Perceived Income Risks and Subjective Attribution

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May 6, 2020

Outline

1. Motivation
2. Model
   - Learning and attribution
3. Empirical facts
   - Cross-sectional patterns
   - Coutercylical perceived risks
4. Conclusion

This paper's agenda

1. **Theory**: a subjective heterogeneous-agent model
   - imperfect understanding of income risks
     - the size: experienced volatility → perceived risks
     - the nature: i.e. aggregate v.s. idiosyncratic → different perceptions
   - life-cycle agents with uninsured idioyncratic (and aggregate) risks
2. **Empirics:** subjective risk perceptions from density surveys
   - Cross-sectional difference across age, generation and income
   - Correlation structure with current labor market outcomes: counter-cylical

Literature

- experience-based learning: Malmendier and Nagel (2015)
- subjective survey, especially on probabilistic surveys: Manski (2004), Delavande et al. (2011), Manski (2018), Bertrand and Mullainathan (2001), Armantier et al. (2017)
- "insurance or information": Kaufmann and Pistaferri (2009), Meghir and Pistaferri (2011), Pistaferri (2001), New York Fed Blog (2019), Flavin (1988)
- consumption/saving and portfolio choice under imperfect perception/understanding: Rozsypal and Schlafmann (2017), Carroll et al. (2018), Lian (2019)
- macroeconomic expectation formation: Coibion and Gorodnichenko (2012), Fuhrer (2018), etc
- counter-cyclical labor income risks: Storesletten et al. (2004), Guvenen et al. (2014), Catherine (2019)

Preview of the theory

- Learning: learns about the parameters of income process from a small sample
- Experience: past experience of volatility → future risk perceptions
- Attribution: subjectively determine whether shocks are aggregate or idiosyncratic → different parameter uncertainty
- Attribution errors: positive (negative) shocks → internal (external) attribution → zero (positive) subjective correlation → low (high) perceived risks
- Countercylical perceived risks: positive (negative) news → low (high) aggregate uncertainty

Outline

Income process

$$y_{i,c,t} = \rho y_{i,c,t-1} + \epsilon_{i,c,t}$$
$$\epsilon_{i,c,t} \sim N(0, \sigma^2) \tag{1}$$

- individual i at time t
- cohort c: year of entering the job market
- ρ: persistence parameter
- $\epsilon_{i,c,t}$: income shock
  - Identical: constant income risks across people and time
  - Independence: purely idiosyncratic risk
  - Both can be relaxed, i.e. cross-sectional correlation for aggregate shocks

Perceived risk

- Perfect understanding

$$\begin{aligned} Var^*_{i,t}(\Delta y_{i,t+1}) &= Var^*_{i,t}(\epsilon_{i,t+1}) \\ &= \sigma^2 \end{aligned} \tag{2}$$

- Imperfect understanding

$$\widehat{Var}_{i,t}(\Delta y_{i,t+1}) = y^2_{i,t-1} \underbrace{\widehat{Var}^{\rho}_{i,t}}_{\text{Persistence uncertainty}} + \underbrace{\hat{\sigma}^2_{i,t}}_{\text{Shock uncertainty}} \tag{3}$$

Learning

$$\underbrace{\hat{\rho}_{i,t}}_{\text{estimated parameter}} = \left(\sum_{k=0}^{t-c}\sum_{j=1}^{n} y_{j,t-k-1}^2\right)^{-1}\left(\sum_{k=0}^{t-c}\sum_{j=1}^{n} y_{j,t-k-1}y_{j,t-k}\right) \tag{4}$$

- sample: past experience of both i's own and others' income
- size: $N_{i,t} = n_i(t - c_i)$
  - n_i, an arbitrarily small n is sufficient
  - $t - c_i$, the duration of career (approximate for age)
- learning rule: ordinary least square (OLS) (Evans and Honkapohja (2012)), Malmendier and Nagel (2015))

Shock uncertainty

$$\underbrace{\tilde{\sigma}^2_{i,t}}_{\text{estimated shock uncertainty}} = \underbrace{s^2_{i,t}}_{\text{experienced volatility}} = \underbrace{\frac{1}{N_{i,t}-1}\sum_{j=1}^{n}\sum_{k=0}^{t-c}\hat{e}^2_{j,t-k}}_{\text{variance of residuals}} \quad (5)$$

