Essays on Household Expectations and Macroeconomic Dynamics

A Ph.D. Dissertation in Economics

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Outline

- *Perceived versus Calibrated Income Risks in Heterogeneous-agent Consumption Models*
- *How Do Agents Form Inflation Expectations? Evidence from the Forecast Uncertainty*
- *Learning from Friends in a Pandemic: Social Networks and the Macroeconomic Response of Consumption*

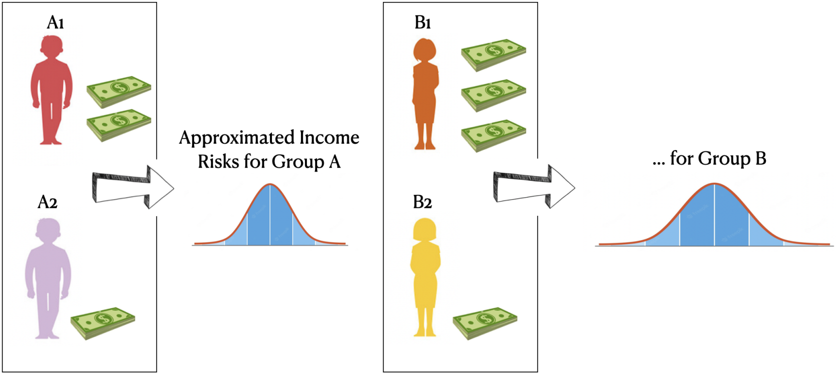
Roadmap

Perceived versus Calibrated Income Risks

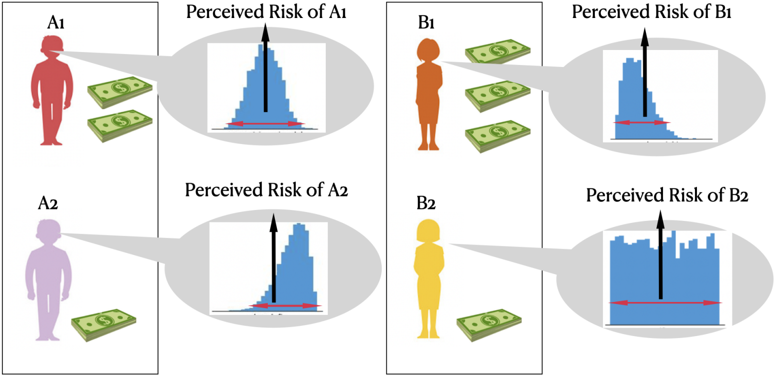
Inflation Uncertainty and Expectation Formation

Social Networks and Aggregate Consumption

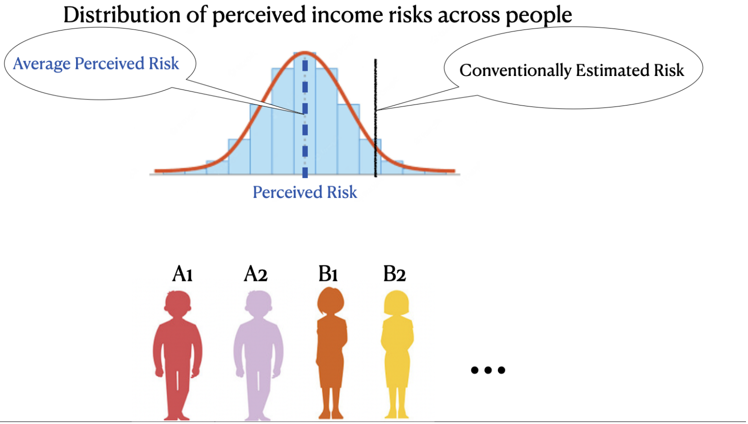
Conventional calibration: estimated from panel data



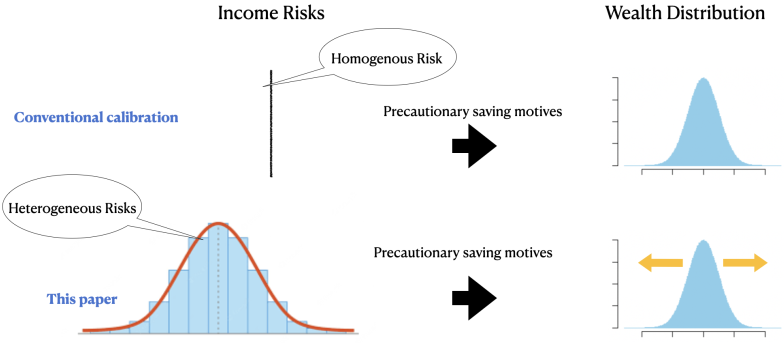
This paper: reported perceived risks in a survey



