Perceived Income Risks

Tao Wang
Johns Hopkins University

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Macro Seminar

Outline

1. Motivation
2. Theoretical framework
3. Empirical evidence
   - Cross-sectional patterns
   - Permanent versus transitory risks
   - Perceived risks and macroeconomic history
   - Extrapolation of recent experience
   - Countercyclical PR
   - Perceived risks and decisions
   - Summary of empirical findings
4. Model
5. Conclusion

Motivation

- Risks matter for individual decisions
  - precautionary saving
  - stock market participation
  - portfolio choice
- Risks matter for macroeconomic outcomes
  - since idiosyncratic risks are not perfectly insured
    - $\rightarrow$ income/wealth inequality
    - $\rightarrow$ heterogeneous MPCs
    - $\rightarrow$ distributional channel of macroeconomic policies
    - $\rightarrow$ business cycle fluctuations
- Income risks are central inputs of any incomplete-market model
- My question: perceptions $\approx$ estimates $\approx$ "the truth"?

Some macro facts

- Wealth inequality and heterogeneity in MPCs
  - a standard incomplete market model generates insufficient inequality seen in the data
  - unless additional features such as preference heterogeneity or costly adjustment are introduced
- Liquid assets holdings
  - too few in data compared to a standard one-asset incomplete market model
- "Excessive sensitivity" to unanticipated transitory shocks
  - high MPCs seen in the data than PIH model prediction

Preview of the findings

1. **Empirics:** subjective risk profiles from a density survey
    - Heterogeneity: sizable difference across/within groups
    - Superior information: on average lower than standard parameterizations used by economists
    - State-dependence: negative correlation with recent/past labor market conditions
    - Extrapolation: correlated with negative labor outcomes
    - History-dependence: positive correlation with experienced volatility/unemployment
    - Decisions: spending plans react to risk perceptions

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    - History-dependence: positive correlation with experienced volatility/unemployment
    - Decisions: spending plans react to risk perceptions
2. **Model**:
    - a survey-informed subjective OLG / incomplete-market GE model
        - With heterogeneous perceived risks (PR)
        - Lower PR $\rightarrow$ lower savings + more wealth inequality
        - State-dependence/extrapolation $\rightarrow$ higher savings
        - Heterogeneity in PR $\rightarrow$ more wealth inequality

Literature

- income risks and partial insurance: Gottschalk et al. (1994), Carroll and Samwick (1997), Meghir and Pistaferri (2004), Storesletten et al. (2004), Blundell et al. (2008), Moffitt and Gottschalk (2002), Guvenen et al. (2014), Arellano et al. (2017), Bloom et al. (2018)
- subjective/probabilistic survey of beliefs: Manski (2004), Delavande et al. (2011), Manski (2018), Bertrand and Mullainathan (2001), Armantier et al. (2017)
- incomplete market macro: Bewley (1976), Aiyagari (1994), Huggett (1996), Krusell and Smith (1998), Heathcote et al. (2009), Carroll et al. (2017), Krueger et al. (2016), Bayer et al. (2019)
- consumption/saving under incomplete information/imperfect perception: Pischke (1995), Wang (2004), Rozsypal and Schlafmann (2017), Carroll et al. (2018), Lian (2019)

Log income process

$$\underbrace{y_{i,c,t}}_{\text{idiosyncratic log earning}} = \underbrace{z_{i,c,t}}_{\text{predictable component}} + \underbrace{e_{i,c,t}}_{\text{stochastic component}}$$

- individual i at time t
- group c: share income process/risks $\sigma^2_{c,t}$
  - i.e. education/year of birth/gender/age
- $e_{i,c,t}$: to be specified later

Perceived risks (PR)

- Income growth

$$\Delta y_{i,c,t+1} = \Delta z_{i,c,t+1} + \Delta e_{i,c,t+1}$$

- To the agent: **conditional** variance under FIRE

$$Var^*_{i,c,t}(\Delta y_{i,c,t+1}) = \sigma^2_{c,t+1|t}$$

- To econometricians: **approximated unconditional** variance

$$Var^c(\Delta \hat{e}_{i,c,t+1}) = \hat{\sigma}^2_{c,t} + \hat{\sigma}^2_{c,t+1} - 2Cov^c(\hat{e}_{i,c,t}, \hat{e}_{i,c,t+1})$$

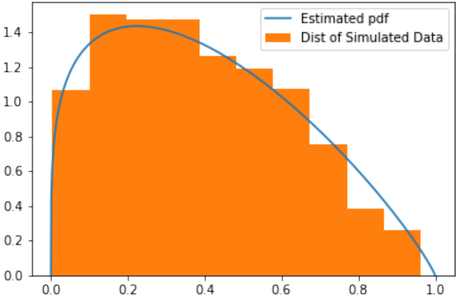
Data and sample

- Density survey: SCE
  - 2013M6-2020M4 (monthly)
  - 1300 households
  - 12-month panel
- Income panel: PSID
  - 1970-1996 (annual), 1997-2017 (biennial)
  - approximately 5000 males/females
  - variable: wage/earning of household heads
  - stay in the sample for 11+ years
  - CPI adjusted
  - age 25-65
- Income panel: SIPP
  - 2014M1-2019M12 (monthly)
  - earning from the primary job
  - 900-2700 respondents
  - CPI adjusted
  - age 25-65

Survey question

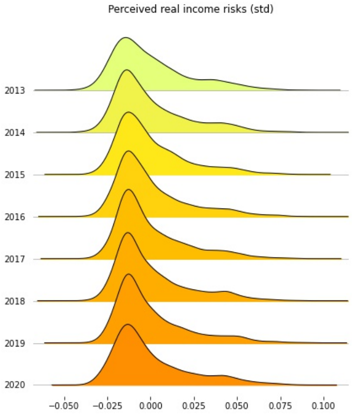
- Individual-specific bin-based forecast on $\Delta y_{i,t+1}$
  - earning growth of the same job/position/hours
  - exl. endogenous labor supply changes/promotion/demotion/separation
- Measurement of PR:
  - variance: $\overline{Var}_{i,t}(\Delta y_{i,t+1})$
- density estimation following Engelberg et al. (2009)
- restricted to attentive/high numeracy score sample
- adjusted into real terms using inflation uncertainty