- $\hat{e}_{i,t}$: unexpected income shocks

Persistence uncertainty

$$\tilde{Var}^{\rho}_{i,t} = (\sum_{k=0}^{t-c}\sum_{j=1}^{n} y^2_{j,t-k-1})^{-1}(\sum_{k=0}^{t-c}\tilde{\Omega}_{i,t-k})(\sum_{k=0}^{t-c}\sum_{j=1}^{n} y^2_{j,t-k-1})^{-1} \tag{6}$$

$$\tilde{\Omega}_{i,t} = \underbrace{\tilde{E}_{i,t}(Y'_{t-1}e_t e'_t Y_{t-1})}_{\text{attribution matrix}} \tag{7}$$

$$Y'_{t-1} = [y_{1,t-1}, y_{2,t-1}\cdots y_{n,t-1}]'$$

- **Attribution**: how i thinks about the correlation between her own income and others

Attribution

- Under constant risk across people and time (homoscedasticity)

$$\tilde{\Omega}_{i,t} \approx \sum_{j=1}^{n} y_{j,t}^2 \tilde{(}1 + \underbrace{\tilde{\delta}_{i,t}}_{\equiv \tilde{\delta}_{y,i,t}\tilde{\delta}_{\epsilon,i,t}} (n-1))\tilde{\sigma}_t^2 \tag{8}$$

- $\tilde{\delta}_{i,t} \in$ **[0,1]**: attribution parameter - perceived correlation of individual outcome with others
- $\tilde{\delta}_{\epsilon,i,t}$: short-run attribution - perceived correlation in income shocks
- $\tilde{\delta}_{y,i,t}$: long-run attribution -perceived correlation in income

Perceived risk under internal v.s. external attribution

- External: $\tilde{\delta}_{i,t} > 0$, i.e. "something common affects all of us"

$$\begin{aligned} \tilde{Var}_{i,t}(\Delta y_{i,t+1}) &= y_{i,t-1}^2 \tilde{Var}_{i,t}^{\rho} + \tilde{\sigma}_{i,t}^2 \\ &= [(\sum_{k=0}^{t-c} \sum_{j=1}^{n} y_{j,t-k-1}^2)^{-1}(1 + \tilde{\delta}_{i,t}(n-1))y_{i,t}^2 + 1]s_{i,t}^2 \end{aligned} \tag{9}$$

