What Do Data on Millions of U.S. Workers Reveal About Life Cycle Income Risk?[1]

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Toronto

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SSA

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[1] The findings and conclusions expressed are solely those of the authors and do not represent the views of Federal Reserve Board, Federal Reserve Bank of New York or SSA.

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2. How do these properties vary:
   A. over the life cycle?
   B. across income groups?
3. Dynamics of earnings:
   A. Do positive and negative shocks have similar persistence?
   B. Do large and small shocks have similar persistence?

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Existing work:

1. Small survey-based data sets, e.g., the PSID
    - between 500 to 2000 individuals per year

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2. Move beyond CME and target economically significant moments.

Covariance Matrix Estimation: A Recap

1. Specify a parametric income process, e.g.:

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2. Derive the theoretical autocovariances of income implied by this specification:

$$\text{var}_i(y_t^i) = \sigma_\alpha^2 + \text{var}_i(z_t^i) + \sigma_\varepsilon^2,$$
$$\text{var}_i(z_t^i) = \sum_{s=1}^{t} \rho^2 \sigma_\eta^2,$$
$$\text{cov}(y_t^i, y_{t+n}^i) = \sigma_\alpha^2 + \rho^n \text{var}_i(z_t^i).$$

Covariance Matrix Estimation

3. Construct the empirical counterpart of the covariance matrix:

$$\begin{bmatrix} \mathrm{var}_i(y_1^i) & & & & \\ \vdots & \mathrm{var}_i(y_2^i) & & & \\ \vdots & \cdots & \ddots & & \\ \mathrm{cov}(y_1^i, y_t^i) & \cdots & \mathrm{var}_i(y_t^i) & & \\ \vdots & & & \ddots & \\ \mathrm{cov}(y_1^i, y_T^i) & & & & \mathrm{var}_i(y_T^i) \end{bmatrix}$$

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4. Choose $(\rho, \sigma_\alpha^2, \sigma_\eta^2, \sigma_\varepsilon^2)$ to bring the theoretical covariance matrix as close to its empirical part as possible.

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  - Discards lots of useful information.
- Also ignores higher-order moments, which we find to be very important.
- With CME, selecting among rejected models is very hard:
  - moments that are missed do not have clear economic interpretations.

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    - by matching economically important moments (as opposed to the "covariance matrix of income residuals")

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1. Document new empirical facts on life-cycle earnings dynamics
2. Estimate lifecycle earnings dynamics
    - by matching economically important moments (as opposed to the "covariance matrix of income residuals")
3. Provide a reliable "user's guide" for earnings process specifications.

NEW EMPIRICAL FACTS

Data: SSA Master Earnings File

- Representative sample of US males covering 34 years: 1978 to 2011

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- Representative sample of US males covering 34 years: 1978 to 2011
- Salary and wage workers (from W-2 forms)
- Individuals aged 25–60
- Key Advantages:
  - Very large sample size (200+ million observations)
  - No survey response error
  - No sample attrition
  - No top-coding

Four Sets of Empirical Facts

1. Average income growth over the life cycle

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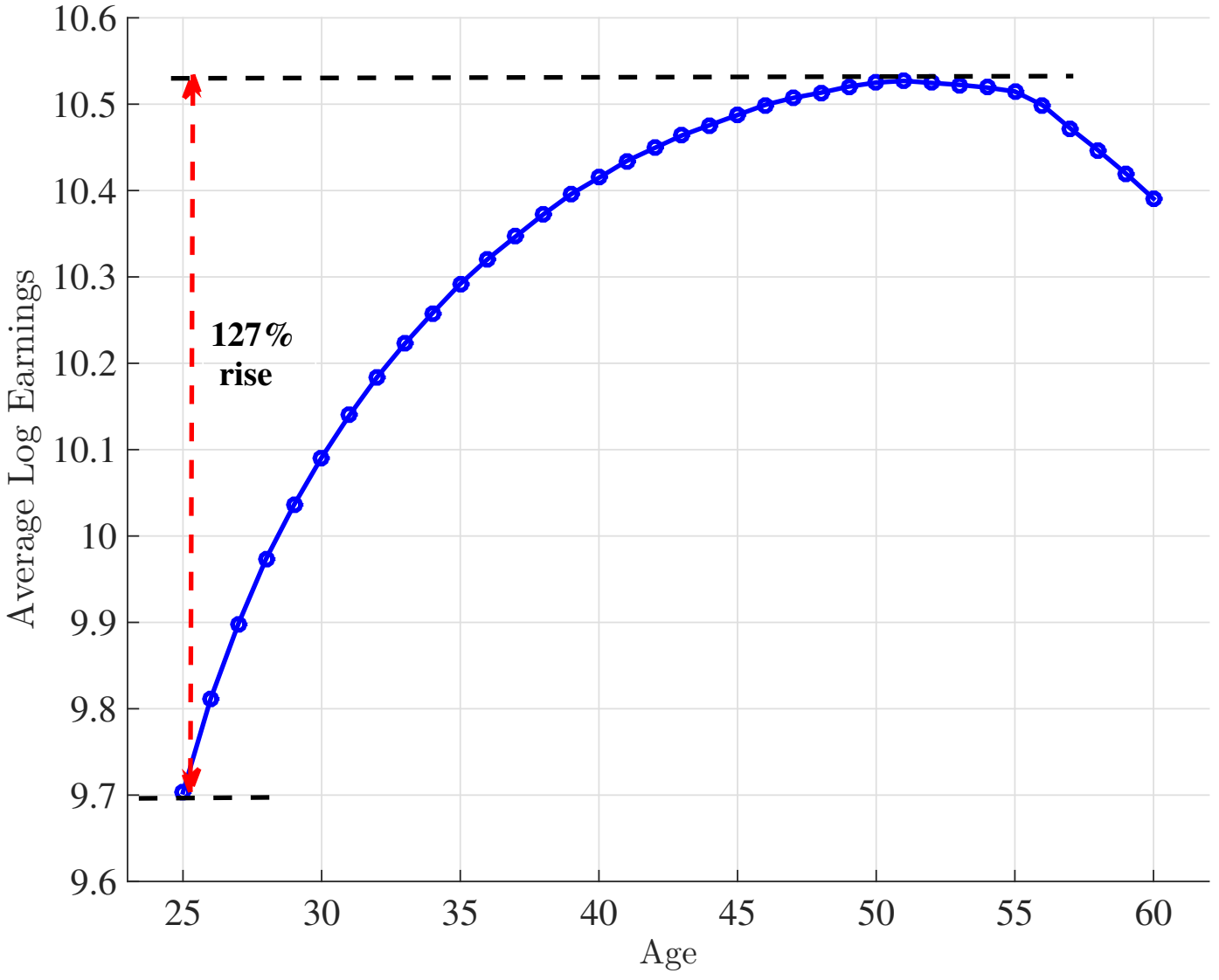
1. Average income growth over the life cycle
2. Cross-sectional moments of earnings growth
3. Short- and long-run dynamics of income growth
4. Scarring Effects of Long-Term Unemployment
5. Distribution of Lifetime Income (skip today)

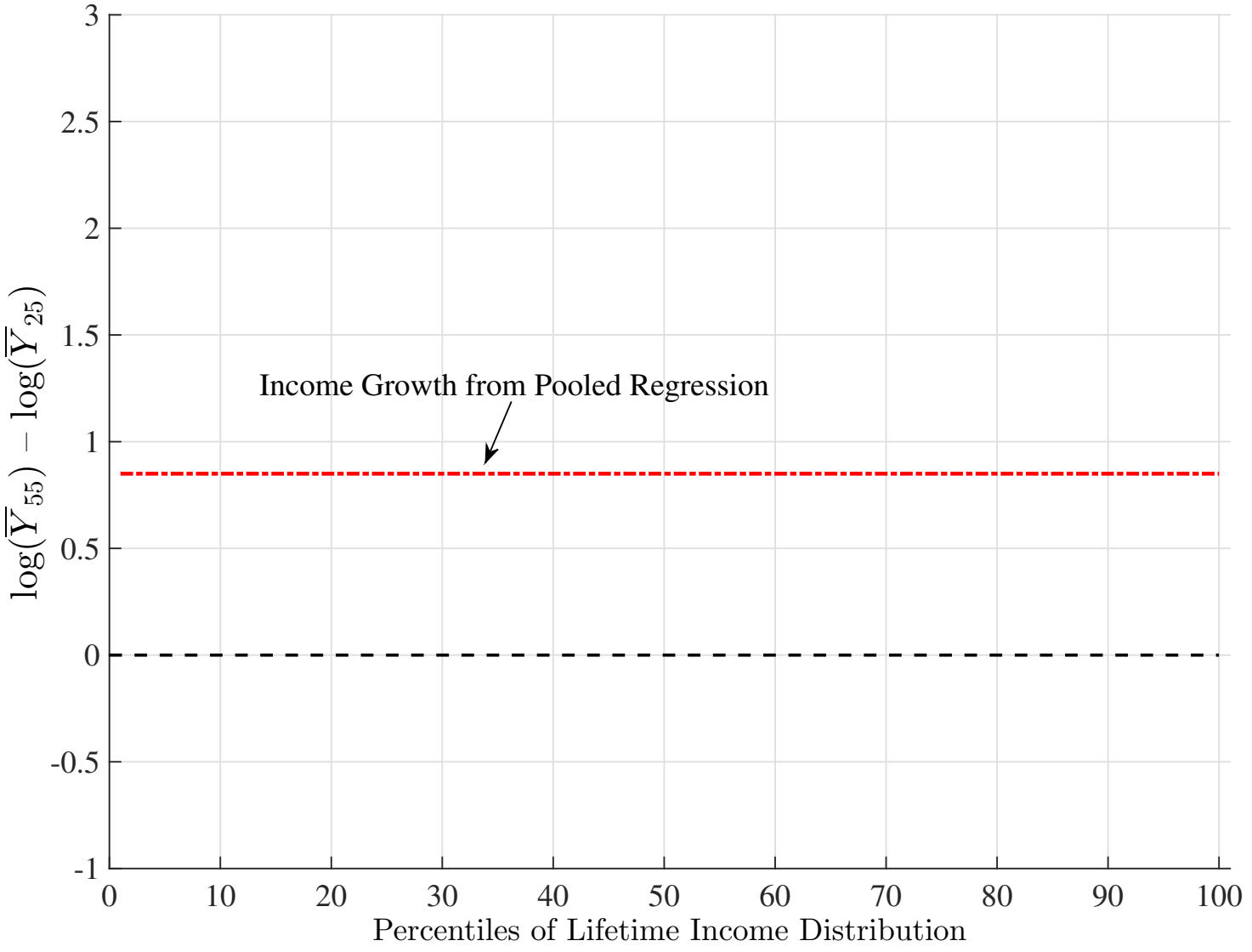
Four Sets of Empirical Facts

1. Average Income growth over the life cycle
2.
3.
4.

I. Age Profile of Labor Income



I. Income Growth Over Life Cycle



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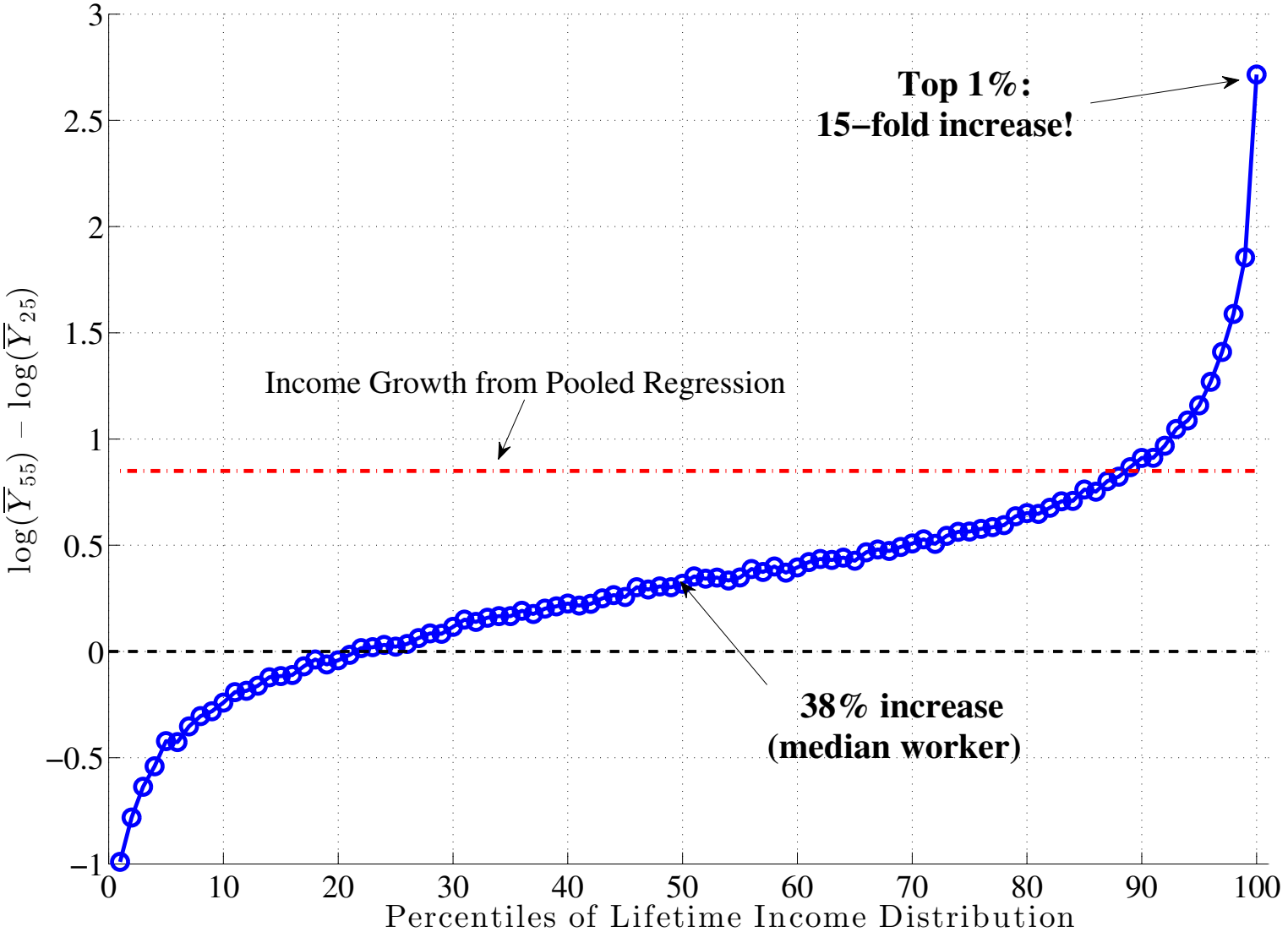

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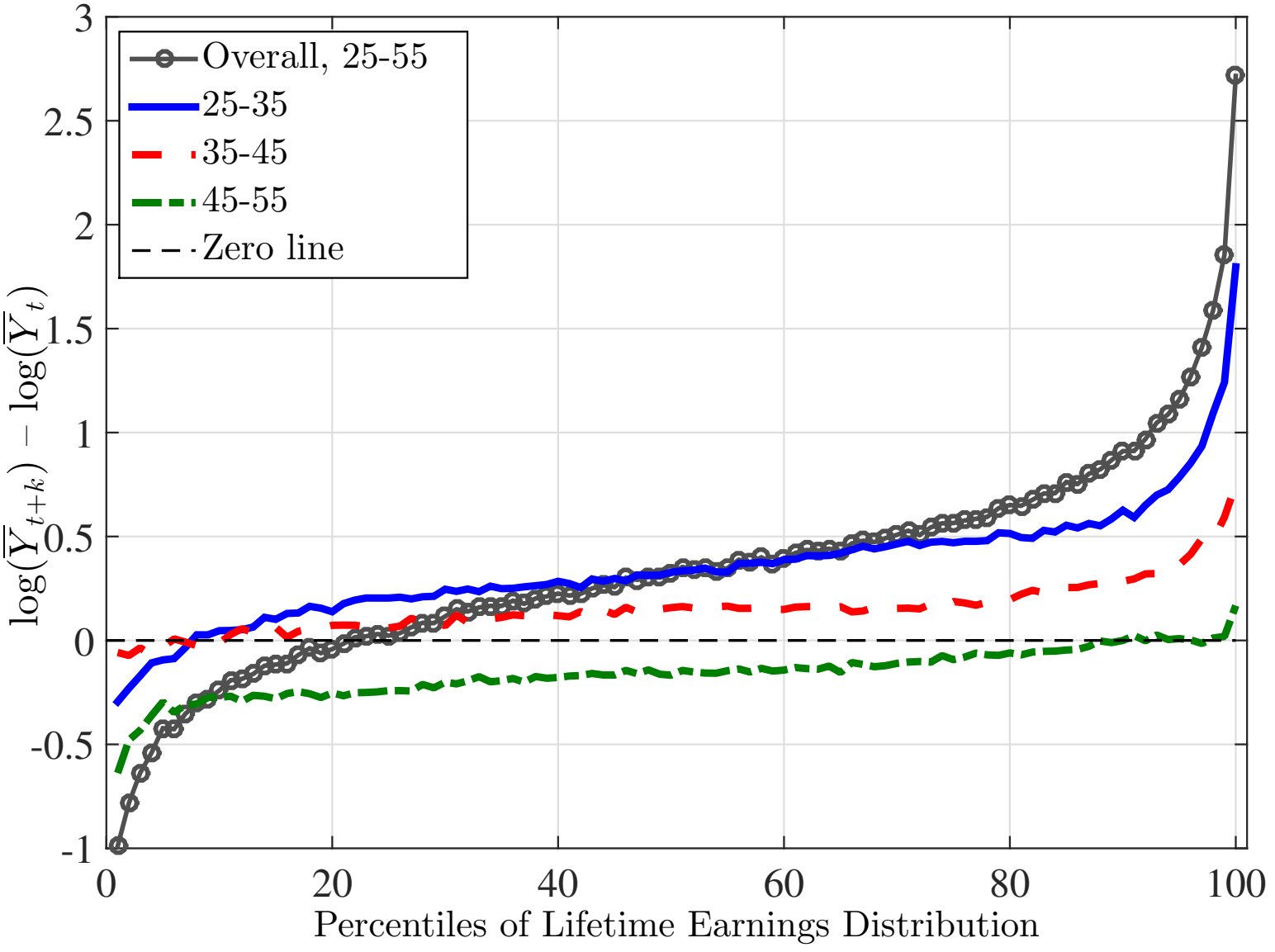
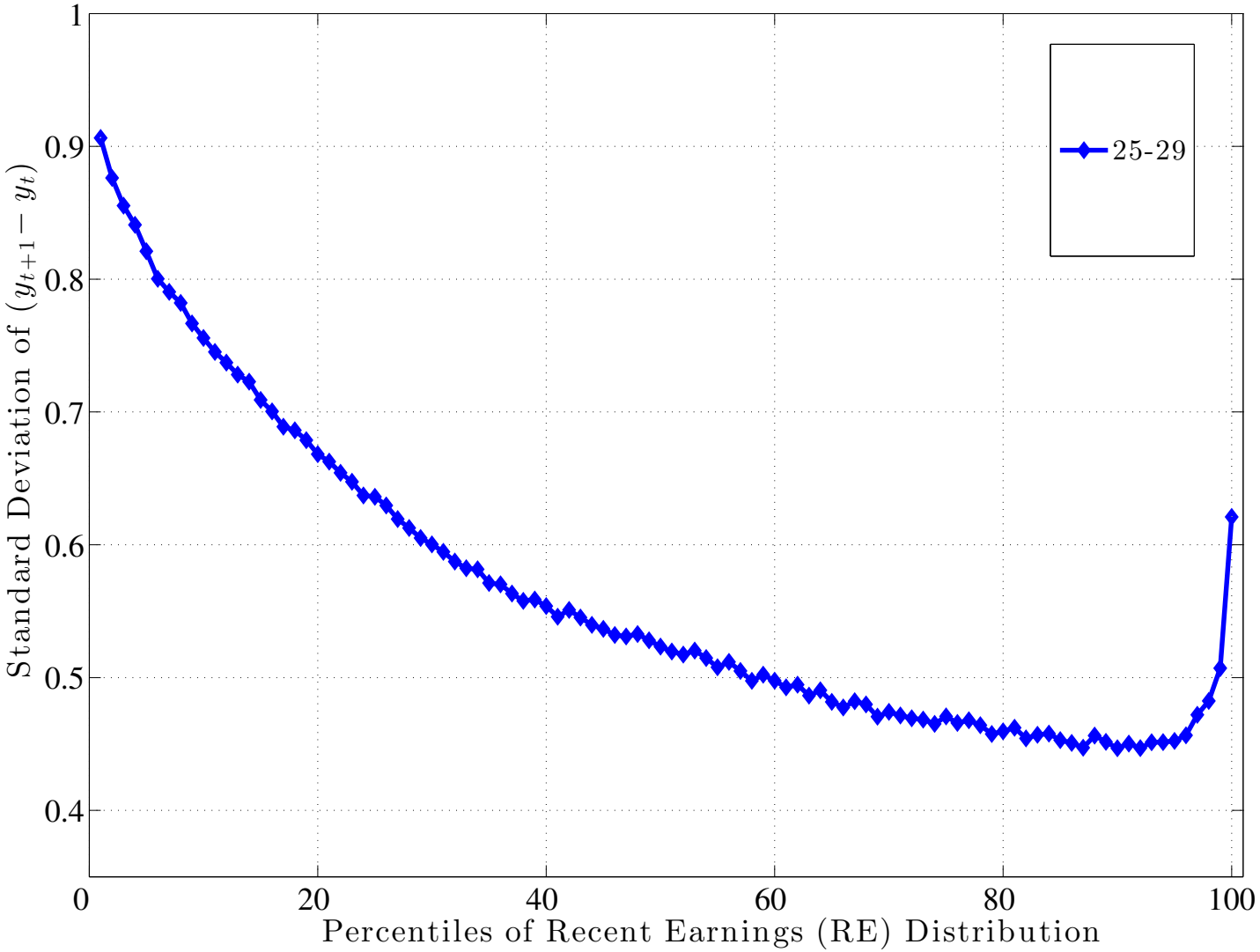