An illustration of the density forecast estimation



- case 1. 3+ intervals with positive probs, to be fitted with a generalized beta distribution
- case 2. exactly 2 adjacent intervals with positive probs, to be fitted with a triangle distribution
- case 3. one interval only, to be fitted with a uniform distribution

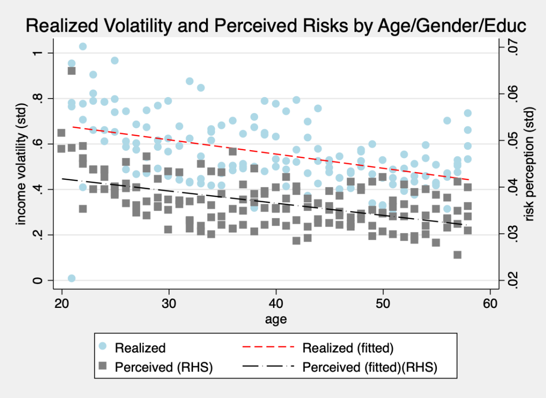
Within-group dispersion in perceived income risks



- residuals controlling for observables + time FE ($R^2 = 0.07$)
- average PR: 3.5% in std; 10/90 IQR: 5.2% in std nominal

skewness

By age/gender/education



- e.g. a male high school graduate aged 30 growth by age by age/education by 5-yr of birth/education/gender
- consistent with Moffitt and Gottschalk (2002), Sabelhaus and Song (2010)

Time series structure of income shocks

$$e_{i,c,t} = \underbrace{log(p_{i,c,t})}_{\text{permanent}} + \underbrace{log(\theta_{i,c,t})}_{\text{transitory}}$$

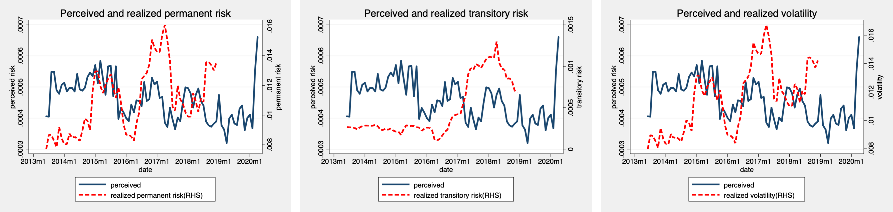
$$log(p_{i,c,t+1}) = log(p_{i,c,t}) + log(\psi_{i,c,t+1})$$

$$log(\psi_{i,c,t}) \sim N(\frac{-\sigma^2_{c,t,\psi}}{2}, \sigma^2_{c,t,\psi})$$

$$log(\theta_{i,c,t}) \sim N(\frac{-\sigma^2_{c,t,\theta}}{2}, \sigma^2_{c,t,\theta})$$

Permanent versus transitory risks (from monthly earning data)

(a) permanent (b) transitory (c) volatility



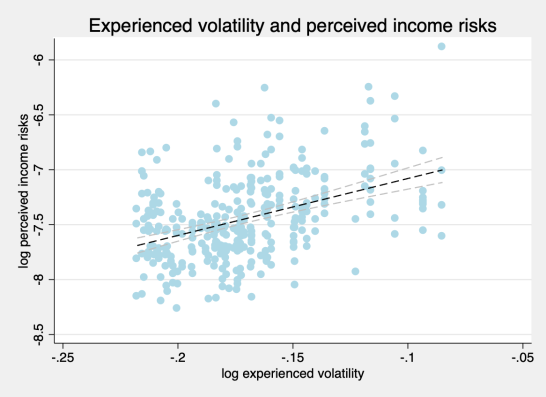
- i.e. one-year-ahead perceived risk at 2014m1 v.s. realized risk over the same period
- monthly wage rate: earning per hour of work
- estimated monthly risks aggregated into annual frequency

More details PSID

Perceptions versus economists' estimates

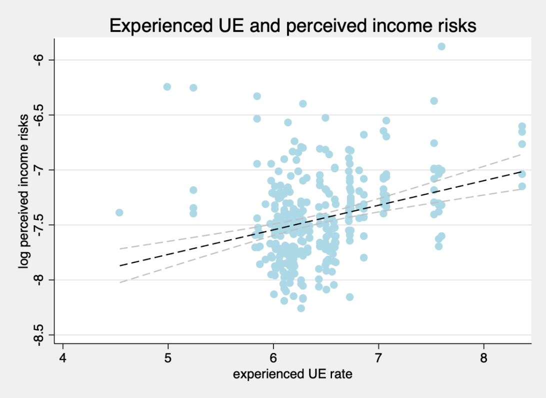
	PerceivedRisk	PerceivedRisk(median)	RealizedGroupVolatility	RealizedPRisk	RealizedTRisk
full sample (100%)	0.029	0.021	0.090	0.101	0.016
gender					
1 (50%)	0.030	0.022	0.091	0.102	0.016
2 (49%)	0.028	0.022	0.089	0.101	0.016
education					
HS dropout (0%)	0.036	0.022	0.051	0.100	0.016
HS graduate (42%)	0.030	0.022	0.085	0.101	0.016
College/above (56%)	0.028	0.021	0.094	0.101	0.016
5-year age					
20 (2%)	0.037	0.031	0.072	0.102	0.015
25 (12%)	0.032	0.027	0.115	0.102	0.016
30 (12%)	0.030	0.023	0.091	0.101	0.016
35 (13%)	0.029	0.021	0.098	0.101	0.016
40 (13%)	0.028	0.020	0.084	0.101	0.016
45 (14%)	0.028	0.020	0.065	0.101	0.016
50 (15%)	0.027	0.019	0.078	0.101	0.016
55 (15%)	0.027	0.018	0.105	0.100	0.016

Experienced income volatility and perceived risks



- income volatility conditional on macroeconomic history Storesletten et al. (2004)
- e.g. the experience by a 25-year old till 2015 is between 1990-2015