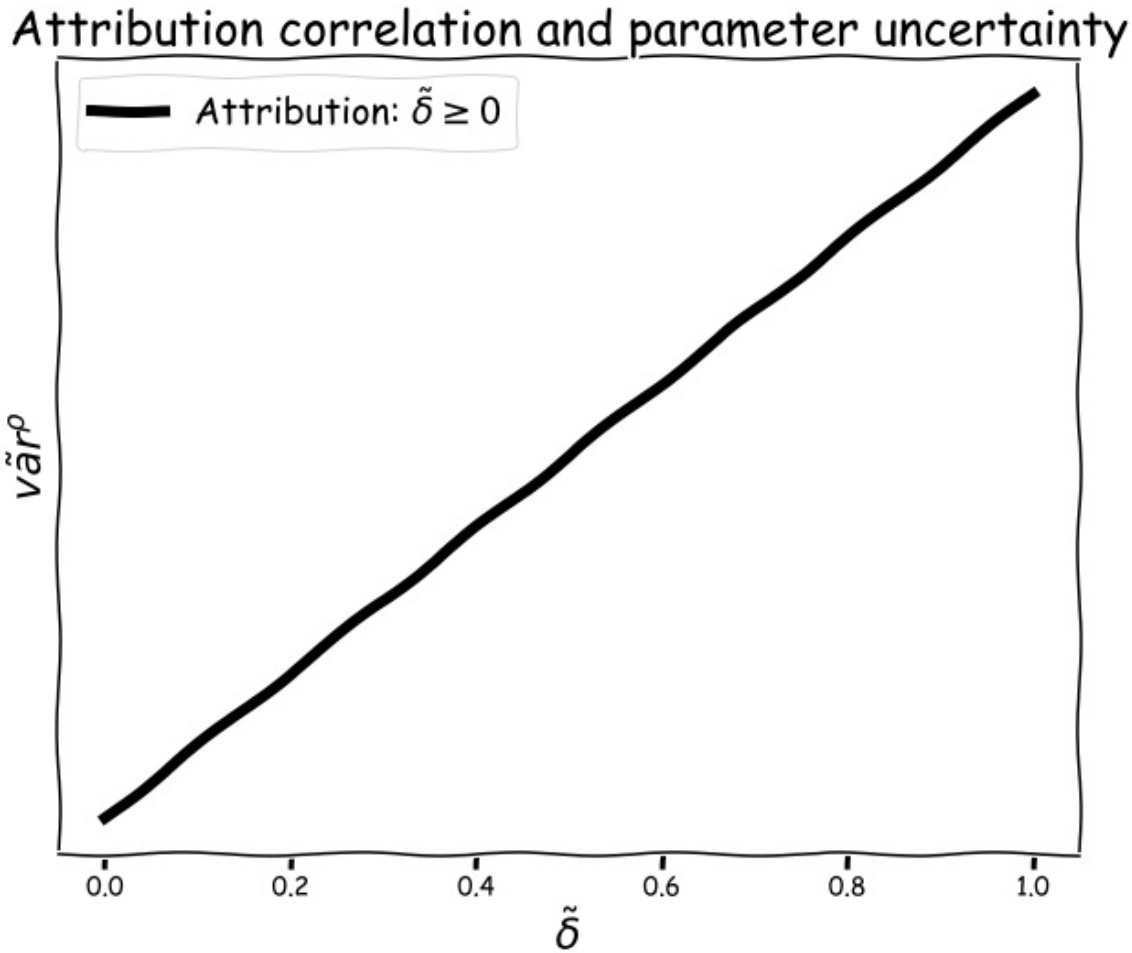
- Internal: $\tilde{\delta}_{i,t} = 0$, i.e. "my income has nothing to do with others"

$$\widehat{Var}_{i,t}(\Delta y_{i,t+1}) = [(\sum_{k=0}^{t-c} \sum_{j=1}^{n} y_{j,t-k-1}^2)^{-1} y_{i,t}^2 + 1]s_{i,t}^2 \tag{10}$$

