Non-linear household earnings dynamics, self-insurance and welfare

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Motivation

- Nature of income inequality/risk: critical for many questions in economics. E.g.:
  - Consumption and wealth distribution
  - Ability to self-insure/welfare
  - $\Longrightarrow$ Scope for social insurance and redistribution
- Better datasets and new methods are challenging long held views about labour income risk
- $\Longrightarrow$ What are the implications for:
  - Consumption and wealth inequality
  - Self-insurance
  - Welfare

"Canonical" model of earnings dynamics

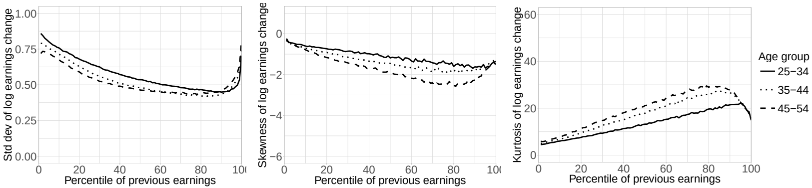
- Detrended labor earnings follow a (log-) linear process. E.g.

$$\log Y_{it} = f(t) + \delta_i + \eta_{it} + \varepsilon_{it}$$
$$\eta_{it} = \rho \eta_{i,t-1} + v_{it}$$

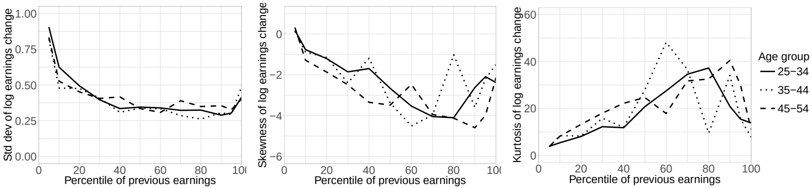
  with $\delta_i, \eta_{i1}, v_{it}, \varepsilon_{it}$ normally distributed.
- Three main features:
  - Age-independence of conditional 2nd and higher moments
  - Normality: Shocks are symmetrically distributed + no fat tails
  - Linearity: conditional 2nd and higher moments independent of $\eta_{i,t-1}$

Individual, pre-tax earnings do not fit the canonical model

W2 Social Security Data (Guvenen et al. 2016):

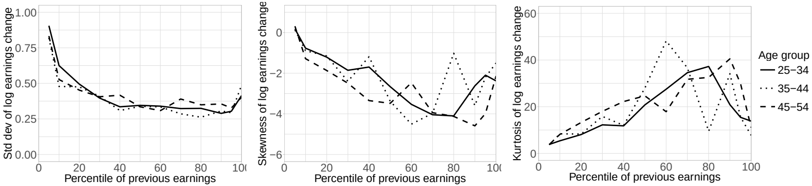


Similarly in the PSID:



...nor do HH, disposable earnings

Rich features of individual, pre-tax earnings



are also present in disposable, HH earnings

This paper

- Estimate a flexible process à la Arellano, Blundell and Bonhomme (2017) for household post-tax labor earnings using the PSID.
- Use a structural life-cycle model to compare the implications of the flexible process against canonical permanent + transitory process.

Findings

- Allowing for a flexible earnings dynamics:
  - Significantly improves the fit of the growth of consumption dispersion over age
  - Implies a pass-through of "permanent" earnings shocks in line with the estimates in Blundell, Pistaferri and Preston (2008)
  - ... but does not improve the fit of the wealth distribution
- Lower welfare gains from removing earnings risk

Two strands of literature

- **Quantitative models of consumption and wealth inequality**
  (Huggett, 1996; De Nardi, 2004; Storesletten, Telmer and Yaron, 2006; . . .)
- **Richer specifications of earnings dynamics**
  (Geweke and Keane, 2000; Meghir and Pistaferri, 2004; Browning, Ejrnaes and Alvarez, 2010; Altonji, Smith and Vidangos, 2013; Blundell, Graber and Mogstad, 2015; Arellano, Blundell and Bonhomme, 2017; Guvenen, Karahan, Ozkan and Song, 2016...)