Experienced labor market and perceived risks



- e.g. experienced UE by a 25-year old in 2015 is between UE over 1990-2015

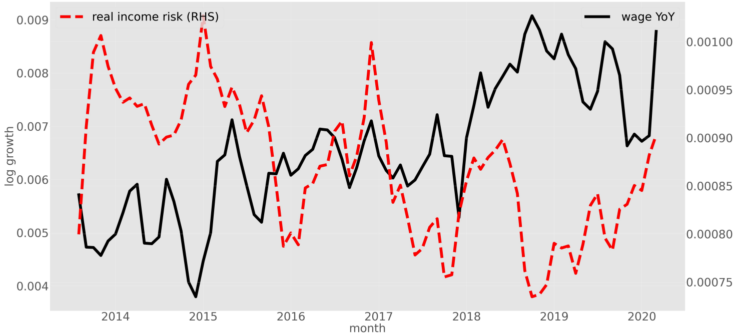
Extrapolation from individual experiences

- higher experienced volatility → higher PR
- recent unemployment experience → higher PR

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
income shock squared	0.0225***	0.0222***	0.0217***	0.0207***	0.000773	0.00205***	0.000566	0.00183***	0.000614	0.00184***
	(0.00562)	(0.00570)	(0.00562)	(0.00564)	(0.000743)	(0.000516)	(0.000744)	(0.000515)	(0.000745)	(0.000516)
recently unemployed				0.511*	0.228***	0.0895***				
				(0.260)	(0.0330)	(0.0200)				
unemployed since m-8							0.161***	0.0783***		
							(0.0207)	(0.0121)		
unemployed since y-1									0.138***	0.0701***
									(0.0193)	(0.0113)
Observations	3662	3662	3662	3662	3701	1871	3701	1871	3701	1871
R-squared	0.004	0.013	0.016	0.017	0.015	0.030	0.019	0.041	0.016	0.039

Perceived risks and recent (past) wage growth

- $\overline{\text{var}_t}$: average perceived risk across individuals
- $log(\text{wage}_t) - log(\text{wage}_{t-1/4})$: quarterly growth in average hourly wage



expected growth | correlation | state-level evidence

Perceived risks and household spending

$$E_{i,t}(\Delta c_{i,t+1}) = u_0 + {\color{red}u_1}\overline{\text{risks}}_{i,t}(\Delta y_{i,t+1}) + \xi_{i,t}$$

	(1)	(2)	(3)	(4)	(5)	(6)
perceived earning risk	8.394***	8.399***	3.642***	3.243***		
	(1.175)	(1.176)	(0.533)	(0.537)		
perceived earning risk (nominal)					3.656***	
					(0.990)	
perceived ue risk						0.353***
						(0.0553)
R-squared	0.0010	0.00282	0.928	0.928	0.941	0.633
Sample Size	53178	53178	53178	53178	54584	6269
Time FE	No	Yes	No	Yes	Yes	No
Individual FE	No	No	Yes	Yes	Yes	Yes

- Higher perceived risks → higher expected spending growth.

Taking stock

- People do have some clues
  - consistent with inter-group differences in income volatility
  - other covariates
    - $\downarrow$ with education, household income, being a male
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- But huge amount of heterogeneity remains
  - including all above: $R^2 = 0.10$
  - individual fixed effects only: $R^2 = 0.71$
- Possible explanations
  - "superior information"/ unobserved heterogeneity
  - state dependence: aggregate economy conditions matter
  - past dependence: experiences matters Kuchler and Zafar (2019)
  - intrinsic heterogeneity: some are more uncertain than the other Ben-David et al. (2018)

Implications for consumption/saving

- On level of aggregate savings
  1. $\downarrow$ lower PR: lower precautionary saving motives $\rightarrow$ less liquid holding $\rightarrow$ higher MPC

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- On wealth inequality
  - $\uparrow$ Direct effect: heterogeneous PR $\rightarrow$ heterogeneity in saving/wealth
  - $\uparrow$ Indirect effect: lower PR $\rightarrow$ lower self-insurance $\rightarrow$ higher ex-post wealth inequality

Model overview

- Overlapping generation
- General equilibrium
- Uninsured idiosyncratic income risks
  - Permanent+ transitory productivity shock
  - Persistent unemployment spells
- No aggregate risk a la Krusell and Smith (1998)
- A blend of Huggett (1996) and Carroll (1997)
- Single one risk-free asset
- Allowing for subjective risk perceptions
  - Individuals swing between low/high risk perceptions

Benchmark model (objective risk perceptions)

$$\max \quad \mathbb{E}\left[\sum_{\tau=0}^{\tau=L-1}(1-D)^{\tau}\beta^{\tau}u(c_{i,\tau})\right]$$

$$\underbrace{a_{i,\tau}}_{\text{Savings}} = \underbrace{m_{i,\tau}}_{\text{Cash in hand}} - c_{i,\tau}$$

$$b_{i,\tau+1} = a_{i,\tau}R$$

$$m_{i,\tau+1} = b_{i,\tau+1} + (1 - \underbrace{\lambda}_{\text{Income tax}})y_{i,\tau+1}$$

$$a_{i,\tau} \geq 0$$

- CRRA: $u(c) = \frac{c^{1-\rho}}{1-\rho}$
- Work age: $\tau = 1, 2..., T$ (since entering job market)
- Life length: $\tau = 1, 2..., L$ (since entering job market)
- Survival probability: 1-D

Income process over the life-cycle

- income

$$y_{i,\tau} = n_{i,\tau} W$$
$$n_{i,\tau} = p_{i,\tau} \xi_{i,\tau}$$

- permanent component

$$p_{i,\tau} = G_\tau p_{i,\tau-1} \psi_{i,\tau}, \quad log(\psi_{i,\tau}) \sim N(-\sigma^2_\psi/2, \sigma^2_\psi) \quad \forall \tau \leq T$$

- persistent/transitory component

$$\xi_{i,\tau} = \begin{cases} \theta_{i,\tau} \quad \text{if} \quad \nu_{i,\tau} = e \quad \& \quad \tau \leq T, \quad log(\theta_{i,\tau}) \sim N(-\frac{\sigma^2_\theta}{2}, \sigma^2_\theta) \\ \zeta \quad \text{if} \quad \nu_{i,\tau} = u \quad \& \quad \tau \leq T \\ \mathbb{S} \quad \text{if} \quad \tau > T \end{cases}$$

- transition probability between $\nu = u$ and $\nu = e$

$$\pi(\nu_{\tau+1} | \nu_\tau) = \begin{bmatrix} \mho & 1 - \mho \\ 1 - E & E \end{bmatrix}$$

Objective versus subjective profile

- objective: agents perceive $\underbrace{\Gamma = \{\sigma^2_\psi, \sigma^2_\theta, \mho, E\}}_{\text{income risk parameters}}$
- subjective with state-dependence: each agent i swings between two subjective risk state $\tilde{\Gamma}_{i,\tau} = \tilde{\Gamma}_l$ and $\tilde{\Gamma}_{i,\tau} = \tilde{\Gamma}_h$, with transition matrix Ω.
  - heterogeneity in risk perceptions
- subjective model with extrapolation: $\tilde{\Gamma}_{i,\tau}$ depends on employment status $\nu_{i,\tau}$, i.e. $\tilde{\Gamma}_{i,\tau}(\nu_{i,\tau} = 0) = \tilde{\Gamma}_l$ and $\tilde{\Gamma}_{i,\tau}(\nu_{i,\tau} = 1) = \tilde{\Gamma}_h$

Why subjective risk perceptions?