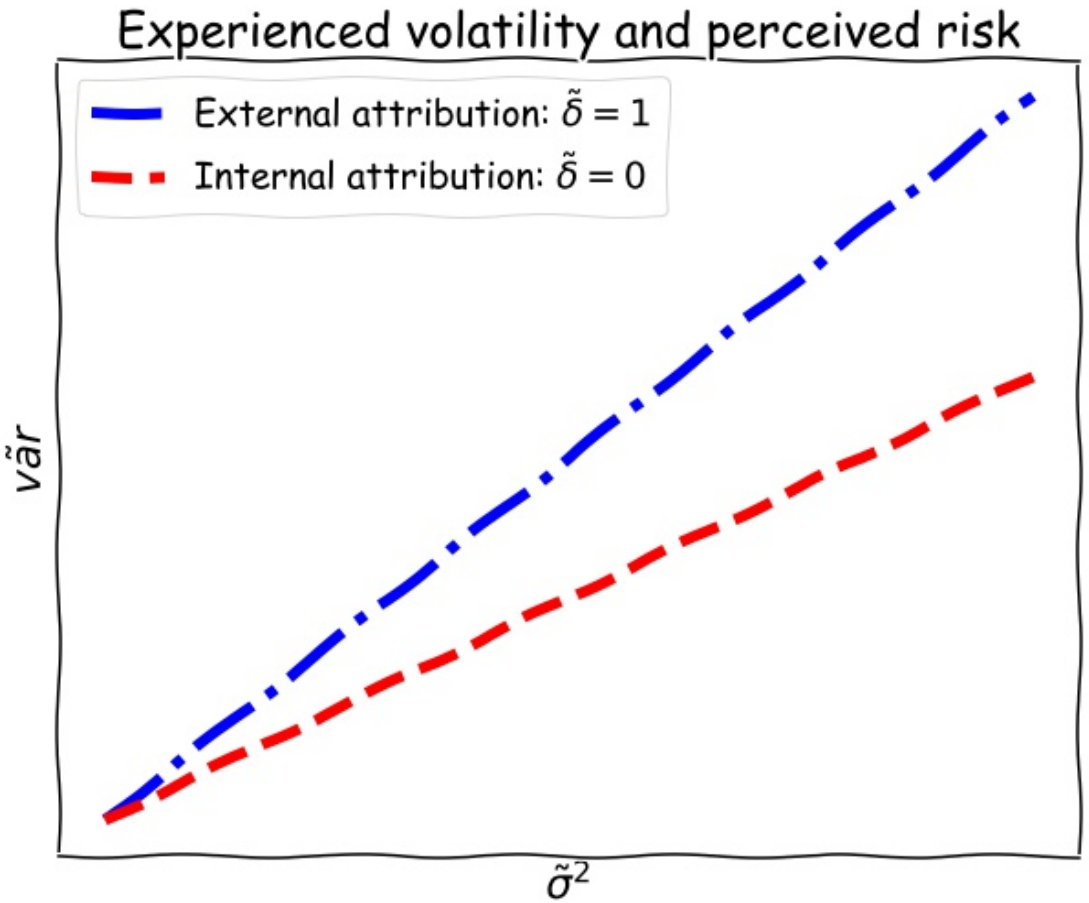
- Comparison

$$\tilde{Var}_{i,t}(\Delta y_{i,t+1}) > \widehat{Var}_{i,t}(\Delta y_{i,t+1}) \tag{11}$$

Prediction 1. higher degree of external attribution leads to higher perceived risks



Prediction 2. extrapolation of experienced volatility into perceived risks

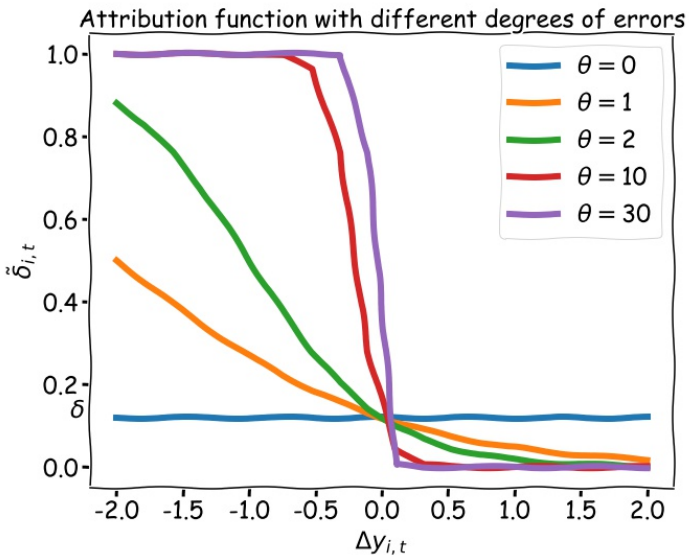


Attribution errors

- positive (negative) shock $\rightarrow$ internal (external) attribution

$$\text{Attribution function:} \quad \tilde{\delta}(\Delta y_{i,t}) = 1 - \frac{1}{(1 + e^{\alpha - \theta \Delta y_{i,t}})} \tag{12}$$