Four Sets of Empirical Facts

1. Income growth over the life cycle
2. Cross-sectional moments of earnings growth: $y_{t+k} - y_t$
3.
4.

Standard Deviation

II.A Standard Deviation of $y_{t+1} - y_t$



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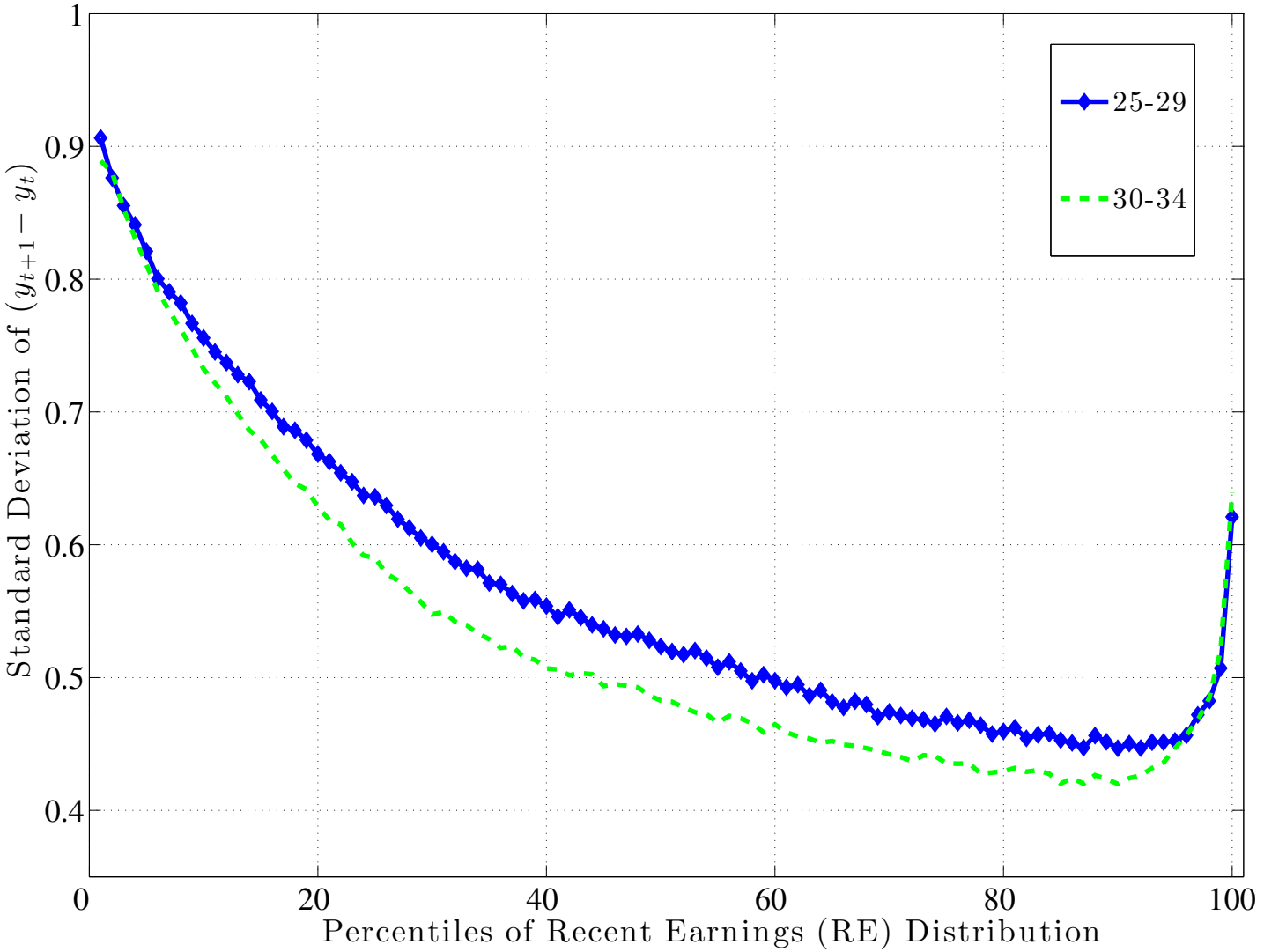

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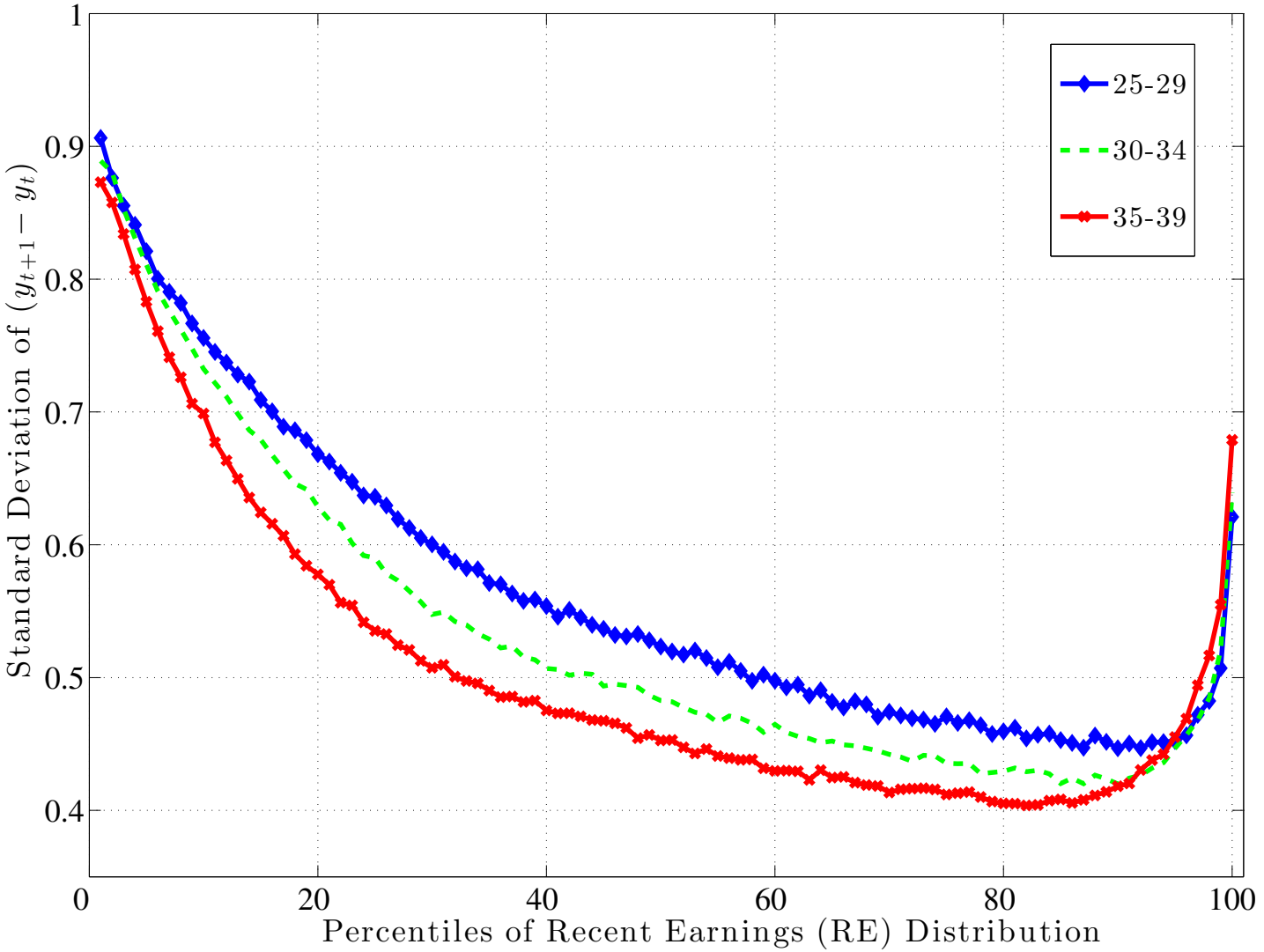

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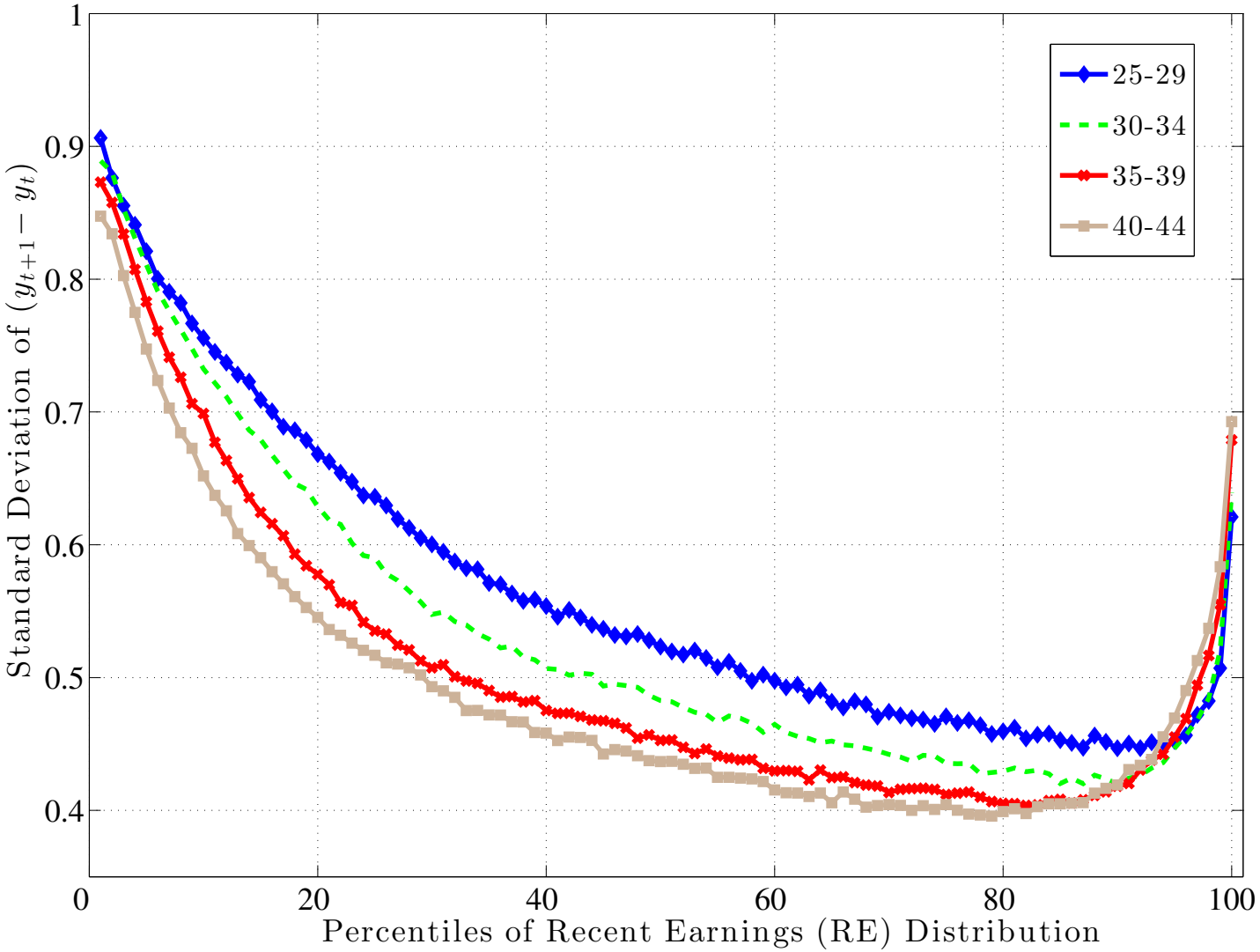

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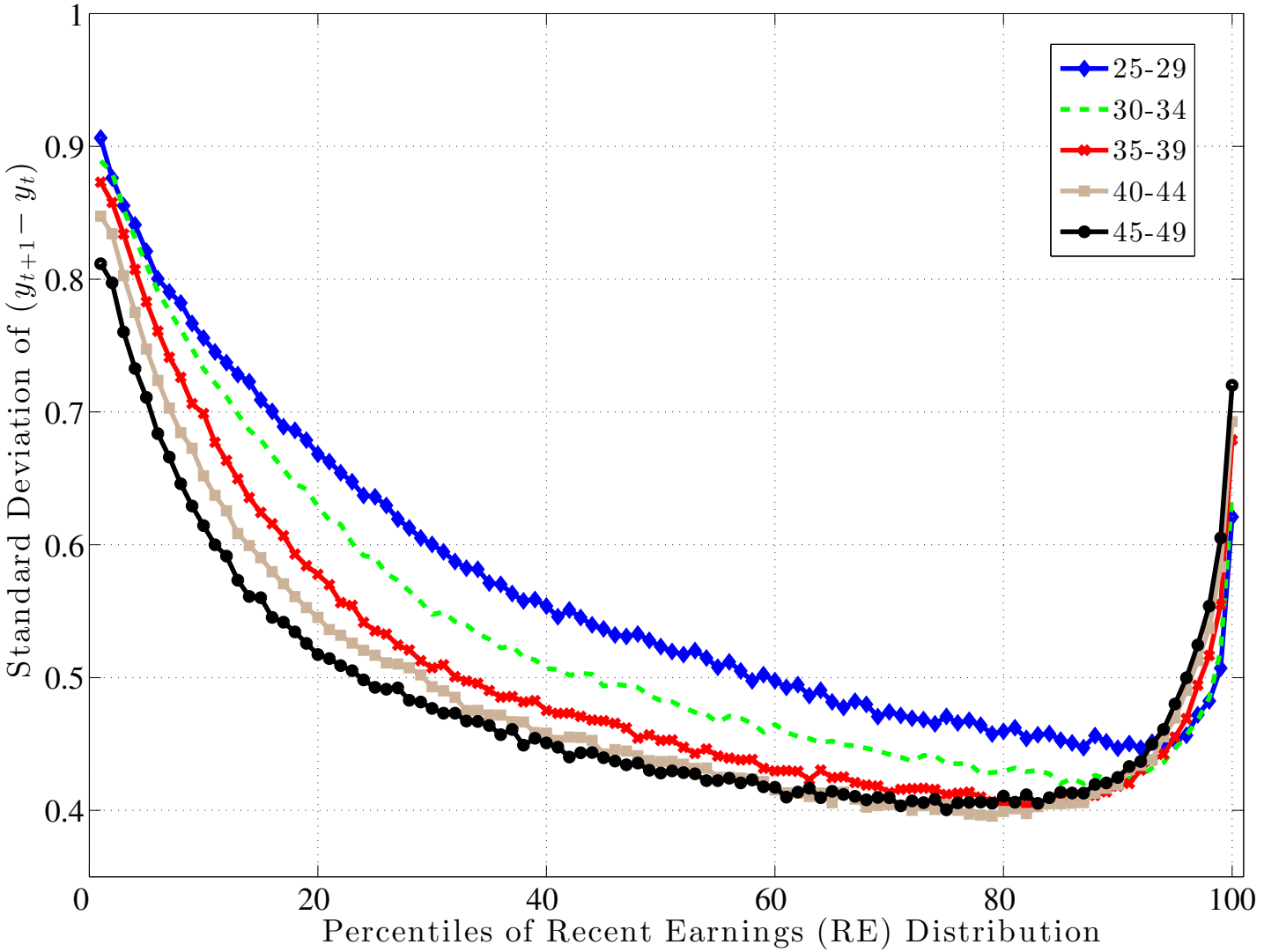