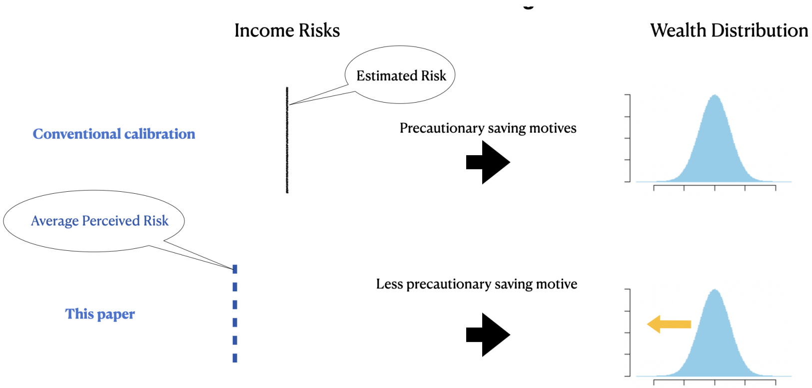
Perceived versus Calibrated Risk



Heterogeneous risks → differential savings



Smaller risks → lower level of savings



Individual PRs explain **their own** spending decisions

$$E_{i,t}(\Delta c_{i,t+1}) = u_0 + u_1 E_{i,t}(\Delta w_{i,t}) + u_2 \text{Var}_{i,t}(\Delta w_{i,t+1}) + \xi_{i,t}$$

	(1)	(2)	(3)	(4)	(5)
expected wage growth	0.324***	0.306***	0.254***	0.243***	
	(0.0825)	(0.0828)	(0.0334)	(0.0334)	
perceived wage risk	6.127***	6.185***	2.096***	1.711***	
	(1.163)	(1.165)	(0.439)	(0.442)	
perceived UE risk next 4m					0.353***
					(0.0553)
R-squared	0.000939	0.00318	0.953	0.953	0.633
Sample Size	56046	56046	56046	56046	6269
Time FE	No	Yes	No	Yes	Yes
Individual FE	No	No	Yes	Yes	Yes

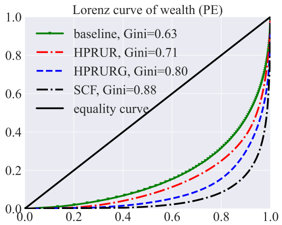
- Higher perceived risks $\rightarrow$ higher expected spending growth.

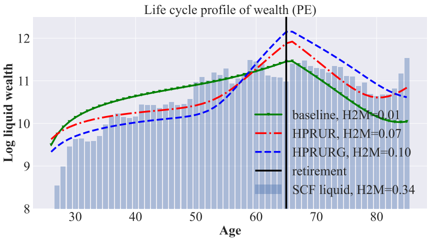
Model overview

- Overlapping generation
- Uninsured idiosyncratic income risks
  - Permanent+ transitory idiosyncratic wage shock
  - Persistent unemployment spells
- Partial/general equilibrium
- No aggregate risk a la Krusell and Smith, 1998
- A blend of Huggett, 1996 and C. D. Carroll, 1997
- Only one risk-free asset
- Calibrating income risks using survey versus estimates from panel
- Extension: subjective model
  - subjective PR $\neq$ objective income risks

Hetero perceived wage /UE risks/ growth rates (HPRURG)

$\sigma_\psi = \sigma_\theta = [0.01, 0.02, 0.04]$, $U2U = [0.1, 0.5, 0.8]$, $E2E = [0.85, 0.97, 0.99]$, $\text{std}(G) = 0.03$





Extension: subjective PR

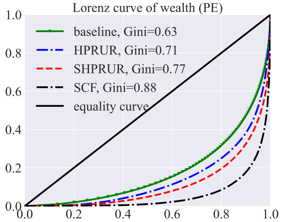
Key assumption:

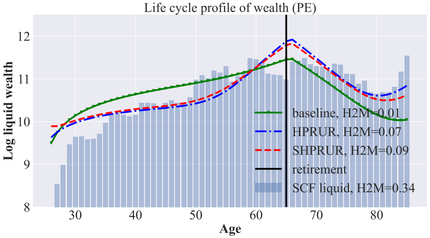
- Ex-ante: saving decisions $\leftarrow$ subjective PRs
- Ex-post: realized income inequality $\leftarrow$ objective size of income risks

Two purposes:

- A robustness check: what if PRs are incorrect?
  - but we did find people behave according to their PRs
- A model breakdown into ex-ante and ex-post channels

Subjective (SHPRUR) v.s. Objective (HPRUR)





Conclusion

- People's saving behaviors better explained by their perceptions

  ... than what economists assume to be their perceptions

Other results: drivers of PR

- Macroeconomic conditions
- Experienced labor market outcomes
- Experienced income volatility

Roadmap

Perceived versus Calibrated Income Risks

Inflation Uncertainty and Expectation Formation

Social Networks and Aggregate Consumption

FIRE predictions

Inflation process (AR1)

$$y_t = \rho y_{t-1} + \omega_t, \quad \omega_t \sim N(0, \sigma_\omega^2)$$

FIRE

$$\overline{FE}^{*}_{t+1|t} = -\omega_{t+1} \rightarrow \quad \begin{aligned} \overline{FE}^{*2}_{\bullet+1|\bullet} &= \sigma_\omega^2 \\ \overline{\text{Var}}^{*}_{\bullet+1|\bullet} &= \sigma_\omega^2 \\ \overline{Disg}^{*}_{\bullet+1|\bullet} &= 0 \end{aligned}$$

FIRE predictions v.s. data

	SPF	SCE	FIRE+AR	FIRE+SV
InfAV	0	0	0	0
InfVar	0.159	0.653	$\sigma^2_\omega/(1-\rho^2)$	N/A
InfATV	0.125	0.621	$\rho\sigma^2_\omega/(1-\rho^2)$	N/A
FE	0.136	1.772	0	0
FEVar	0.133	0.923	σ^2_ω	$\bar{\sigma}^2_\eta + \bar{\sigma}^2_\epsilon$
FEATV	0.097	0.89	0	0
Disg	0.183	2.585	0	0
DisgVar	0.028	0.057	0	0
DisgATV	0.021	0.025	0	0
Var	0.242	1.75	σ^2_ω	$\bar{\sigma}^2_\eta + \bar{\sigma}^2_\epsilon$
VarVar	0.001	0.023	0	>0
VarATV	0.001	0.004	0	>0

Structural Estimation: SMM

$$\widehat{\Omega}^o = \underset{\{\Omega^o \in \Gamma^o\}}{argmin} (M_{\text{data}} - F^o(\Omega^o, H)) W (M_{\text{data}} - F^o(\Omega^o, H))'$$

- $o \in \{se, ni, de, deni\} \times \{ar, sv\}$
- Γ^o: parameter space
- H: real-time historical realizations
- W: weighting matrix

Scoring card

Table: Scoring card of different theories

Criteria	SE	NI	DE	DENI
Sensitive to moments used for estimation?	No	No	Yes	Yes
Sensitive to the assumed inflation process?	No	Yes	Yes	Yes
Sensitive to two-step or joint estimate?	Yes	Yes	Yes	Yes
Sensitive to the type of agents?	Yes	Yes	Yes	Yes

Roadmap

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Empirical specification

We estimate panel fixed effects regressions of the form:

$$Y_{ct} = \gamma COVID^{SCI}_{ct} + \phi COVID^{d}_{ct} + \zeta_c + \lambda_t + \epsilon_{ct}$$

- γ: consumption elasticity with respect to SCI cases
- ϕ: elasticity to local coronavirus cases
- county-fixed effects + day-of-the-year fixed effects
- Robustness: controlling cases/deaths weighted by physical distance proximity
- Robustness: state $\times$ month fixed effects
- Robustness: exclude counties in the same state

Baseline results: COVID19 cases

Dep. var. =	log(Consumption Expenditures)				
	(1)	(2)	(3)	(4)	(5)
Has SAHO			-.058***	.007	-.058***
			[.005]	[.012]	[.005]
log(SCI-weighted Cases)	-.051***	-.015*	-.014*	-.003	
	[.007]	[.008]	[.008]	[.009]	
× SAHO				-.024***	
				[.004]	
log(SCI-weighted Cases, Other States)					-.016*
					[.009]
log(County Cases)		-.015***	-.006*	-.006	-.006*
		[.004]	[.004]	[.004]	[.004]
log(County Deaths)		-.015***	-.018***	-.018***	-.017***
		[.004]	[.003]	[.003]	[.003]
R-squared	.97	.97	.97	.97	.97
Sample Size	351645	351645	351645	351645	351645
County FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
State Policies	No	No	Yes	Yes	Yes
State x Month FE	No	No	Yes	Yes	Yes