- θ: degree of attribution error
- α: unbiasedness of attribution



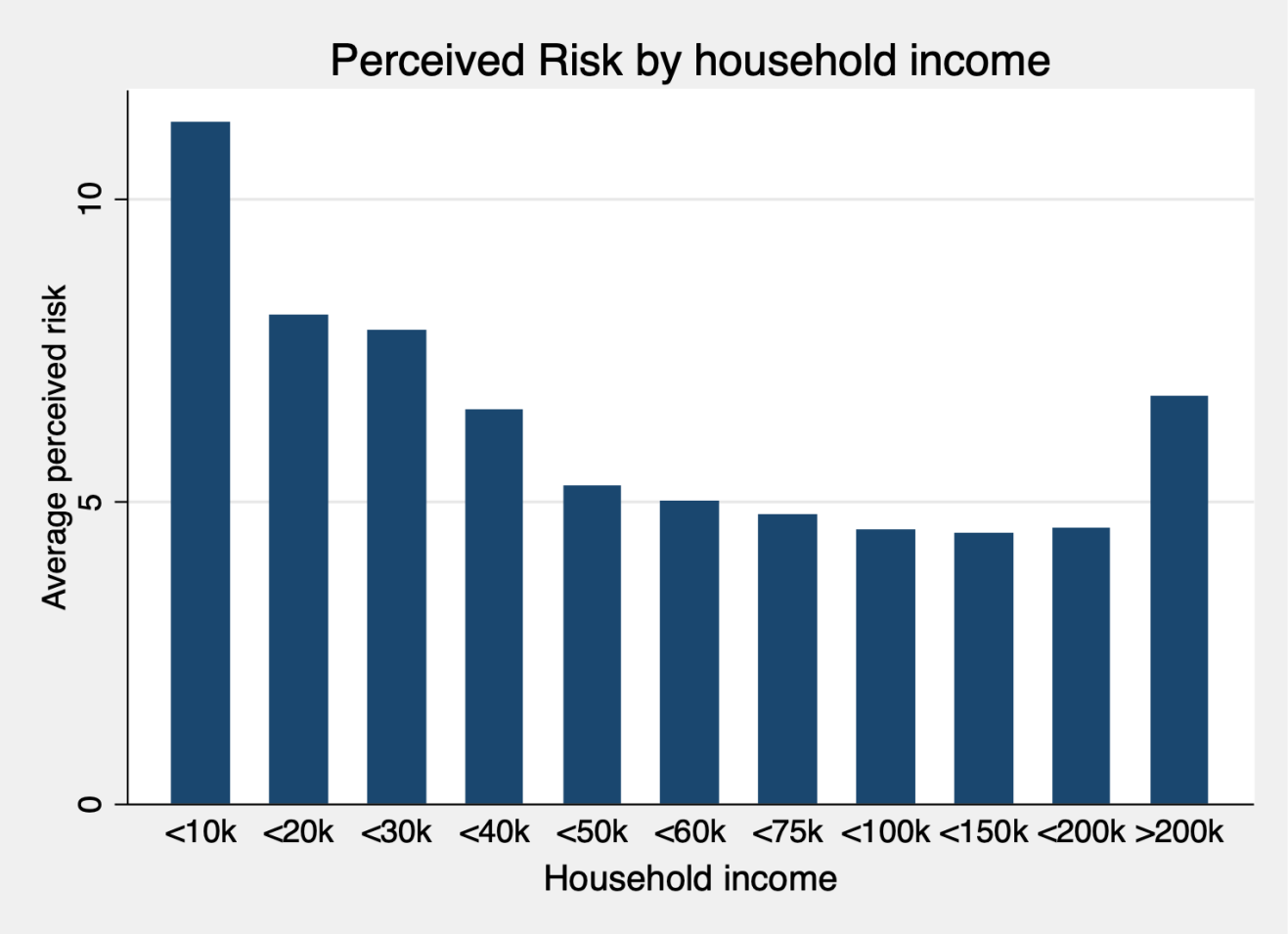
Prediction 3. Counter-cylical perceived risks under aggregate risk and attribution error

$$\tilde{Var}_t(\Delta y_{i,t+1}) = \underbrace{\lambda_t}_{\text{lucky fraction}} \tilde{Var}_t^{internal} + (1-\lambda_t)\tilde{Var}_t^{external} \tag{13}$$