- I don't take a stance on if agents perceptions are correct or wrong
  - unobserved information to economists
  - or agents under-perceive the true risks
- The subjective risk profile is disciplined by the survey data
- Risk parameters are exogenous to the model, therefore, does not contradict with rational expectation.

Economic environment

- Technology

$$Y = ZK^{\alpha}N^{1-\alpha}$$

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- Government (balance budget)

$$\lambda\left[1 - \Pi^{\mho} + \zeta\Pi^{\mho}\right] = \zeta\Pi^{\mho} \tag{1}$$

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- Demographics
  - Stable age distribution $\{\mu_\tau\}_{\mu=1,2,..L}$

$$\mu_{\tau+1} = (1-D)\mu_\tau$$

$$\sum_{\tau=1}^{L}\mu_\tau = 1$$

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$$\mu_{\tau+1} = (1-D)\mu_{\tau}$$
$$\sum_{\tau=1}^{L}\mu_{\tau} = 1$$

- Accidental bequests
  - Newborn starts with a bank-balance equal to $0-1$ fraction of the lump-sum of the accidental deceased's wealth

Value functions under different profiles

- objective:

$$V_\tau(\underbrace{\nu_{i,\tau}, m_{i,\tau}, p_{i,\tau}}_{x_{i,\tau}}) = \max_{\{c_{i,\tau}, a_{i,\tau}\}} \quad u(c_{i,\tau})$$
$$+ (1-D)\beta \mathbb{E}_\tau \left[V_{\tau+1}((\nu_{i,\tau}, m_{i,\tau+1}, p_{i,\tau+1}) \right]$$

- subjective:

$$\tilde{V}_\tau(\underbrace{\tilde{\Gamma}_\tau, \nu_\tau, m_\tau, p_\tau}_{\tilde{x}_{i,\tau}}) = \max_{\{c_\tau\}} \quad u(c_\tau)$$
$$+ (1-D)\beta \mathbb{E}_\tau \left[\tilde{V}_{\tau+1}(\tilde{\Gamma}_{\tau+1}, \nu_\tau, m_{\tau+1}, p_{\tau+1}) \right]$$

Evolution of the distribution over state variables

- objective:

$$\psi_\tau(B) = \int_{x\in X} \underbrace{P(x,\tau-1,B)}_{\text{transition funcs}} \mathrm{d}\psi_{\tau-1} \quad \text{for all} \quad B \in B(X)$$

  - $B(X)$: distribution measure on state space X
  - ψ_τ: distribution over state variables x for agents in age τ
  - ψ_1 depends on initial draws of income shocks

- subjective:

$$\tilde{\psi}_\tau(\tilde{B}) = \int_{\tilde{x}\in \tilde{X}} \tilde{P}(\tilde{x},\tau-1,\tilde{B})\mathrm{d}\tilde{\psi}_{\tau-1} \quad \text{for all} \quad \tilde{B} \in \tilde{B}(X)$$

Stationary equilibrium (StE)

- Optimal consumption and saving policies given W, R, λ
- Distribution evolution consistent with optimal c and a policies and exogenous probabilities of income/beliefs
- The factor markets are clearing.

$$\sum_{\tau} \mu_\tau \int_X a(x,\tau) \mathrm{d}\psi_\tau = K$$

$$\sum_{\tau=0}^{T-1} \mu_\tau \Pi_\tau^E = N$$

- Firm optimization under competitive factor markets.

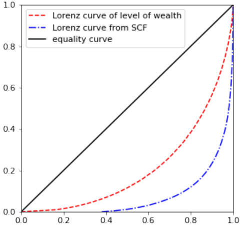
$$W = Z(1-\alpha)(K/N)^\alpha$$

$$R = 1 + Z\alpha(K/N)^{\alpha-1} - \delta$$

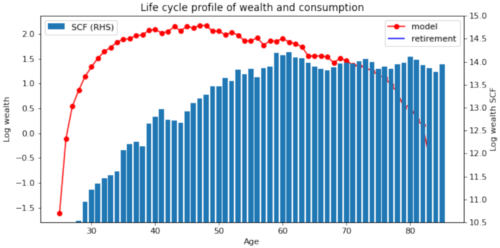
- Newborn's bank balance equal to accidental bequests
- Balanced government budget

StE Distribution of the objective model (preliminary)

(a) Wealth inequality



(b) Life-cycle wealth distribution



Calibration Partial equilibrium

Estimation of subjective risk profile

$$\underbrace{\tilde{\Gamma}^s_{i,t}}_{\text{reported PR}} = \underbrace{\tilde{\Gamma}_l + \mathbb{1}(\overbrace{J_{i,t}}^{\text{Hidden state}} = 1)(\tilde{\Gamma}_h - \tilde{\Gamma}_l)}_{\tilde{\Gamma}_{i,t}} + \xi_t + \eta_i + \epsilon_{i,t}$$

$$\text{Prob}(J_{i,t+1}|J_{i,t}) = \Omega$$

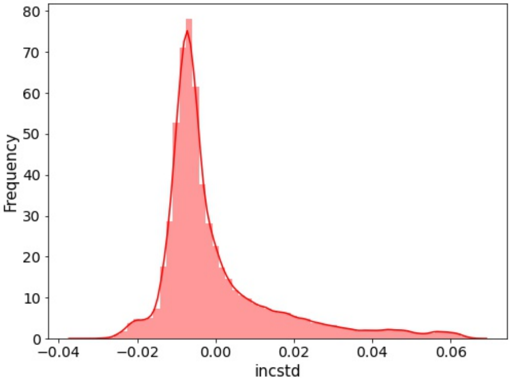
- $J_{i,t} = 0$ for low and $= 1$ for high PR state
- a short time series of $\tilde{\Gamma}_{i,t}$ for many is observed in the survey
- $\{\tilde{\Gamma}_l \, \tilde{\Gamma}_h, \Omega\}$ can be estimated by MLE
- a modified Hamilton (1989) 2-regime-switching model
- $J_{i.t}$ can be also dependent upon business cycles