Data

- PSID core sample, 1968-1992, joint earnings for all HH (25-60)
- Disposable earnings obtained by regression as in Guvenen and Smith (2014)
- Equivalization by regression on number of family members
- Residual disposable earnings net of time and age fixed-effects

A flexible but parsimonious model

Arellano, Blundell and Bonhomme (2017)

Let $Q_z(q|\cdot)$ denote the conditional quantile function for z

$$
\begin{aligned}
y_{it} &= \eta_{it} + \varepsilon_{it}, \qquad t = 1, \ldots, T \\
\eta_{it} &= Q_\eta(v_{it}|\eta_{i,t-1}, t) \\
\varepsilon_{it} &= Q_\varepsilon(u_{it}|t) \\
\eta_{i1} &= Q_{\eta_1}(v_{i1}) \\
u_{it}, v_{i1}, (v_{it}|\eta_{i,t-1}, \eta_{i,t-2}, \ldots) &\sim U(0,1)
\end{aligned}
$$

Persistence

$$
\rho_t(q, \eta_{i,t-1}) = \frac{\partial Q_\eta(q|\eta_{i,t-1}, t)}{\partial \eta_{i,t-1}}, \quad \rho_t(q) = \mathbb{E}_\eta \left[\frac{\partial Q_\eta(q|\eta_{i,t-1}, t)}{\partial \eta_{i,t-1}} \right]
$$

The flexible model: summary
Extra features

The flexible model considered allows for

- Age dependence of conditional 2nd and higher moments
- Non-normality of shocks
- Non-linearity in $\eta_{i,t-1}$ and its innovation

A flexible but parsimonious model

Parameterization

Let $\psi^k, \quad k = 0, 1, \ldots$ denote a family of bivariate, polynomial fns.

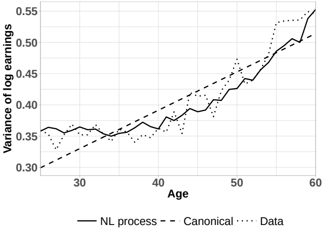
$$Q_\eta(q|\eta_{i,t-1}, age_{it}) = \sum_{k=0}^{K} \alpha_k^\eta(q)\psi^k(\eta_{i,t-1}, age_{it})$$

$$Q_\varepsilon(q|age_{it}) = \sum_{k=0}^{K} \alpha_k^\varepsilon(q)\psi^k(age_{it})$$

$$Q_{\eta_1}(q|age_{i1}) = \sum_{k=0}^{K} \alpha_k^{\eta_1}(q)\psi^k(age_{i1})$$

Canonical benchmark

- Estimated by fitting variances and autocovariances of earnings over the life-cycle



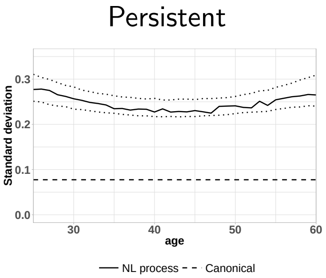
$$y_{it} = \eta_{it} + \varepsilon_{it}$$
$$\eta_{it} = \rho\eta_{i,t-1} + v_{it}$$

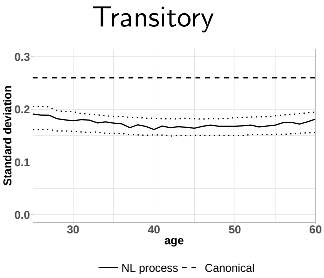
	σ^2_ϵ	$\sigma^2_{\eta_1}$	σ^2_ν	ρ
Benchmark	0.0675	0.2363	0.0059	1

