Trends in Earning Volatility for U.S. Men: 1979-2017

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Two types of income volatility

Volatility measures the degree of change in an economic variability from one period to the next

1. Variance of income change or income growth (Gross Volatility): Bloom et al. (2017), Carr & Wiemers (2018), Braxton et al. (2021), Carr & Wiemers (2021), Moffitt et al. (2022)
2. Permanent and transitory variances: Moffitt & Gottschalk (2012), Hryshko et al. (2017), Moffitt & Zhang (2018), Braxton et al. (2021)

- Trends in transitory variance also fall into the income risk category of income mobility, according to Jäntti & Jenkins (2015)
- A gross volatility study is straightforward and does not require delicate model assumptions
- But, trends in permanent and transitory variances provide more useful policy implications (ex., consumption, inequality, welfare).

Implication of variance decomposition

Increase in permanent variance

- Causes income distribution to widen over time
- Rankings are preserved
- Possible determinants: Labor demand shift from skill biased technology and international trade

Increase in transitory variance

- Shuffles income rankings
- Implies higher income risk
- Possible determinants: Worker-firm attachment, labor market competitiveness, regulation, and temporary employment

Contribution

- The gross volatility analysis in this article contributes to the recent effort to reconcile discrepancies across studies (Moffitt et al., 2022)
- The first study that investigates a permanent-transitory variance of earnings in the Current Population Survey (CPS) by constructing a pseudo panel.

Data: CPS

The Annual Social and Economic Supplement (ASEC) of the Current Population Survey (CPS)

- The publicly-available version downloaded from the Center for Economic and Policy Research (CEPR)
- Ranges from 1979 to 2017
- Restrict to men between ages 30 and 59, who are not full-time students, with positive earned income and non-missing educational attainment information
- Drop zero-weighted samples
- Converted to 2017 CPI-U-RS dollars
- Trim the top 4% to eliminate top-coded incomes

Descriptive Statistics: CPS Cross-Section

	Mean	Standard Deviation	Minimum	Maximum
Age	43	8.424	30	59
Married (%)	0.74	0.437	0	1
Race:				
White (%)	0.78	0.415	0	1
Black (%)	0.08	0.275	0	1
Hispanic (%)	0.09	0.283	0	1
Others (%)	0.05	0.219	0	1
Education:				
Less than high school (%)	0.12	0.329	0	1
High school (%)	0.33	0.472	0	1
Some college (%)	0.25	0.432	0	1
College (%)	0.19	0.391	0	1
Advanced (%)	0.11	0.308	0	1
Employment:				
Full time, full year (%)	0.82	0.385	0	1
Working hours per week	43.56	9.46	1	99
Working weeks	48.82	8.87	1	52
Wage and Salary (2017 Dollars)	56,584	33,668	1	200,000

Data overview: CPS cross-section

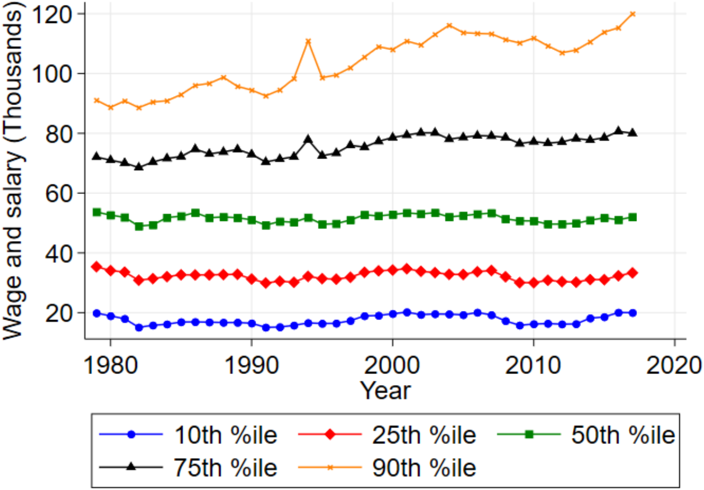


Figure: Male earnings by percentiles

Cross-sectional variance

- Researchers disagree about the degree of the rise in cross-sectional variance (those above the 90th percentile)
  - Partially results from methodological choices for imputing income sources that are not directly observed.
- However, the rise in cross-sectional variance is still a conventional view on U.S. income (Bloom et al., 2017).
- On the other hand, researchers disagree on trends in earnings volatility.