More details

Summary

- Survey data can inform incomplete-market macro models
  - Direct evidence for heterogeneity in perceptions that *matter*
  - Closer to agents' information set that truly affects their decisions
  - No need to make stringent assumptions on expectation formation
- More work needed on
  - heterogeneous beliefs in HM models
  - understanding risk perception formation

Within-group dispersion in nominal PR



- residuals controlling for observables /time fixed effects
- average PR: 2.1% in std; 10/90 IQR: 3.2% in std

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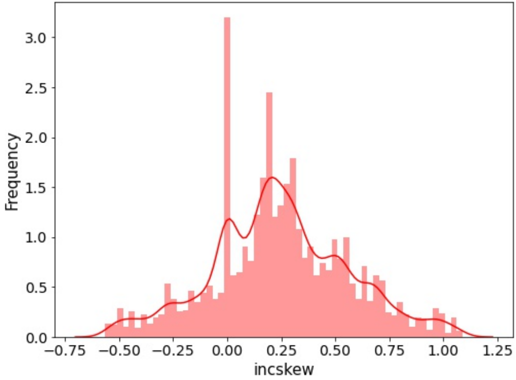
Within-group dispersion in PR skewness



- residuals controlling for observables / time fixed effects

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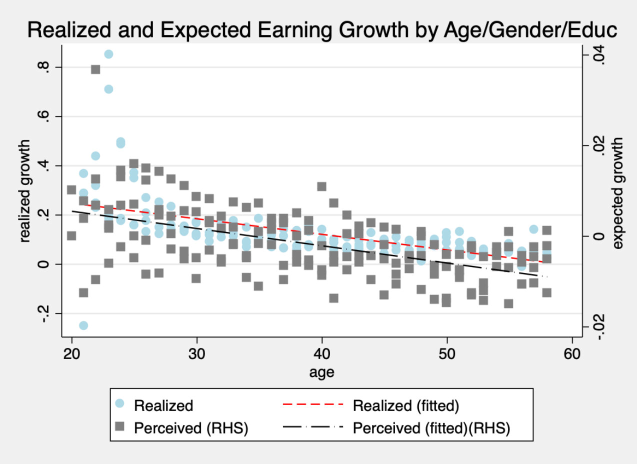
Appendix: expected growth by age



- e.g. a male high school graduate aged 30

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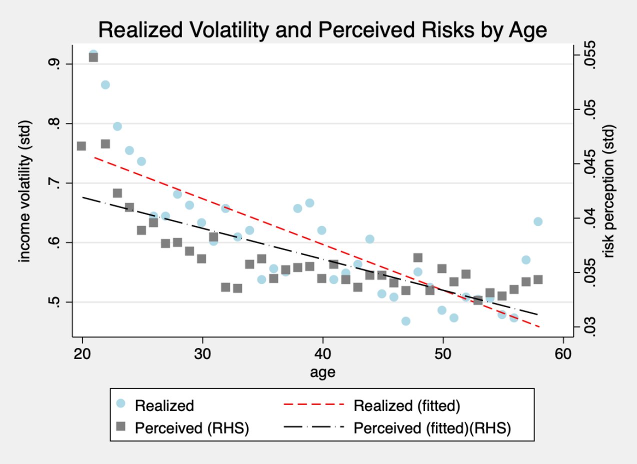
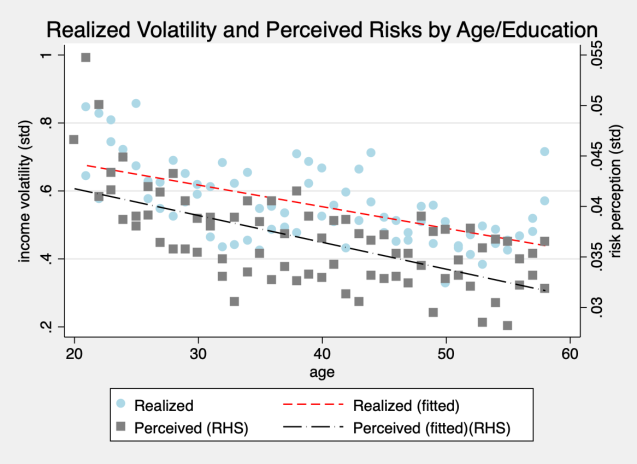
Appendix: PR by age



- e.g. a 35-year old Back

Appendix: PR by age/education



- e.g. a 35-year old high school graduate

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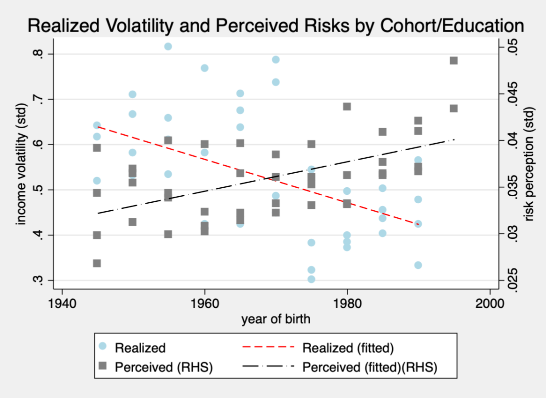
Appendix: PR by cohort/education/gender

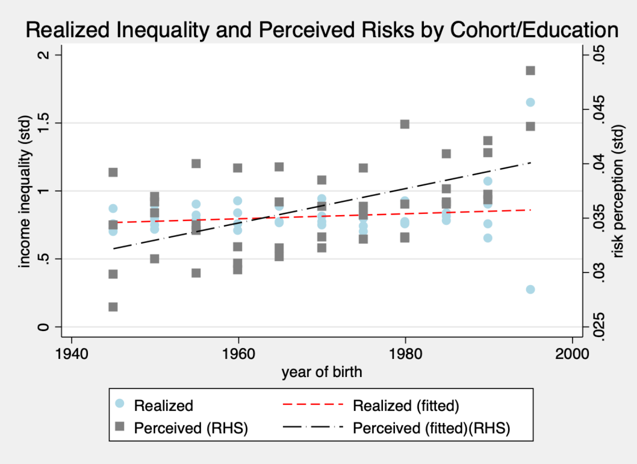


- e.g. a male higher school graduate born between 1990-1995

inequality inequality by 5-year/education 5-year/education Back

- declining income volatlity between 1978-2013 Sabelhaus and Song (2010), Bloom et al. (2018)