Belief updating via social network

- ψ_t: an aggregate state of the economy not perfectly observable and to be learned via local signals $\xi_{i,t}$

$$\tilde{\psi}_{i,t} = \underbrace{(1-\lambda)\hat{\psi}_{i,t}}_{\text{private updating}} + \underbrace{\lambda \sum_{j=1}^{N} w_{i,j}\tilde{\psi}_{j,t-1}}_{\text{social communication}}$$

$$\hat{\psi}_{i,t} = (1-k)\underbrace{\tilde{\psi}_{i,t-1}}_{\text{prior belief}} + k\underbrace{s_{i,t}}_{\text{local news}}$$

- λ: the degree of social communication
- k: individual responsiveness to local news
- $w_{i,j}$: the “listening weight” that i gives to j’s belief

More Why ‘Naive’? Social Network

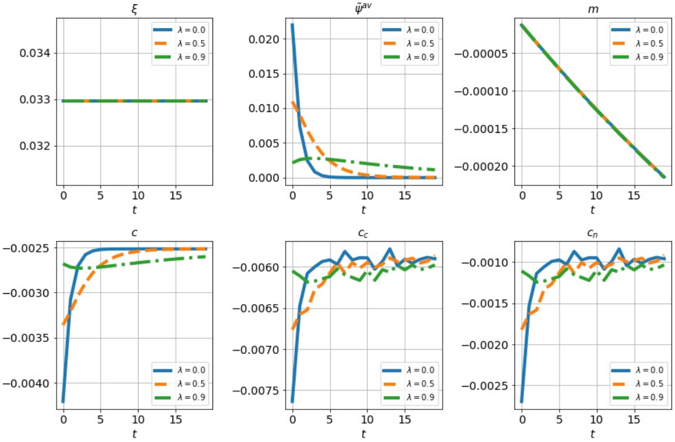
A consumption model before/during the pandemic

- Incomplete market Consumer's problem
  - uninsured income risks
  - borrowing constraints
- Local infections $\xi_{i,t}$
  - subject to aggregate spreading ψ_t and local shocks More
  - it affects
    - idiosyncratic income
    - taste toward the contact consumption More
- Incomplete information
  - about the ψ_t: aggregate $R0$ of the Covid
  - learned from local infections and social communications

Optimal consumption

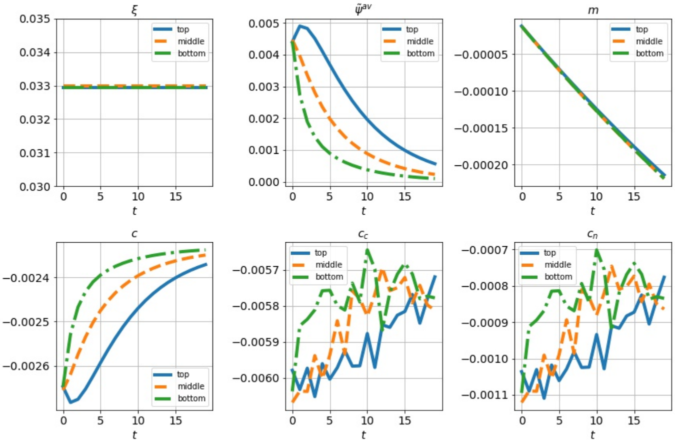
Experiment 1: Degree of social communication

Following a 10% increase in infection at one-third of the influential nodes...