Data: Pseudo panel

- In the CPS, individuals are followed at most two years.
- To investigate longer-term earnings patterns, a **pseudo panel** is constructed:
  Each individual is classified into only one cohort where the characteristics for creating cohorts are exogenous and time-invariant.
- Based on an individual's year of birth, education level, and race

Methodology: Obtain residuals

- Regress log earnings on education, an age polynomial, and interactions between age and education variables, separately by calendar year $\rightarrow$ Obtain residuals $\hat{\epsilon_{ct}}$

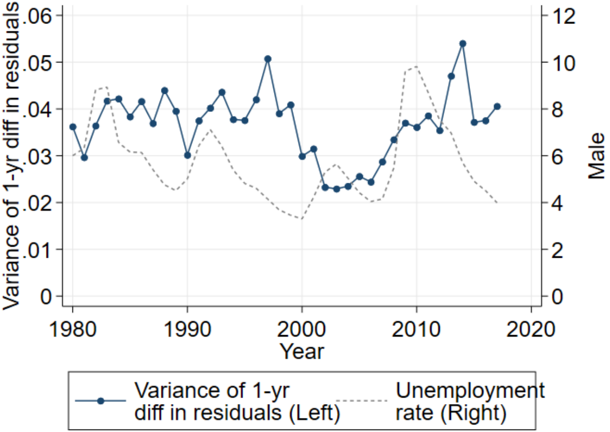
$$y_{ct} = \beta_{0t} + \mathbf{X}'_{\mathbf{ct}}\beta_{1t} + \mathbf{Y}'_{\mathbf{ct}}\beta_{2t} + \mathbf{Z}'_{\mathbf{ct}}\beta_{3t} + \epsilon_{ct} \tag{1}$$

  - y_{ct} is log earnings for cohort c and time t
  - $\mathbf{X_{ct}}$ is a vector of five education dummy variables
  - $\mathbf{Y_{ct}}$ is an age polynomial (cubic)
  - $\mathbf{Z_{ct}}$ is interaction between education dummies and age
- The regressions are weighted by the square root of the cohort size

Result: Gross volatility

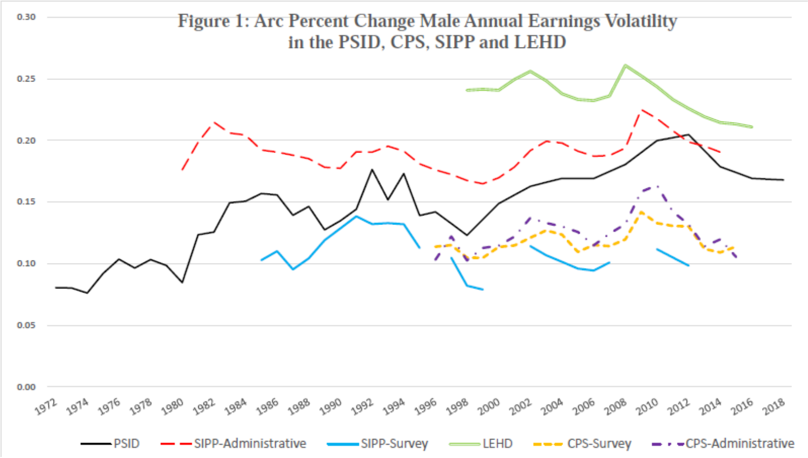
Gross volatility = The variance of first-differenced residuals

Figure: Gross volatility of male log earnings residuals



Result: Gross volatility

Figure: Gross Volatility (Moffitt et al., 2022)



