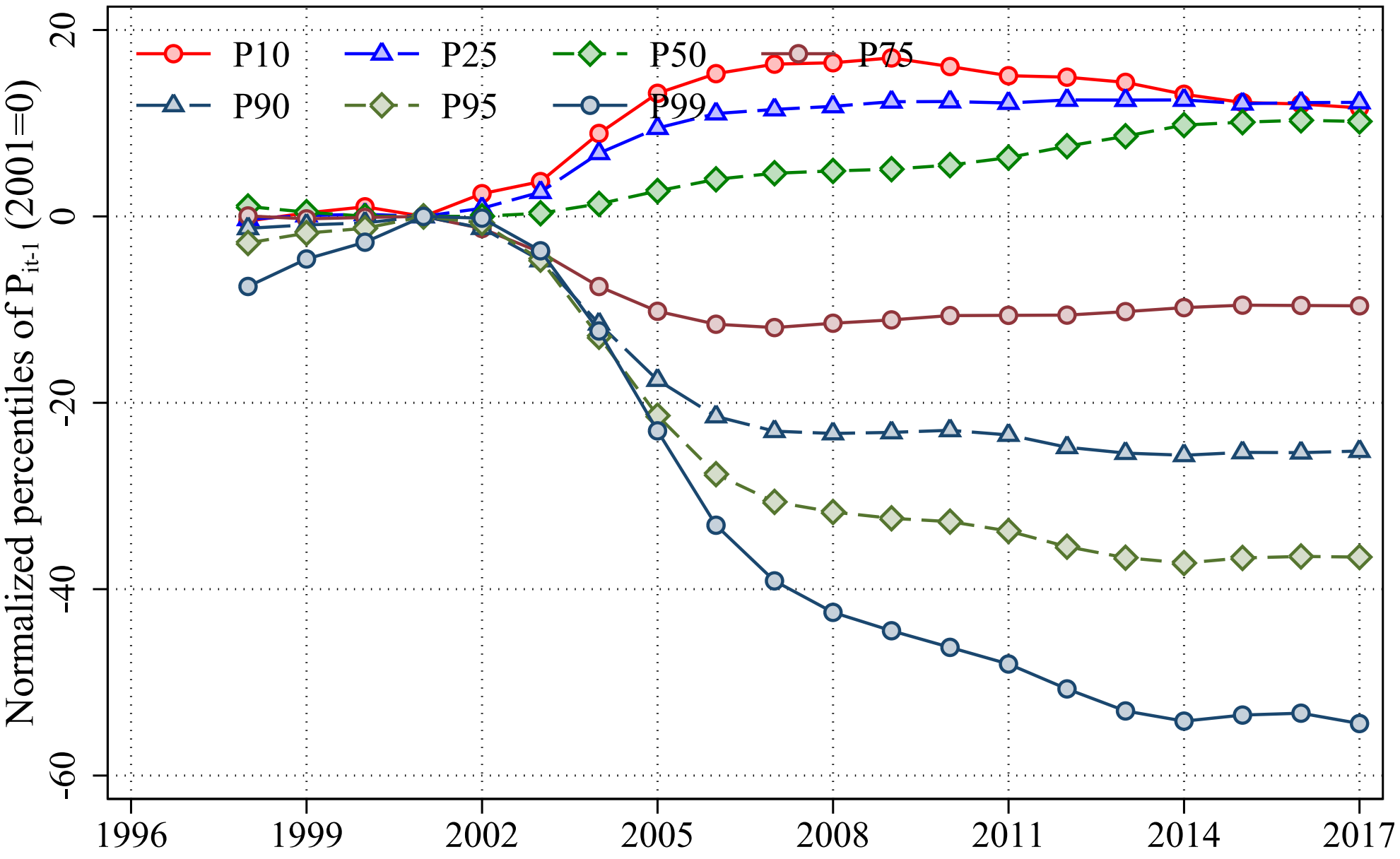
	MEED (SIPA)	LFS (EPH)
Source	Sworn statements	Survey
Reporting	3rd party/Mandatory	Self-reported/Voluntary
Frequency	Monthly	Semi-Annual/Quarterly
Structure	-	Rotating panel
Coverage	Formal Employees	All
Public sector	National	All
Censoring	No	Right-tail

Steps to make datasets more comparable:

- Drop public sector in both datasets
- Convert monthly income in LFS to annual frequency

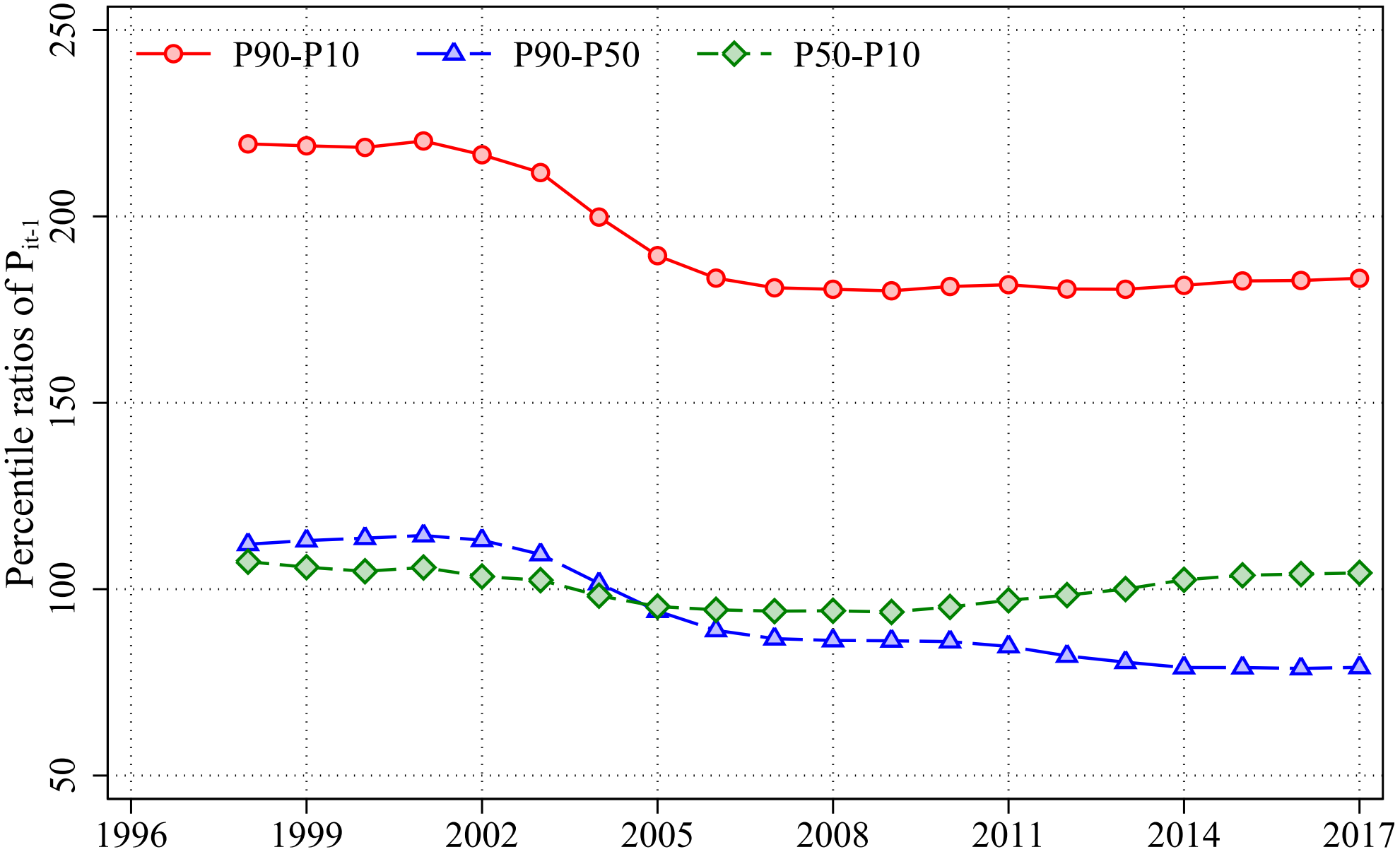
Normalized Log Permanent Earnings Percentiles

Back



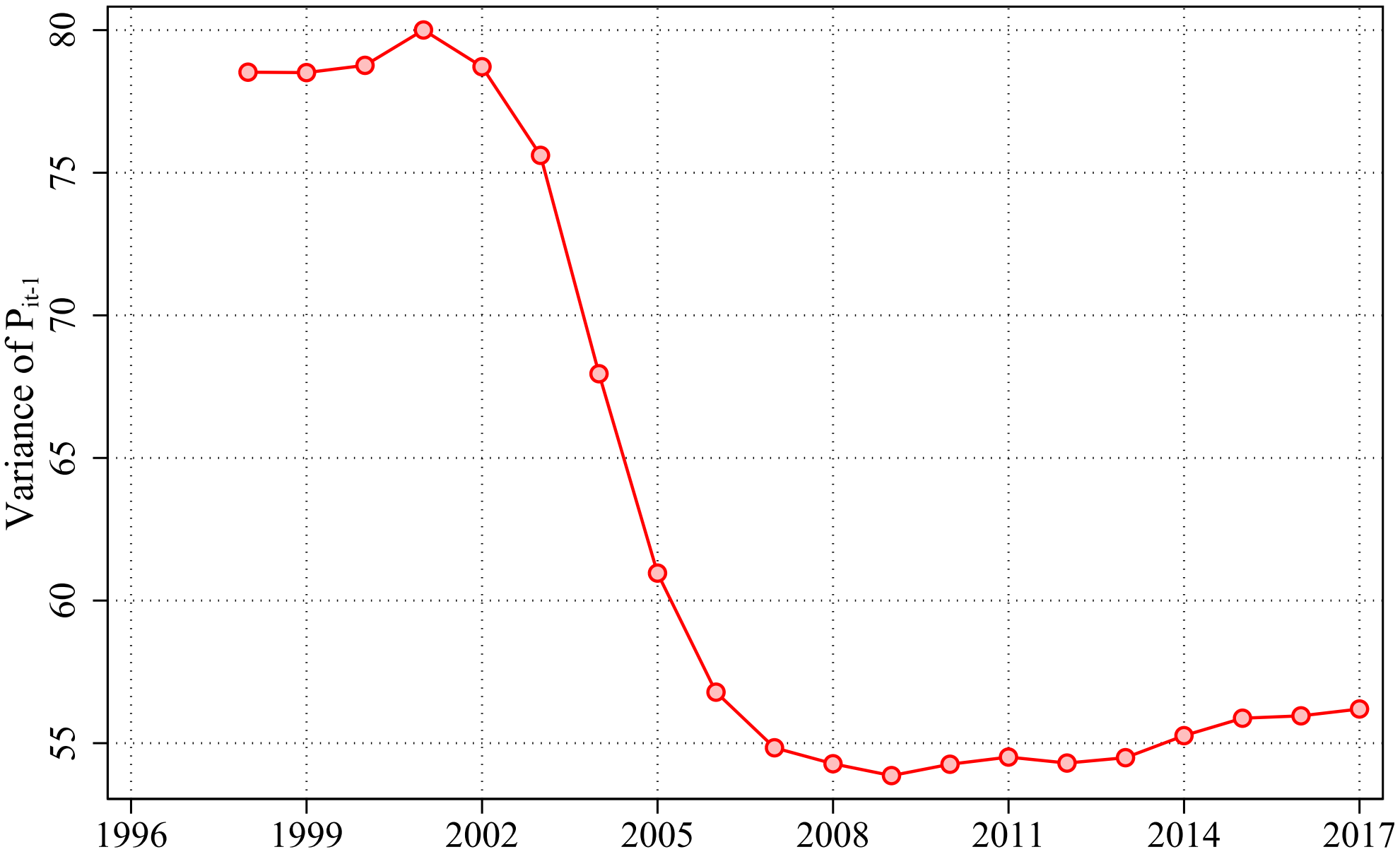
Log Permanent Earnings Percentile Ratios