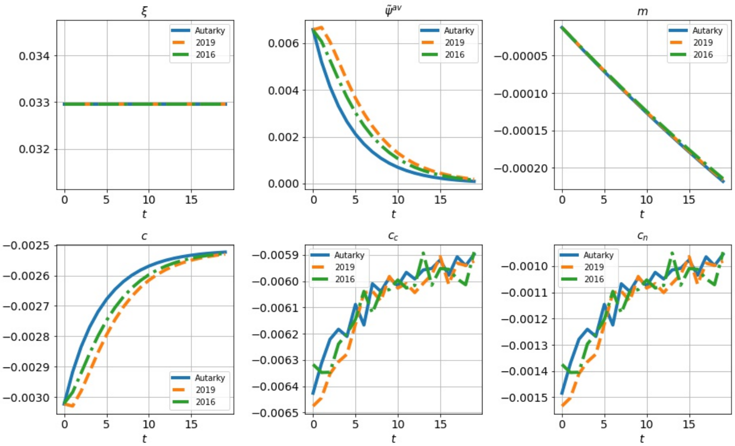
Experiment 2: location of the shock

Following a 10% increase in infection at the top/middle/bottom third agents in terms of influence...



Experiment 3: Structure of the network

Following a 10% increase in infection at one-third of the influential nodes...



Summary of the dissertation

- Beliefs in $>$2nd moments: $\mathbb{E} \rightarrow \mathbb{V}ar$(risk/uncertainty beliefs)
- Individual heterogeneity: $\mathbb{E}$ about aggregate $\rightarrow$ individual variables
- Social mechanisms of $\mathbb{E}$ formation social + macroeconomics
- Research methodology: survey data + structural macro models

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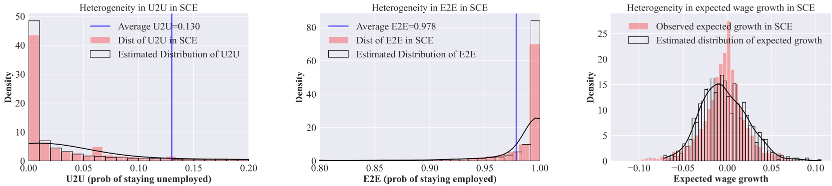
  - "heterogeneity or risk": Cunha, Heckman, and Navarro, 2005, Primiceri and Van Rens, 2009, Guvenen and Smith, 2014
  - "insurance or information": Pistaferri, 2001, Kaufmann and Pistaferri, 2009, Meghir and Pistaferri, 2011, Kaplan and Violante, 2010
- subjective/probabilistic survey of beliefs: Manski, 2004, Delavande, Giné, and McKenzie, 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, Storesletten, and Violante, 2009, C. Carroll et al., 2017, Krueger, Mitman, and Perri, 2016, Bayer et al., 2019
- consumption/saving under incomplete information/imperfect

Calibrating heterogeneous PRs

- Fit a truncated log-normal dist over the cross-section of PRs



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Appendix: PR and current labor market conditions

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

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

	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, Telmer, and Yaron, 2004, Guvenen, Ozkan, and Song, 2014, Bayer et al., 2019

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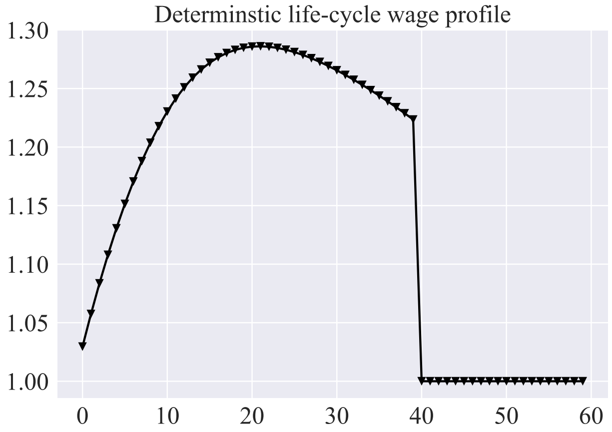
Appendix: PR and current labor market condition