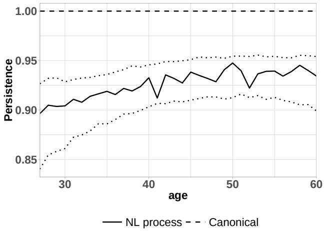
more

Features of NL vs canonical earnings processes

Second moments

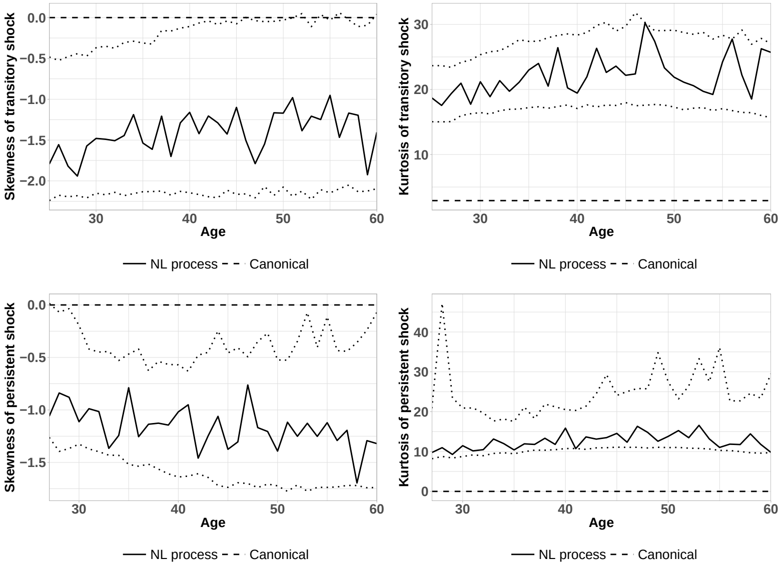






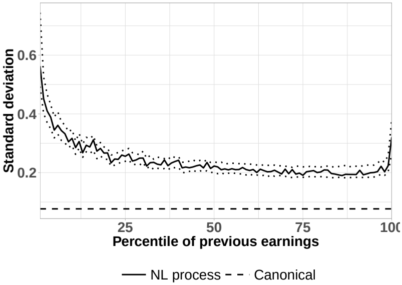
Features of NL vs canonical earnings processes

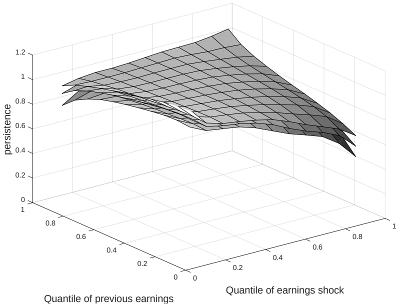
Skewness and Kurtosis



Features of NL vs canonical earnings processes

Nonlinearity





Study consumption and wealth

- So, these earnings dynamics are much richer. Does it matter for:
  - Evolution of consumption inequality over the life cycle?
  - Saving behavior and wealth inequality?
  - Households ability to self-insure and welfare
- Use these earnings process in a quantitative life-cycle model
- Decompose the contribution of different features of the earnings process

Model implications

OLG model, key features

- Ex-ante identical agents. Idiosyncratic earnings shocks
- Working life age 25-60, then retirement until death
- Age-dependent probability of dying. Die for sure at age 86
- Infinitely-lived government, old age Social Security
- Single risk-free asset

Preferences and technology

- Period utility
$$u(c_t) = \frac{c_t^{1-\sigma}}{1-\sigma}.$$
- Discount factor β
- Agents supply labor inelastically
- Earnings follow, alternatively, the two empirical processes described

Markets and government

- Incomplete assets markets: Agents can invest in a risk-free asset and can only borrow up to exogenous limit $\underline{a}$
- No annuity markets $\Rightarrow$ Flow of accidental bequests lost to the economy
- Government
  - Provides old-age pensions
  - r net of tax
  - Earnings process estimated on disposable income

Workers

$$V(t, z, \eta) = \max_{c, a'} \Big\{ u(c) + \beta s_t E_t V(t+1, z', \eta') \Big\}$$

$$\text{s.t. } a' = z - c, \quad a' \geq \underline{a}$$

$$z = (1+r)a + \eta + \epsilon$$

Retirees

$$
\begin{aligned}
W(t,z,p) = \max_{c,a'} & \Big\{ u(c) + \beta s_t E_t W(t+1, z', p) \Big\} \\
\text{s.t. } & a' = z - c, \quad a' \geq \underline{a} \\
& z = (1+r)a + p
\end{aligned}
$$