Appendix: PR by cohort



- e.g. a female college graduate born between 1970-1975

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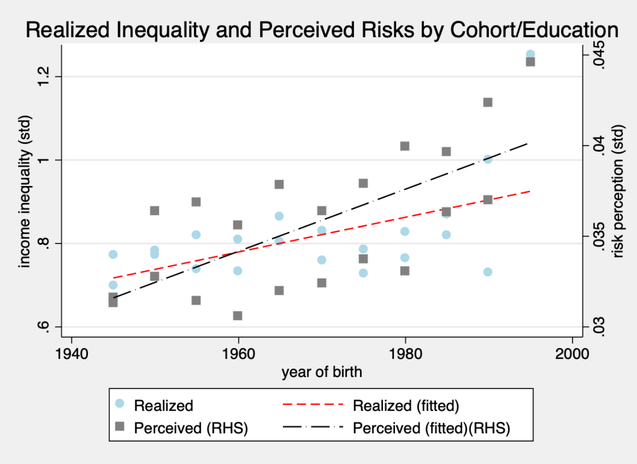
Appendix: PR by cohort/education



- e.g. a high school graduate born between 1985-1990

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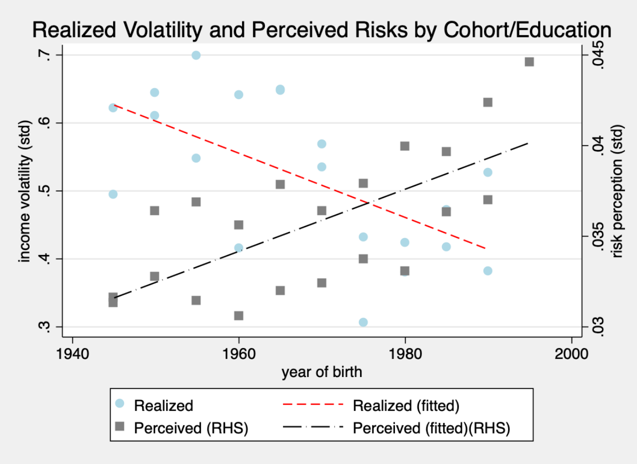
Appendix: PR by cohort/education



- a college graduate born between 1985-1990

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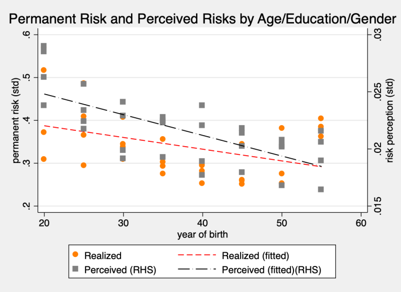
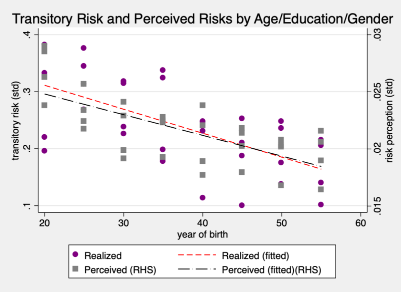
Permanent versus transitory risks

(a) permanent



(b) transitory



- e.g. a female high school graduate aged 30-35

5-yr cohort/education/gender

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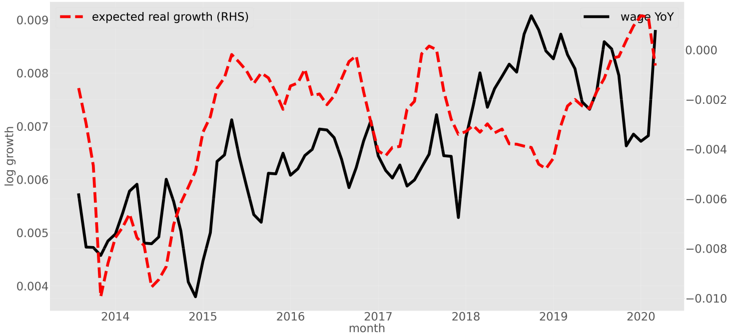
Appendix: expected income growth and recent (past) wage growth

- $\overline{\exp_t}$: average expected growth across individuals
- quarterly growth in average hourly wage



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Appendix: Perceived risks and current labor market condition

$$\underbrace{\overline{\text{risk}_t}}_{\text{average perceived risk}} = \alpha + {\color{red}\beta} \underbrace{(log(\text{wage}_{t-k/12}) - log(\text{wage}_{t-(k-3)/12}))}_{\text{wage growth}} + \epsilon_{i,t}$$

$$\forall k = 0...4$$

	mean:var	mean:iqr	mean:rvar	mean:skew
0	-0.28**	-0.42***	-0.48***	-0.02
1	-0.42***	-0.53***	-0.51***	0.12
2	-0.43***	-0.48***	-0.44***	-0.01
3	-0.43***	-0.48***	-0.42***	-0.1
4	-0.31***	-0.41***	-0.32***	-0.21*

- Counter-cyclical income risks: Storesletten et al. (2004), Guvenen et al. (2014), Bayer et al. (2019)

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Appendix: Perceived risks and current labor market condition

$$\underbrace{\overline{\text{risk}}_{s,t}}_{\text{median perceived risk in state } s} = r + \psi \underbrace{LM_{s,t}}_{\text{state labor market condition}} + \eta_{s,t}$$

	(1)	(2)	(3)	(4)
	log(var)	log(risk)	log(iqr)	log(iqr)
wage growth	-0.05***		-0.03***	
	(0.01)		(0.01)	
unemp rate		0.04*		0.04***
		(0.02)		(0.01)
Observations	3529	3529	3546	3546
R-squared	0.023	0.020	0.025	0.028