Back



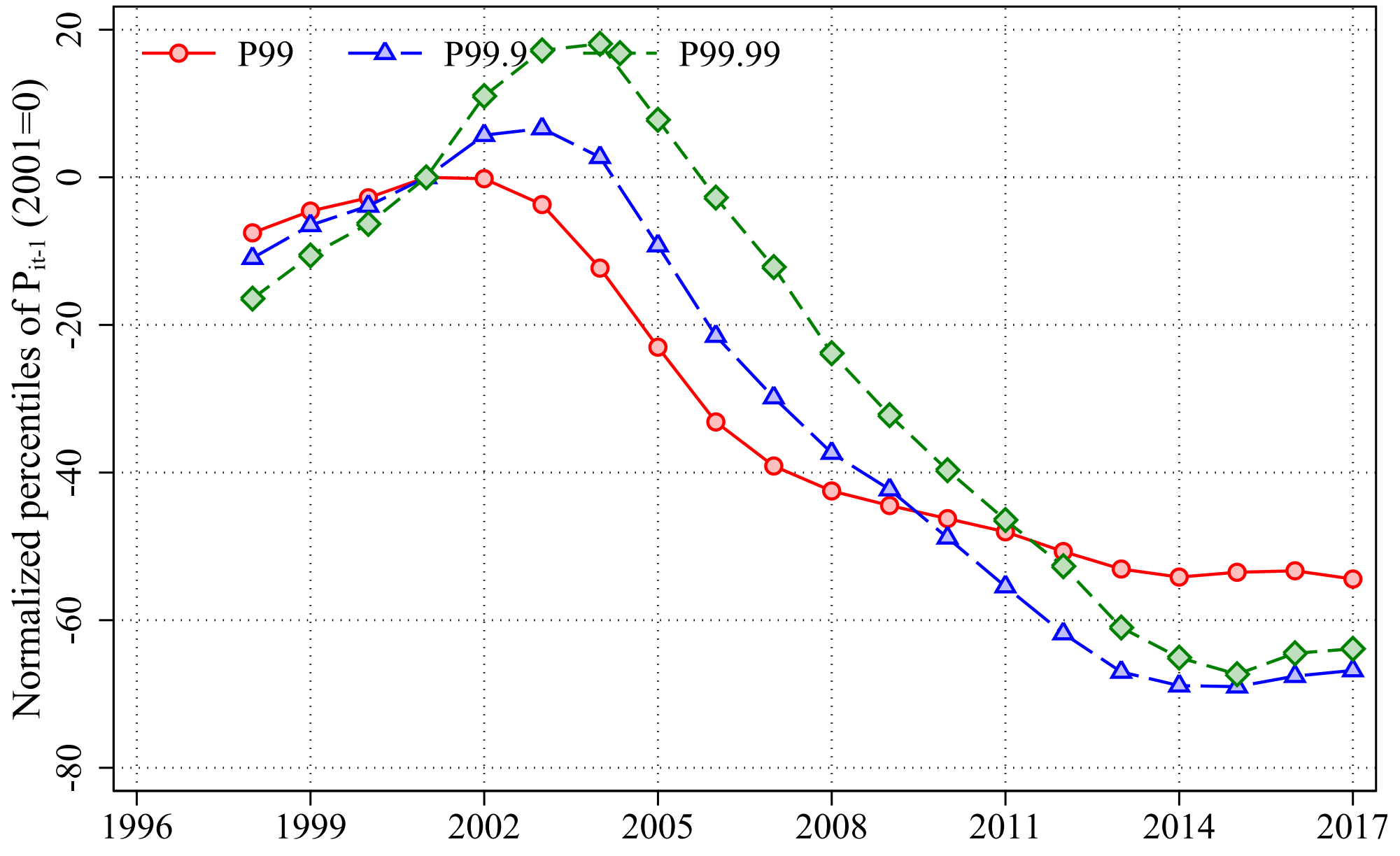
Variance of Log Permanent Earnings

Back



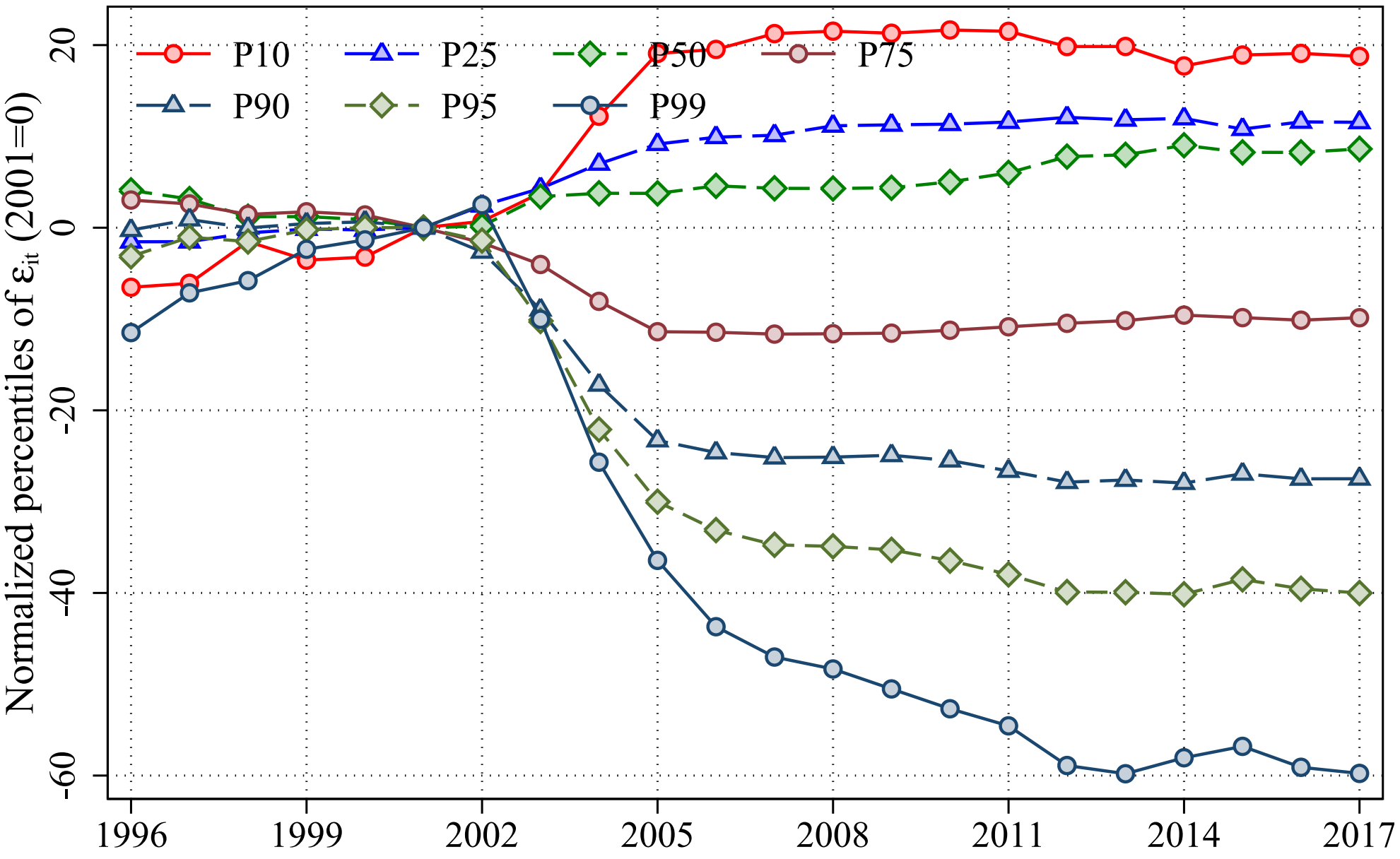
Top Log Permanent Earnings Percentiles

Back



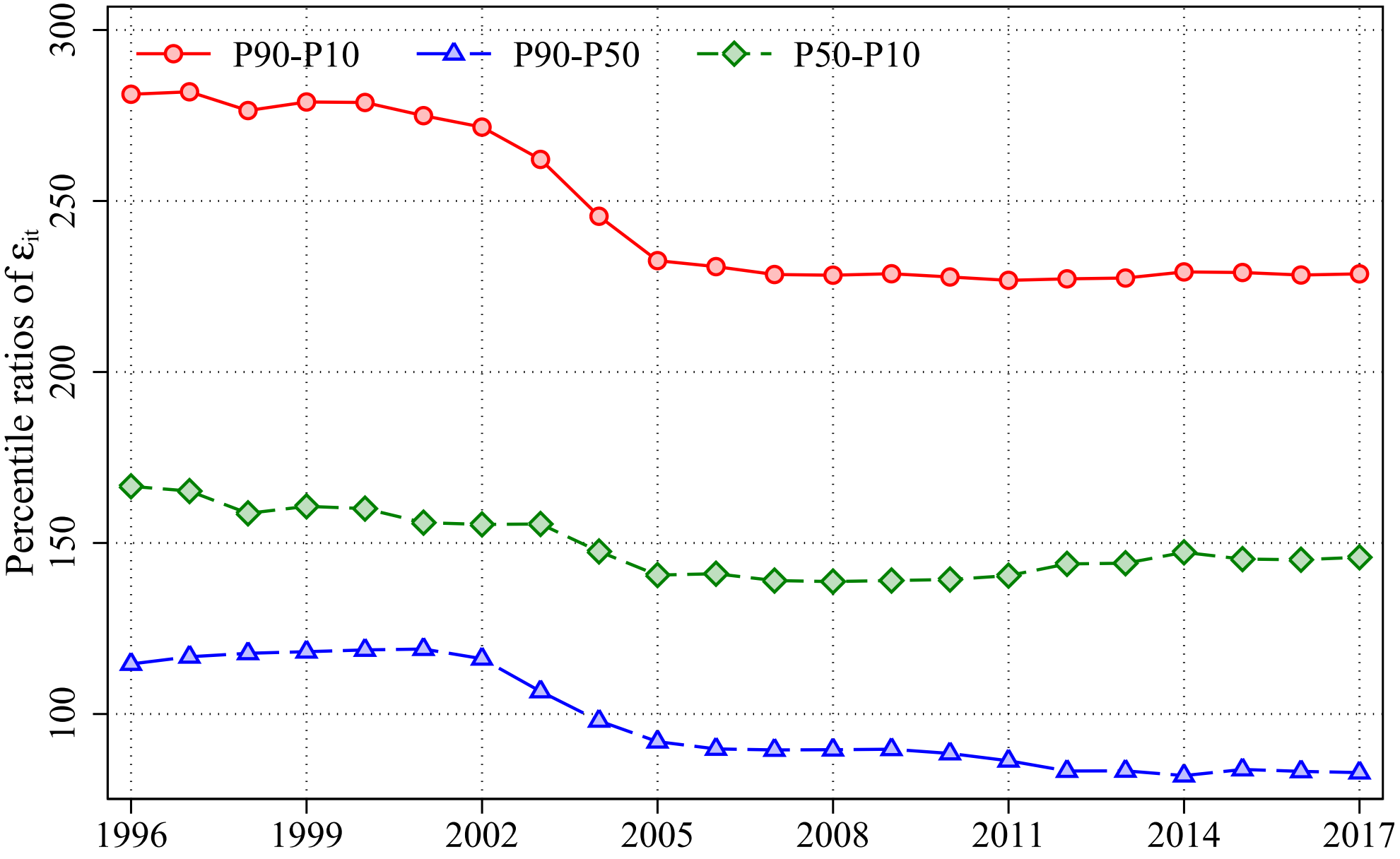
Normalized Log Residual Earnings Percentiles