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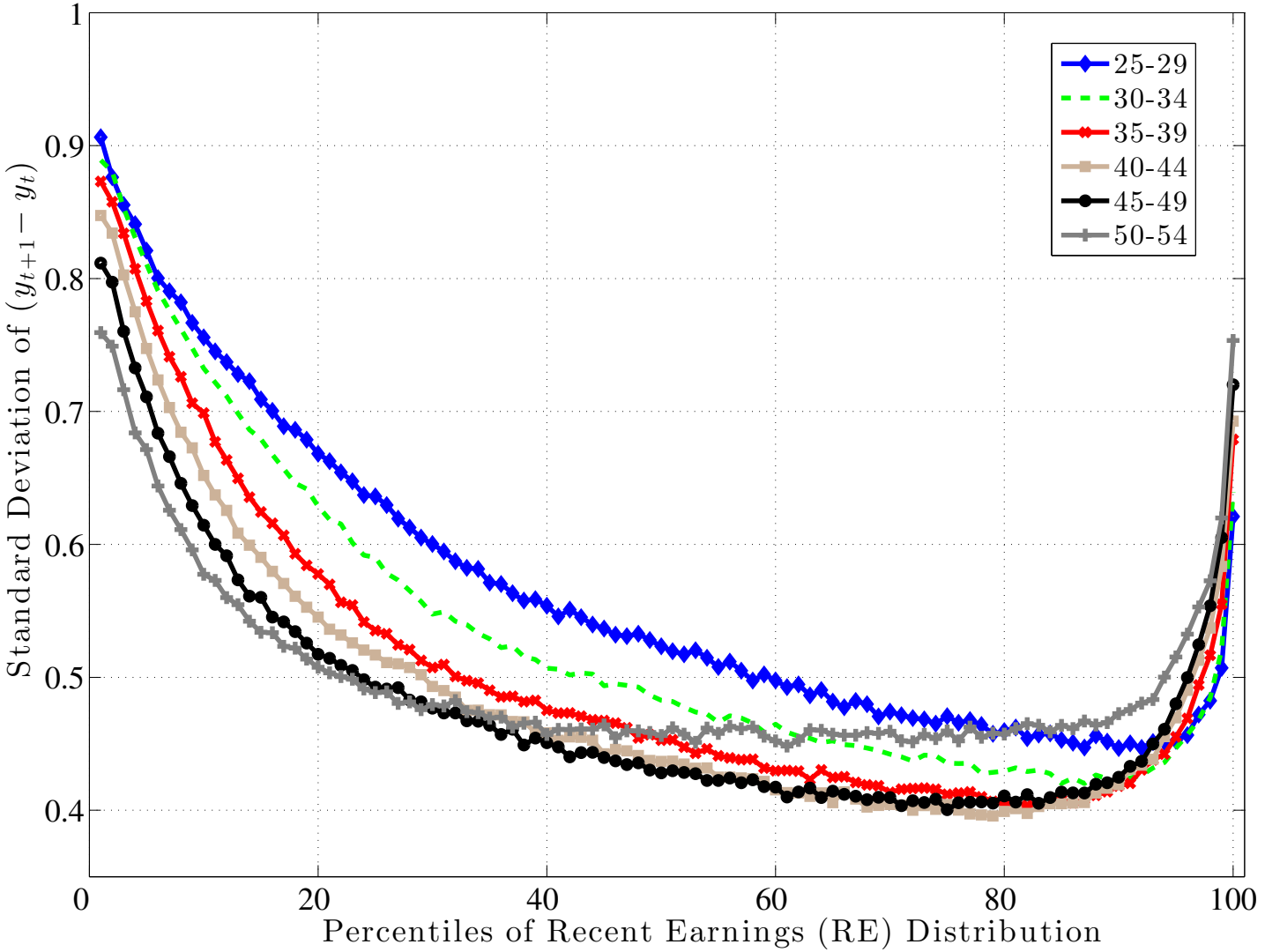
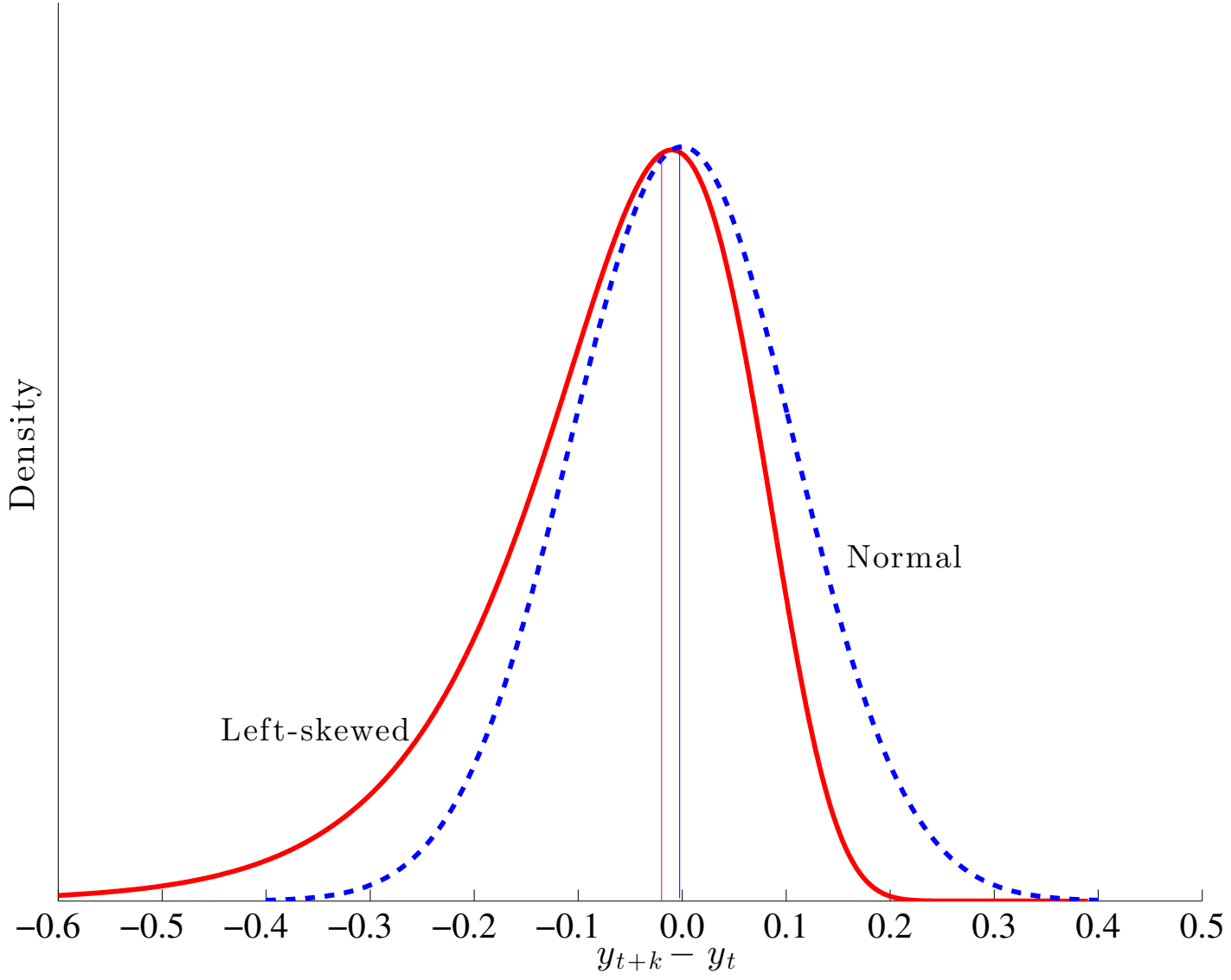
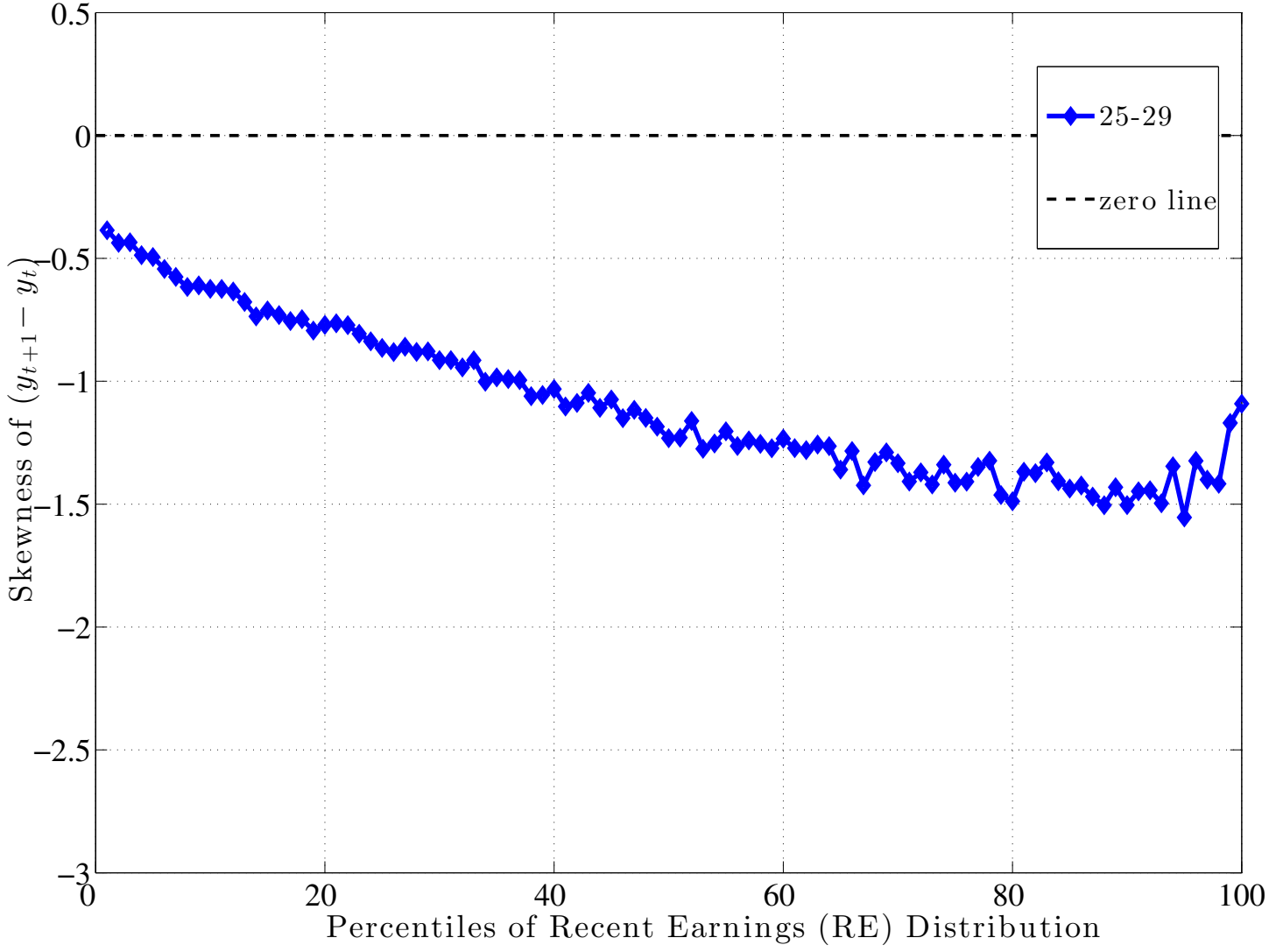


Skewness

Left-Skewness



II.B Skewness of $y_{t+1} - y_t$



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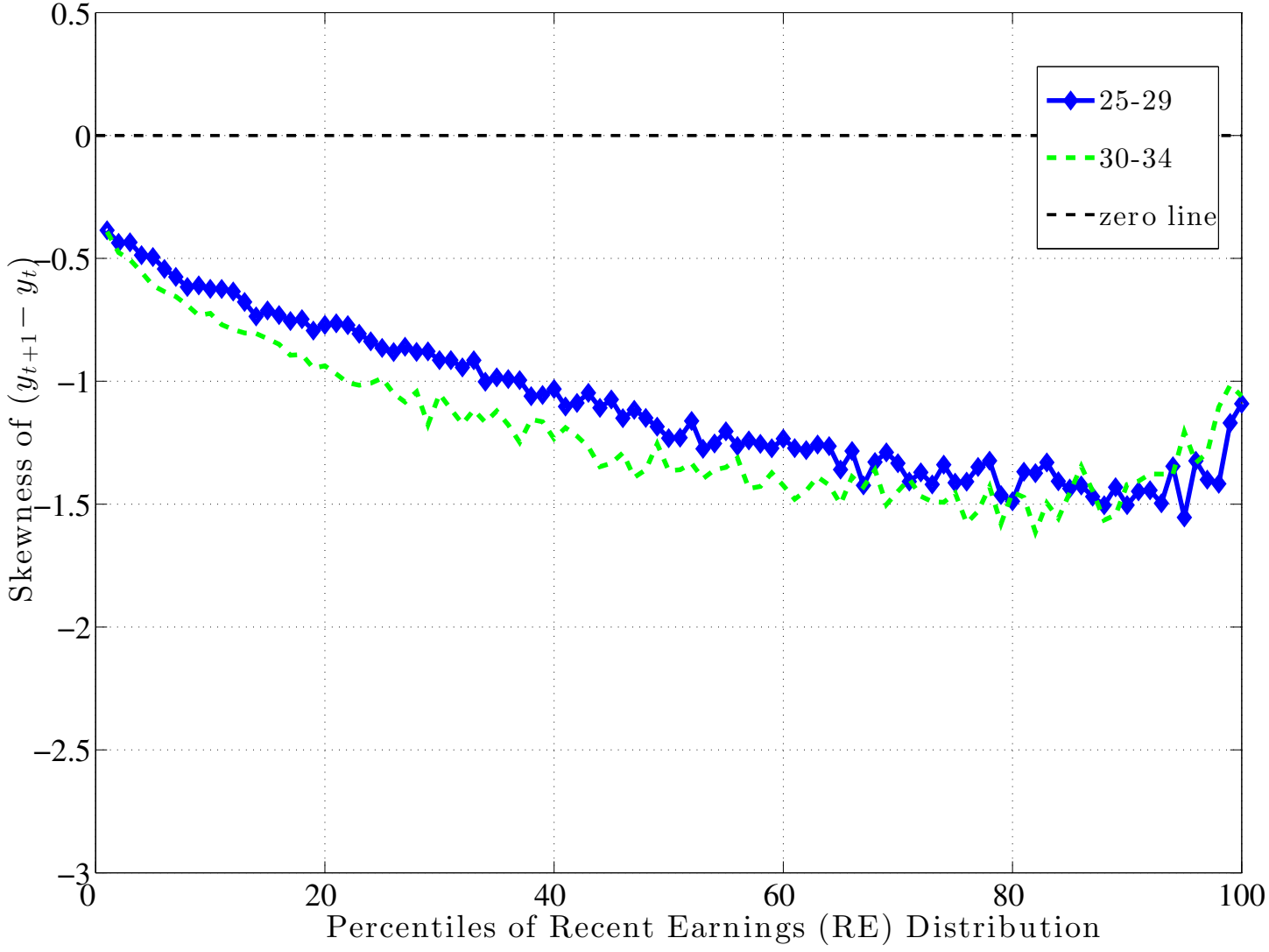

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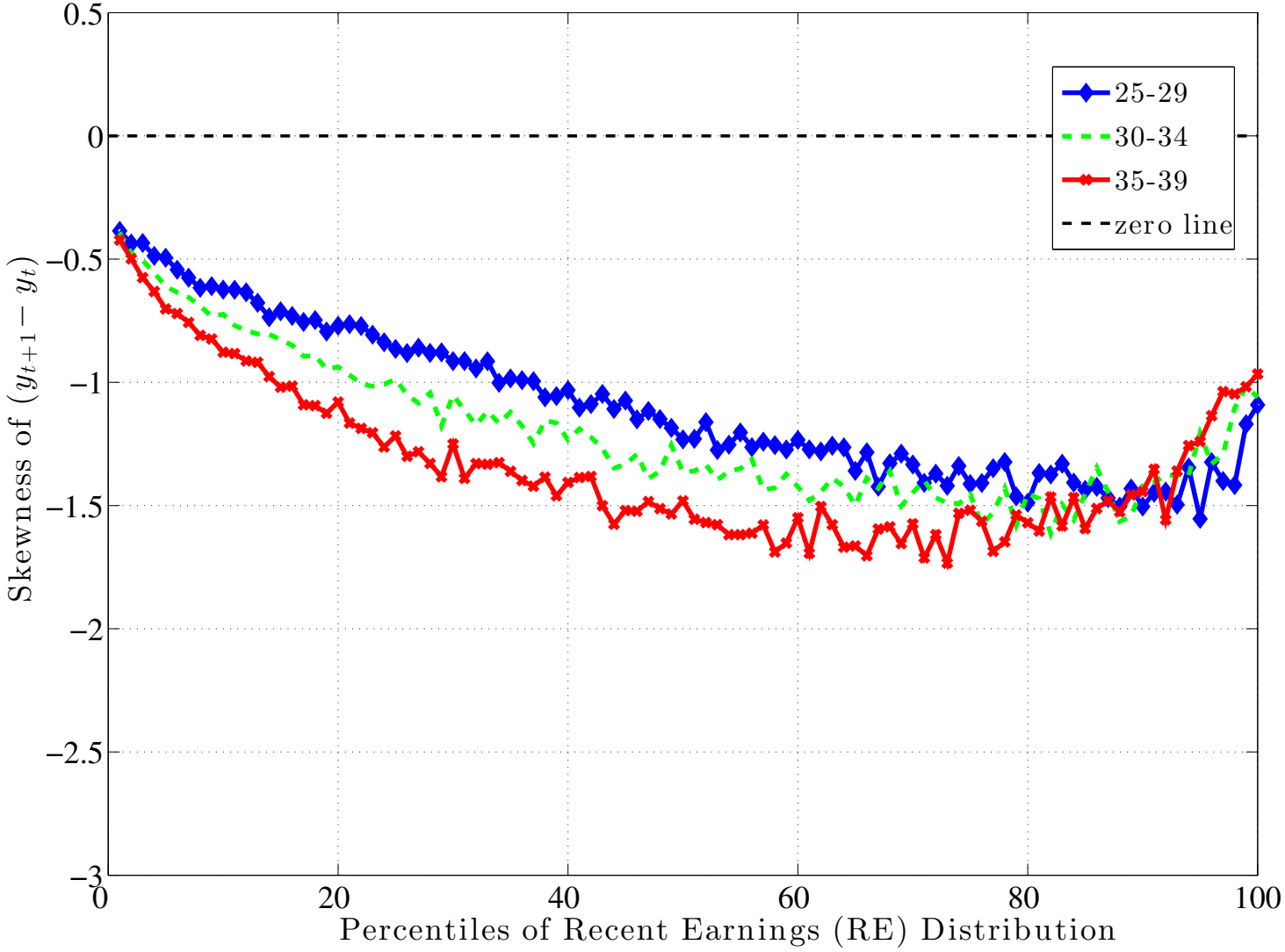

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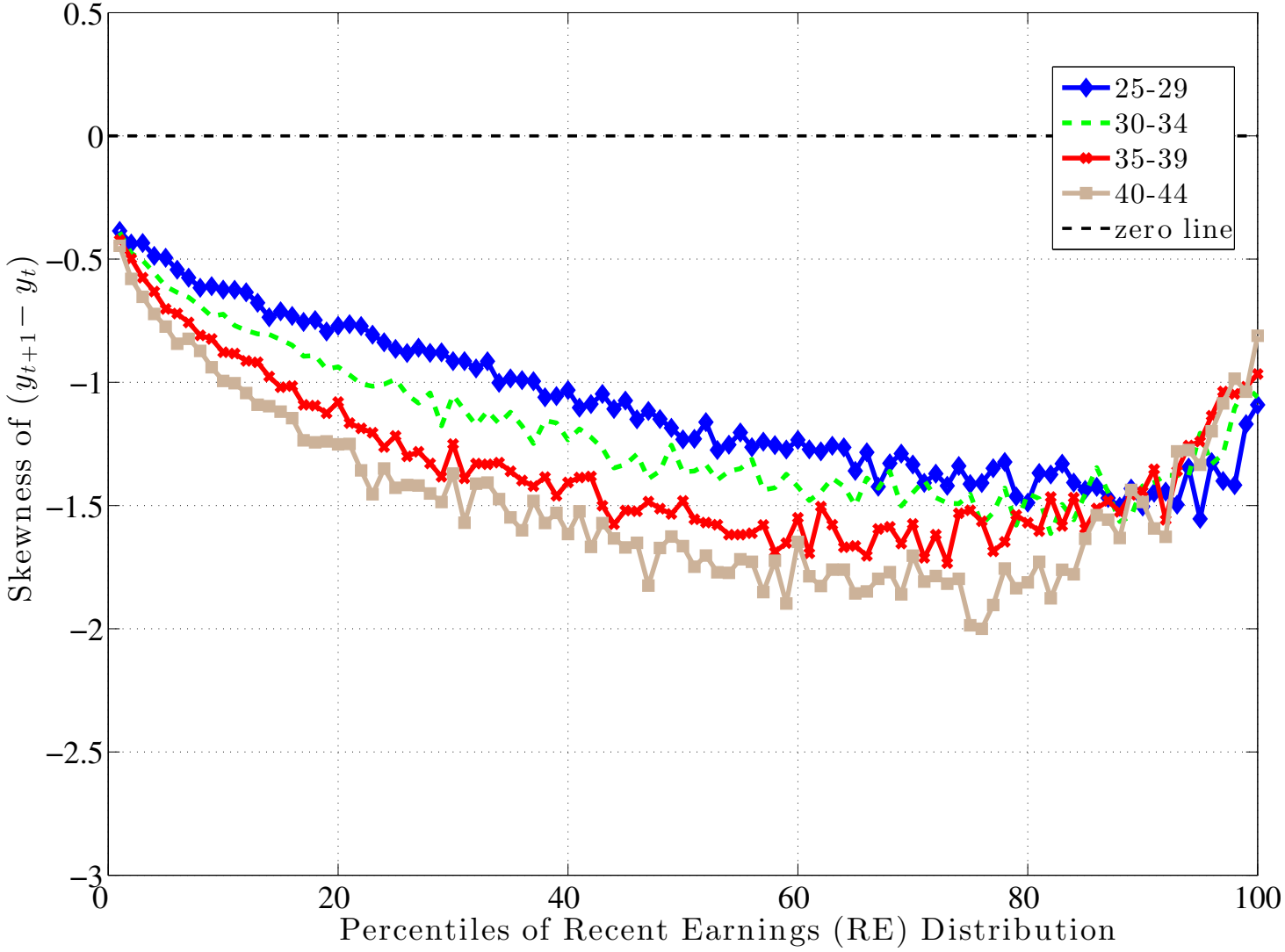