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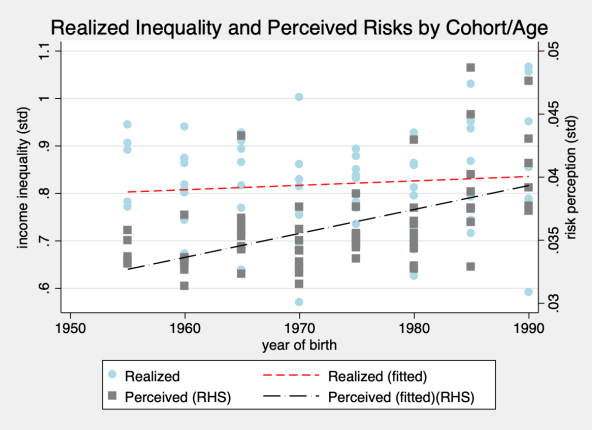
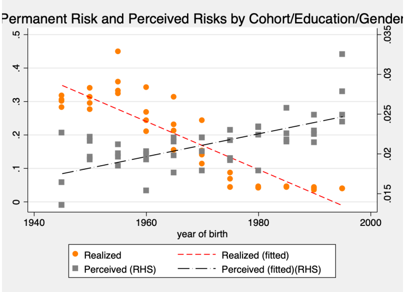
Appendix: by **5-yr of birth/age**



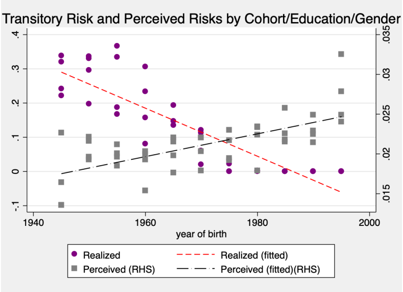
- e.g. a 25-year old born between 1985-1990
- only possible for post-2013 sample Back

Appendix: permanent versus transitory risks

(a) permanent



(b) transitory



- e.g. a female high school graduate born between 1985-1990

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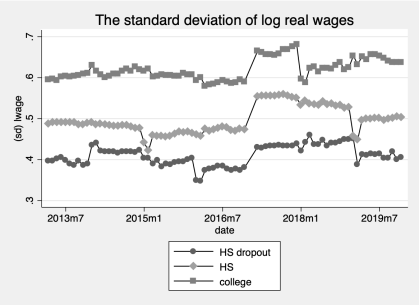
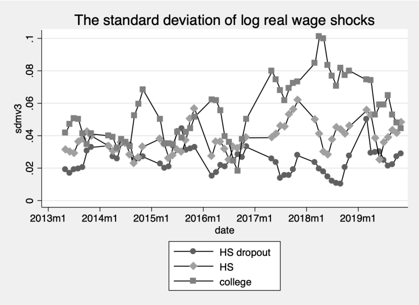
Appendix: monthly earning inequality and volatility

(a) Inequality



(b) Volatility



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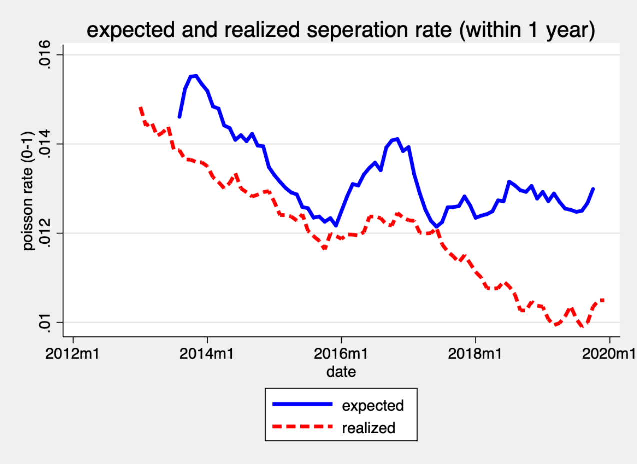
Perceived UE risk and realized job separation rate



- realized job separation rate is computed from CPS survey

Appendix: estimation of subjective risk profile

$$\log(\tilde{\text{var}}_{i,t}) = (12 + \frac{1}{12\kappa^2})\tilde{\sigma}^2_{i,t,\psi} + \xi_t + \eta_i + \epsilon_{i,t}$$

- κ: externally assumed ratio of permanent and transitory risks $\frac{\tilde{\sigma}_{i,t,\psi}}{\tilde{\sigma}_{i,t,\theta}}$

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Appendix: calibration of the objective model

Table: Model parameters

block	parameter name	values	source
risk	σ_ψ	0.15	Median estimates from the literature
	σ_heta	0.1	Median estimates from the literature
	$U2U$	0.18	Median estimates from the literature
	$E2E$	0.96	Median estimates from the literature
initial condition	$\sigma_\psi^{\text{init}}$	0.629	Estimated for age 25 in the 2016 SCF)
	bequest ratio	0	assumption
life cycle	T	40	standard assumption
	L	60	standard assumption
	$1-D$	0.994	standard assumption
preference	ρ	1.5	standard assumption
	β	0.98	standard assumption
policy	λ	0	endogenously determined
	λ_{SS}	0	endogenously determined
	μ	0.15	standard assumption
production	W	1	target values in steady state
	K2Y ratio	3	target values in steady state
	α	0.33	standard assumption
	δ	0.025	standard assumption

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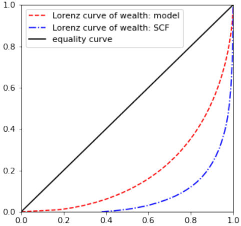
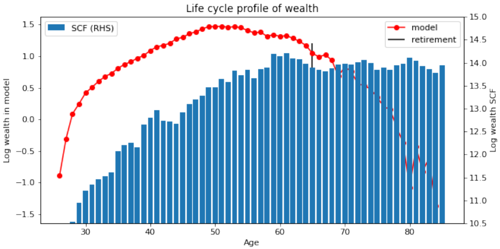
Appendix: distribution in the partial equilibrium

(a) Wealth inequality



(b) Life-cycle wealth distribution



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Extensions: additional heterogeneity in MPC