Methodology: Extended Semiparametric (ESP) Model

- Developed by Moffitt & Zhang (2018) (Hereafter MZ)
- The model overcomes one criticism on the widely used error component (EC) model, under which estimates are often sensitive to parametric assumption.
- The ESP model is non-parametric with respect to the dynamic evolution of permanent and transitory variances but maintains a traditional linear framework of the EC model.

$$\hat{\epsilon_{cat}} = \underbrace{\alpha_t \mu_{ca}}_{\text{Permanent Component}} + \underbrace{\beta_t \nu_{ca}}_{\text{Transitory Component}} \tag{2}$$

$\hat{\epsilon_{cat}}$: Log earnings residual for cohort c at age a and year t
α_t and β_t: Calendar time shifts

Note: Parameters to be estimated are colored red.

Methodology: Extended Semiparametric (ESP) Model

Permanent Component:

$$\mu_{ca} = \mu_{c0} + \sum_{s=1}^{a} \omega_{cs} \tag{3}$$

Transitory Component:

$$\nu_{ca} = \xi_{ca} + \sum_{s=1}^{a-1} \psi_{a,a-s} \xi_{c,a-s} \text{ for } a \geq 2 \tag{4}$$

$$\nu_{c1} = \xi_{c1} \text{ for } a = 1 \tag{5}$$

$|\psi_{a,a-s}| < 1$
ω_{cs}: Permanent shocks
$\xi_{c,a-s}$: Transitory shocks
$\mu_{c0} \sim N(0, Var(\mu_{c0}))$

Note: Parameters to be estimated are colored red.

Methodology: Extended Semiparametric (ESP) Model

- ω and ξ are nonparametric functions of age a
- ψ are nonparametric functions of age a and leg length b

$$Var(\omega_{ca}) = e^{\sum \delta_j (a-25)^j} \tag{6}$$

$$Var(\xi_{ca}) = e^{\sum \gamma_j (a-25)^j} \text{ for } a \geq 2 \tag{7}$$

$$Var(\xi_{c1}) = k e^{\sum \gamma_j (1-25)^j} \text{ for } a = 1 \tag{8}$$

$$\psi_{a,a-b} = [1 - \pi(a-25)][\sum e^{-\lambda_j b}] + \sum \eta_j D(b = j) \tag{9}$$

- The degree of the expansion is chosen by generalized cross-validation (GCV)

Note: Parameters to be estimated are colored red.

Methodology: Generalized method of moments (GMM)

- The GMM estimator finds close matches for **population variances and autocovariances** in equations (2)-(9) to **their sample counterparts** from log earning residuals $\hat{\epsilon_{ct}}$
- Estimation with the weighing matrix can lead to biases in finite samples (Doris et al., 2011)
  $\rightarrow$ An identity matrix can be chosen as an alternative (Altonji et al., 2013)
  $\rightarrow$ Minimum distance method

Result: ESP model estimates

Table: Estimates of the ESP Parameters

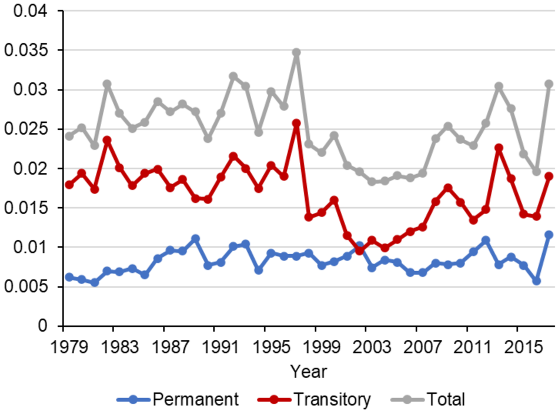
	Coefficient	Standard Error
$Var(\mu_{i0})$	0.0062	0.0001
λ	0.0551	0.0029
η_0	-11.5137	0.4775
π	-0.1468	0.0048
k	1.5188	0.0997
η_1	-2.3291	0.0579
δ_0	-15.4304	29.0889
δ_1	-0.0074	2.1871
γ_0	-8.6724	0.0877
γ_1	0.0344	0.0005
η_2	-0.2634	0.0083