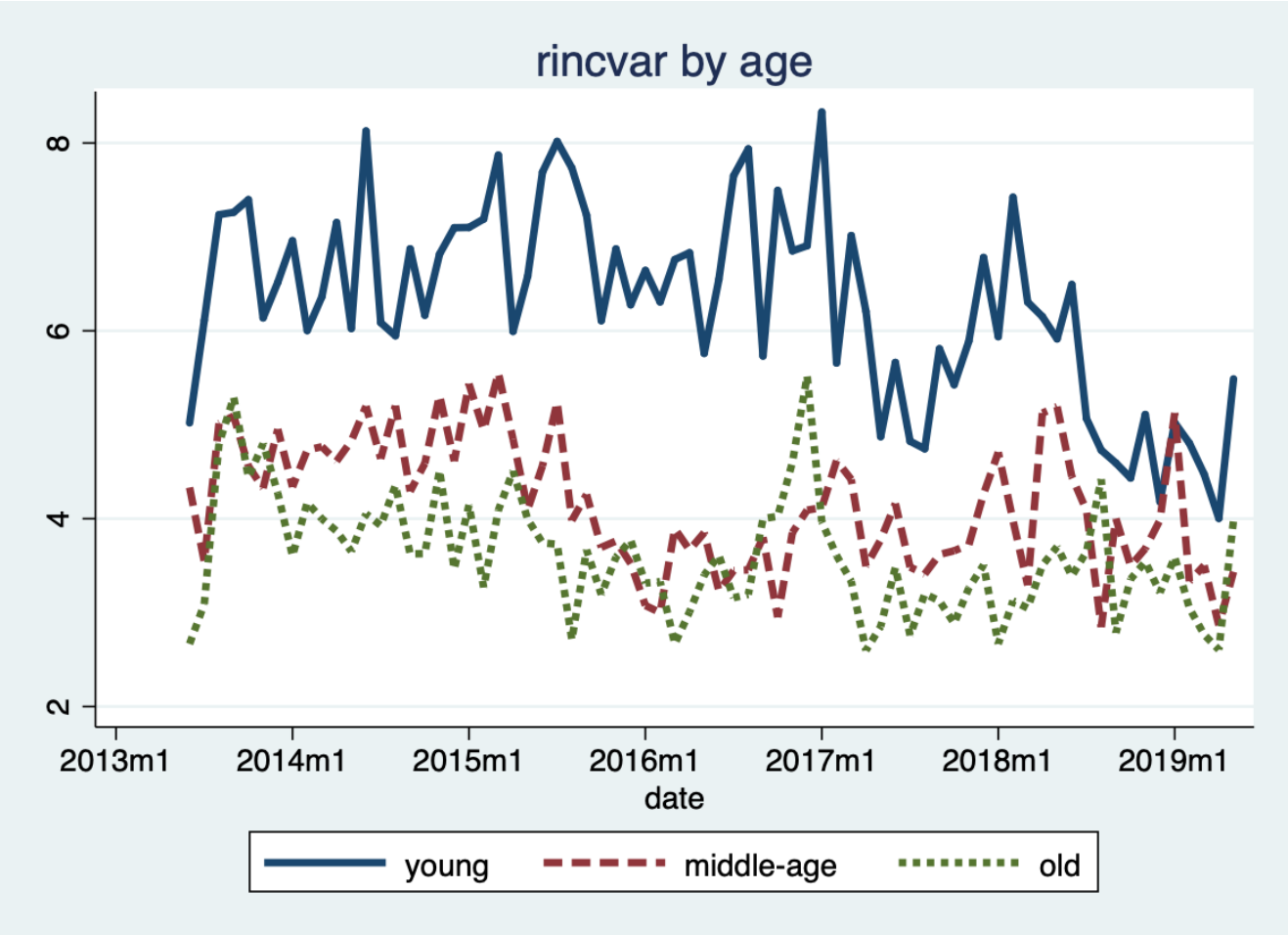
- Aggregate versus idionsyncratic risks
  - Aggregate: λ_t is procyclical.
  - Idionsyncratic: $\lambda_t \approx 0.5$
- With and without attribution errors
  - Attribution error: $\tilde{Var}_t^{external} > \tilde{Var}_t^{internal}$
  - No error: $\tilde{Var}_t^{external} = \tilde{Var}_t^{internal}$