- Heterogeneous time preferences
  - Ex-ante differences in β, a la Krusell and Smith (1998); Carroll et al. (2017); Krueger et al. (2016).
- Costly adjustments

$$
\begin{aligned}
V_{i,\tau}(c_{i,\tau-1}, x_{i,\tau}) &= \max \quad \{V^A_\tau(x_{i,\tau}) - \chi, V^N_\tau(c_{i,\tau-1}, x_{i,\tau})\} \\
V^A_\tau(x_{i,\tau}) &= \max_{\{c_{i,\tau}\}} \quad u(c_{i,\tau}) + (1-D)\beta\mathbb{E}_\tau\left[V_{\tau+1}(x_{i,\tau+1})\right] \\
V^N_\tau(c_{i,\tau-1}, x_{i,\tau}) &= u(c_{i,\tau-1}) + (1-D)\beta\mathbb{E}_\tau\left[V_{\tau+1}(c_{i,\tau}, x_{i,\tau+1})\right]
\end{aligned}
$$

  - Utility cost from adjusting consumption in each period
  - To introduce extensive margin of consumption change and match high MPC from data

Aiyagari, S. R. (1994). Uninsured idiosyncratic risk and aggregate saving. *The Quarterly Journal of Economics*, 109(3):659–684.

Arellano, M., Blundell, R., and Bonhomme, S. (2017). Earnings and consumption dynamics: a nonlinear panel data framework. *Econometrica*, 85(3):693–734.

Armantier, O., Topa, G., Van der Klaauw, W., and Zafar, B. (2017). An overview of the Survey of Consumer Expectations. *Economic Policy Review*, (23-2):51–72.

Bayer, C., Lütticke, R., Pham-Dao, L., and Tjaden, V. (2019). Precautionary savings, illiquid assets, and the aggregate consequences of shocks to household income risk. *Econometrica*, 87(1):255–290.

Ben-David, I., Fermand, E., Kuhnen, C. M., and Li, G. (2018). Expectations uncertainty and household economic behavior. Technical report, National Bureau of Economic Research.

Bertrand, M. and Mullainathan, S. (2001). Do people mean what they say? Implications for subjective survey data. *American Economic Review*, 91(2):67–72.

Bewley, T. (1976). The permanent income hypothesis: A theoretical formulation. Technical report, HARVARD UNIV CAMBRIDGE MASS.

Bloom, N., Guvenen, Fatih, P. L., Sabelhaus, J., Salgado, S., and Song, J. (2018). The great micro moderation. Working paper.

Blundell, R., Pistaferri, L., and Preston, I. (2008). Consumption Inequality and Partial Insurance. *American Economic Review*, 98(5):1887–1921.

Caballero, R. J. (1990). Consumption puzzles and precautionary savings. *Journal of monetary economics*, 25(1):113–136.

Carroll, C., Slacalek, J., Tokuoka, K., and White, M. N. (2017). The distribution of wealth and the marginal propensity to consume. *Quantitative Economics*, 8(3):977–1020.

Carroll, C. D. (1997). Buffer-stock saving and the life cycle/permanent income hypothesis. *The Quarterly journal of economics*, 112(1):1–55.

Carroll, C. D., Crawley, E., Slacalek, J., Tokuoka, K., and White, M. N. (2018). Sticky expectations and consumption dynamics. Technical report, National Bureau of Economic Research.

Carroll, C. D. and Samwick, A. A. (1997). The nature of precautionary wealth. *Journal of monetary Economics*, 40(1):41–71.

Delavande, A., Giné, X., and McKenzie, D. (2011). Measuring subjective expectations in developing countries: A critical review and new evidence. *Journal of development economics*, 94(2):151–163.

Engelberg, J., Manski, C. F., and Williams, J. (2009). Comparing the point predictions and subjective probability distributions of professional forecasters. *Journal of Business & Economic Statistics*, 27(1):30–41.

Gottschalk, P., Moffitt, R., Katz, L. F., and Dickens, W. T. (1994). The growth of earnings instability in the us labor market. *Brookings Papers on Economic Activity*, 1994(2):217–272.

Guvenen, F., Ozkan, S., and Song, J. (2014). The nature of countercyclical income risk. *Journal of Political Economy*, 122(3):621–660.

Hamilton, J. D. (1989). A new approach to the economic analysis of nonstationary time series and the business cycle. *Econometrica: Journal of the econometric society*, pages 357–384.

Heathcote, J., Storesletten, K., and Violante, G. L. (2009). Quantitative macroeconomics with heterogeneous households. *Annu. Rev. Econ.*, 1(1):319–354.

Huggett, M. (1996). Wealth distribution in life-cycle economies. *Journal of Monetary Economics*, 38(3):469–494.

Krueger, D., Mitman, K., and Perri, F. (2016). Macroeconomics and household heterogeneity. In *Handbook of Macroeconomics*, volume 2, pages 843–921. Elsevier.

Krusell, P. and Smith, Jr, A. A. (1998). Income and wealth heterogeneity in the macroeconomy. *Journal of political Economy*, 106(5):867–896.

Kuchler, T. and Zafar, B. (2019). Personal experiences and expectations about aggregate outcomes. *The Journal of Finance*, 74(5):2491–2542.

Lian, C. (2019). Consumption with imperfect perception of wealth. Working paper.

Manski, C. F. (2004). Measuring expectations. *Econometrica*, 72(5):1329–1376.

Manski, C. F. (2018). Survey measurement of probabilistic macroeconomic expectations: progress and promise. *NBER Macroeconomics Annual*, 32(1):411–471.

Meghir, C. and Pistaferri, L. (2004). Income variance dynamics and heterogeneity. *Econometrica*, 72(1):1–32.

Moffitt, R. A. and Gottschalk, P. (2002). Trends in the transitory variance of earnings in the united states. *The Economic Journal*, 112(478):C68–C73.

Pischke, J.-S. (1995). Individual income, incomplete information, and aggregate consumption. *Econometrica: Journal of the Econometric Society*, pages 805–840.

Rozsypal, F. and Schlafmann, K. (2017). Overpersistence bias in individual income expectations and its aggregate implications.

Sabelhaus, J. and Song, J. (2010). The great moderation in micro labor earnings. *Journal of Monetary Economics*, 57(4):391–403.

Storesletten, K., Telmer, C. I., and Yaron, A. (2004). Cyclical dynamics in idiosyncratic labor market risk. *Journal of political Economy*, 112(3):695–717.

Wang, N. (2004). Precautionary saving and partially observed income. *Journal of Monetary Economics*, 51(8):1645–1681.