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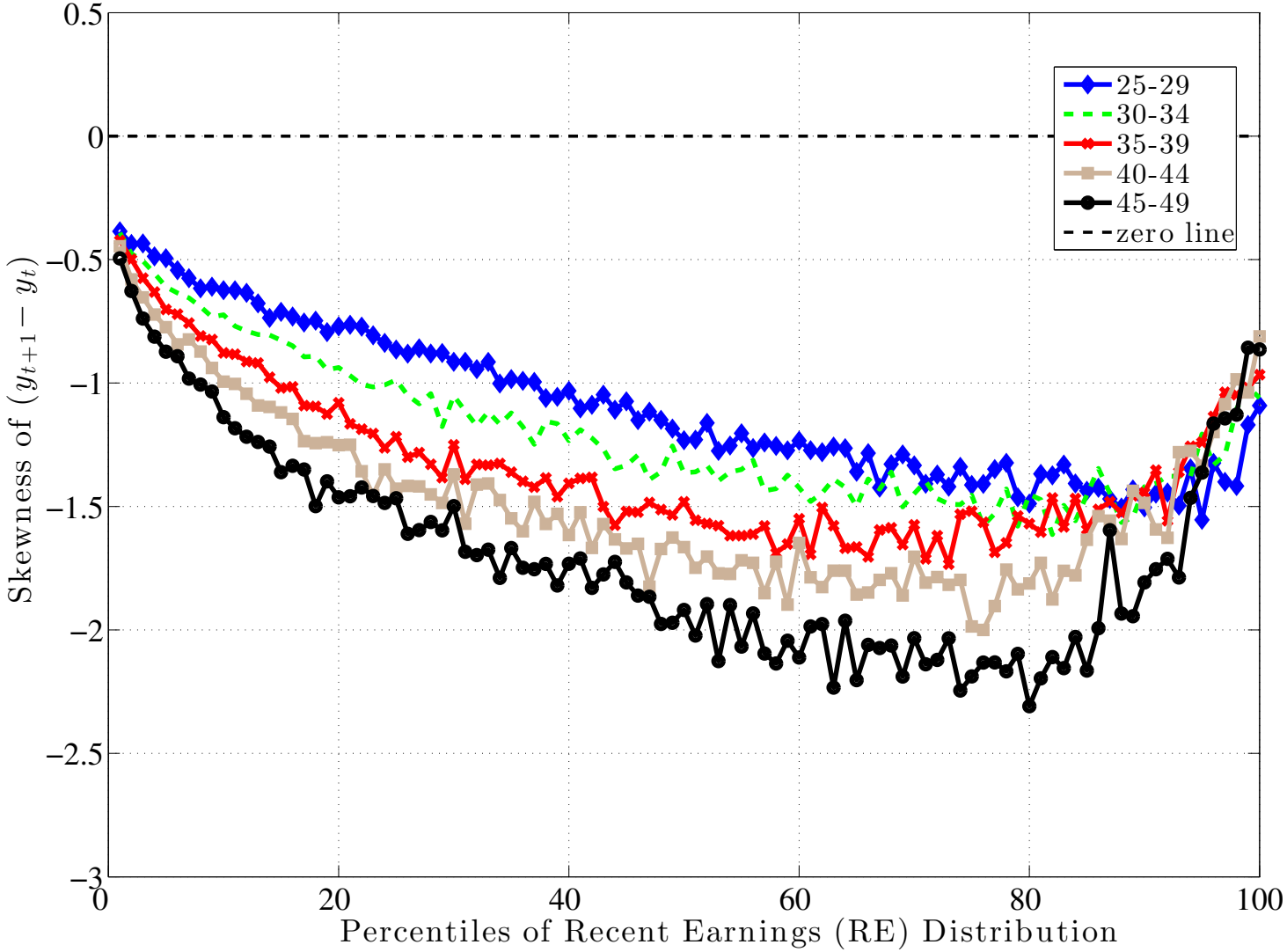

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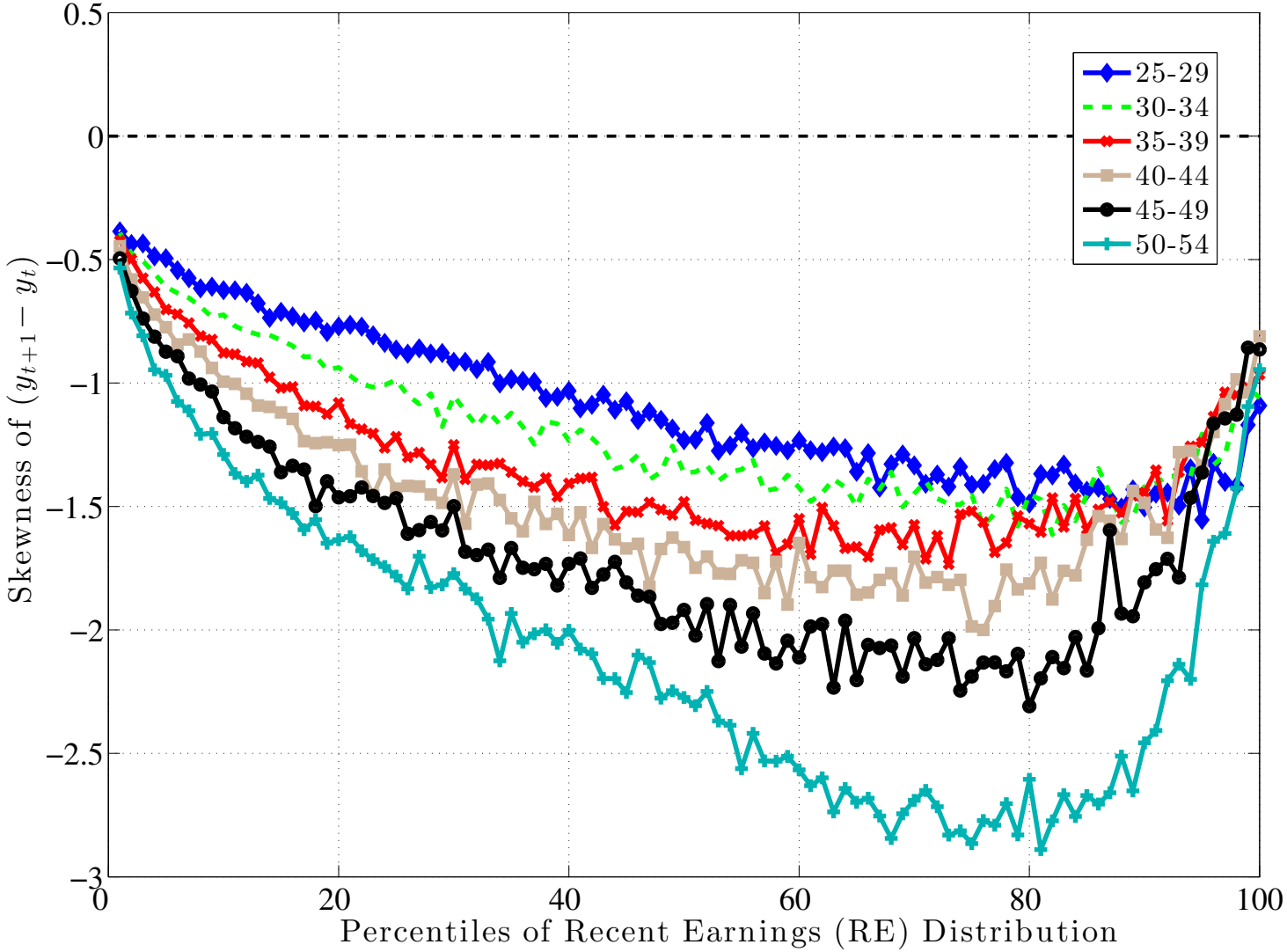
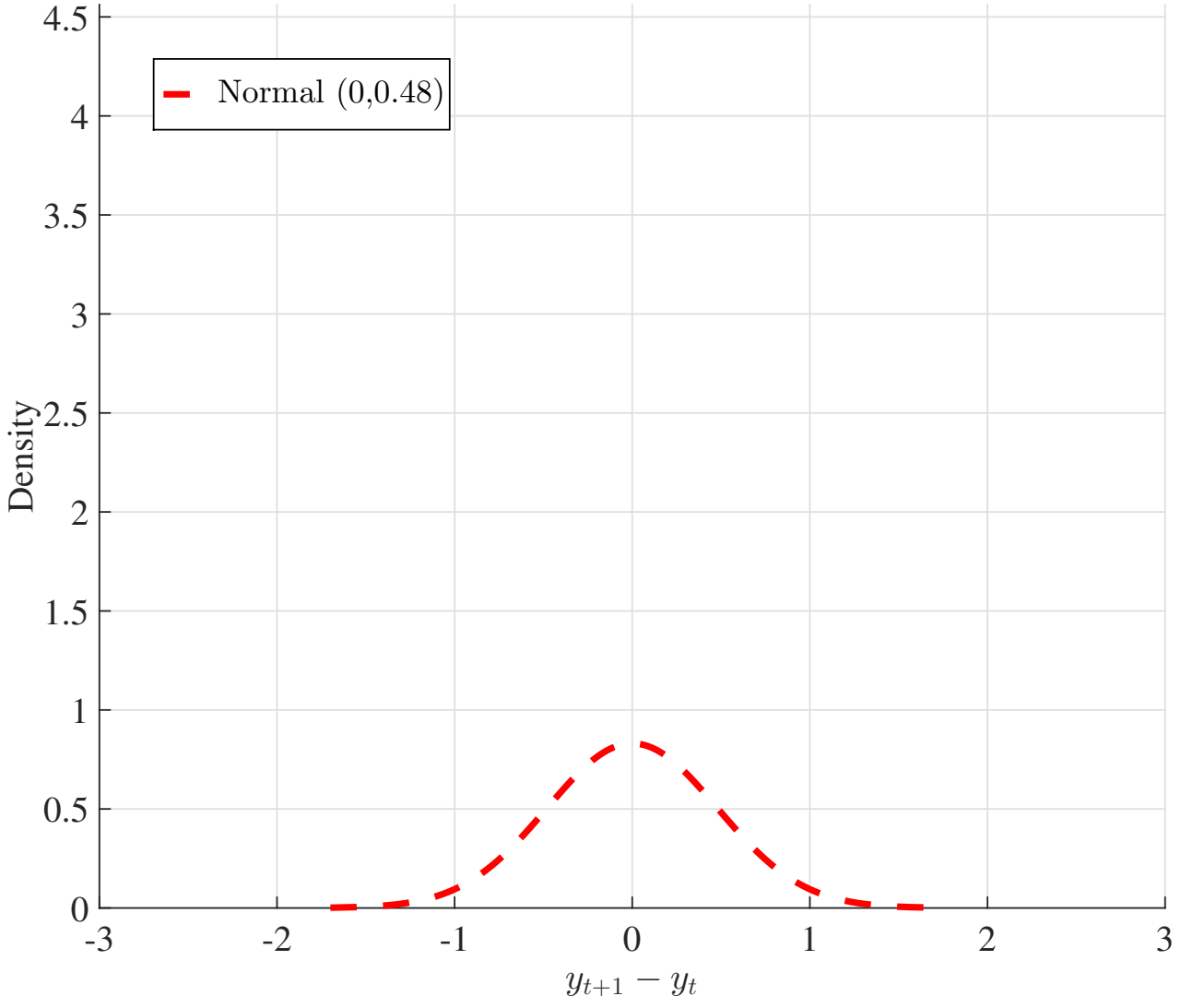


Kurtosis

II.c Histogram of $y_{t+1} - y_t$



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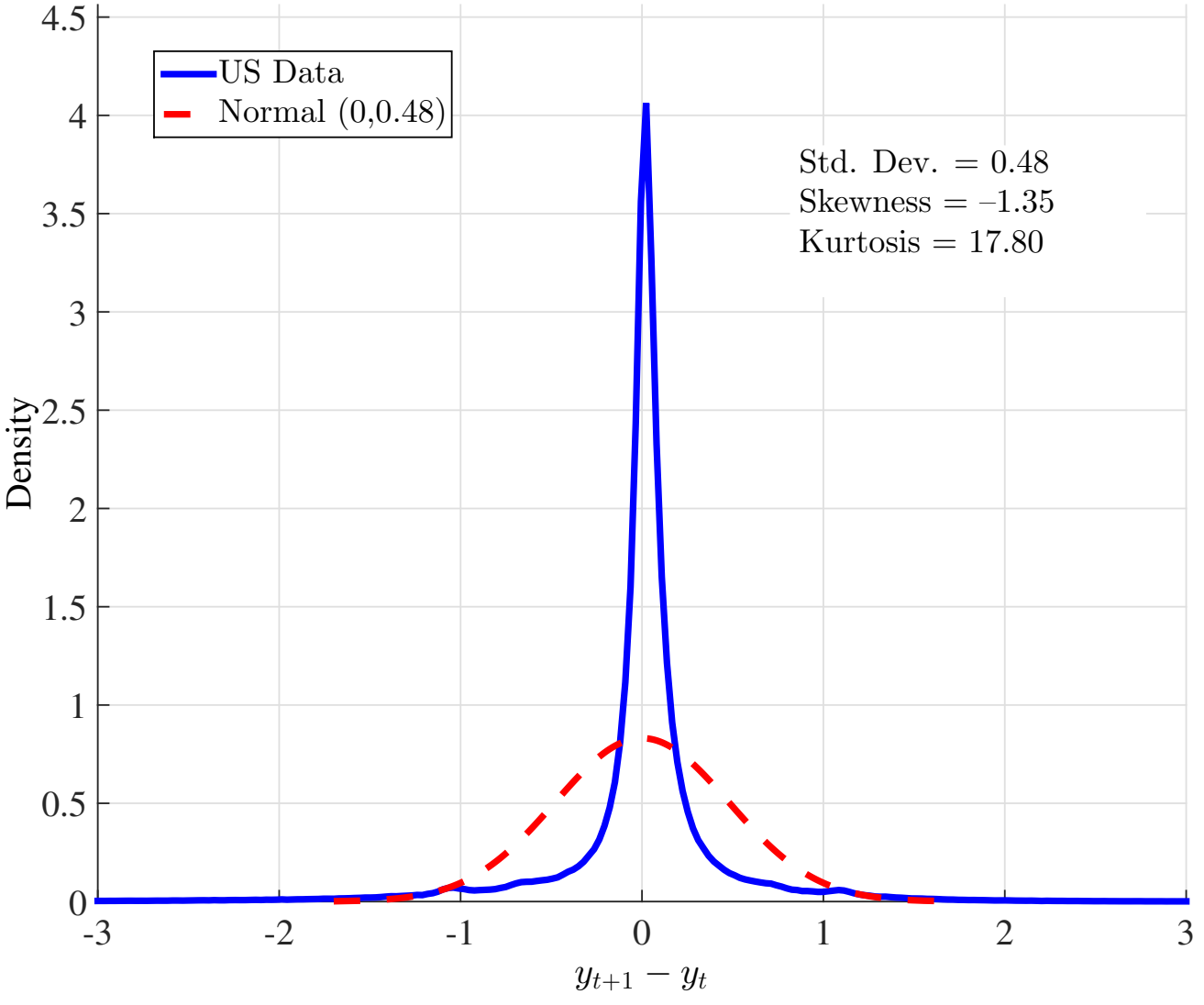
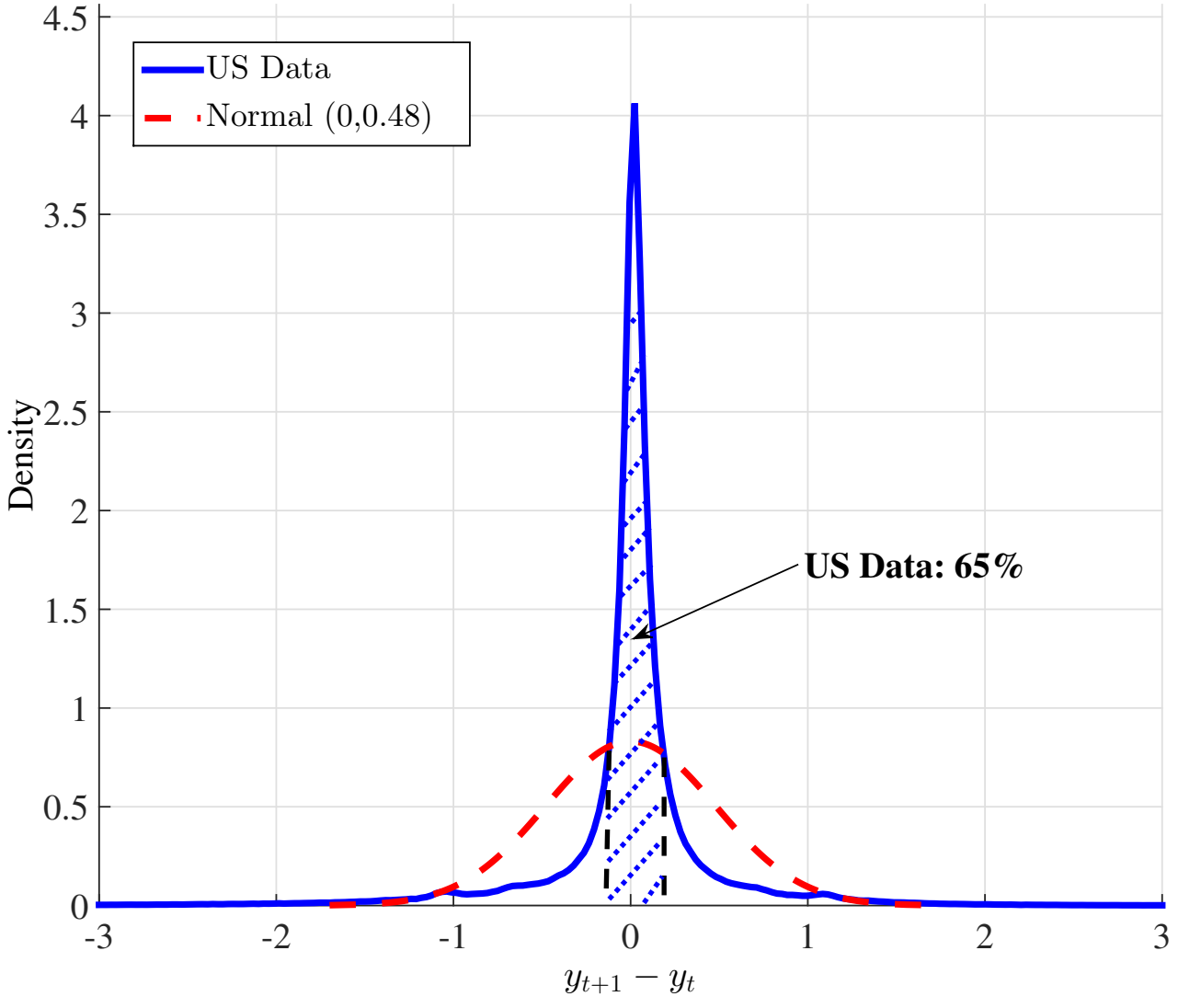


II.c Center of Histogram: [-0.12, 0.19]