Outline

Perceived risks by household income

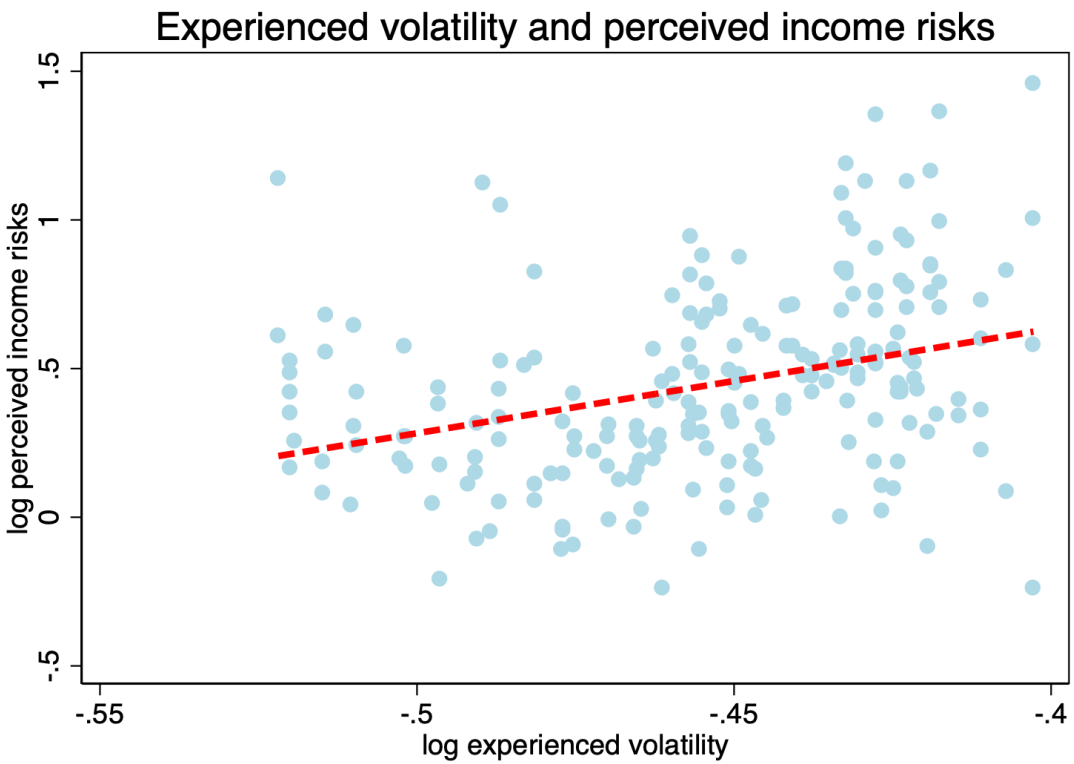


Perceived risks by age



Perceived risks and experience

- Approximated experienced volatility: $s^2_{c,t}$, MSE of the income regression for the PSID sample between c and t
- Perceived risk: $\overline{var_{c,t}}$: average across individuals within cohort c at time t