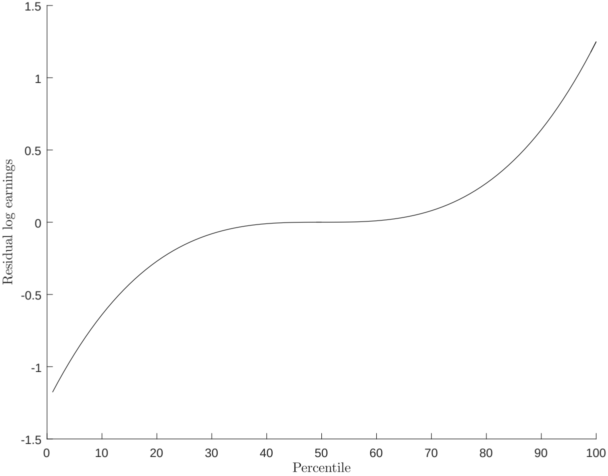
- No utility from bequests $W(T,z,p) = 0$

Calibration

- CRRA coefficient $\sigma = 2$
- Risk-free rate $r = 0.04$
- Survival probabilities are taken from Bell, Wade and Goss (1992)
- β calibrated to match $W/Y = 3.1$ in each of the economies
  - Benchmark: $\beta = 0.957$
  - NL process: $\beta = 0.939$
- $\underline{a} = 0.12$ (SCF average credit card limit)
- Pension benefit: non-linear function of last period gross earnings (Kaplan and Violante 2010)
- Discretization of NL earnings process by simulation