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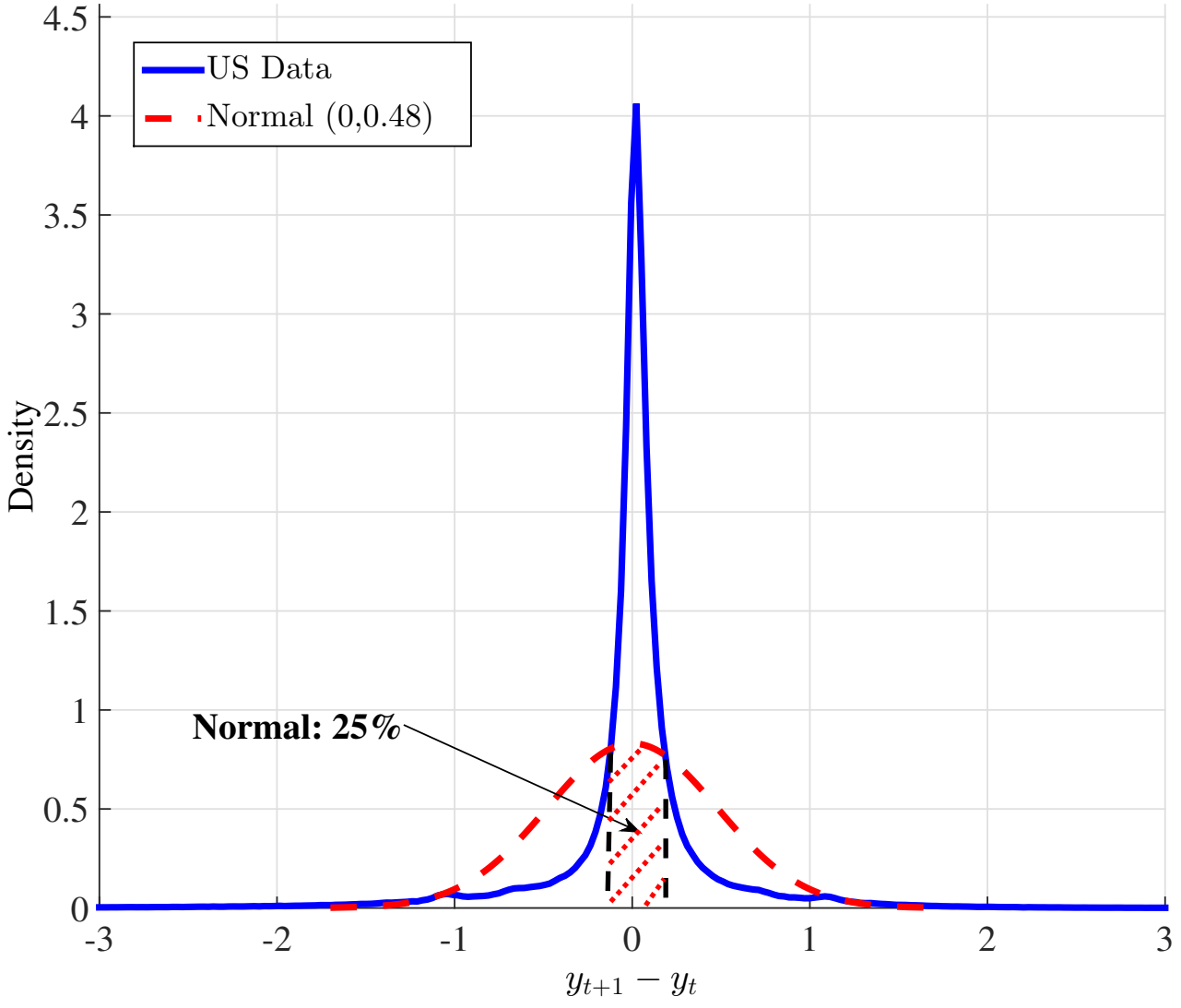
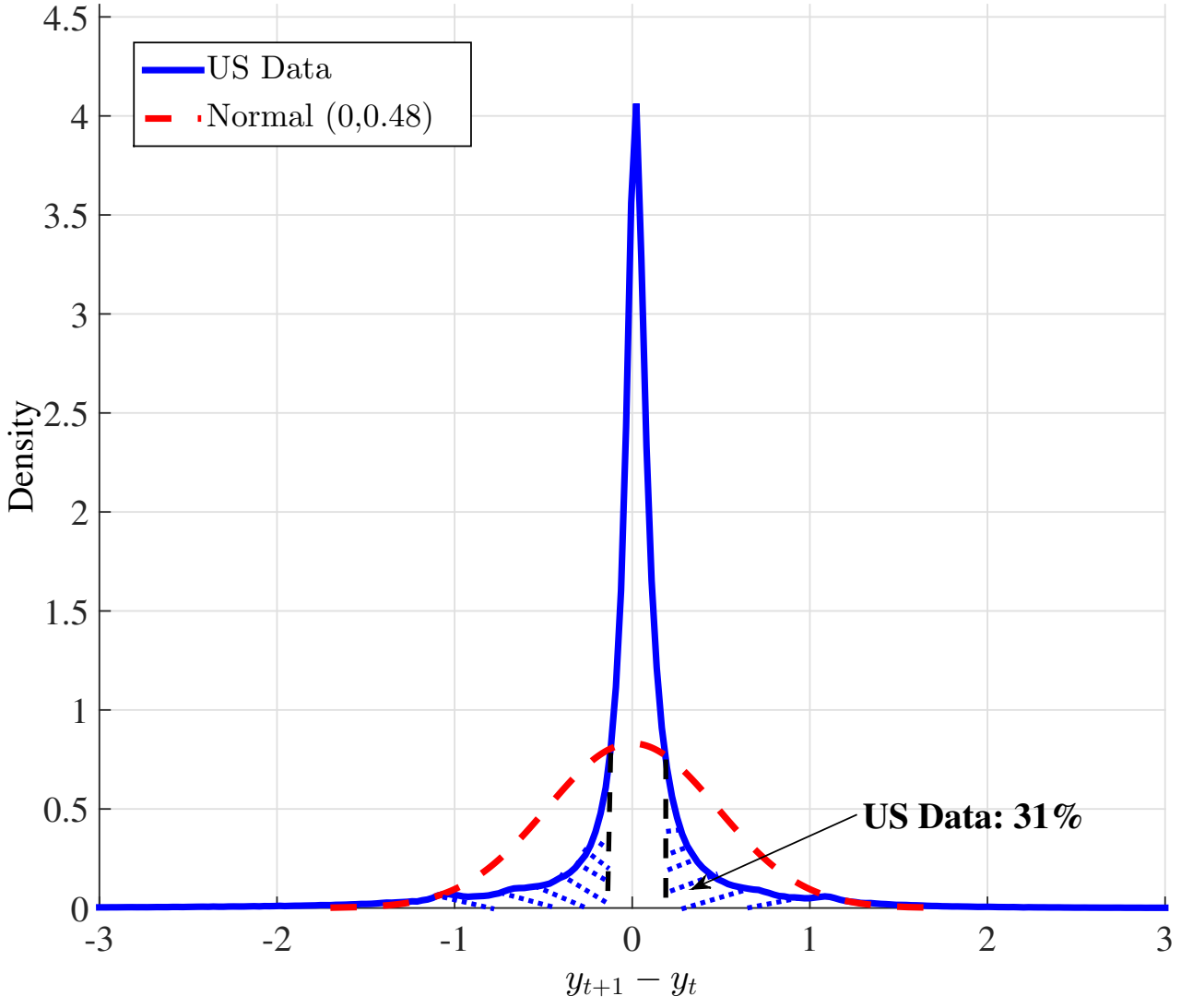


II.c Shoulders of Histogram



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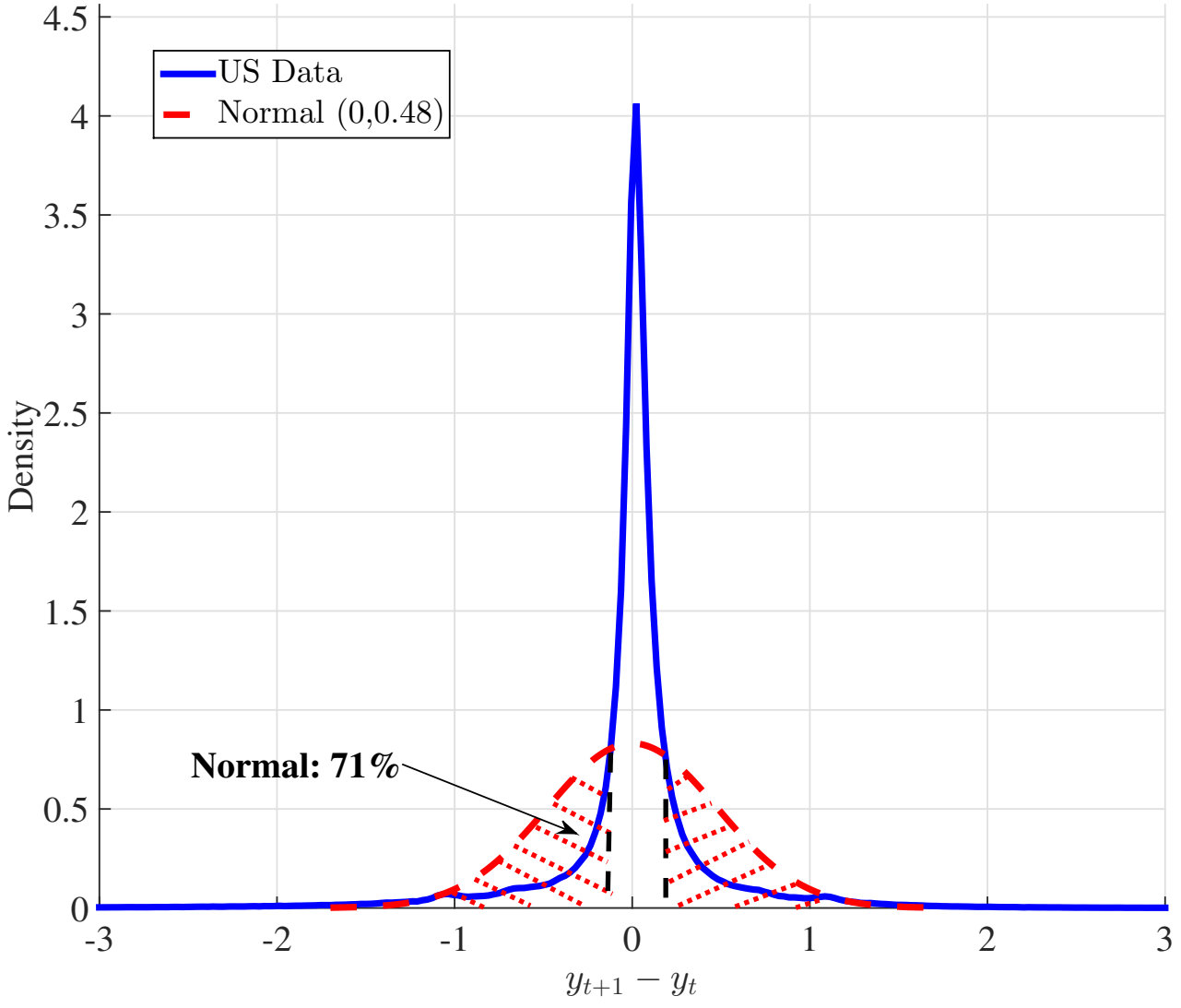
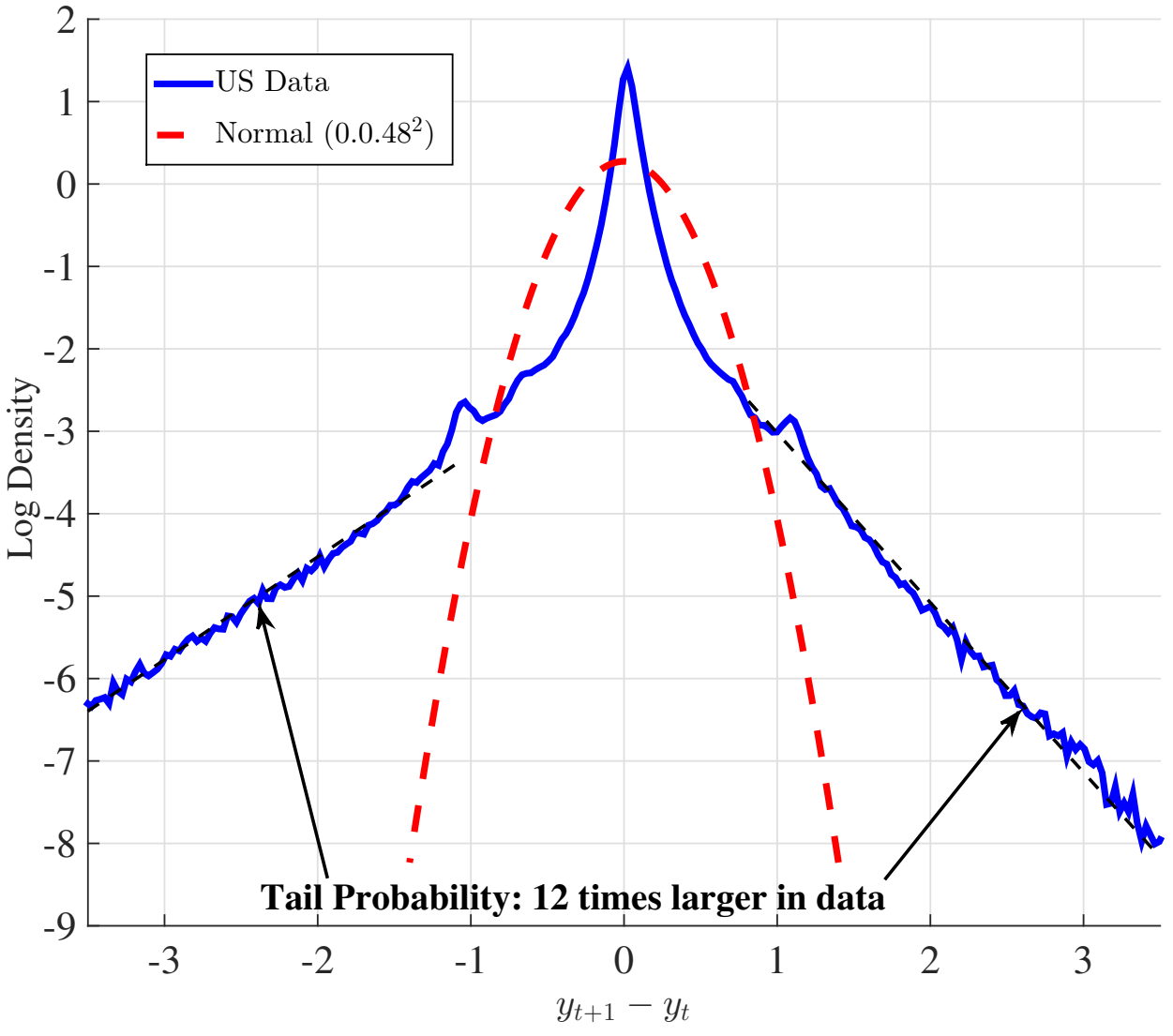


I. Tails of Histogram



II.c Distribution of Income Changes

	Prob($\lvert y^i_{t+1} - y^i_t \rvert < x$)		
x :	Data*	$\mathcal{N}(0, 0.48^2)$	Ratio
0.05	0.35	0.08	4.38
0.10	0.54	0.16	3.38
0.20	0.71	0.32	2.23
0.50	0.86	0.70	1.22
1.00	0.94	0.96	0.98

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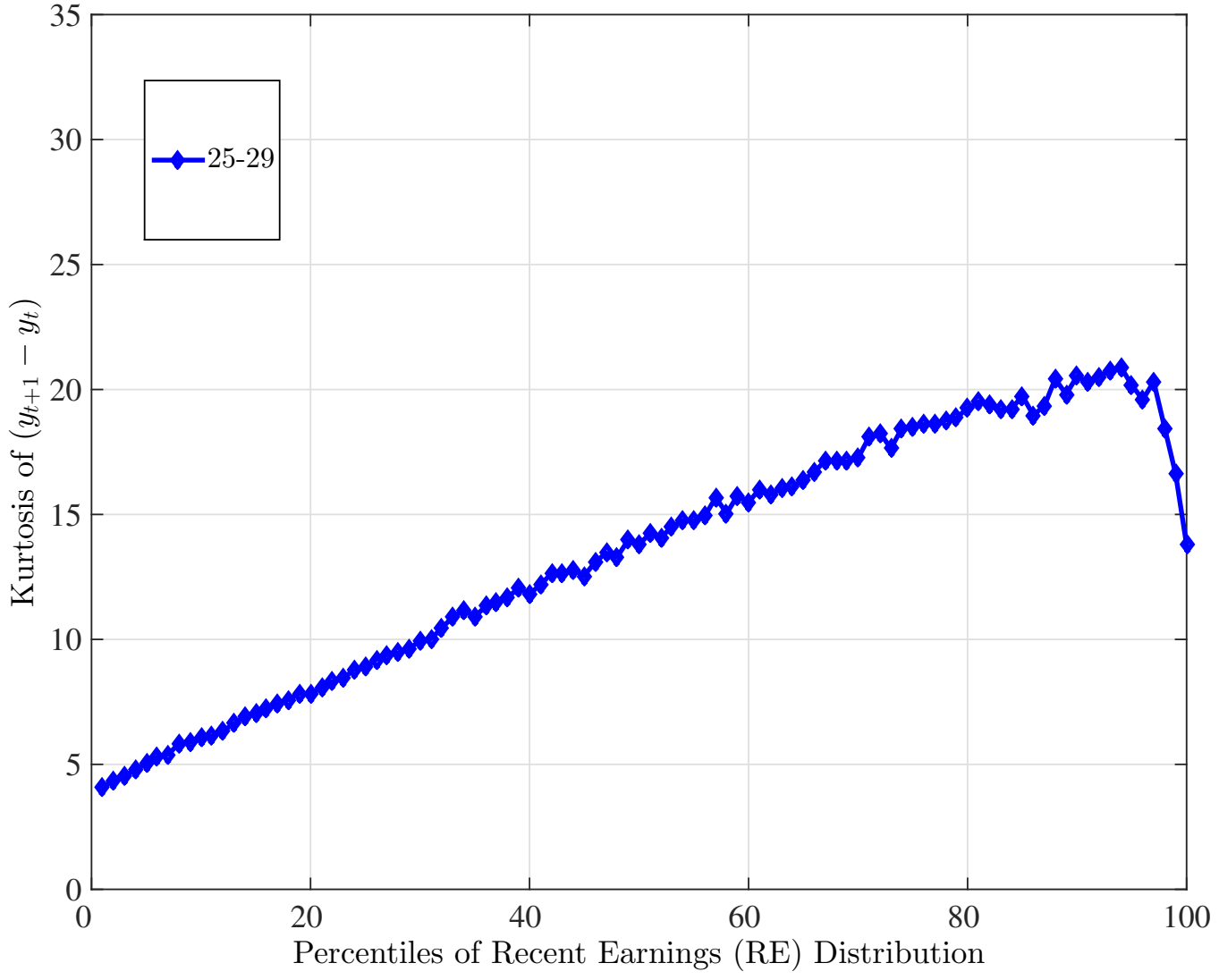

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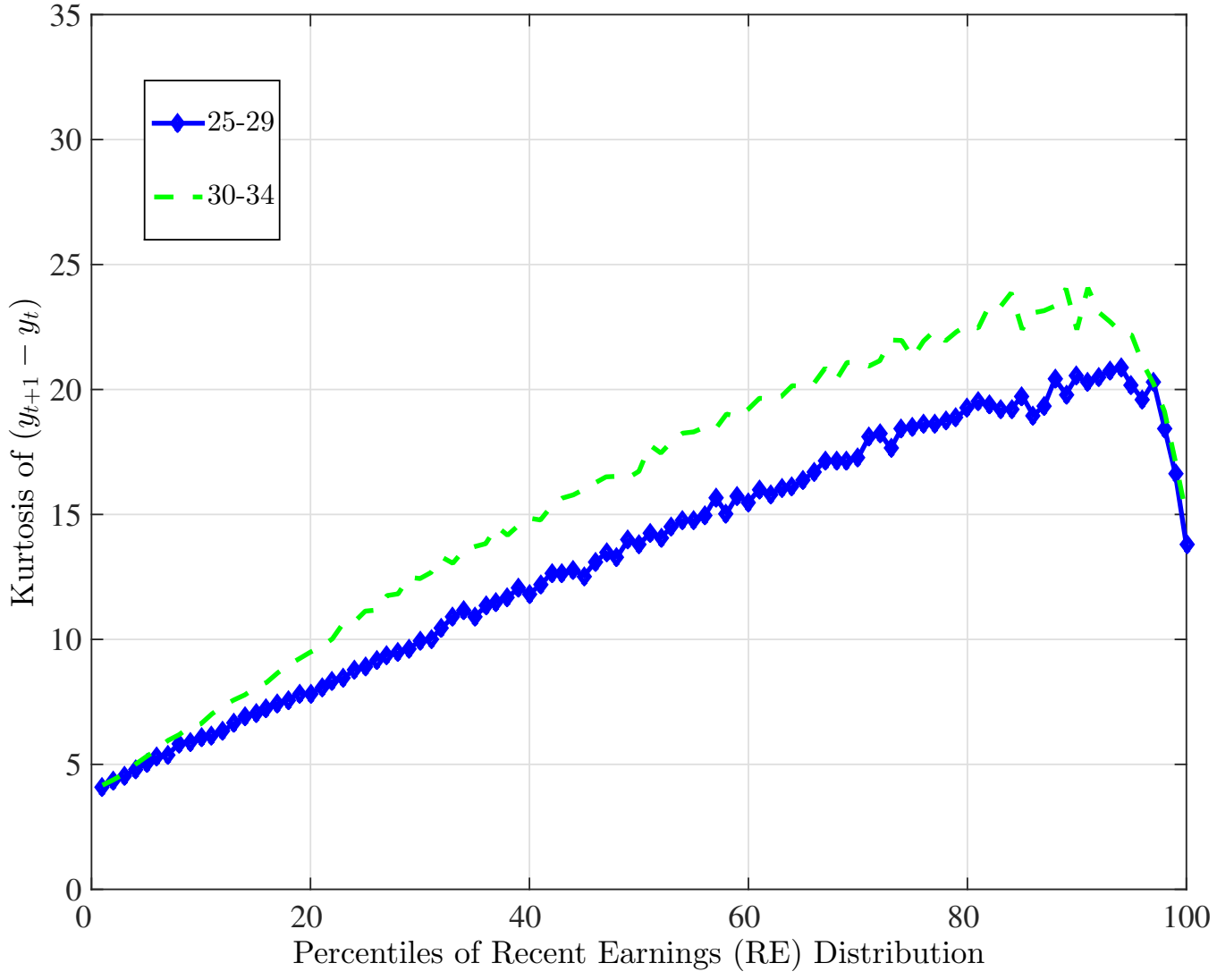