Back



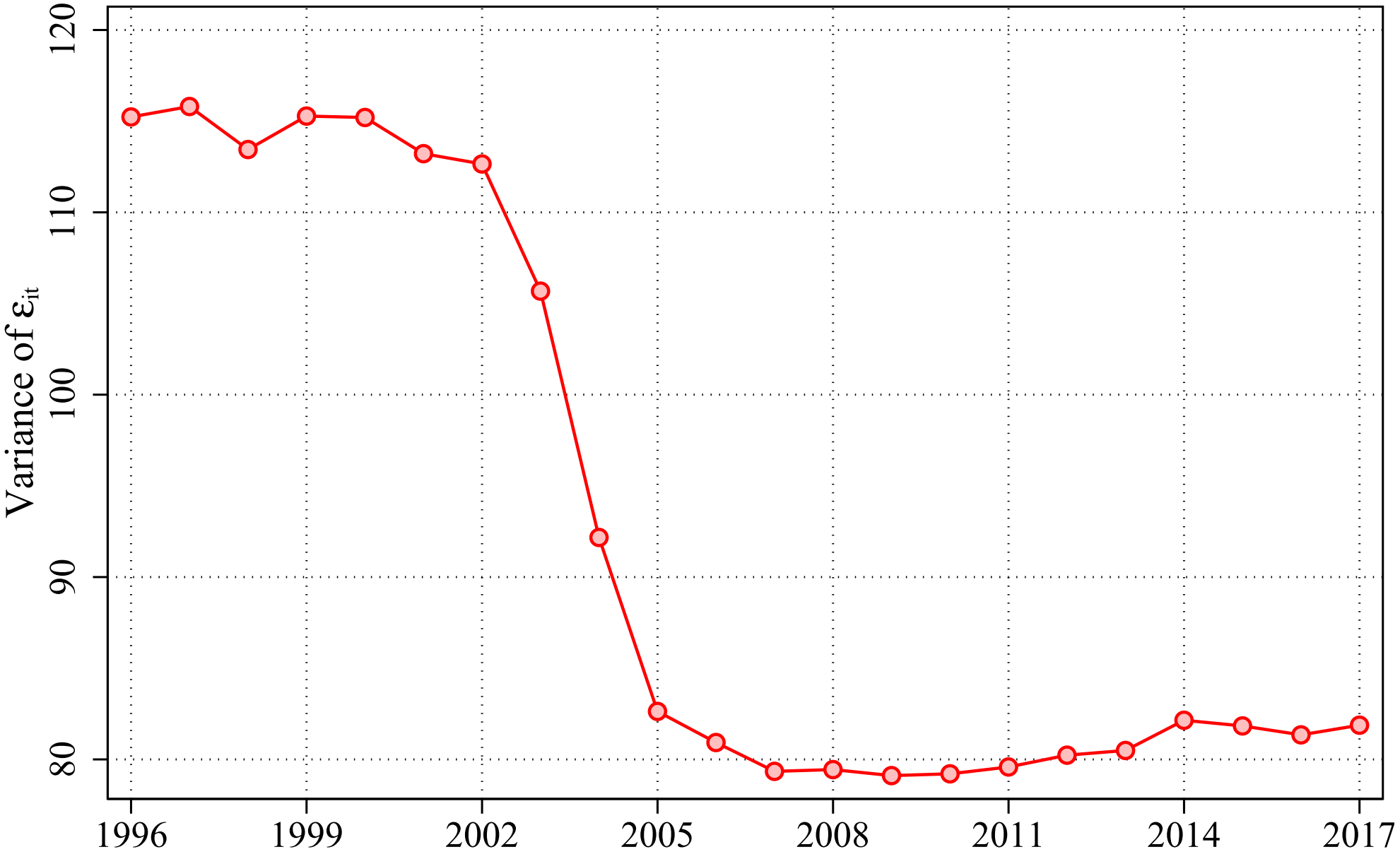
Log Residual Earnings Percentile Ratios

Back



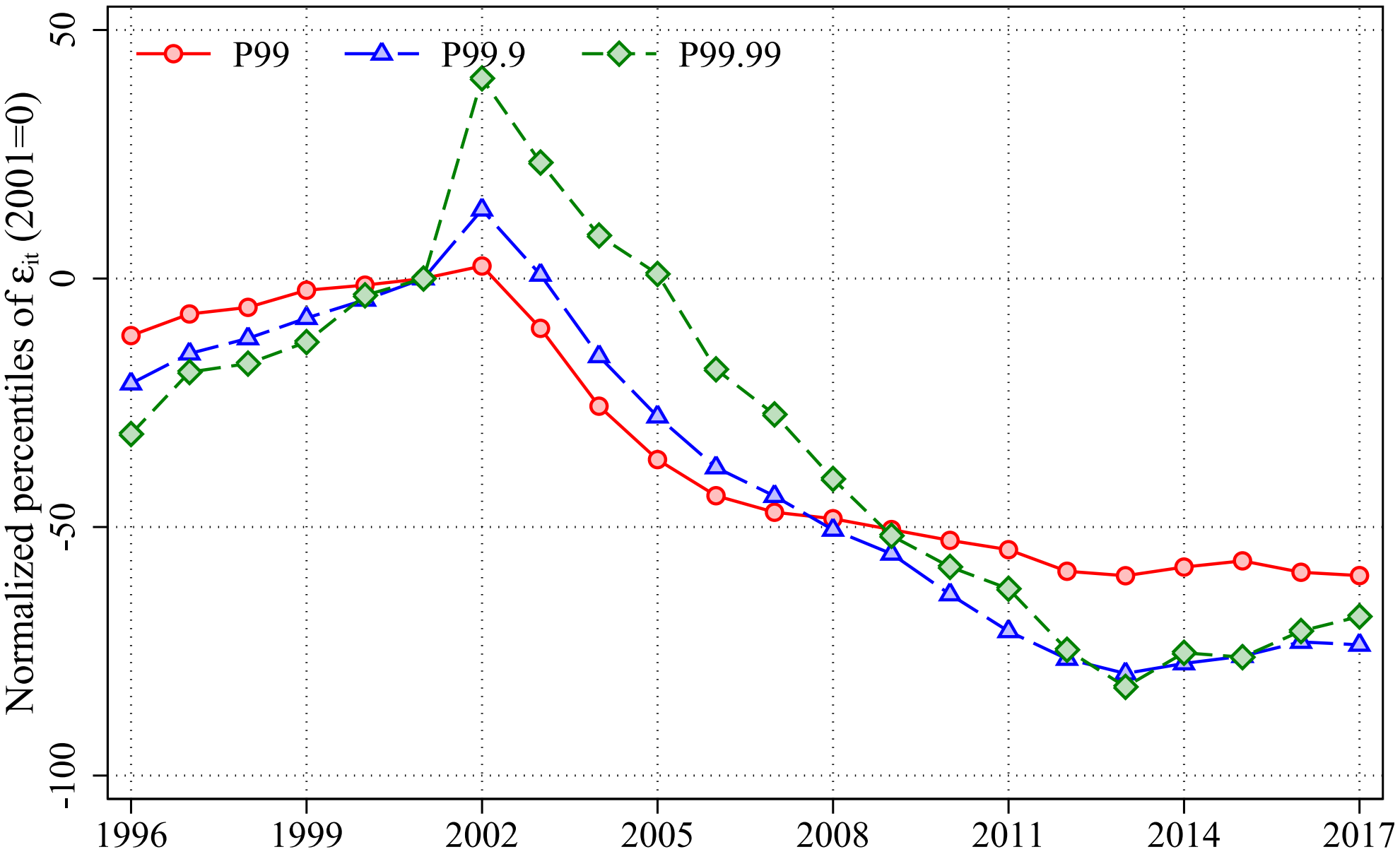
Variance of Log Residual Earnings

Back



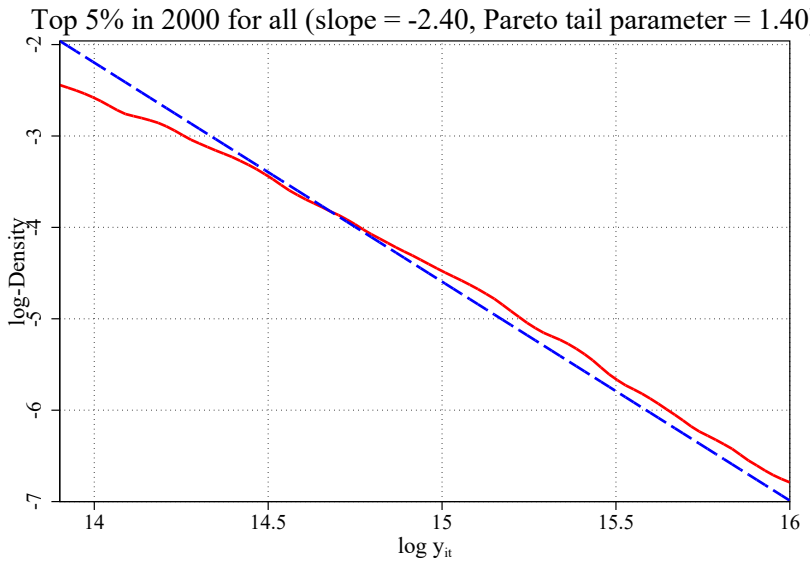
Top Log Residual Earnings Percentiles

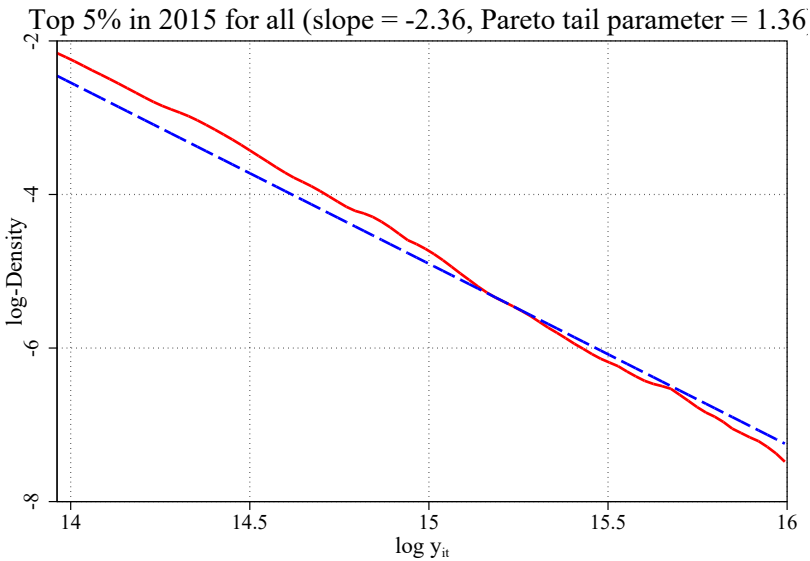
Back

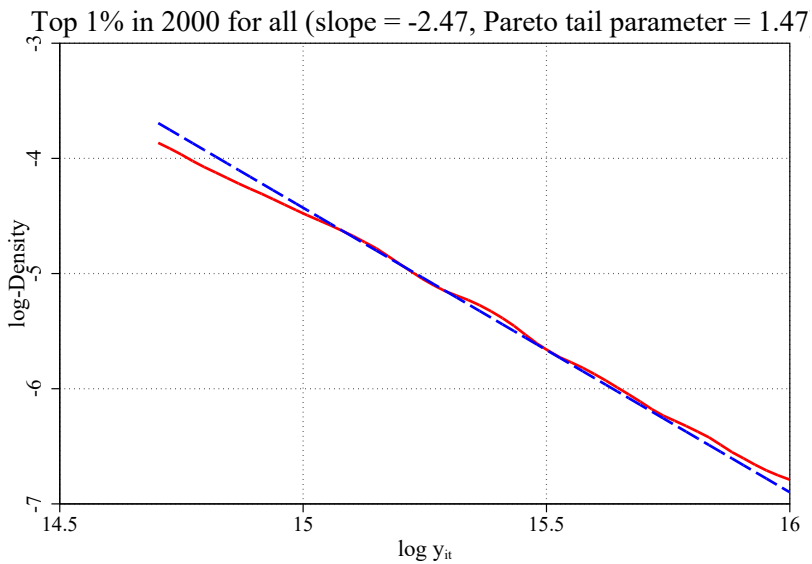


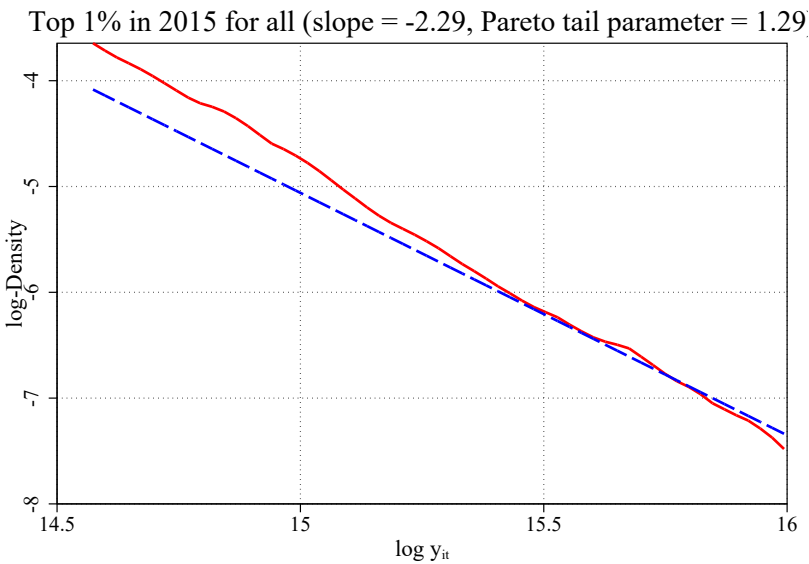
The Pareto Tail of Earnings in Log-Log Density Plots

Back





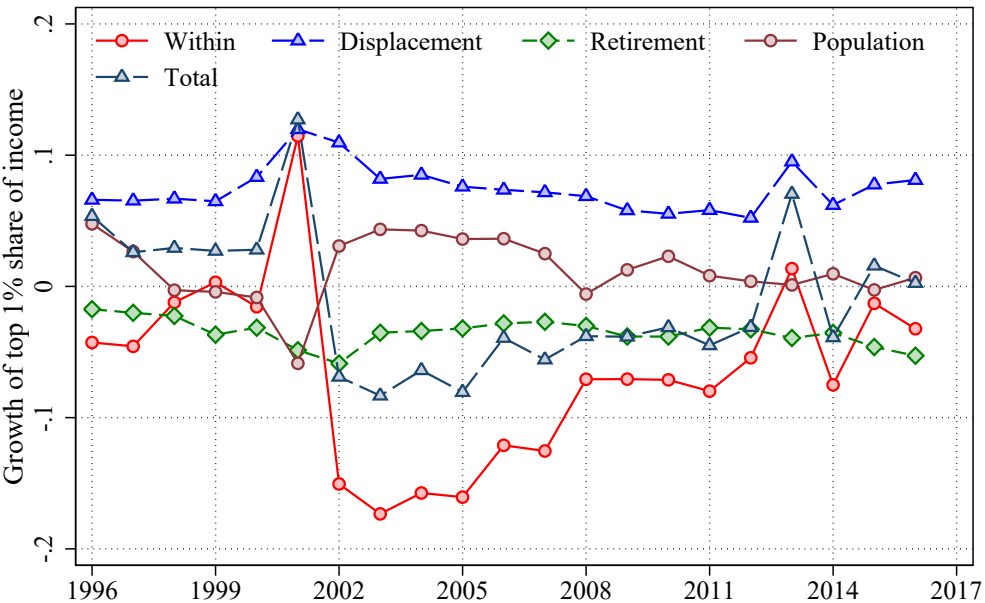


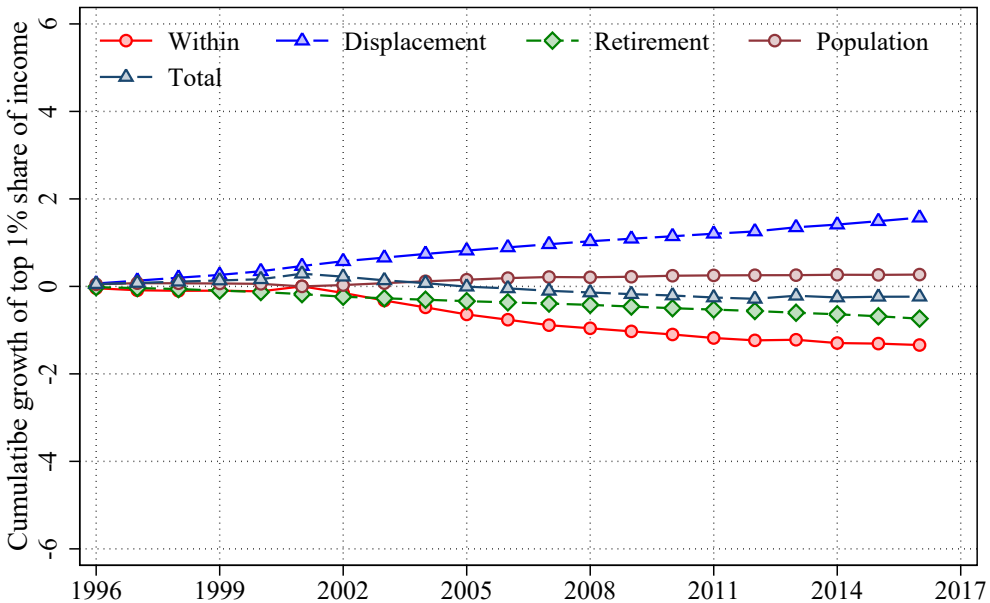


Note: Pareto tail $\alpha = (-\text{slope} - 1)$ in log-log density plots.