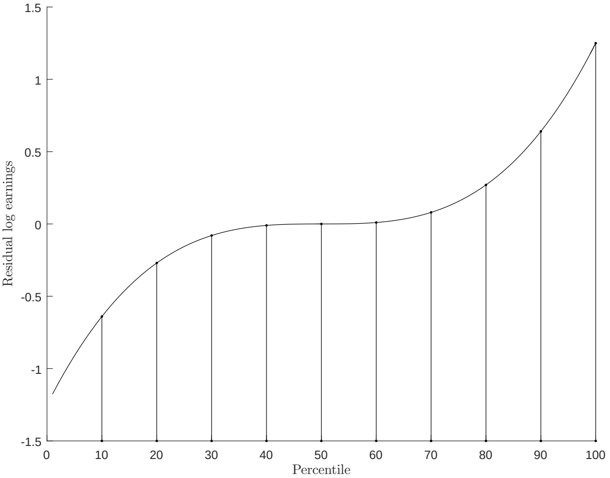
Discretization of NL earnings process

Grid points



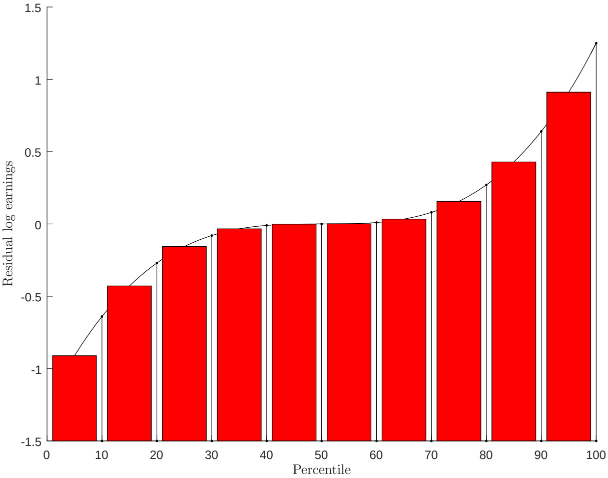
Discretization of NL earnings process

Grid points



Discretization of NL earnings process

Grid points



Discretization of NL earnings process

Transition matrices

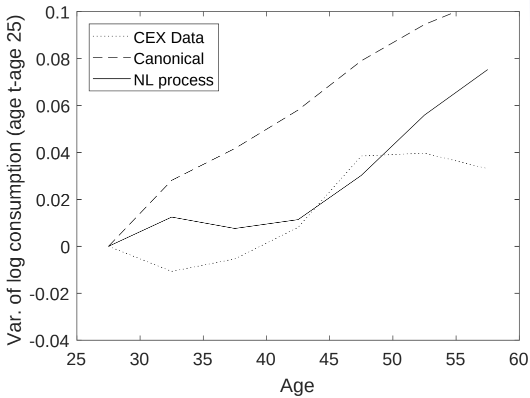
- The elements π^t_{mn} of the transition matrix Π^t between age t and $t+1$ are the proportion of individuals in bin m at age t that are in bin n at age $t+1$.

$$\begin{pmatrix} \bar{z}^1_t \\ \bar{z}^2_t \\ \dots \\ \bar{z}^N_t \end{pmatrix} \qquad \begin{pmatrix} \pi^t_{11} & \pi^t_{12} & \dots & \pi^t_{1N} \\ \pi^t_{21} & \pi^t_{22} & \dots & \pi^t_{2N} \\ \dots & \dots & \dots & \dots \\ \pi^t_{N1} & \pi^t_{N2} & \dots & \pi^t_{NN} \end{pmatrix}$$

$$\mathbf{z_t} \qquad \mathbf{\Pi^t}$$

Consumption implications

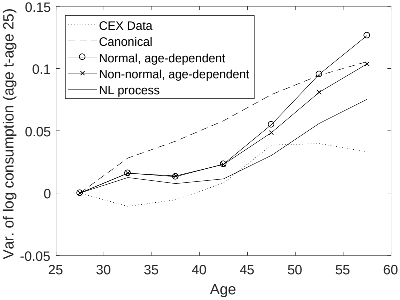
Variance of log consumption, data and models

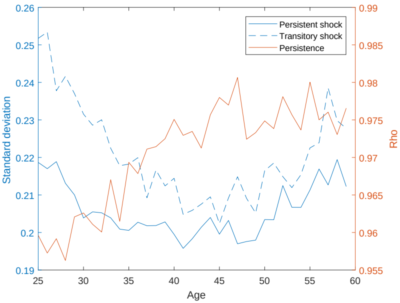


- Benchmark generates too large increase by age
- NL process generates substantially lower growth and captures (until age 47) non-monotonicity
- Very hard to match without HIP (Guvenen 2007; Huggett, Ventura and Yaron 2011)

Opening the black box

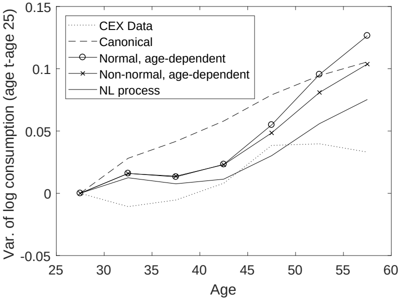
Age-dependent second moments

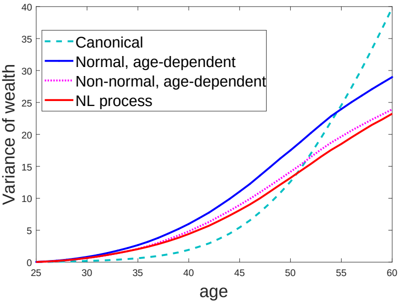




Opening the black box

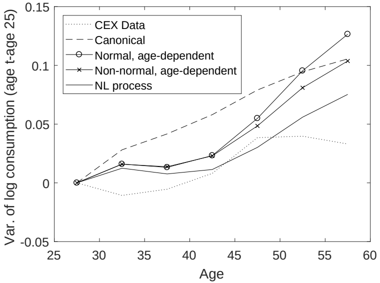
Age-dependent moments + non-normality

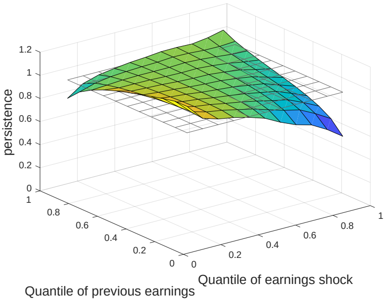




Opening the black box

Full NL





BPP insurance coefficients

- Blundell, Pistaferri and Preston (2008): Fraction of earning shock not reflected in consumption response

$$\phi^x = 1 - \frac{\text{cov}(\Delta c_{it}, z_{it}^x)}{\text{var}(z_{it}^x)}$$

with z_{it}^x shock to x_{it}.