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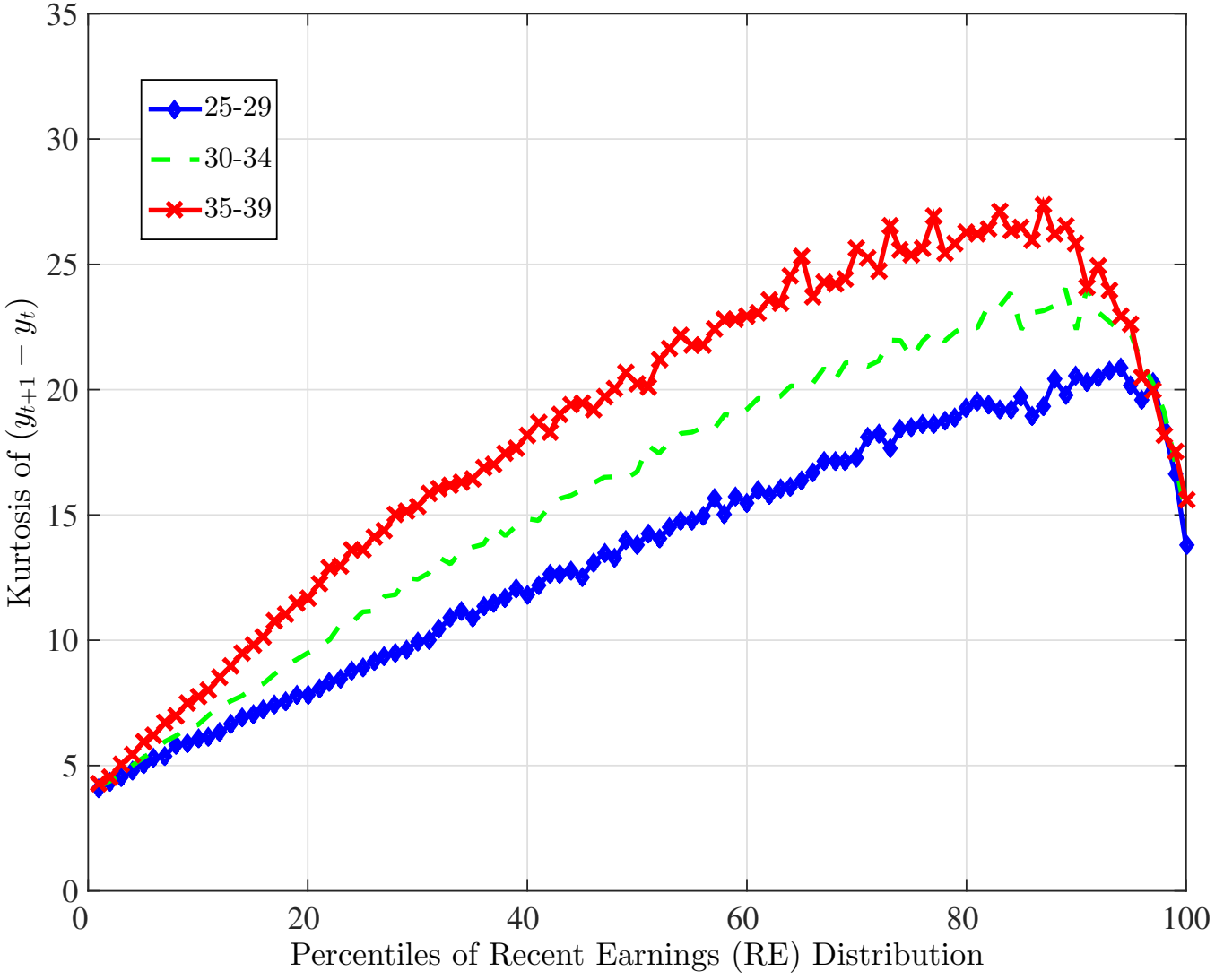

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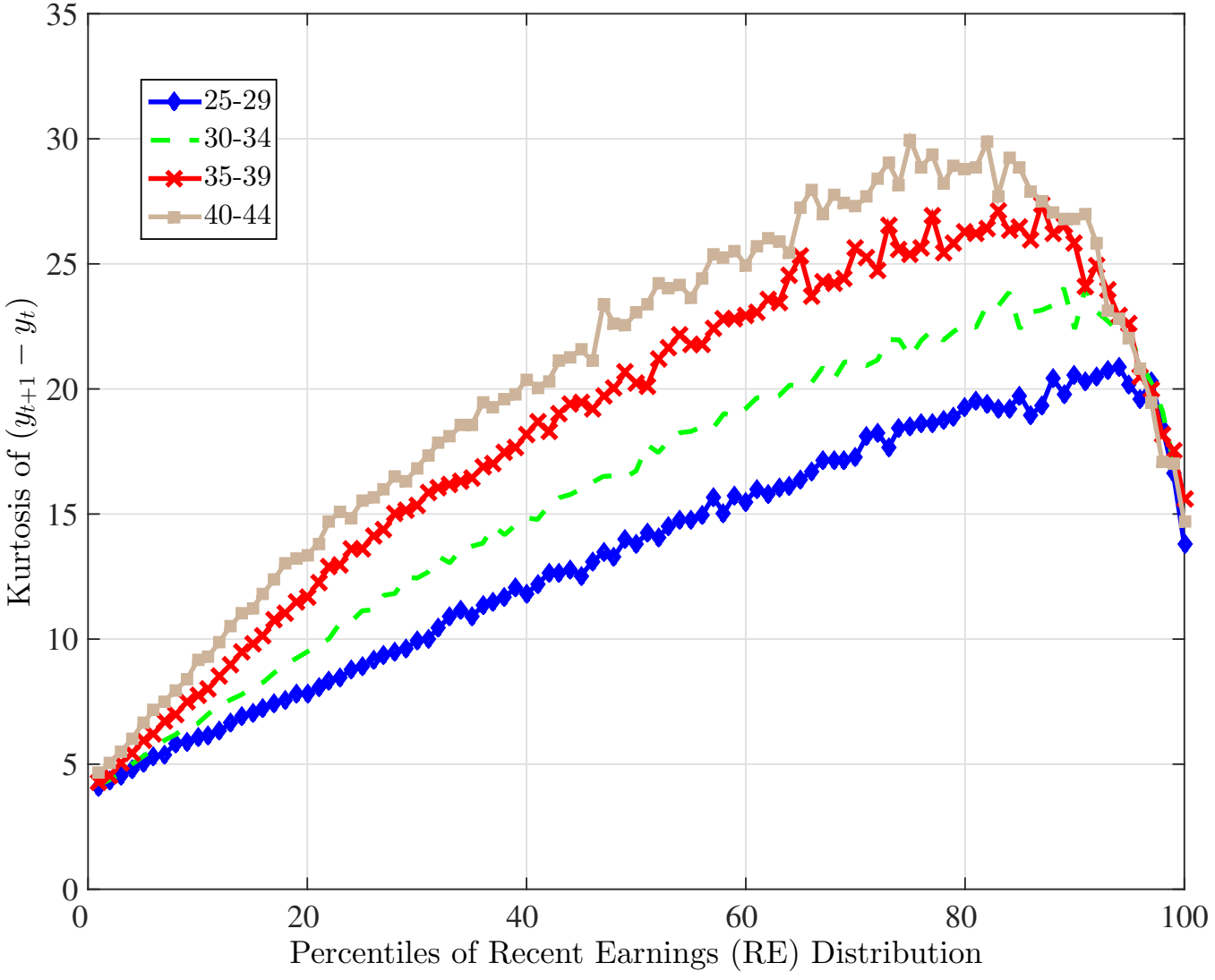

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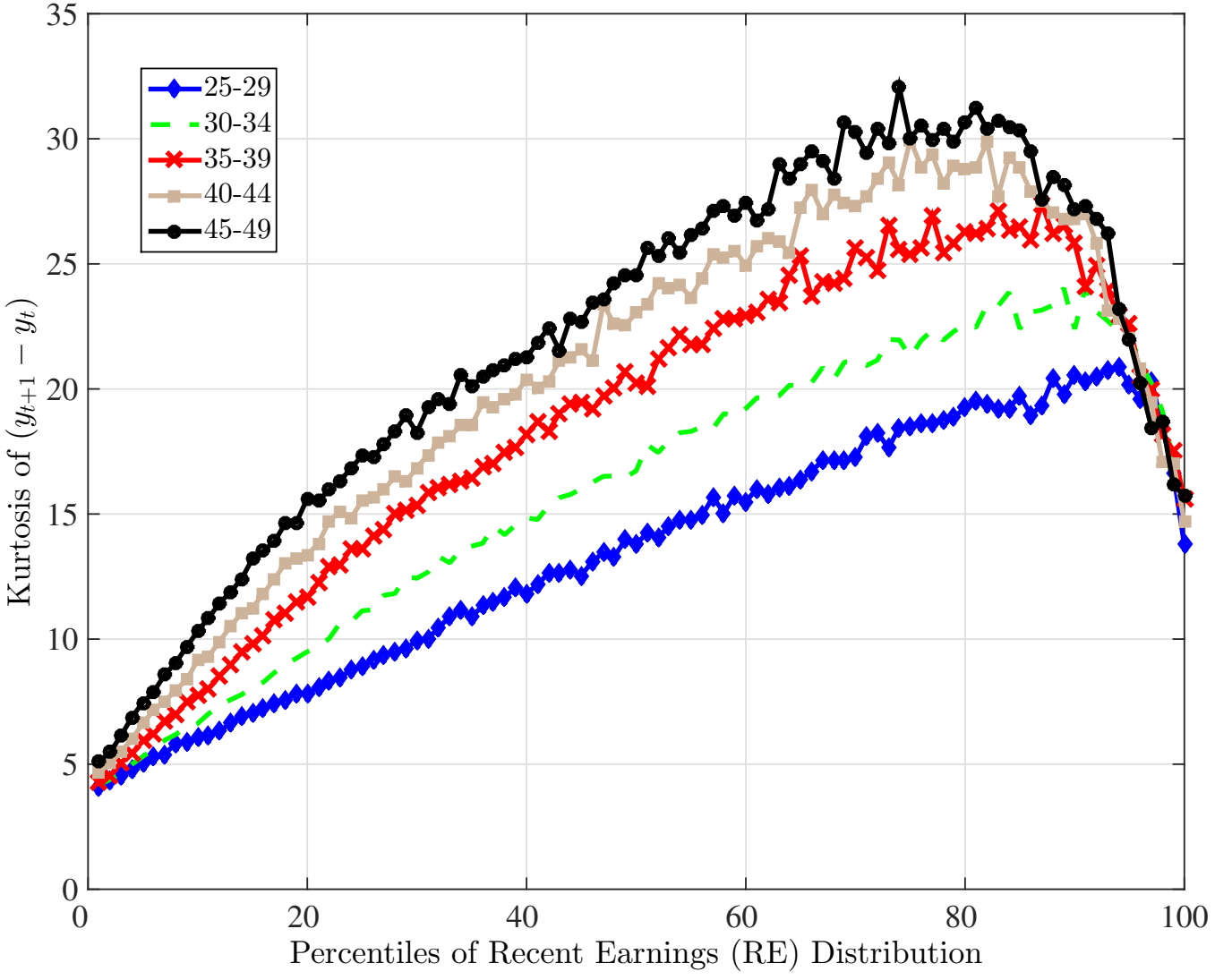

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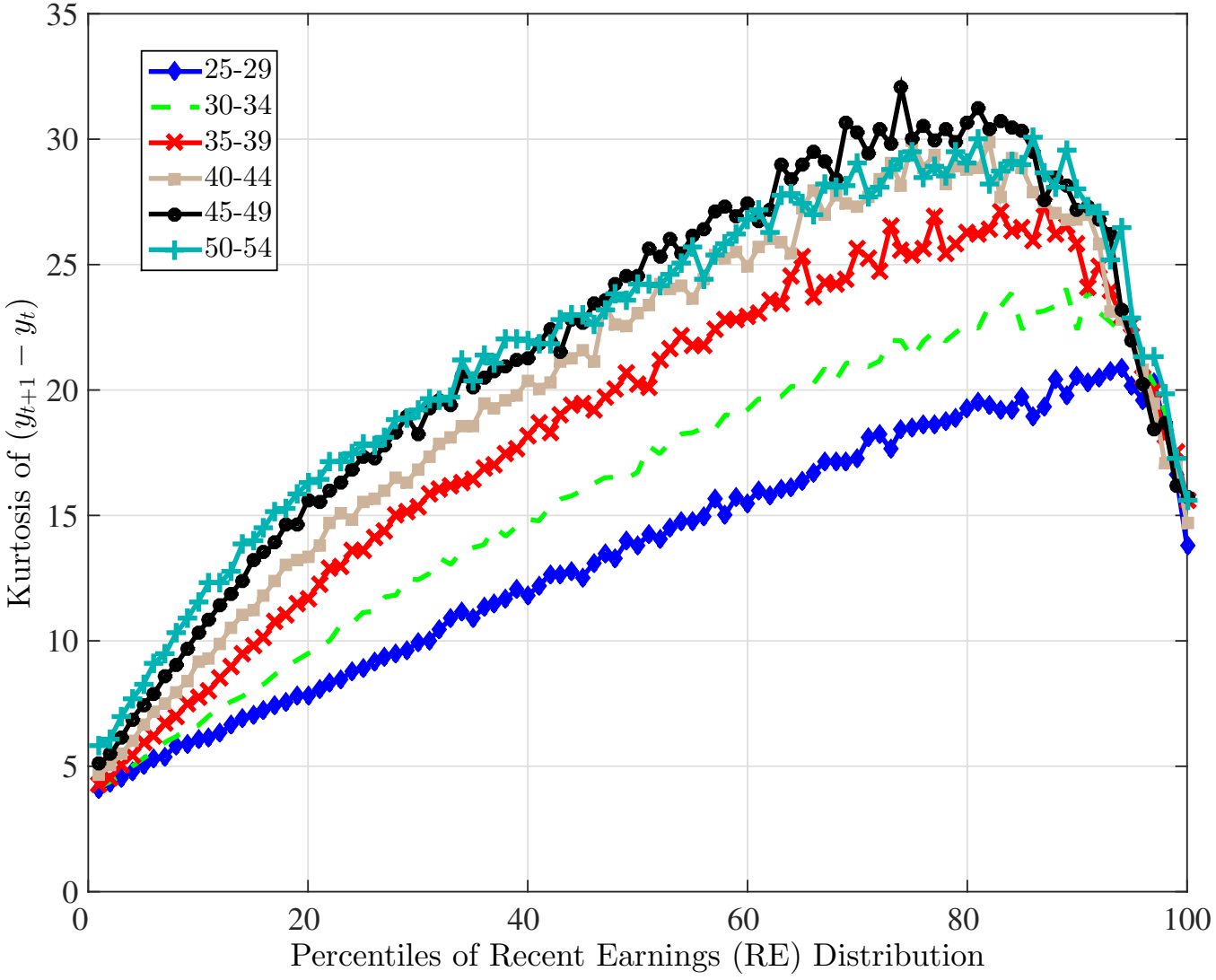

Risk Premium: Skewness and Kurtosis

Let $\tilde{\delta}$ be a static gamble. And π is the risk premium to avoid it:

$$U(c \times (1 - \pi)) = \mathbb{E}\left[U(c \times (1 + \tilde{\delta}))\right].$$

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	Risk Premium (π)	
Gamble:	$\tilde{\delta}^A$	$\tilde{\delta}^B$
Mean	0.0	
Standard Deviation	0.10	
Skewness	0.0	
Excess Kurtosis	0.0	
Premium	.	

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Mean	0.0	0.0
Standard Deviation	0.10	0.10
Skewness	0.0	–2.0
Excess Kurtosis	0.0	27.0
Premium	4.88%	**22.15%**

Four Sets of Empirical Facts

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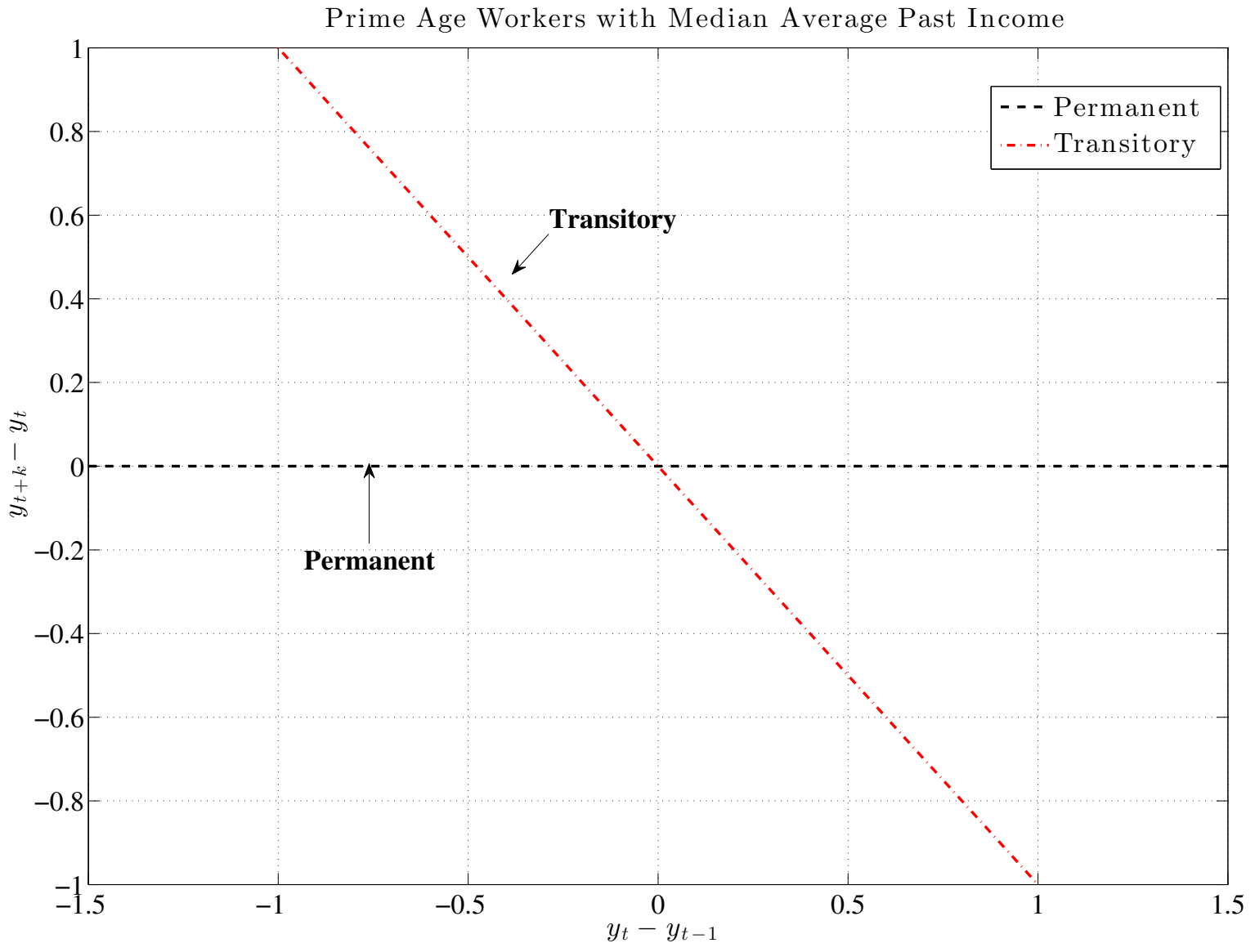
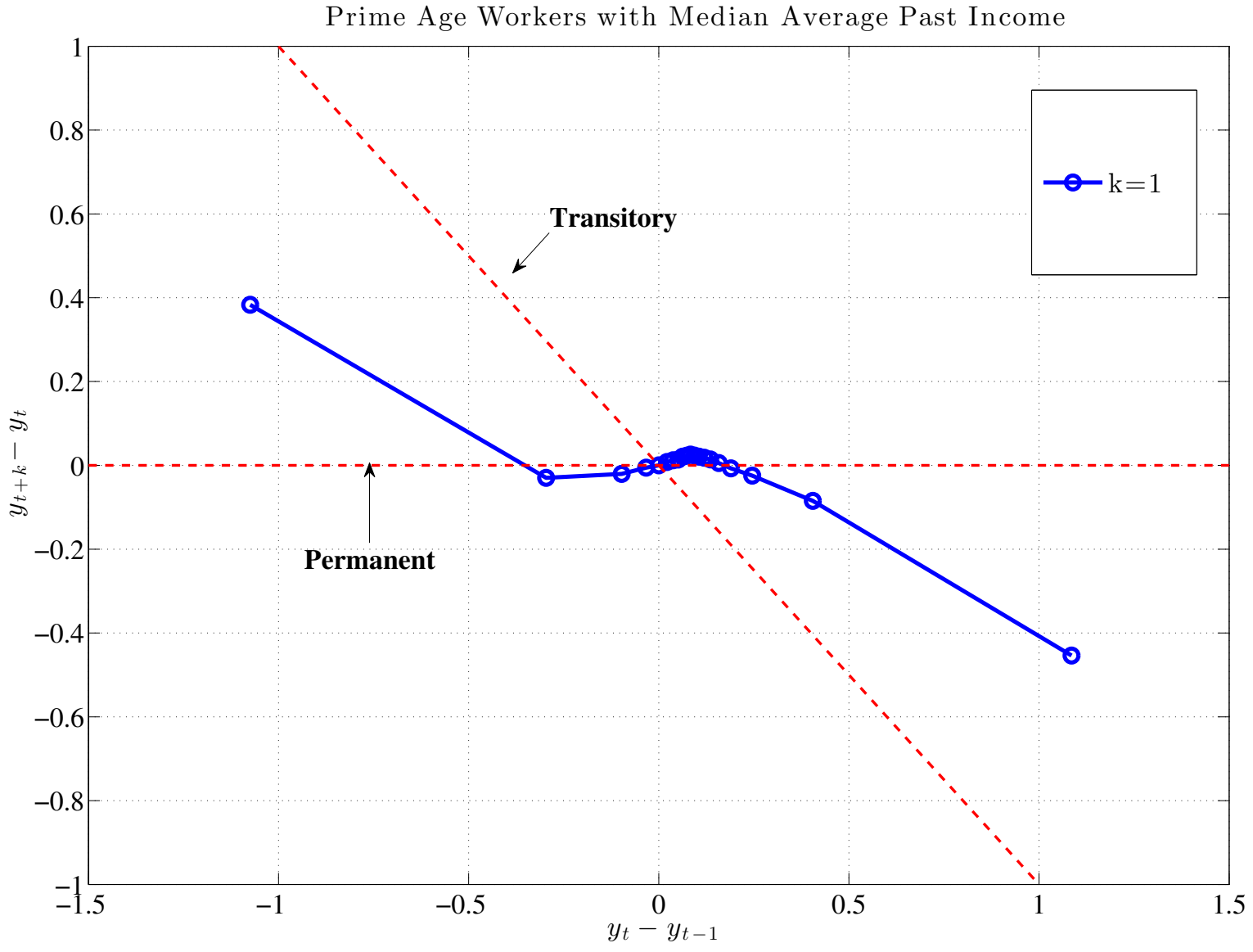
2. Cross-sectional moments of earnings growth: $y_{t+k} - y_t$
3. Short- and long-run dynamics of income growth
4.