Gomez ('19) Decomposition of Top Income Growth

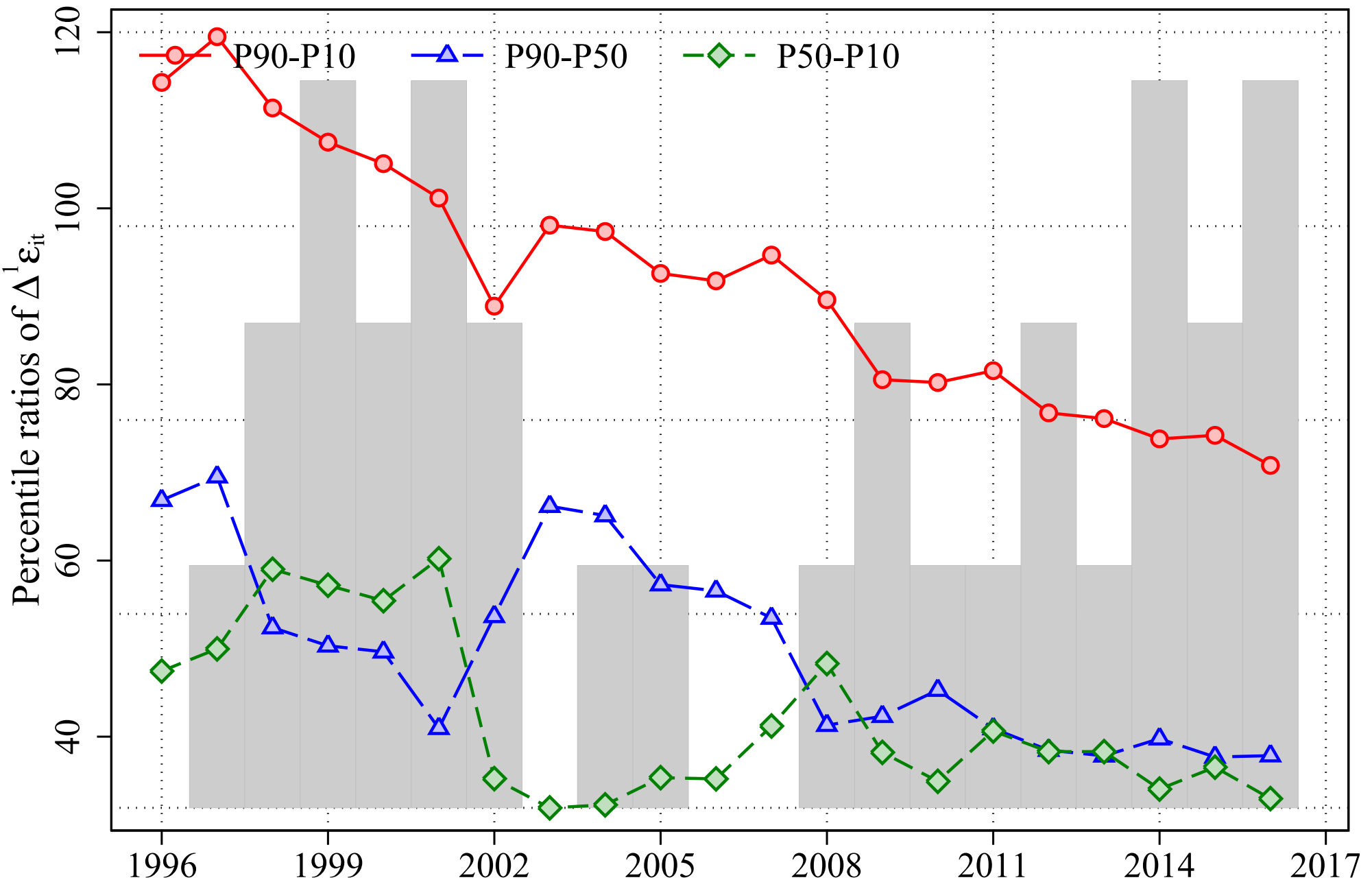
Back





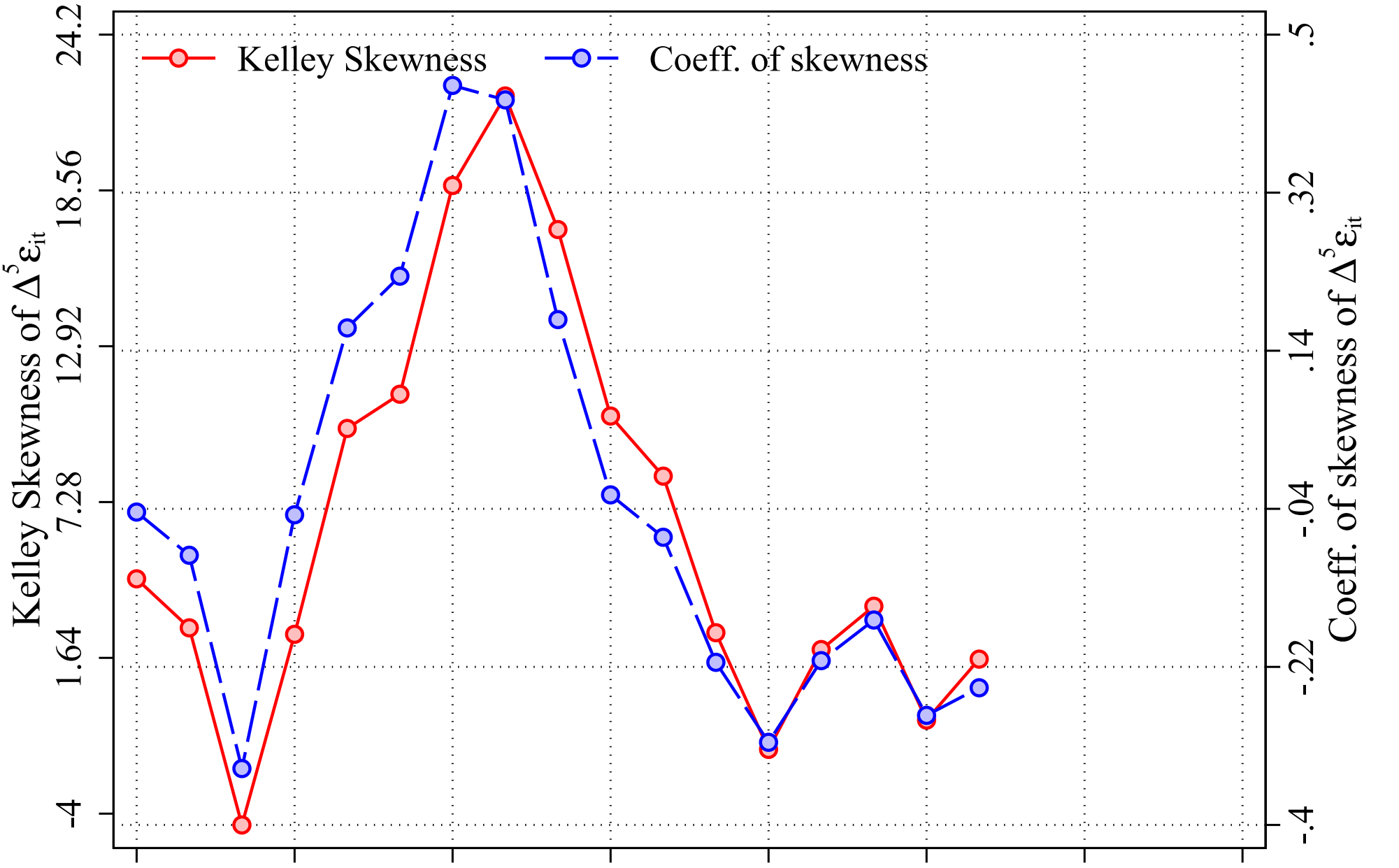
Log Perc. Ratios of 1-Year Resid. Earnings Change

Back



Comparison of Measures of Skewness of 5-Year Residualized Earnings Change

Back



Skewness of 1-Year Residualized Earnings Change

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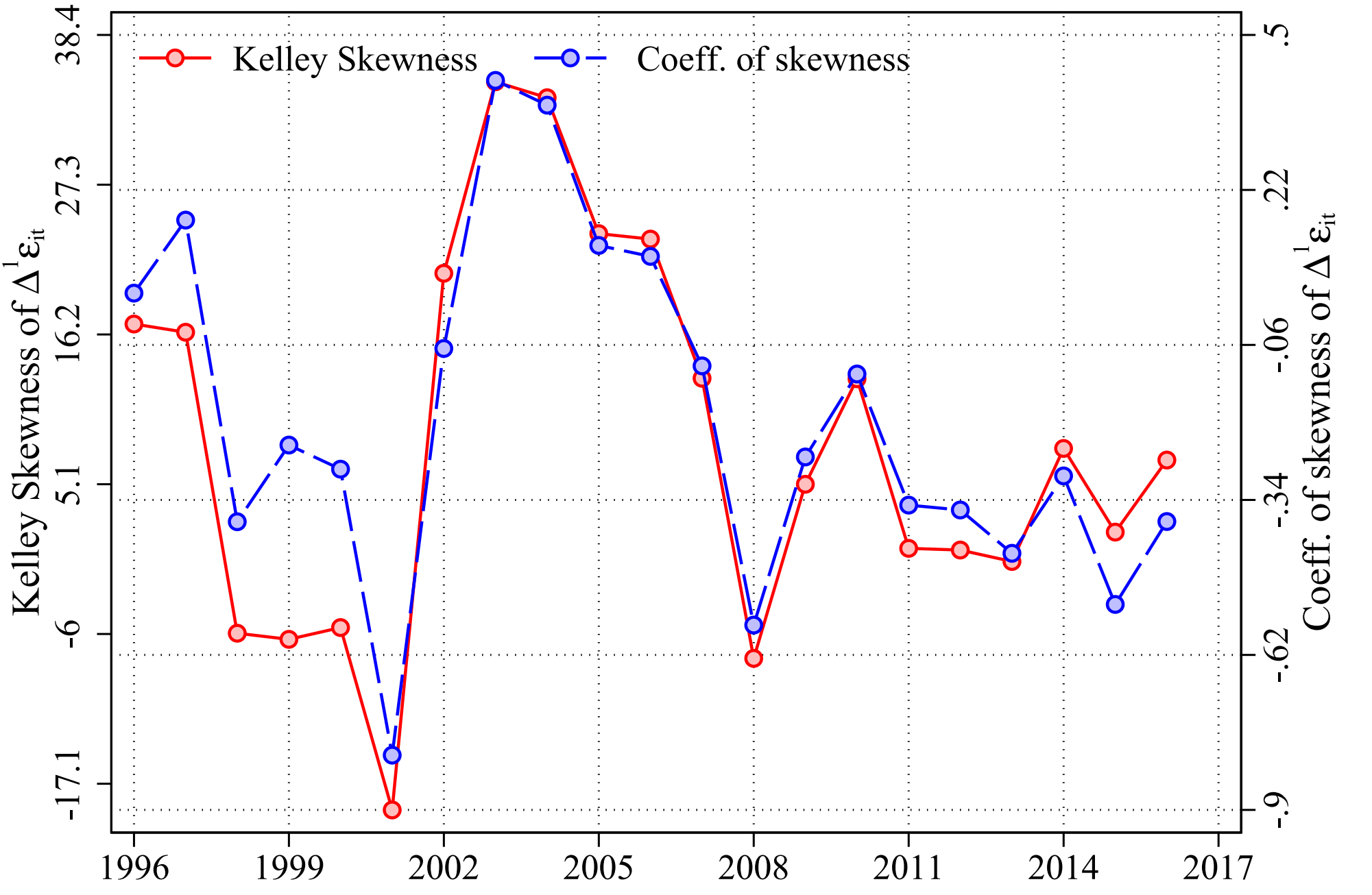
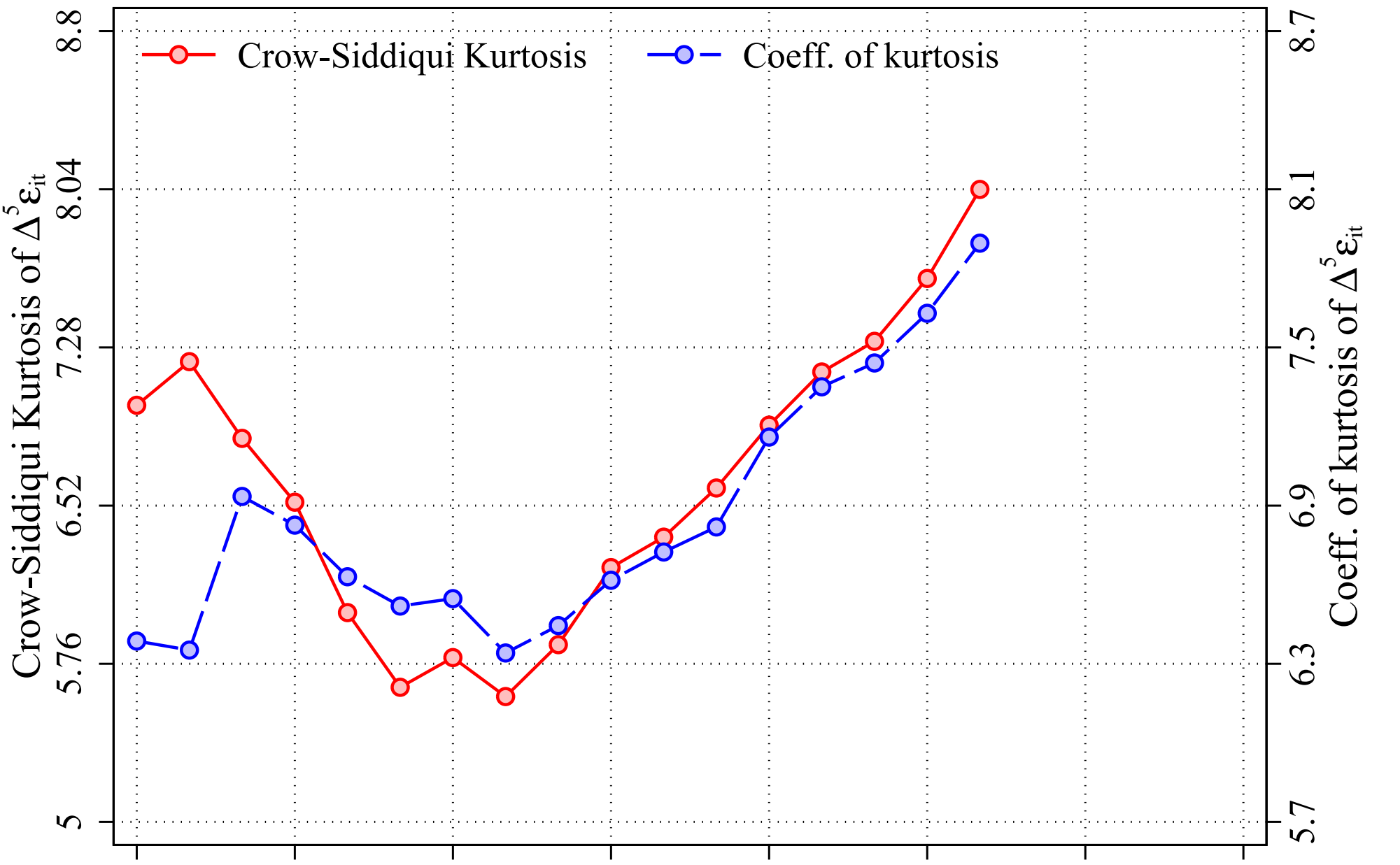


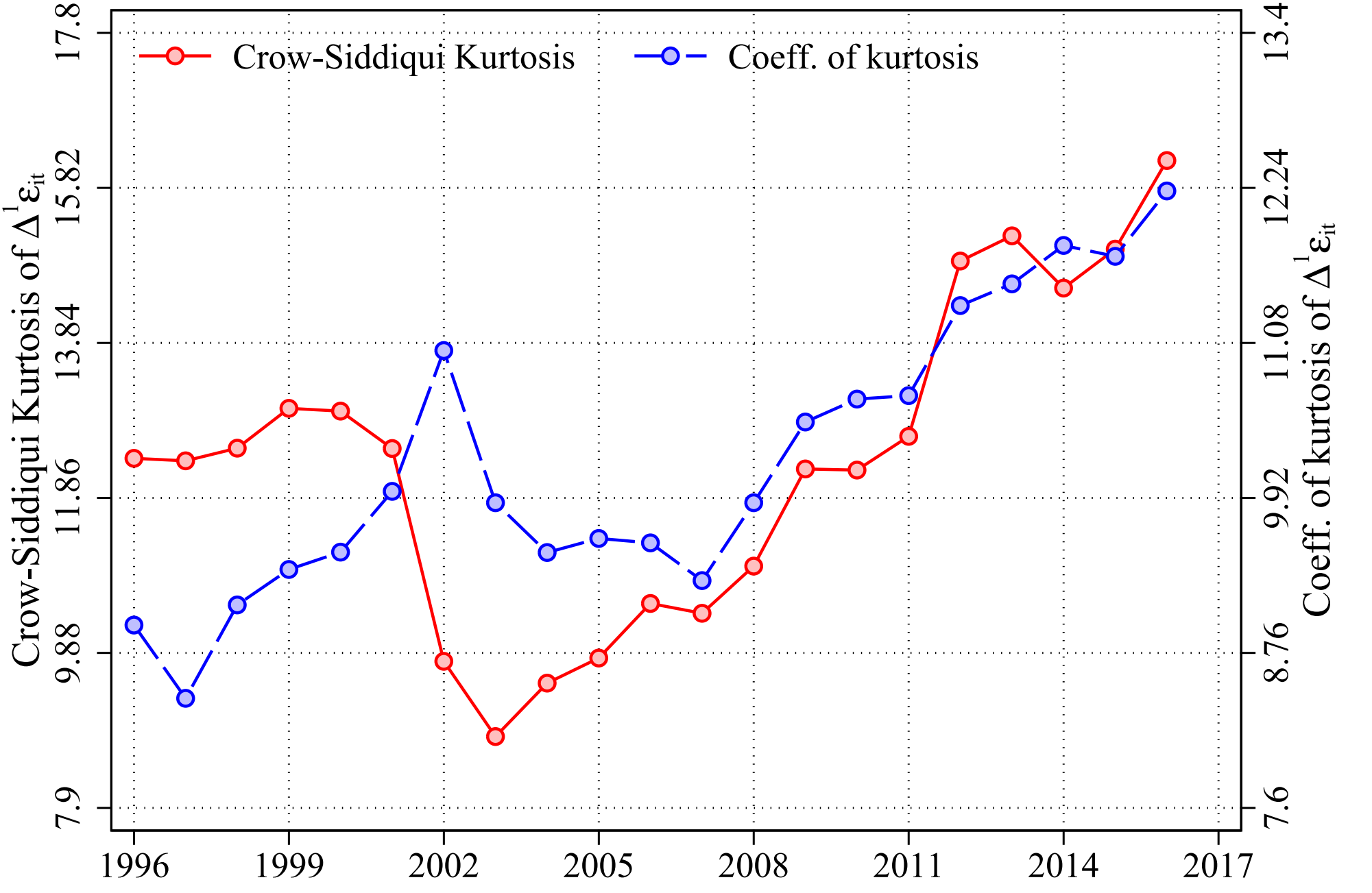
Comparison of Measures of Kurtosis of 5-Year Residualized Earnings Change