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

	(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

Deterministic wage profile over life cycle



- Estimated from SIPP with a fourth-order age polynomial regression

Appendix: 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

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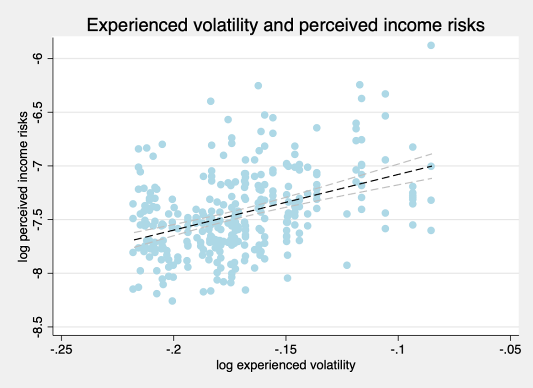
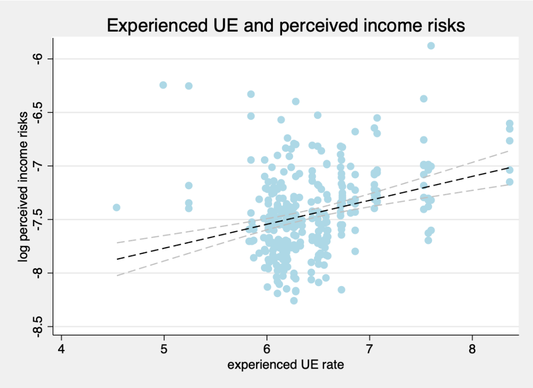
Appendix: Experienced volatility and PR



- income volatility conditional on macroeconomic history Storesletten, Telmer, and Yaron, 2004
- e.g. the experience by a 25-year old till 2015 is between 1990-2015

Appendix: Experienced UE rates and PR



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

Relation to the literature

- private updating
  - Kalman filtering/efficient learning:
    - $\kappa_{i,t}$ dynamically adjusted based on the signals' precision (Woodford, 2001)
    - stead-state gain: k^*
  - Constant-gain learning: $\kappa_{i,t} = k > 0$
    - $k < k^*$: underreaction/inattention (Mankiw and Reis, 2002; Sims, 2003; Coibion and Gorodnichenko, 2015)
    - $k > k^*$: overreaction, a la diagnostic expectation (Bordalo et al., 2020)
- social communication (SC) via naive learning (DeGroot, 1974; DeMarzo, Vayanos, and Zwiebel, 2003)
  - $\lambda = 0$: no SC
  - $\lambda = 1$: full SC
- rational benchmark (under imperfect information)
  - $\kappa_{i,t} = k^*$ and $\lambda = 0$: no SC and efficient private updating

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Social network

- "Listening matrix" W (sized $N \times N$):

$$w_{i,j} = \frac{l_{i,j}}{\sum_{k=1}^{N} l_{i,k}}$$

  - Degree $d_j = \sum_{i=1}^{N} w_{i,j}$: how influential j is in the network
  - Row sum: $\sum_{i=1}^{N} w_{i,j} = 1 \quad \forall i$
  - $w_{i,i} = 1$ if "you only have yourself as a friend"

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Why "naive"?

- Ideally: weights $=$ true precision
- Realistically: bounded rationality
  - not knowing perfectly friend ties: who are friends' friends
  - not knowing perfectly the precision of friend's signals
  - i.e. treating them as independent signals
- Experimental evidence: (Enke and Zimmermann, 2019; Chandrasekhar, Larreguy, and Xandri, 2020)
- Consequence: "persuasion bias" (DeMarzo, Vayanos, and Zwiebel, 2003):
  - **inefficiency** due to dominant weights of the influencers
  - **no "wisdom of crowds"**: the converged belief (if any) of the society is not the "truth" starting from different priors
  - persistent **disagreements** in beliefs

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Social network and beliefs

- Key statistic: the dispersion of the degrees (always mean 1)
  - Zero dispersion (social autarky, egalitarian, or symmetric influence)

$$d_i = 1 \forall i$$

  - Non-zero dispersion (W being asymmetric)
    - Belief multiplier effect: following an exogenous shock to belief of each node, average belief response is greater than the shock Details
- Similar mechanism in the production networks (Acemoglu et al., 2012) or social multiplier via peer effects (Manski, 1993)

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Belief multiplier effect

- To a single node j

$$MP^j_{t+1|t} = \frac{\delta\tilde{\psi}^{av}_{t+v}/\delta\tilde{\psi}_{j,t}(\lambda \neq 0)}{\delta\tilde{\psi}^{av}_{t+v}/\delta\tilde{\psi}_{j,t}(\lambda = 0)}$$
$$= (\frac{d_j}{1-k} - 1)\lambda + 1$$

  - $MP^j_{t+1|t} > 1$ if $d_j + k > 1$ and $\lambda > 0$

- To all the nodes

$$MP_{t+v|t} = \frac{1}{N}\sum_{j=1}^{N} MP^j_{t+v|t} = \Theta^v$$
$$\Theta = 1 + \frac{k\lambda}{1-k}$$