- Model true coefficients: earnings shocks are observed
- In the data, BPP identification (assuming "canonical" process):

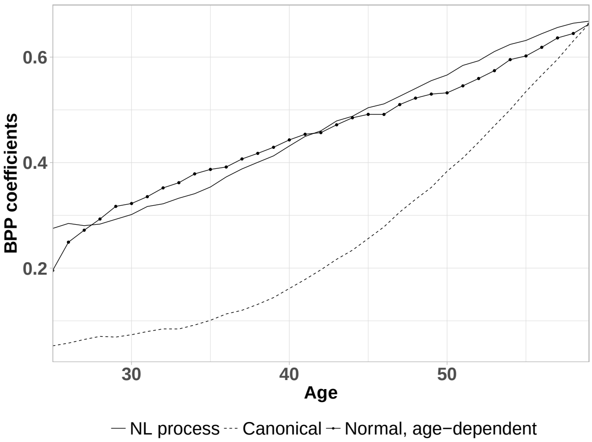
$$\phi^\eta = 1 - \frac{\text{cov}(\Delta c_{it}, y_{i,t+1} - y_{i.t-2})}{\text{cov}(\Delta y_{it}, y_{i,t+1} - y_{i,t-2})}, \ \phi^\epsilon = 1 - \frac{\text{cov}(\Delta c_{it}, \Delta y_{i,t+1})}{\text{cov}(\Delta y_{i,t}, \Delta y_{i,t+1})}$$

BPP insurance coefficients

Process/Coefficients	ψ^{p}_{BPP}	ψ^{tr}_{BPP}	ψ^{p}	ψ^{tr}
	Data: BPP (2008)			
Canonical (S.E. in parenthesis)	0.36	0.95	–	–
	(0.09)	(0.04)		
	Model			
Canonical	0.13	0.89	0.31	0.92
Nonlinear process	0.43	0.82	0.46	0.91
Normal, age-dependent	0.42	0.83	0.46	0.88
Non-normal, age-dependent	0.42	0.83	0.46	0.88

Table: Insurance coefficients

ϕ^η by age



Wealth Inequality

Wealth-income ratio	Wealth Gini	1%	5%	20%	40%	60%	80%
		Percentage wealth in the top					
U.S. data (SCF 1989)							
3.1	.79	30	54	81	94	99	100
Benchmark							
3.1	.64	9	29	65	88	97	100.1
NL Process							
3.1	.61	7	25	61	85	96	99.9

- NL process does not help to improve the fit of the wealth distribution
- Not even with a process based on W2 administrative data (De Nardi, Fella, and Paz-Pardo, 2016)

Welfare costs of earnings risk

Process	Welfare cost
Benchmark	28.3
NL process	26.2

- Lower persistence $\rightarrow$ lower relevance of initial realization
- With NL process, more equal distribution of lifetime income
- Easier to insure with precautionary savings

Conclusions

- Disposable, HH Earnings have much richer dynamics that traditionally assumed
- In a life-cycle model these richer dynamics
  - imply an age profile of consumption dispersion substantially closer to that in the data
  - and a more realistic pass-through of persistent earnings shocks to consumption
  - ... but do not improve the fit of the wealth distribution

	σ^2_ϵ	$\sigma^2_{\eta_1}$	σ^2_ν	ρ
Benchmark (year effects)	**0.0675**	**0.2363**	**0.0059**	**1**
Cohort effects (Kaplan)	0.0655	0.2394	0.0057	1
STY04 (coh. effects)	0.063	0.2105	0.0166	0.9989

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