Back



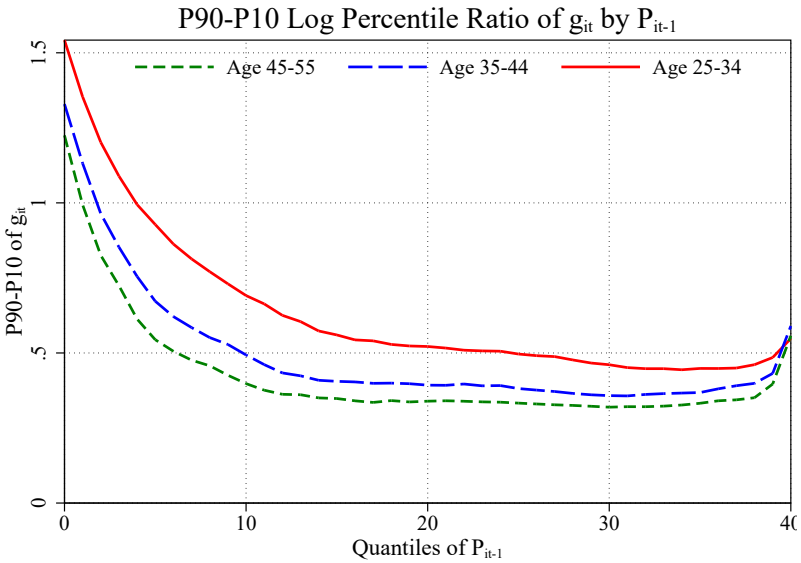
Kurtosis of 1-Year Residualized Earnings Change