Impulse Response Functions



Impulse Response Functions



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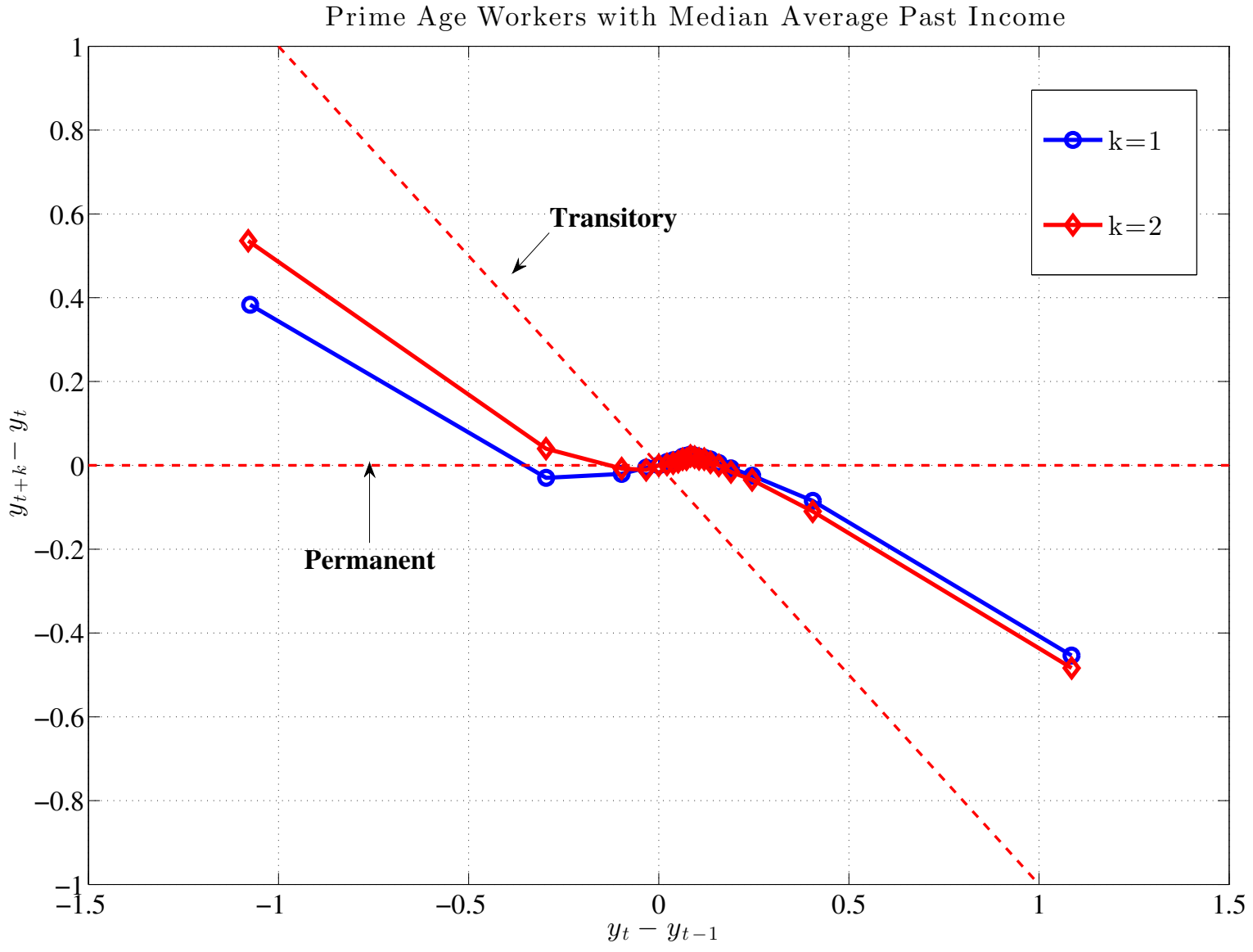

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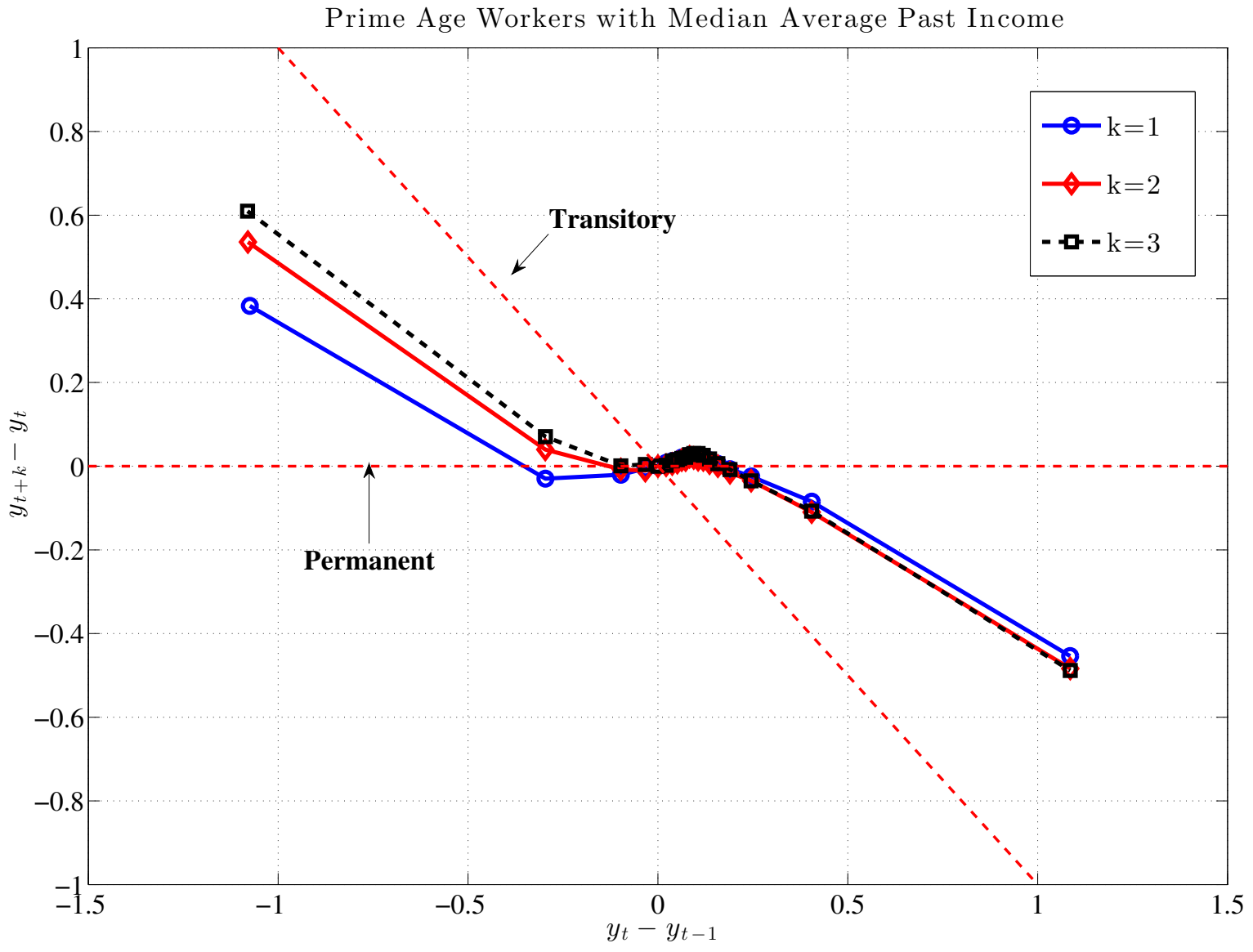

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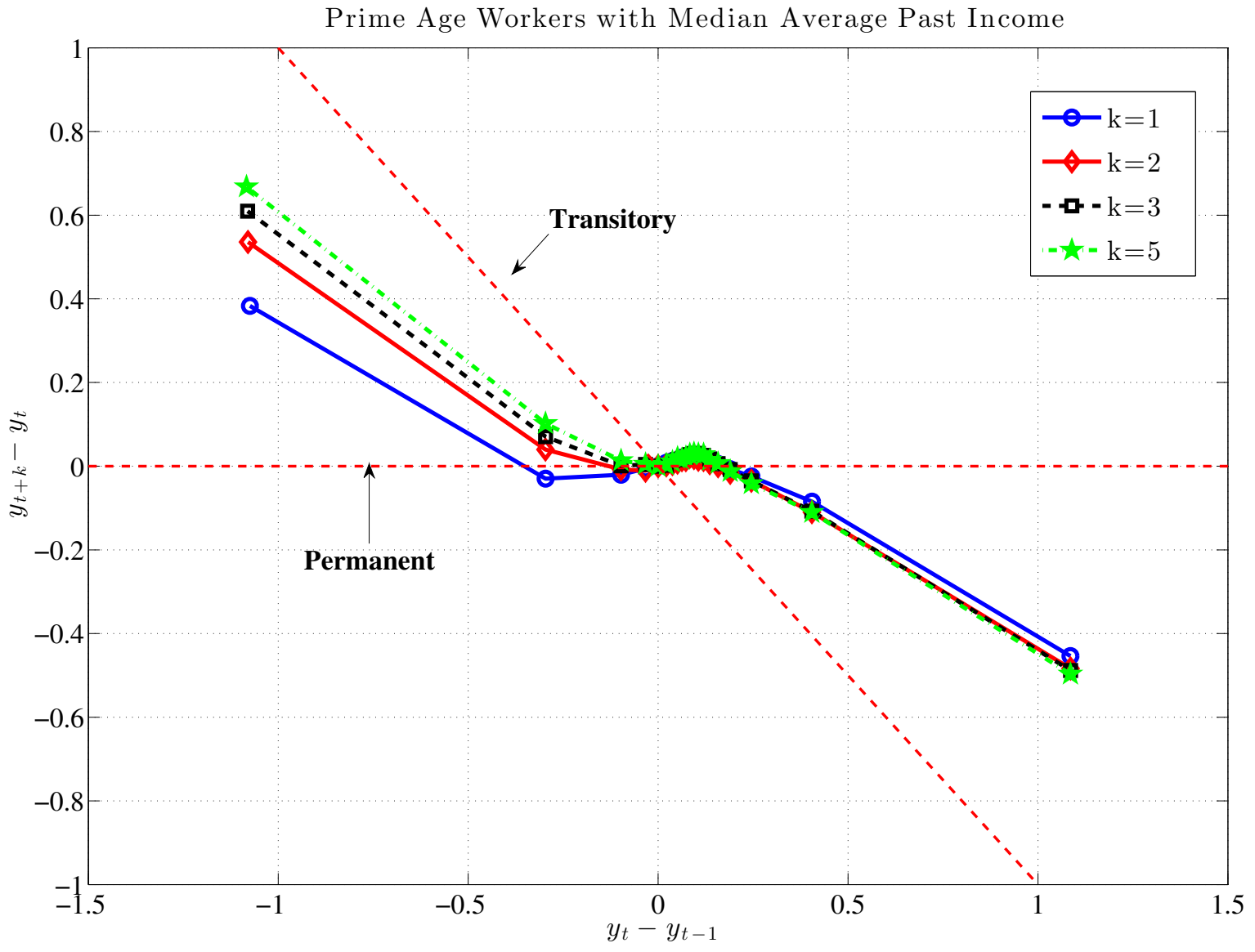

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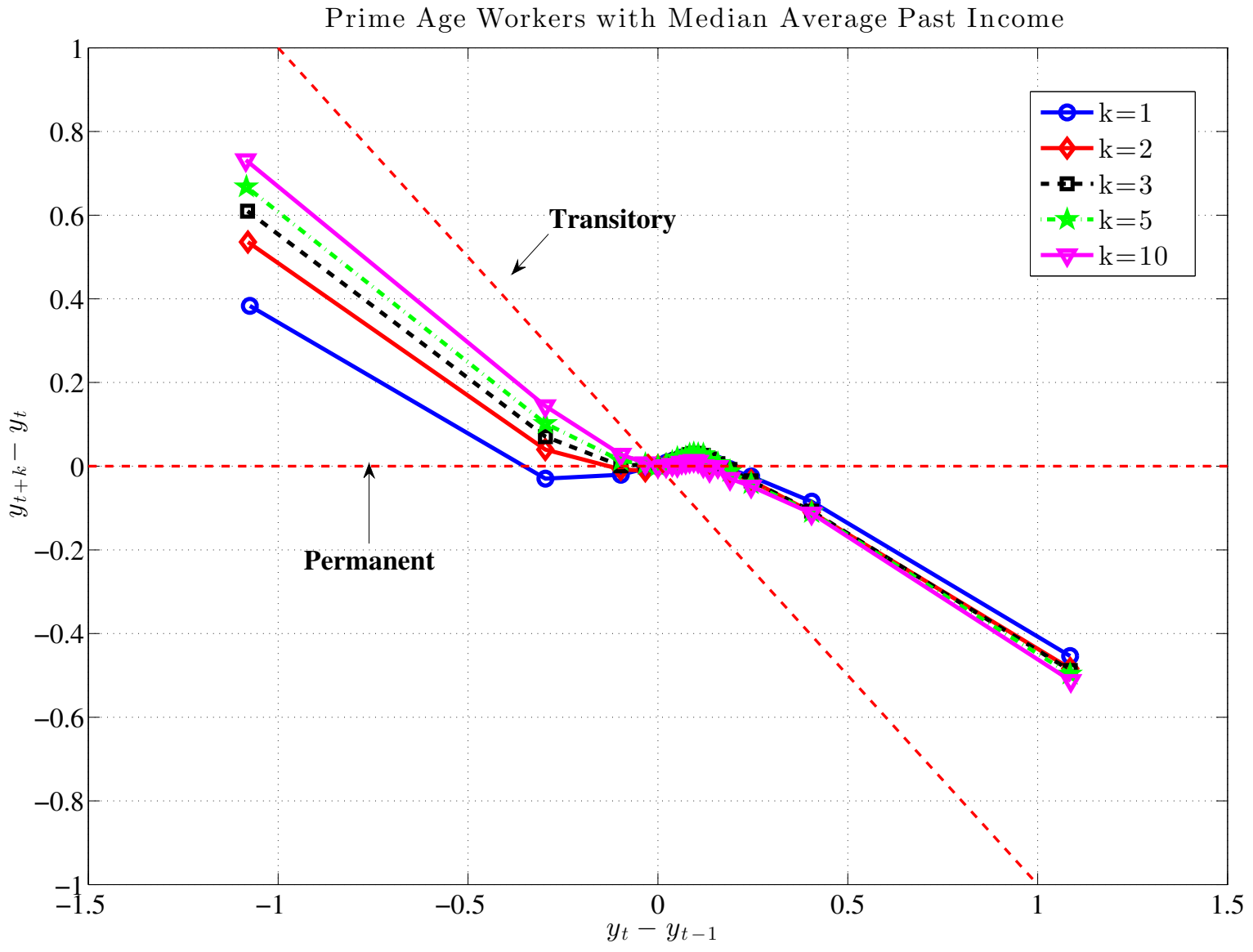