Consumer's problem

- N agents/consumers/nodes: $i = 1, 2 \ldots N$
- Utility

$$\max_{\{c_{i,c,t}, c_{i,n,t}\}} \quad E_0 \sum_{t=0}^{\infty} \beta^t u(c_{i,t})$$

$$u(c) = \frac{c^{1-\rho}}{1-\rho}$$

$$c_{i,t} = (\underbrace{\tau_{i,t}}_{\text{taste shifter}} \phi_c c_{i,c,t}^{\frac{\epsilon-1}{\epsilon}} + (1-\phi_c) c_{i,n,t}^{\frac{\epsilon-1}{\epsilon}})^{\frac{\epsilon}{\epsilon-1}}$$

- Budget/borrowing constraints

$$c_{i,t} + a_{i,t} = \underbrace{m_{i,t}}_{\text{cash in hand}} = \underbrace{y_{i,t}}_{\text{labor income}} + \underbrace{a_{i,t-1}(1+r)}_{\text{bank balance}}$$

$$\geq 0$$

The pandemic

- Local infection:

$$\xi_{i,t} = \underbrace{\psi_t}_{log(R0_t)} + \xi_{i,t-1} + \underbrace{\eta_{i,t}}_{\text{shock}} \quad \eta_{i,t} \sim N(-\frac{\sigma_\eta^2}{2}, \sigma_\eta^2)$$

$$\psi_{t+1} = \psi_t + \theta_t \quad \theta_t \sim N(-\frac{\sigma_\theta^2}{2}, \sigma_\theta^2)$$

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The pandemic and the economy

- Income:

$$y_{i,t} = o_{i,t} z_{i,t}$$

$$ln(o_{i,t}) = ln(o_{i,t-1}) + \underbrace{v_{i,t}}_{\text{permanent}} \qquad v_{i,t} \sim N(-\frac{\sigma_v^2}{2}, \sigma_v^2)$$

$$ln(z_{i,t}) = \underbrace{\alpha_z}_{\leq 0} \xi_{i,t} + \underbrace{\zeta_{i,t}}_{\text{transitory}} \qquad \zeta_{i,t} \sim N(-\frac{\sigma_\tau^2}{2}, \sigma_\tau^2)$$

- Taste shifter:

$$ln(\tau_{i,t}) = \overbrace{\alpha_s}^{\leq 0} \xi_{i,t} + \mu_{i,t} \quad \mu_{i,t} \sim N(-\frac{\sigma_\mu^2}{2}, \sigma_\mu^2)$$

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Optimal consumption

$$V_{i,t}(m_{i,t}, o_{i,t}, \underbrace{\tilde{\psi}_{i,t}}_{\text{Perception}}, \tau_{i,t}) = \max_{\{c_{i,c,t}, c_{i,n,t}\}} u(c(c_{i,c,t}, c_{i,n,t}))$$

$$+ \beta \tilde{E}_{i,t} V_{i,t+1}(m_{i,t+1}, o_{i,t+1}, \psi_{t+1}, \tau_{i,t+1})$$

- Inter-temporal:

$$V_{i,t}(m_{i,t}, o_{i,t}, \tilde{\psi}_{i,t}) = \max_{\{c_{i,t}\}} u(c_{i,t}) + \beta \tilde{E}_{i,t} V_{i,t+1}(m_{i,t+1}, o_{i,t+1}, \psi_{t+1})$$

- Intra-temporal allocation:

$$\frac{\tau_{i,t}\phi_c}{1-\phi_c}\left(\frac{c_{i,c,t}}{c_{i,n,t}}\right)^{-\frac{1}{\epsilon}} = 1$$

Calibration

Parameters	Value	External source/restriction
		Preference
ϕ_c	0.41	Estimated from CEX
ϵ	0.75	Estimated from CEX
ρ	2	Standard in literature
β	$0.97^{1/4}$	Standard in literature
$1+r$	$1.02^{1/4}$	Standard in literature
		Stochastic Income/Preference Shocks
σ_v^2	$0.01 \times 4/11$	Match pre-pandemic consumption inequality
σ_ζ^2	0.01×4,	Match pre-pandemic consumption inequality
σ_μ^2	0.43	Match pre-pandemic sub-category consumption
		COVID19 Dynamics
σ_θ	0.121	County panel estimation of COVID19 cases
σ_η	0.209	County Panel estimation of COVID19 cases
		Elasticity of Income/Preference to Infection
α_z	-0.1	Externally estimated
α_s	-0.2	Match the subcategory consumption response

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