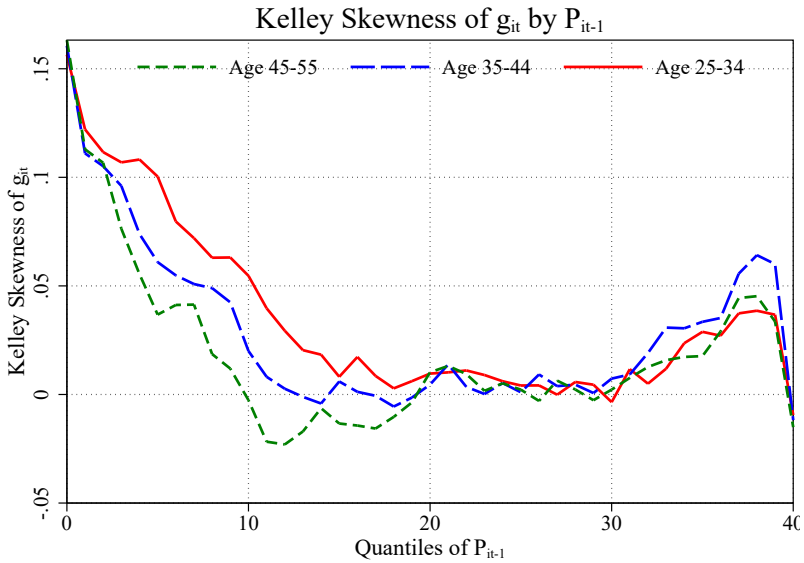
Back

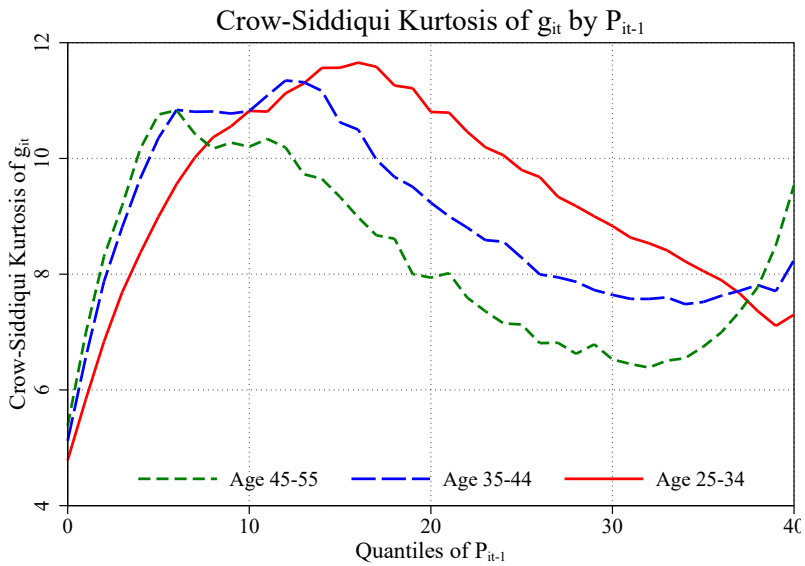


1-Year Resid. Earnings Changes, by Age & Perm. Income

Back

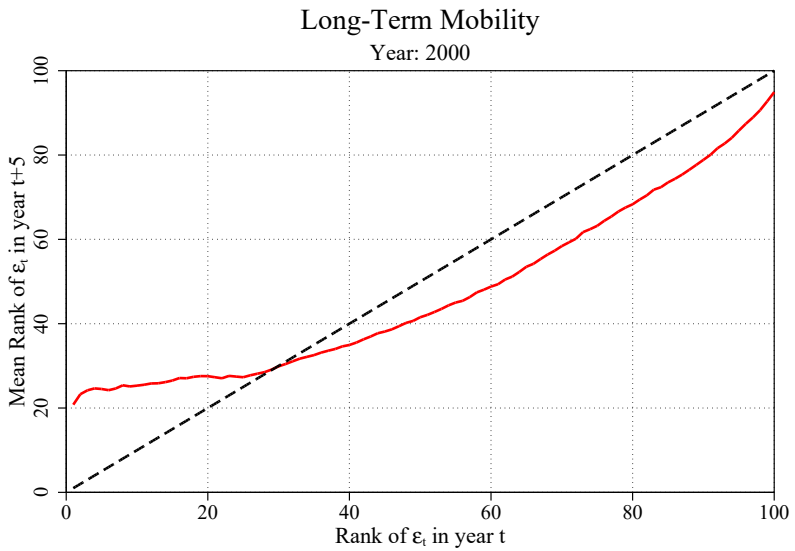


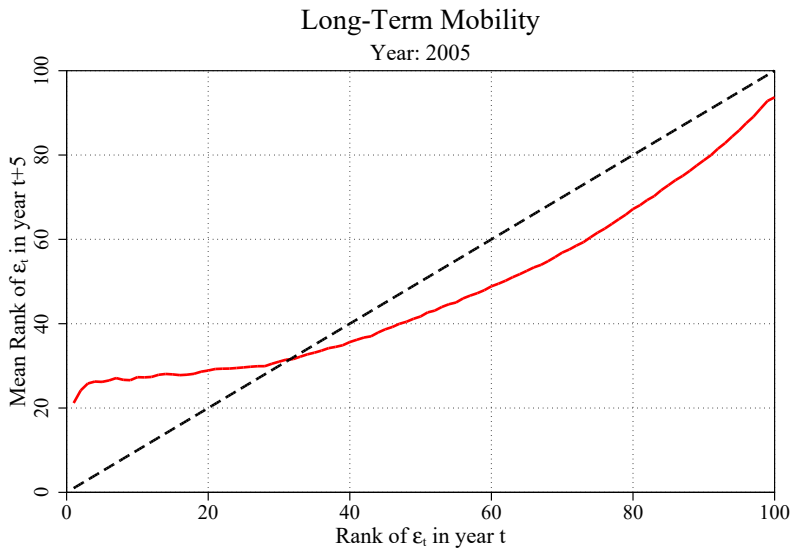


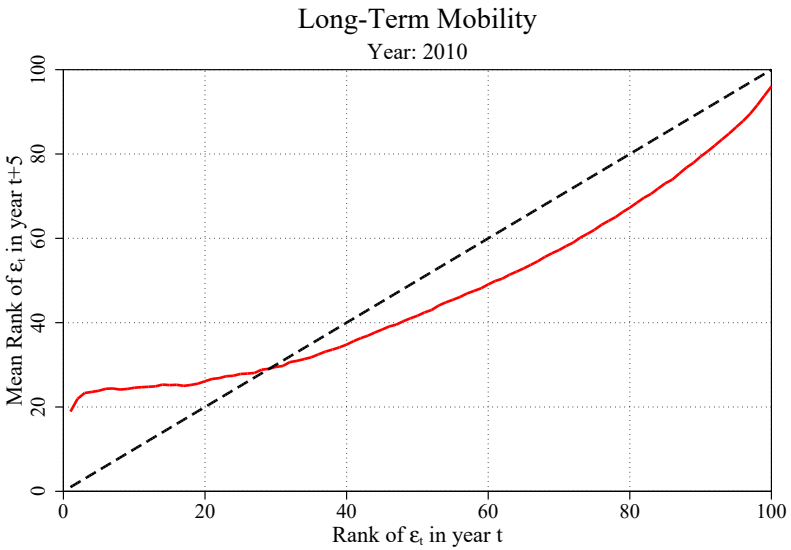


Long-Term Mobility in Residual Income, Various Years

Back

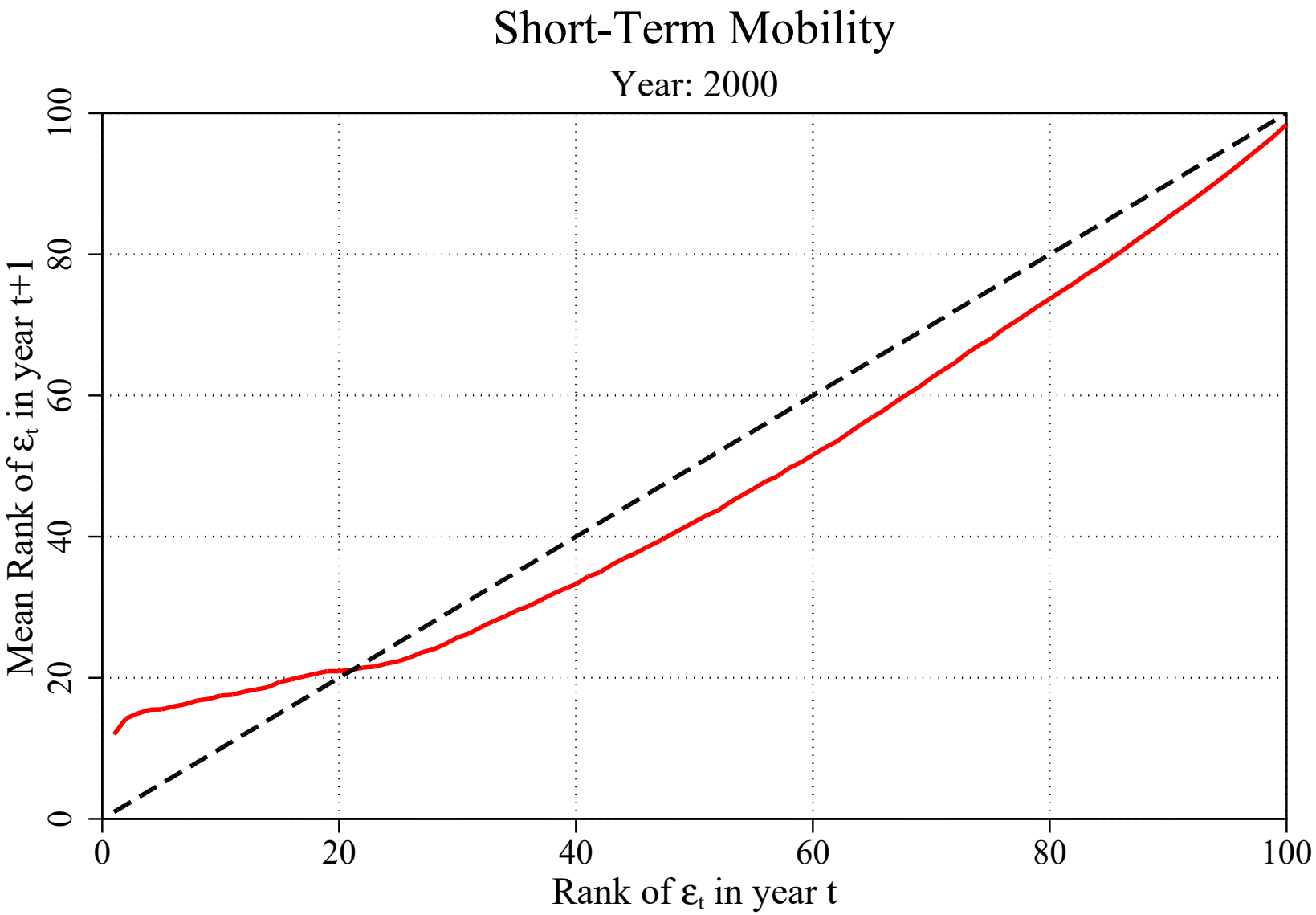






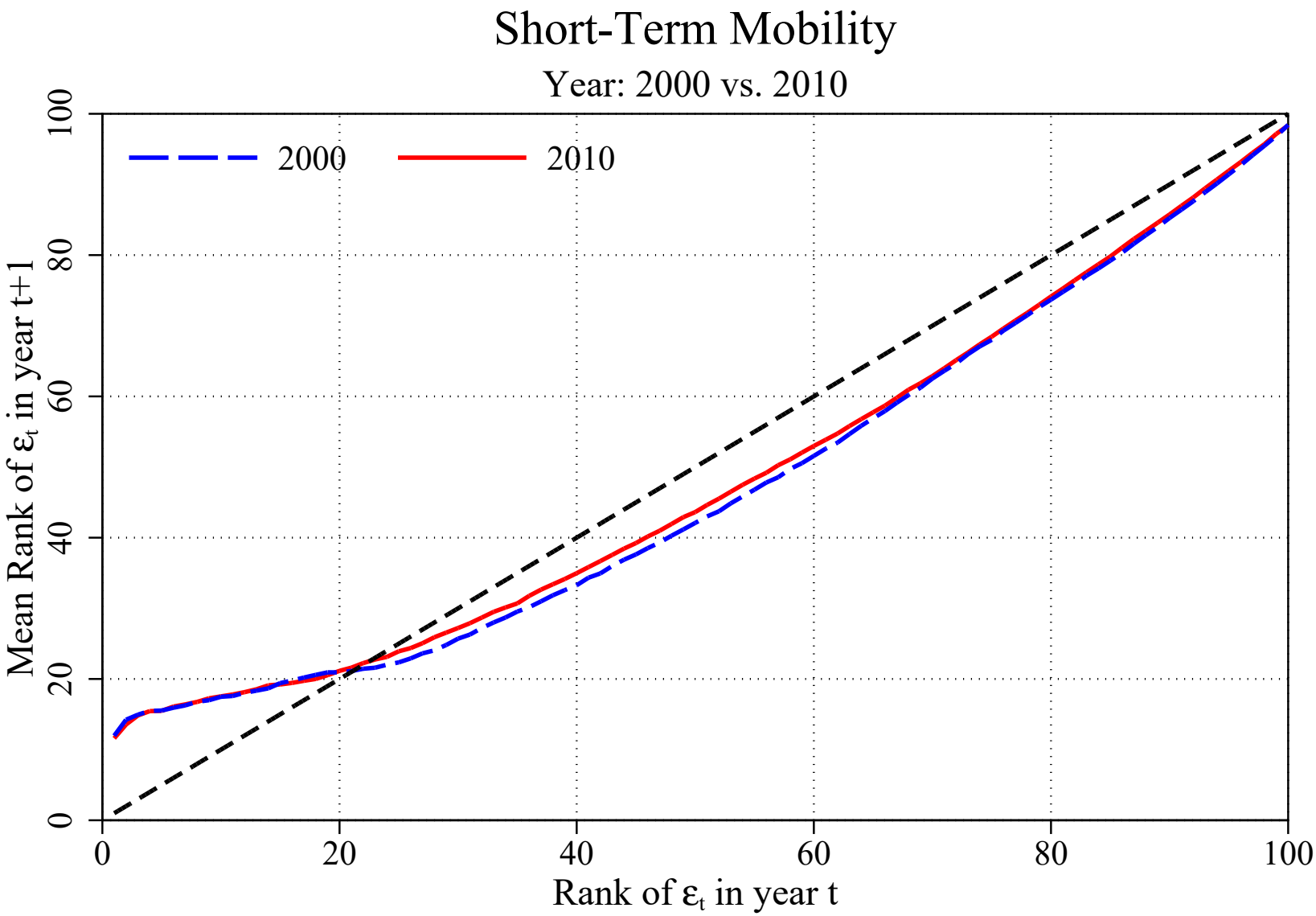
Short-Term Mobility in Residual Income, 2000

Back



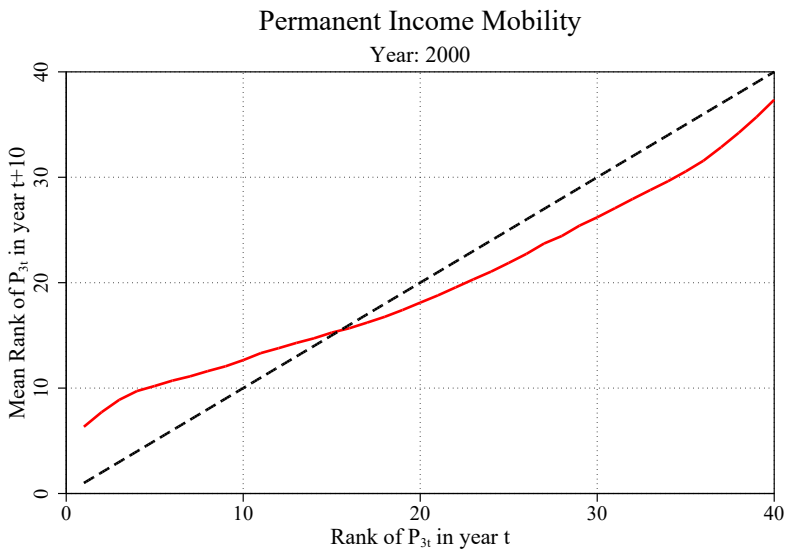
Short-Term Mobility in Residual Income, 2000 vs. 2010

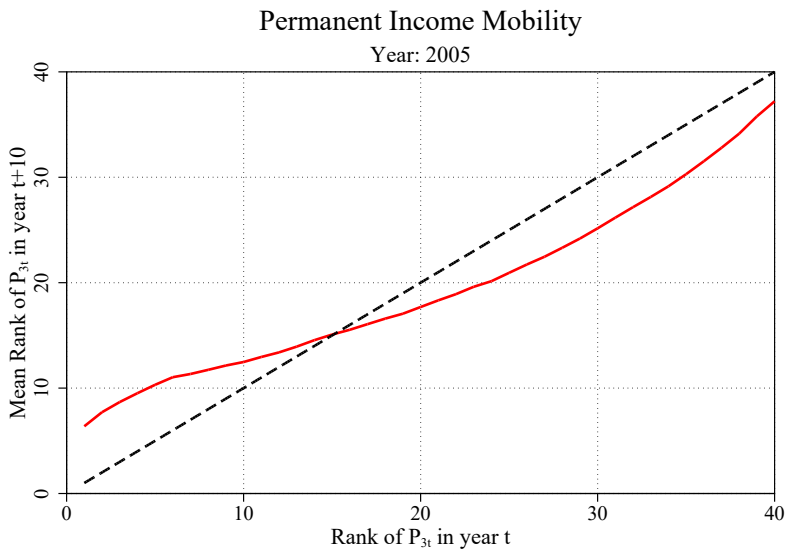
Back



Permanent Mobility in Residual Income, Various Years

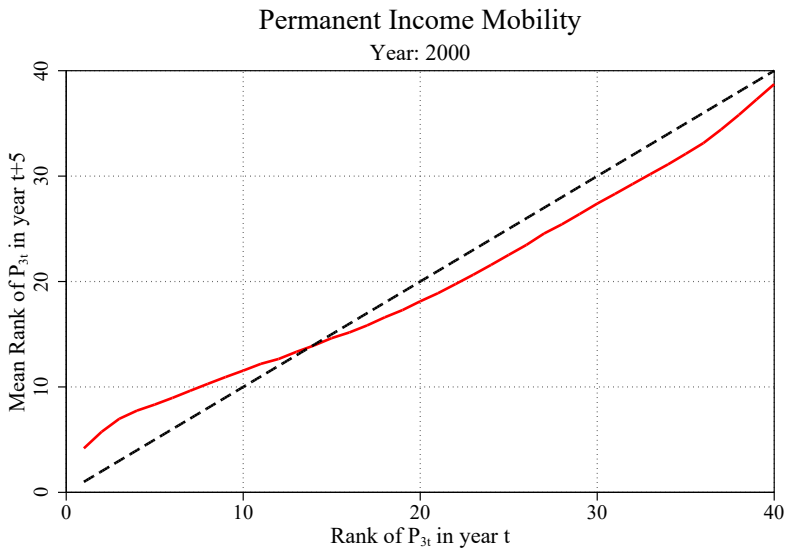
Back

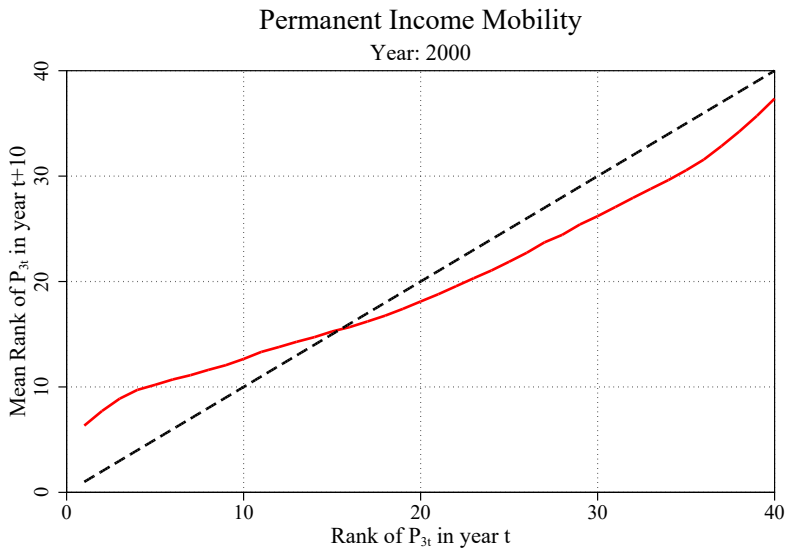


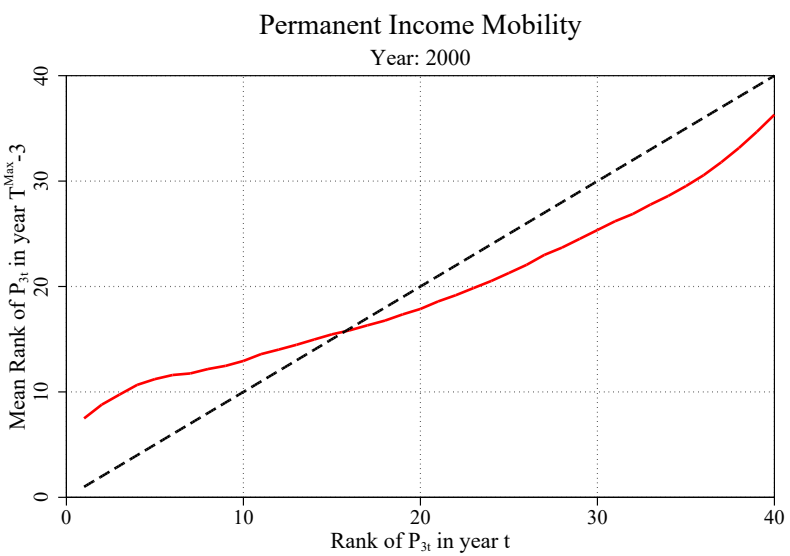


Measures of Perm. Mobility in Residual Income, 2000

Back







Kehoe and Midrigan, JME 2014 Return

- Intuition behind construction of regular wage
  1. Regular wage is the running mode of the original series
  2. Adjust regular wage changes to coincide with wage changes
- Next, formal description of algorithm
  - l : number of periods before & after to construct mode
  - c : cutoff for temporary wages
  - a : number of periods available
- w_{it} : worker i income in period t

Kehoe and Midrigan Algorithm

Return

1. Construct $h_{it} = \sum_{j=-l}^{l} \mathbb{I}(w_{it+j} \text{ non missing})/(2l)$ for all $t \in [l+1, T-l]$

2. Set $f_{it} = \sum_{j=-l}^{l} \mathbb{I}(w_{it+j} \text{ non missing}, w_{it+j} = w_{it}^{m})/(2l)$, where

$$w_{it}^{m} = \begin{cases} mode\{p_{it-l}, \ldots, p_{it+l}\} & \text{If } h_{it} \geq a \\ . & \text{Otherwise} \end{cases}$$

3. Define w_{it}^{r} with the recursive algorithm

   3.1 Set $w_{il+1}^{r} = w_{il+1}^{m}$ if $w_{il+1}^{m} \neq .$/otherwise set $w_{il+1}^{r} = w_{il+1}$

   3.2 For $t \in [l+2, T-l]$

$$w_{it}^{r} = \begin{cases} w_{it}^{m} & \text{if } w_{it}^{m} \neq . \ \& \ f_{it} > c \ \& \ w_{it} = w_{it}^{m} \\ w_{it-1}^{r} & (w_{it}^{m} = . \ or \ f_{it} \leq c \ or \ w_{it} \neq w_{it}m) \end{cases}$$

Kehoe and Midrigan Algorithm Cont' Return

4. Repeat the following algorithm 5 times

$$w^r_{i\{\mathcal{R}\cap\mathcal{C}\}-1} = w_{i\{\mathcal{R}\cap\mathcal{C}\}} \quad \text{and} \quad w^r_{i\{\mathcal{R}\cap\mathcal{P}\}} = w_{i\{\mathcal{R}\cap\mathcal{P}\}-1}$$

- $\mathcal{R}$: Periods with regular wage changes

$$\mathcal{R}_i = \{t : w^r_{it} \neq w^r_{it-1} \quad \& \quad w^r_{it-1} \neq . \quad \& \quad w^r_{it} \neq .\}$$

- $\mathcal{C}$: Periods with regular wages

$$\mathcal{C}_i = \{t : w^r_{it} = w_{it} \quad \& \quad w^r_{it} \neq 0 \quad \& \quad w_{it} \neq 0\}$$

- $\mathcal{P}$: Periods where the last period wage was regular

$$\mathcal{P}_{i1} = \{t : w^r_{it-1} = w_{it-1} \quad \& \quad w^r_{it-1} \neq 0 \quad \& \quad w_{it-1} \neq 0\}$$

$$\mathcal{P}_i = \mathcal{P}_{i1}/(\mathcal{P}_{i1} \cap \mathcal{R}_i \cap \mathcal{C}_i)$$

Kehoe and Midrigan Algorithm Cont' Return

- Two examples for step 4:
  - Regular wage: $w^r_{i98} = 1,\ w^r_{i99} = 1,\ w^r_{i100} = 2,\ w^r_{i101} = 2$
  - Wage example 1: $w^1_{i98} = 1,\ w^1_{i99} = 2,\ w^1_{i100} = 2,\ w^1_{i101} = 2$
  - Wage example 2: $w^2_{i98} = 1,\ w^2_{i99} = 1,\ w^2_{i100} = 1,\ w^2_{i101} = 2$
- Set $\mathcal{R}$, $\mathcal{C}$, and $\mathcal{P}$
  - Ex. 1: $\{100\} \subset \mathcal{R}_{i1},\ \{98, 100, 101\} \subset \mathcal{C}_{i1},\ \{99, 101\} \subset \mathcal{P}_{i1}$

    $$w^r_{i\{\mathcal{R}_{i1} \cap \mathcal{C}_{i1}\}-1}(w^r_{i99}) = w_{i\{\mathcal{R}_{i1} \cap \mathcal{C}_{i1}\}}\ (w_{i100})$$
  - Ex. 2: $\{100\} \subset \mathcal{R}_{i2},\ \{98, 99, 101\} \subset \mathcal{C}_{i2},\ \{98, 99, 100\} \subset \mathcal{P}_{i2}$

    $$w^r_{\{\mathcal{R}_{i2} \cap \mathcal{P}_{i2}\}}(w^r_{i100}) = w_{i\{\mathcal{R}_{i2} \cap \mathcal{P}_{i2}\}-1}\ (w_{i99})$$
- If $\mathcal{R}_i \cap \mathcal{P}_i \cap \mathcal{C}_i \neq \emptyset$, there could be cicles