Result: ESP model estimates

Total variance $= Var(\hat{\epsilon_{cat}})$

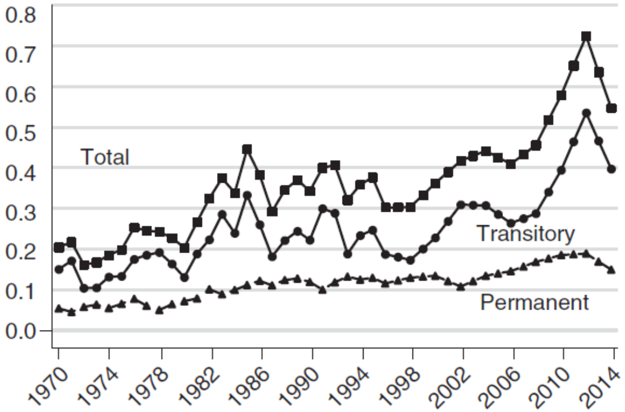
Permanent variance $= Var(\hat{\alpha}_t \hat{\mu_{ca}})$, Transitory variance $= Var(\hat{\beta}_t \hat{\nu_{ca}})$

Figure: Fitted permanent, transitory, and total variances of log earnings residuals: Ages 30-39



Result: ESP model estimates

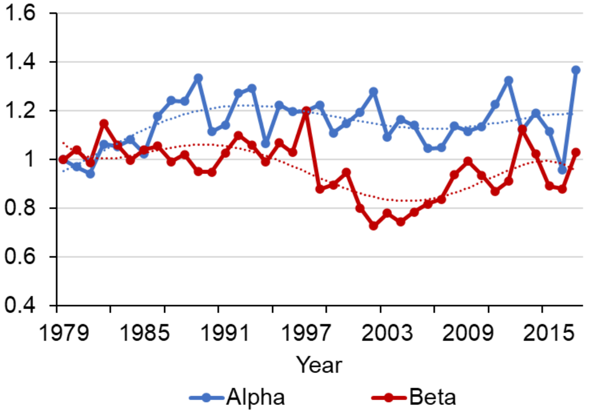
Figure: Fitted Variances of Log Earning Residuals: Age 40-49 (Moffitt and Zhang, 2018)



Result: ESP model estimates

$\hat{\epsilon_{cat}} = \alpha_t \mu_{ca} + \beta_t \nu_{ca}$

Figure: Extended semiparametric (ESP) model estimates of alpha and beta



Note: The trend line is fit from a fifth order polynomial.

Conclusion

Gross volatility

- An essential difference between our work and MZ is the decreasing trend in gross volatility that preceded the Great Recession
- Researchers disagree with the trend in gross volatility from the mid-1980s to the late 1990s, possibly caused by characteristics of data sets (e.g., a heaviness in low tail) and difference in trimming method (real dollar trim vs. percentile trim)
- Consistent with the recent study (Moffitt et al., 2022) that shows little evidence of any significant trend in male earnings volatility since the mid-1990s except a counter-cyclical pattern.

Conclusion

Permanent and transitory variance

- The increase of α in the 1980s corresponds to rises in the return to education and other indices of skill differentials (Moffitt & Gottschalk, 2012)
- Our estimates of β resemble those from MZ in that they increased in years around the Great Recession (countercyclicality)
- The transitory variance: About 74% of the total variance until the late 1990s, and 52% in 2002. Resumed to increase and was about 70% surrounding the Great Recession.

Future Research

- Use the restricted-use version CPS
  - To protect the confidentiality of respondents, incomes in the CPS are top coded. The restrict-use version has higher top-coding thresholds.
- The article focuses on the income volatility of prime-age men, and extensions to other sub-demographic levels – such as females, immigrants, or minorities – are not explored yet.