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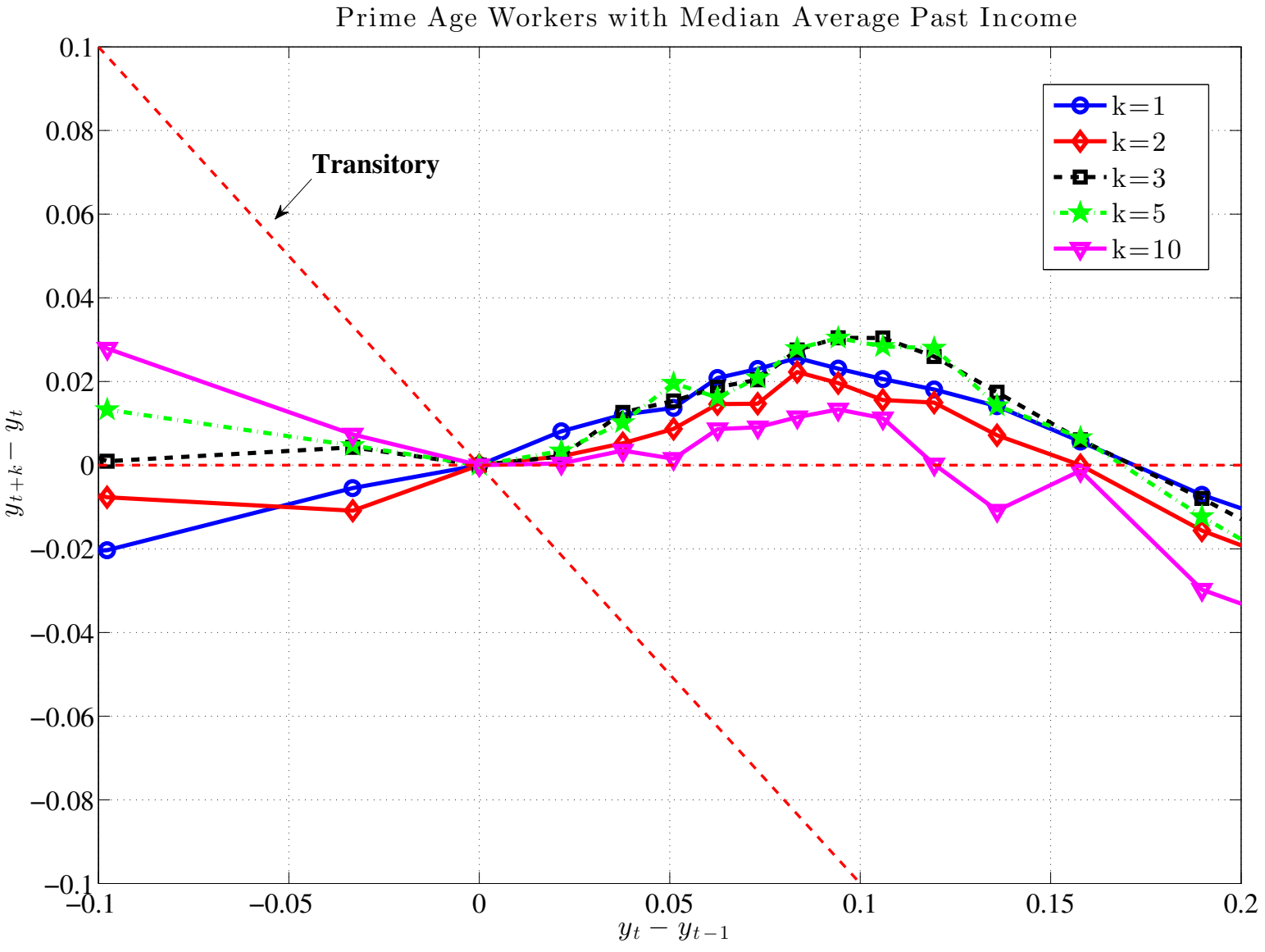
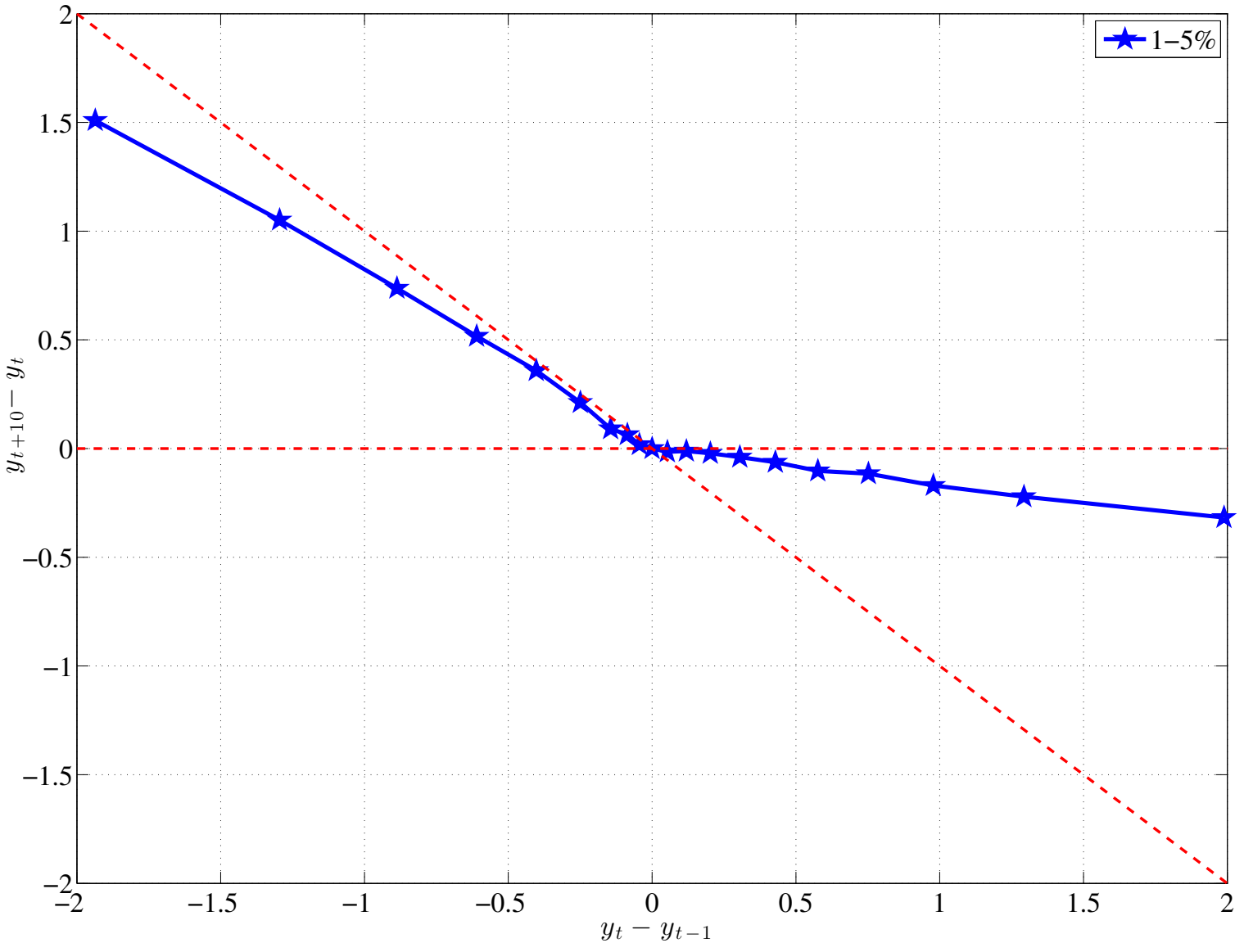


Asymmetric Mean Reversion



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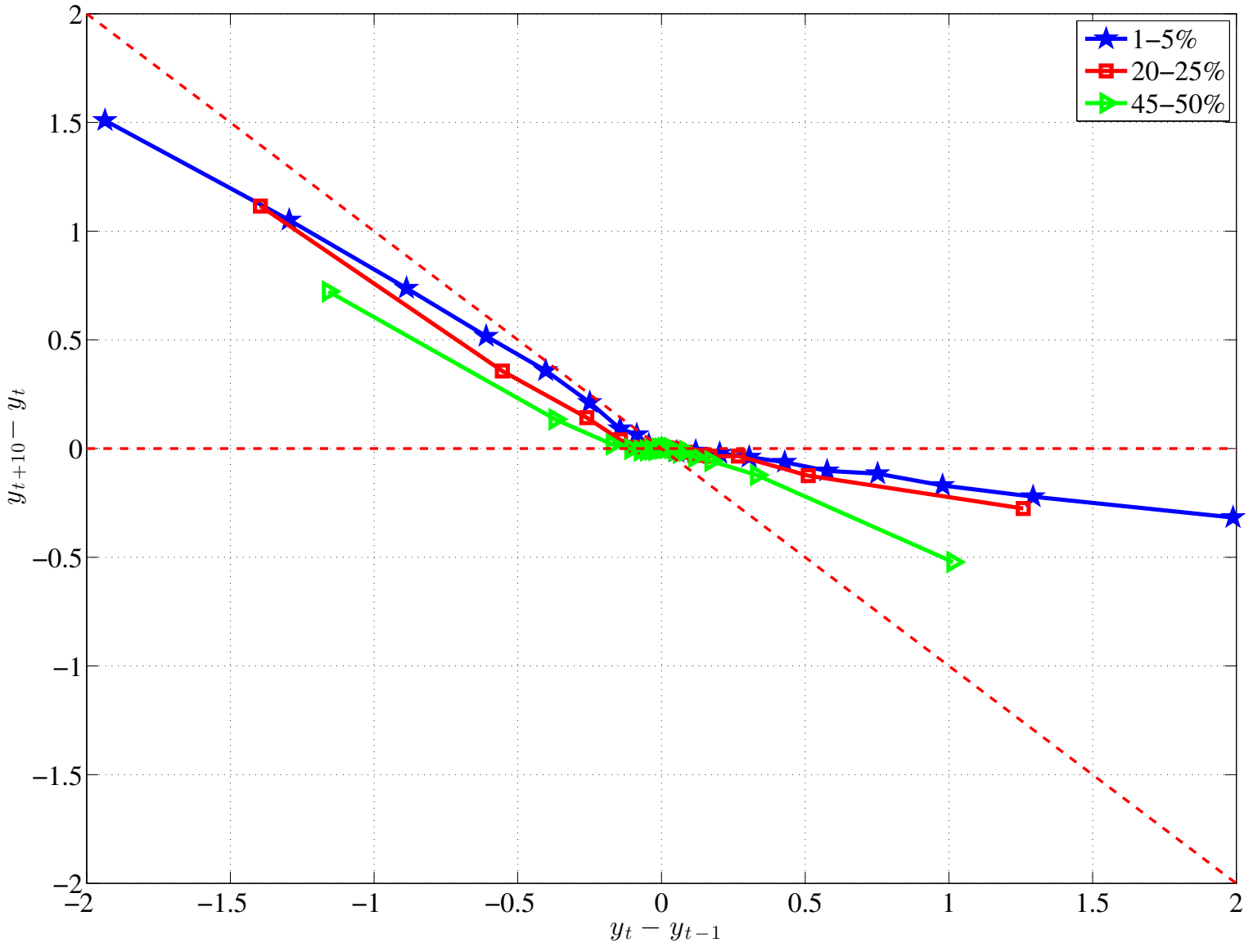

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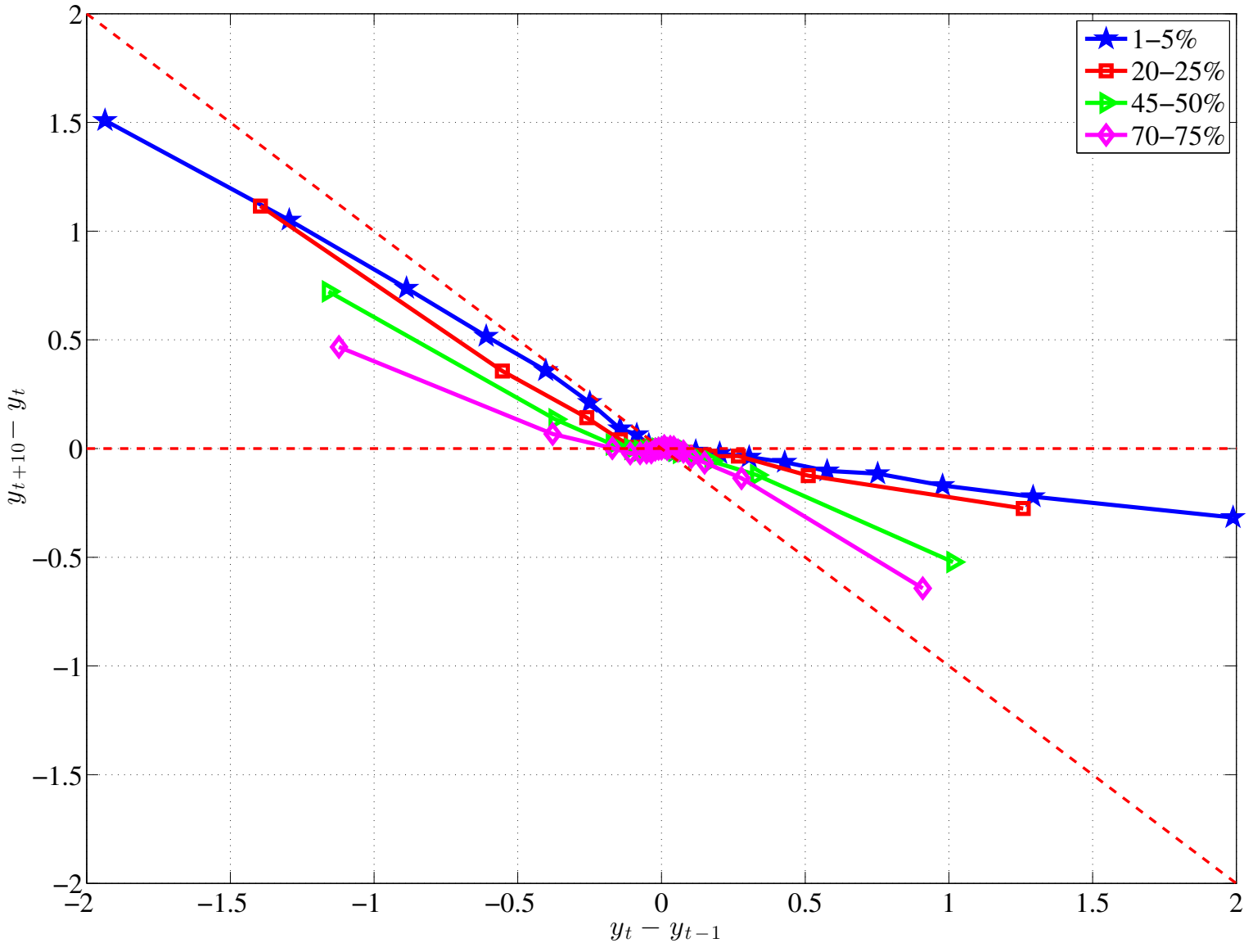

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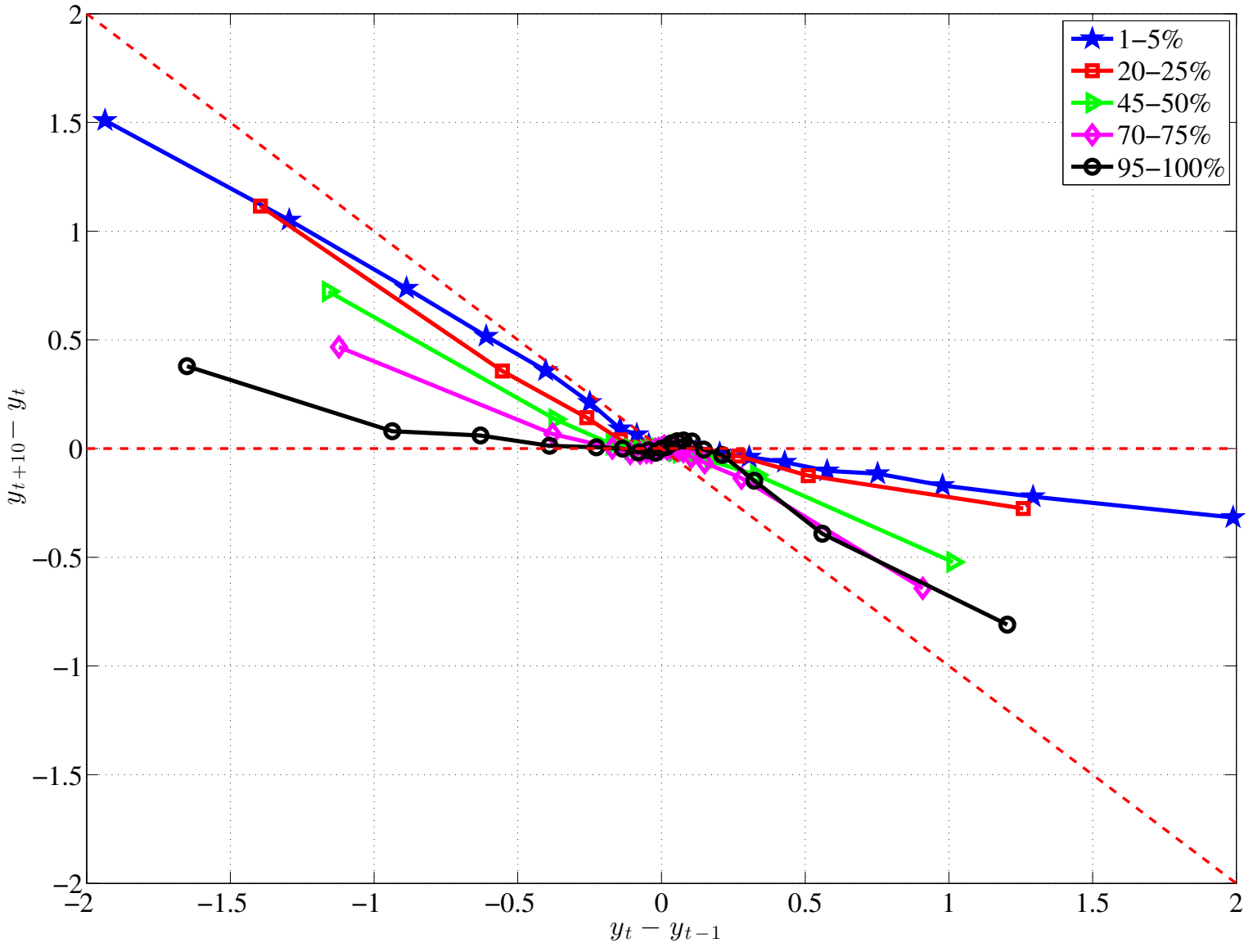

Four Sets of Empirical Facts

1. Average income growth over the life cycle
2. Cross-sectional moments of earnings growth: $y_{t+k} - y_t$
3. Short- and long-run dynamics of income growth
4. "Scarring" Effects of Long-Term Unemployment

ESTIMATION

Econometric Specification

$$y_t^i = \underbrace{\left[\alpha^i + \beta^i t + \gamma^i t^2\right]}_{\text{HIP}} + \underbrace{z_{1,t}^i + z_{2,t}^i + z_{3,t}^i}_{\text{mixture of AR(1)s}} + \underbrace{\varepsilon_t^i}_{\text{i.i.d.}}$$

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and

$$p_j(t, z_{t-1}) = a_j + b_j \times z_{t-1} + c_j \times t + d_j \times z_{t-1} \times t$$
$$1 = p_1 + p_2 + p_3$$

Estimation Results

Specification:	(2)	(4)	(8)
	Benchmark model	**Best fit**	**Standard model**
HIP order	1	1	0
AR(1)	2	3	1
RW	1	0	0
Heterog. variances?	yes	yes	no
Parameter			
σ_α	0.552	0.475	0.673
$\sigma_\beta \times 10$	0.130	0.137	—
$\text{corr}_{\alpha\beta}$	–0.49	–0.04	—
Objective value	**17.17**	**15.29**	**38.75**

Note: $^*\rho_\nu = 1.0$ *is imposed.*

Estimation Results

Specification:	(2)	(4)	(8)
	Benchmark model	**Best fit**	**Standard model**
ρ_z	0.259	0.083	1.00
ρ_x	0.425	0.512	—
ρ_ν	1.0*	0.796	—
$\bar{\sigma}_z$	0.847	0.656	0.172
$\bar{\sigma}_x$	0.361	0.337	—
$\bar{\sigma}_\nu$	0.087	0.082	—
σ_ε	0.029	0.019	0.040
$\sigma_{\nu 0}$	—	0.110	—
σ_{zz}	0.107	0.167	—
σ_{xx}	0.194	0.294	—

Selected Estimated Parameters

		z_1	z_2	z_2
p_j	Probability	0.11	0.23	0.68
ρ	Persistence	0.08	0.51	0.80
σ	Innov. std. dev	0.66	0.34	0.08
σ_α		0.48		
$\sigma_\beta \times 10$		0.14		

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- We intend to construct Markov transition matrices that summarize these processes.
- Catalan-Civale-Fazilet (2015) explore how to do this for processes with excess kurtosis and large skewness.
    - Results to so far quite encouraging.

A Structural Interpretation

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- Skewness: Job losses contribute to the left tail.
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- These insights are mostly missed in income dynamics literature.

Conclusions

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- New benchmarks and targets for calibration.

Initial Conditions

$$\eta_{jt}^{*i} \sim \mathcal{N}(\mu_j, \sigma_j^i) \quad \text{and} \quad \eta_{jt}^i = \eta_{jt}^{*i} \times \mathbb{I}\{s_{i,t} \in I_{p_j}\} \tag{1}$$

$$\log\sigma_j^i \sim \mathcal{N}(\overline{\sigma}_j - \frac{\sigma_{jj}^2}{2}, \sigma_{jj}^2), j = z, x, \qquad \sigma_v^i \equiv \sigma_v \tag{2}$$