- Intuition behind construction of regular wage
  1. Drop wage changes preceded and followed by same wage
  2. Drop large inverse v-shape wage changes
- Next, formal description of algorithm
  - κ : number of periods before & after to drop Δw
  - ϵ : small wage changes
  - η : large inverse-v shape wage changes
- w_{it} : worker i income in period t

Blanco Algorithm Cont'

Return

1. Construct $\mathcal{F}_k$ and $\mathcal{L}_k$

$$\mathcal{F}_k = \left\{(i,t) : |\sum_{j=0}^{\kappa} \Delta w_{t+j}| < \epsilon\right\} \quad \& \quad \mathcal{L}_k = \left\{(i,t) : |\sum_{j=0}^{\kappa} \Delta w_{t-j}| < \epsilon\right\}$$

   - Observation: $(i^*, t^*) \in \mathcal{F}_k \iff (i^*, t^* + \kappa) \in \mathcal{F}_k$

2. Drop $\Delta w_{i,t}$ between (i, t^*) and $(i, t^* + \kappa)$

3. Drop $\Delta w_{i,t}$ if $\Delta w_{i,t} > \eta$ and $\Delta w_{i,t+1} < -\eta$

Nakamura and Steinsson, QJE 2008 Return

1. Idea: remove (inverse) V-shape
2. Next, formal description of algorithm
   - J: Months in step 8 (period for wage returning)
   - L: Months in step 3 (prevalence of regular price)
   - K: Number of different elements in step 3 (prevalence of regular price)
3. w_{it} : worker i income in period t
4. For each period t, repeat 1 to 6

NS Algorithm (paper) Return

0 If $w^r_{it-1} = w_{ti}$, then $w^r_{ti} = w_{ti}$

1 If $w_{ti} < w^r_{it-1}$ (¿), then $w^r_{it} = w_{ti}$

2 If $w^r_{it-1} \in \{w_{t+1}, \ldots, w_{t+J}\}$ and $w_{it+j} \geq w^r_{it-1} (\leq) \forall j \leq J$, then $w^r_{it} = w^r_{it-1}$

3 If $\{w_{it}, \ldots, w_{it+L}\}$ has K or more element, $w^r_{it} = w_{it}$

4 Set $w^{\min}_{it} = \min\{w_{it}, \ldots, w_{it+L}\}$, $k^{\min}_{it} = \text{first-time-min}\{w_{it}, \ldots, w_{it+L}\}$,

If $w^{\min}_{it} = \min\{w_{ik^{\min}_{it}}, \ldots, w_{k^{\min}_{it}+L}\}$, then $w^r_{it} = w^{\min}_{it}$ (max)

5 Set $w^r_{it} = w_{it}$

NS Algorithm (numerical implementation $K = 3$)

Return

1. Set $J = j$ and generate w_{it}^{rJ}
   - Set $w_{it}^{rj} = .$
   - Step 3: If $\{w_{it}, \ldots, w_{it+L}\}$ has K or more element, $w_{it}^{rj} = w_{it}$
     - Imp.: $\exists x \in \{w_{it}, \ldots, w_{it+L}\}$ s.t. $x \neq \min\{\cdot\}$ or $x \neq \max\{\cdot\}$
   - Step 4: If $\ldots$ and $w_{it}^{rj} = .$, $w_{it}^{rj} = w_{it}$
     - Imp.: If $\exists l \leq L$ s.t.

$$\min\{w_{it}, \ldots, w_{it+L}\} = \min\{w_{it+j}, \ldots, w_{it+j+L}\}$$

       set $w_{it}^{r} = \min\{w_{it}, \ldots, w_{it+L}\}$.
   - Step 5: If $w_{it}^{rj} = .$, set $w_{it}^{rj} = w_{it}$

NS Algorithm (numerical implementation $K = 3$)

Return

2 Given w_{it}^{rj+1} generate w_{it}^{rj}

- Set $w_{it}^{rj} = .$
- Step 0: If $w_{it}^{rj+1} = w_{it}$, set $w_{it}^{rj} = w_{it}$
- Step 1: If $w_{it}^{rj} = . \ \& \ w_{it} < w_{it}^{rj+1}$, set $w_{it}^{rj} = w_{it}$
- Step 2: If $w_{it}^{rj} = . \ \& \ \exists \ k \leq J \ s.t. \ w_{it+k} = w_{it}^{rj+1}$, set $w_{it}^{rj} = w_{it}^{rj+1}$
- Step 3: Same as with $j = J$
- Step 4: Same as with $j = J$
- Step 5: Same as with $j = J$

Stevens, Restud 2019

Return

1. Idea: Apply the Kolmogorov-Smirnov test
2. Next, formal description of algorithm
   - K: critical value (if there is no break)
   - W: minimum length of wages without breaks
3. $\{w_{it}\}_{t=1}^{T}$: worker's i income in period $t = 0, \ldots, n$
4. Identify $\{\tau_i\}_{i=0}^{m}$ increasing sequence of breaks ($\tau_0 = 1, \tau_m = T$)

Stevens' Algorithm

Return

1. Set $m = 1$
2. For each $\{\{w_{it}\}_{t=\tau_i}^{\tau_{i+1}}\}_{i=0}^{m-1}$

$$S_i = \sqrt{\tau_{i+1} - \tau_i + 1} \max_{\tau_i \le t \le \tau_{i+1}} \left[\frac{t - \tau_i}{\tau_{i+1} - \tau_i + 1} \frac{\tau_{i+1} + 1 - t}{\tau_{i+1} - \tau_i + 1} D_t \right]$$

$$D(t) = \sup_w |F_{\tau_i, t}(w) - F_{t+1, \tau_{i+1}}(w)|$$

   - $F_{t_1, t_2}(w)$: empirical cdf btw t_1 and t_2

3. If $S_i \le K$ for all i, stop. If $S_i > K$ for some i, do 4 and 5
4. If $S_i \le K$, there is more breaks btw τ_i and τ_{i+1}
5. If $S_i > K$, add new break between τ_i and τ_{i+1}

$$\tau = \arg \max_{\tau_i \le t \le \tau_{i+1}} \sqrt{\frac{(t - \tau_i)(\tau_{i+1} + 1 - t)}{\tau_{i+1} - \tau_i + 1} D_n(t)}$$

Go to 2

Monte Carlo simulation model

Return

1. Monte Carlo simulation for testing break points

$$(\tilde{w}_{it}^{P}, \tilde{a}_{it}) = (w_{t-1}^{P} - \pi_{it} + \sigma_{\epsilon}\eta_{it}, a_{it} + 1)$$

$$(w_{it}^{P}, 0) = \begin{cases} 0 & \text{if } \tilde{a}_{it} \geq T \text{ or } \tilde{w}_{it}^{P} \notin [\underline{w}, \overline{w}] \\ (\tilde{w}_{it}^{P}, \tilde{a}_{it}) & \text{Otherwise} \end{cases}$$

$$\eta_{it} = \mathcal{N}(0, \sigma_{\eta})$$

$$w_{it}^{T} = \phi_{it} + \gamma_{it}$$

$$\phi_{it} = \begin{cases} \mathcal{N}(m_{\phi}, \sigma_{\phi}) & \text{If June or December} \\ 0 & \text{Otherwise} \end{cases}$$

$$\gamma_{it} = \begin{cases} \mathcal{N}(0, \sigma_{\gamma}) & \text{with probability } \beta \\ 0 & \text{with probability } 1 - \beta \end{cases}$$

2. Wage: $w_{it}^{T} + \sum_{j=t_0}^{t} \Delta w_{ij}^{P} I(w_{ij}^{P} = 0)$
3. Breakpoints: $I(w_{it}^{P} = 0)$

SMM results

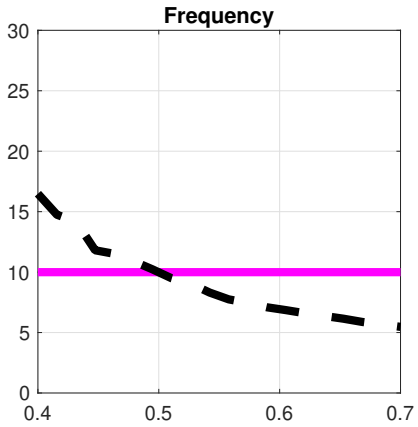
Return

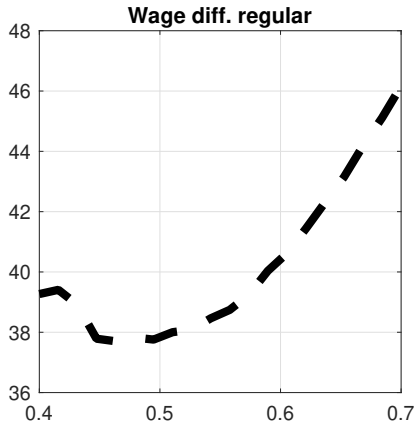
Model	Data	Model
Std 1-yr wage change	0.297	0.295
Std 1-mo wage change	0.243	0.246
Frequency 1-yr wage change	0.030	0.030
Frequency 1-mo wage change	0.219	0.219
Mean 1-mo wage change June/December	0.336	0.335
Std 1-mo wage change June/December	0.261	0.264
3rd gen. CV 1-yr wage change	5.685	5.678
Mean 1-yr wage change	0.044	0.043

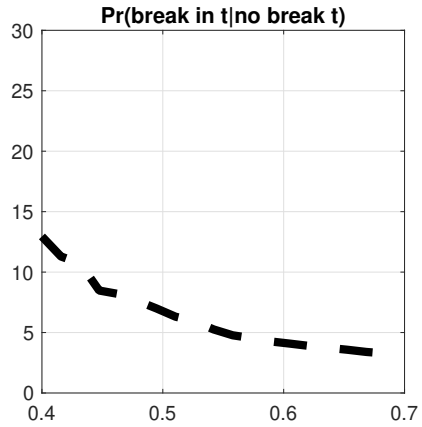
Parameters	Value
$(T, \underline{w}, \overline{w}, \sigma_\eta)$	(19,-0.25,1.47,0.054)
$(m_\phi, \sigma_\phi, \sigma_\gamma, \beta)$	(0.39,0.006,0.20,0.49)