Perceived risks and experienced volatility

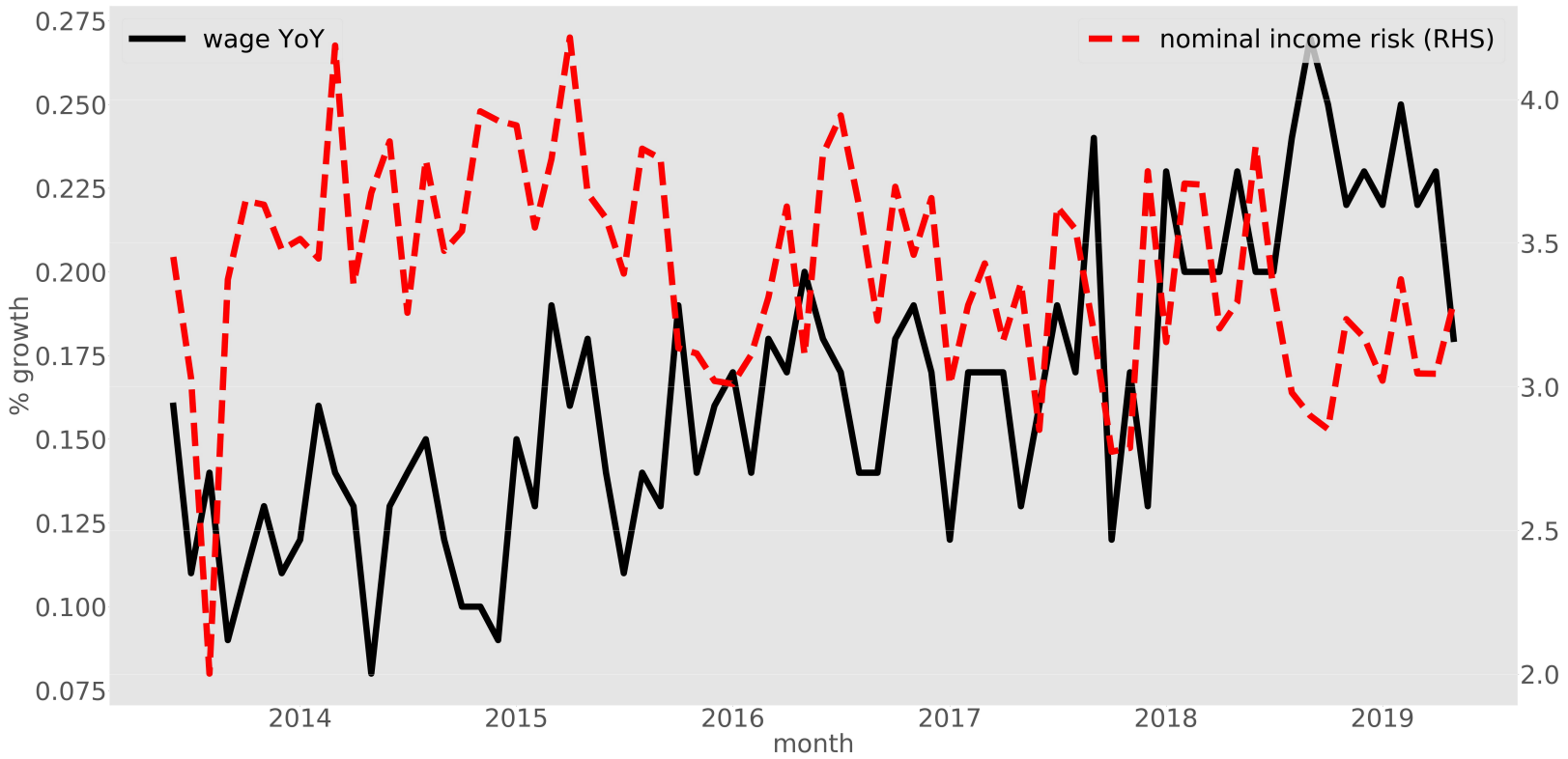
$$\underbrace{log(\overline{\text{var}}_{i,c,t})}_{\text{log perceived risk}} = a + \zeta \underbrace{log(\hat{s}^2_{c,t})}_{\text{log experienced volatility}} + Z \underbrace{\Gamma_{i,t}}_{\text{individual controls}} + \xi_{i,t}$$

	Perceived risk	Perceived risk	Perceived risk	Perceived iqr	Perceived iqr	Perceived iqr
log experienced volatility	1.291**	1.265**	1.208**	0.690**	0.713**	0.650**
	(3.08)	(3.02)	(2.61)	(3.05)	(3.16)	(2.62)
R-squre	0.0170	0.0222	0.0243	0.0118	0.0168	0.0269
N	40158	40158	33485	44454	44454	37058
Control age	Yes	Yes	Yes	Yes	Yes	Yes
Control educ	No	Yes	Yes	No	Yes	Yes
Control income	No	No	Yes	No	No	Yes

Outline

Perceived risks and recent (past) wage growth

- $\overline{\text{var}_t}$: average perceived risk across individuals
- $log(\text{wage}_t) - log(\text{wage}_{t-3})$: quarterly growth in average hourly wage



Perceived risks and current labor market condition

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

$$\forall k = 1...6$$

k	varMean	iqrMean	rvarMean	varMed	iqrMed	rvarMed
1	-2.046**	-0.801***	-10.437***	-0.269	-0.191	-5.121***
2	-3.823***	-1.193***	-12.287***	-0.021	0.009	-5.292***
3	-2.942***	-0.938***	-9.642***	-0.147	-0.077	-4.445***
4	-3.261***	-0.994***	-9.021***	-0.142	-0.094	-4.467***
5	-2.312**	-0.892***	-6.792**	-0.441**	-0.252*	-4.718***
6	-3.419***	-1.207***	-10.791***	-0.412**	-0.274**	-5.466***

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

Conclusion

- Experience + Learning + Attribution → Perception (Expectation)
- Attribution is important if
  - Imperfect understanding in both the size and the nature
  - Forming perceptions about second moments, i.e. income risks
  - Attribution errors → aggregate patterns, i.e. counter-cyclical subjective risk

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