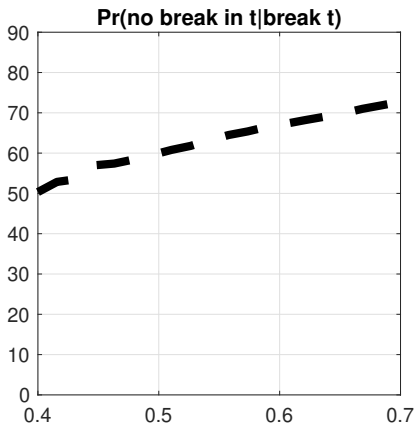
Calibration of K

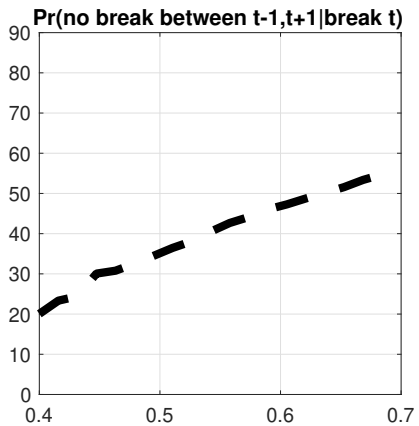
Return

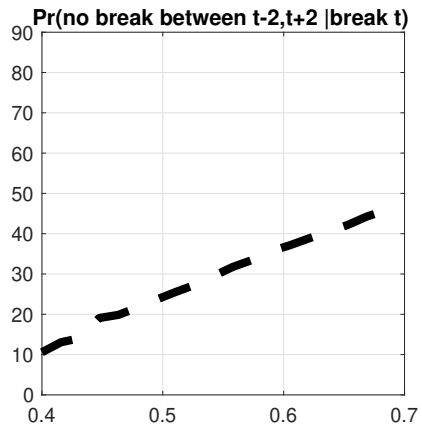






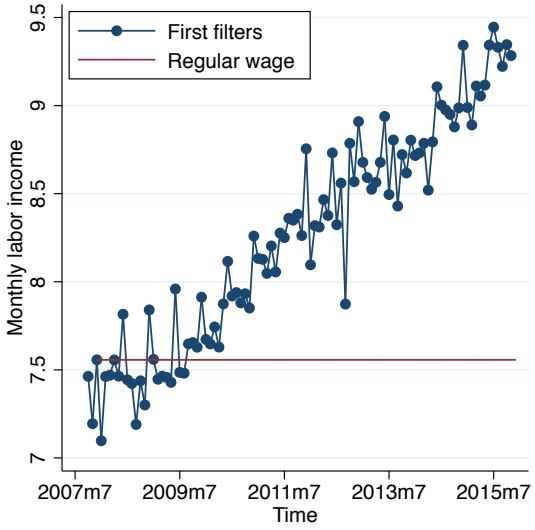




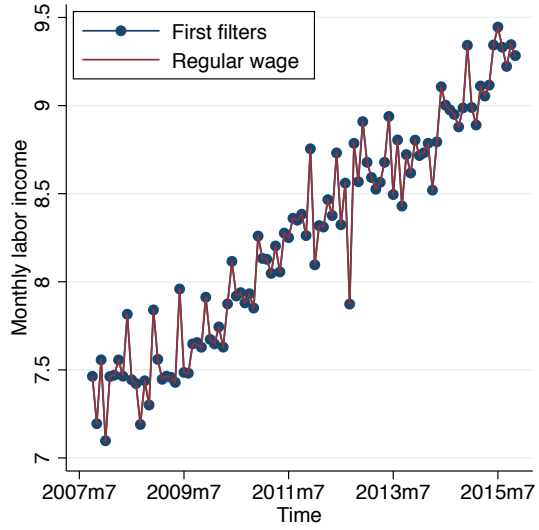


Regular wage under alternative filters

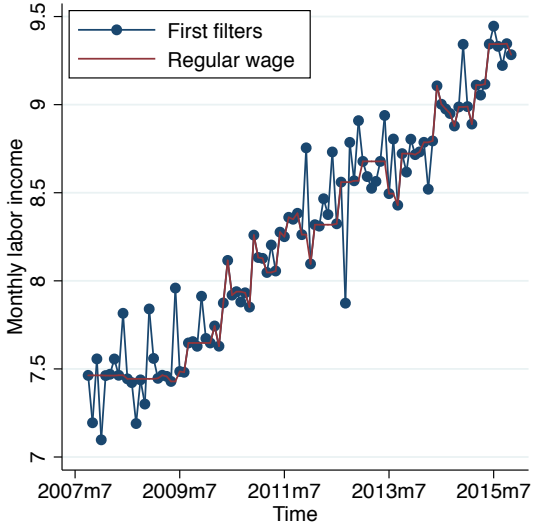
(a) Kehoe-Midrigan



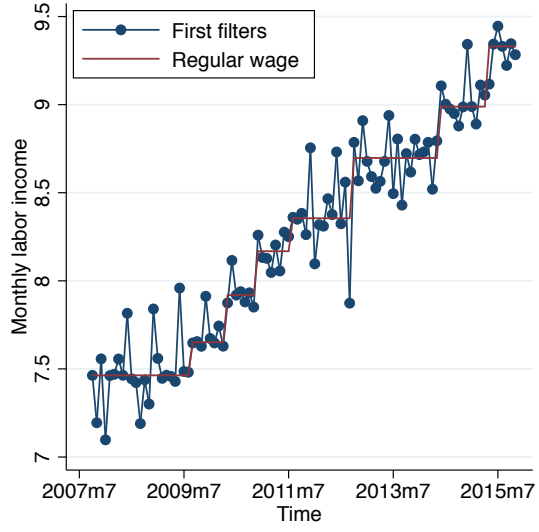
(b) Nakamura-Steinsson



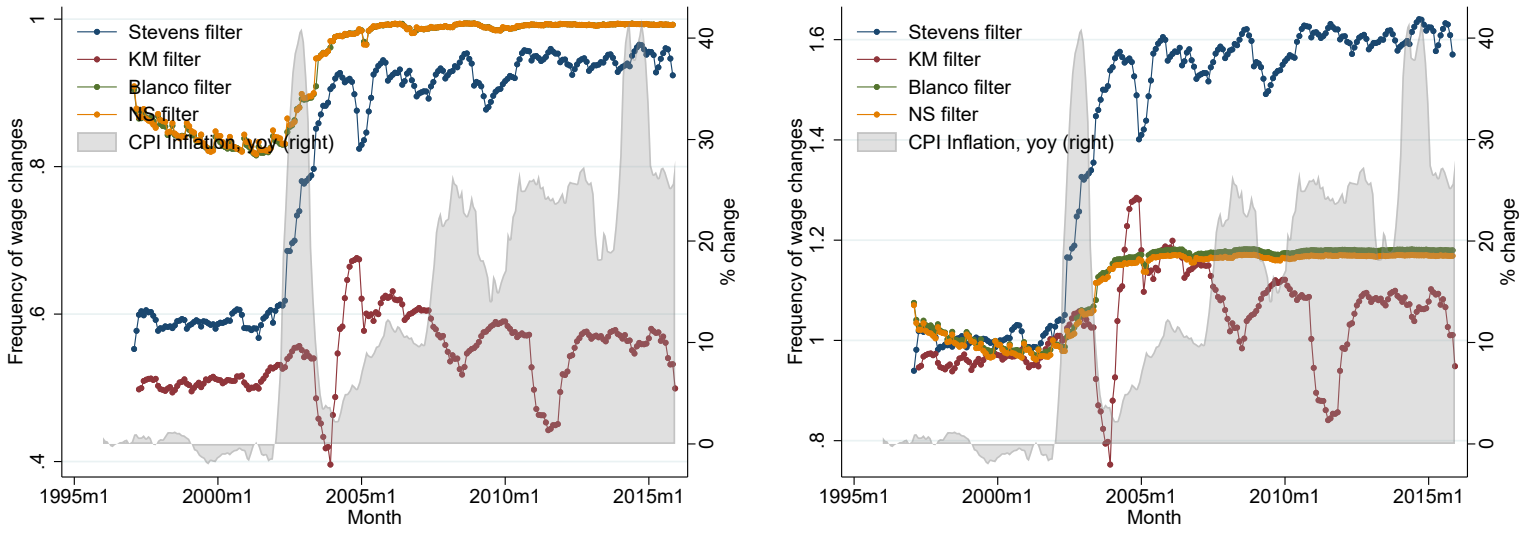
(c) Blanco



(d) Stevens

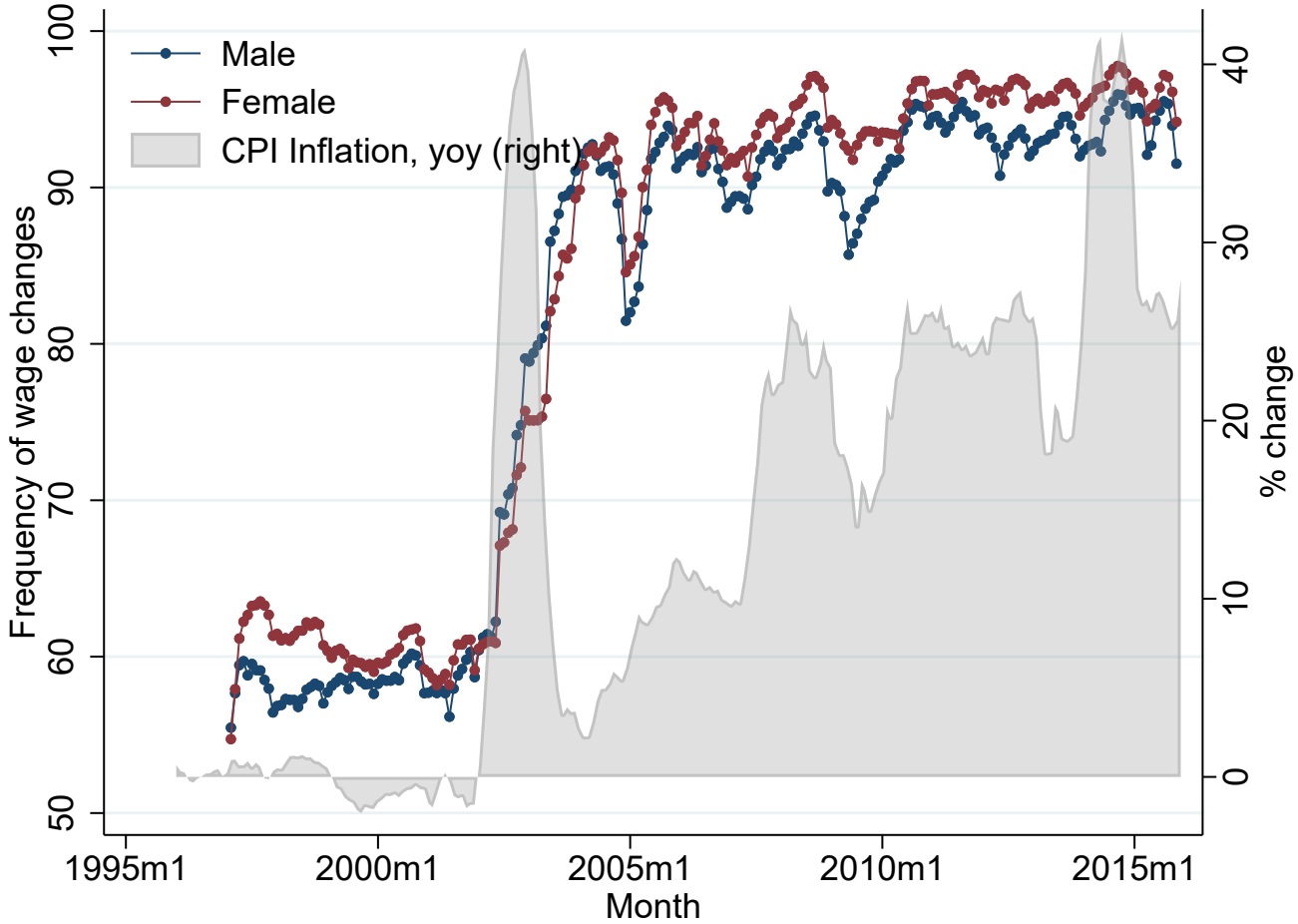


Frequency of wage changes under alternative filters



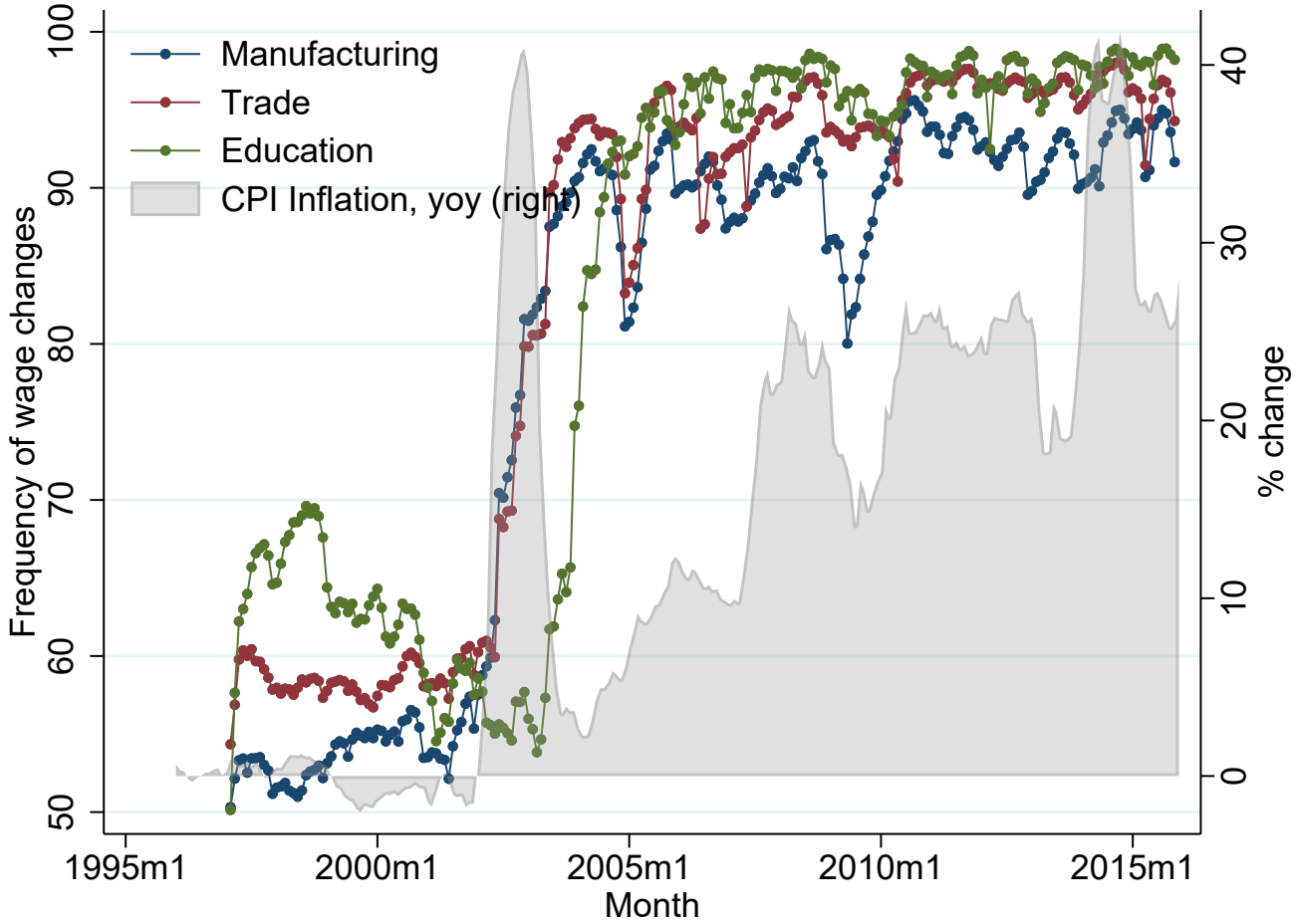
Frequency of 12-month average wage changes
(right: index Dec-2001=1)

Frequency of 12-month wage changes: gender



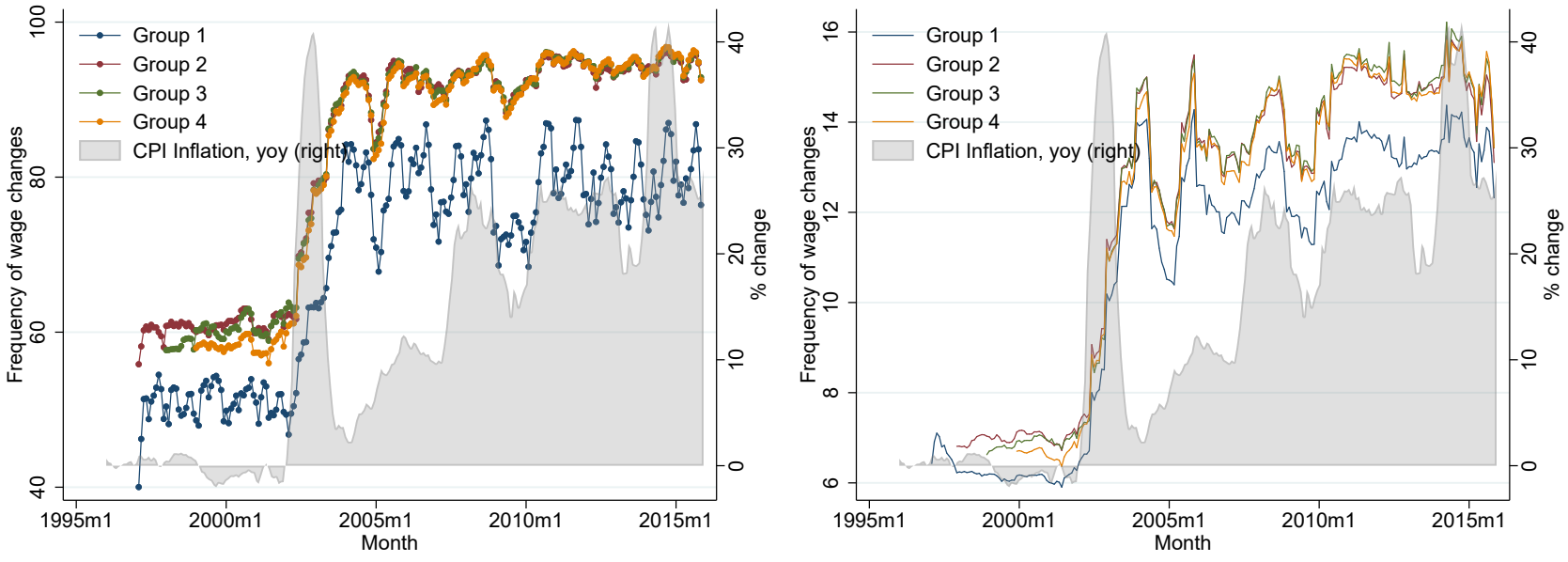
Freq. of wage changes for women is higher and less pro-cyclical than for men

Frequency of 12-month wage changes: sectors



Wages in manufacturing change less frequently and seem more pro-cyclical, and differences between sectors compress with high inflation

Frequency of wage changes: tenure groups



Workers with tenure shorter than 12 months experience lower frequency of wage changes, and differences among longer tenures are small