Bad luck or bad decisions? Macroeconomic implications of persistent heterogeneity in cognitive skills and overconfidence

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Goal of this paper

- Add empirically-grounded behavioral heterogeneity to improve modeling of macroeconomic fluctuations
  - As paper title indicates: Add possibility of "bad decisions" to the increasingly standard accounting for "bad luck"
- Thereby improve stabilization policy analysis and design
  - Social insurance policy too!

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  - differences in economic growth (Hanushek and Woessmann (2008))
  - inflation expectations, responses to incentives & policies (D'Accunto et al. (2019,2023a,b))
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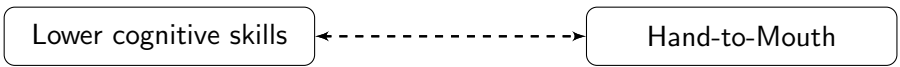
Q: Can cognitive skill heterogeneity explain differences in households' savings behavior and financial situations? If so, does it matter for macro outcomes and stabilization?

What we do

- Use microdata on U.S. consumers to develop several new facts about how cognitive skills, beliefs, and household financial situations are related
- Guided by these facts, we add cognitive skills heterogeneity to an otherwise standard, state-of-the-art quantitative macro model (Heterogeneous Agent New Keynesian, or "HANK" model) to...
  - ... explain the prevalence of persistent financial constraints (i.e. of hand-to-mouth consumers)
  - ... better fit key patterns and moments in macro data
  - ... derive policy implications (re: targeted transfers, basic income, optimal debt)

Preview of empirical findings

- Systematic relationship between cognitive skills and savings behavior:



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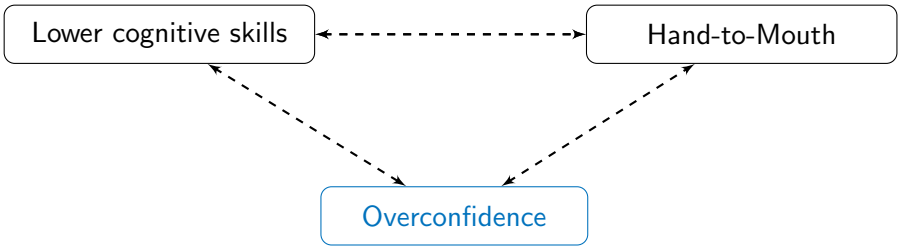

- Cognitively-less skilled households overestimate their skills ("overconfidence")
- Overconfident households also more likely to be overly-optimistic about future financial situations, & HtM and have little precautionary savings

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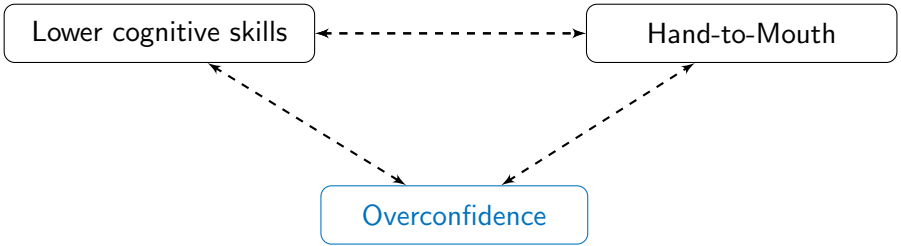
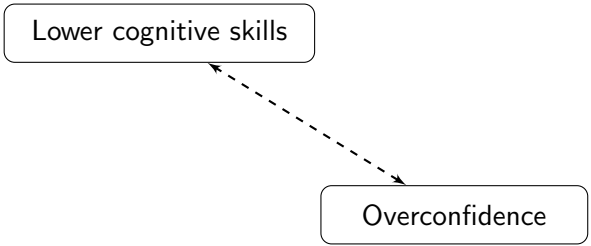


- Overconfidence is common, both in our data and the high-stakes managerial setting of Huffman et al. (2022)

- Accounting for overconfidence is key, because cog skills heterogeneity alone won't fit the data: in standard business-cycle models, permanently low-productivity consumers will save their way out of financial constraints, IF they are classically rational

Preview of model results

- Develop a HANK model with heterogeneity in cognitive skills and overconfidence



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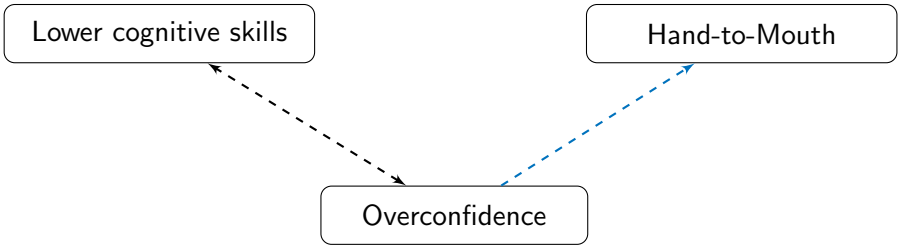

- accounts for our empirical findings and improves upon existing models:
  - matches average MPCs and total wealth jointly, and no "missing-middle" puzzle
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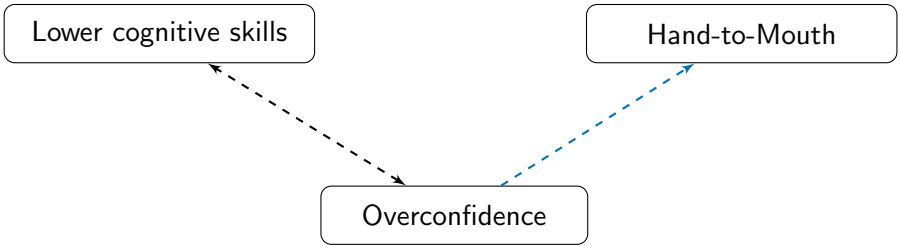

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  - key decision making mechanism: oc households undervalue (self-)insurance: they think things will improve $\Rightarrow$ consume, don't precautionary save
- reason *why* certain households are HtM matters for policy

Literature Review

- Cognitive skills, behavioral biases, subjective income risk: D'Acunto et al. (2019, 2023a,b), Stango and Zinman (2023), Rozsypal and Schlafmann (2023), ...
  - ⇒ Contribution: link cognitive skills to beliefs, savings behavior and financial situations (incl. HtM status)
- HA(NK) models deviating from FIRE: Farhi and Werning (2019), Pfäuti and Seyrich (2022), Ilut and Valchev (2023) ...
  - ⇒ Contribution: introduce cognitive skills + overconfidence in HANK, matching key moments, fiscal policy implication
- Permanent heterogeneity in HA(NK): Aguiar et al. (2021), Krueger et al. (2016), ...
  - ⇒ Contribution: heterogeneity in cognitive skills + overconfidence and its fiscal policy implication

Literature Review II

- Aspirations literature: Genicot and Ray (2017), Dalton et al. (2016)
  - ⇒ Contribution: over-optimism vs. over-pessimism; different macro questions; beliefs vs. problem-solving/preferences
- Financial stress literature: Sergeyev et al. (2023)
  - ⇒ Contribution: overlap some in RQ and model; many key differences incl. focus to match key moments (HtM and MPCs),... ▸ Detailed comparison

We are the first paper to show:

- empirical link between heterogeneity in cognitive skills, overconfidence, and heterogeneity in households' financial situation
- that introducing heterogeneity in cognitive skills and overconfidence improves HA(NK) models w.r.t. to key moments
- macro policy implications of heterogeneity in cognitive skills and overconfidence

Outline

1. **Empirics**
2. Model, in words and one slide
3. Model performance: How and why our model fits the data
4. Some policy implications

Data

American life panel:

- Two rounds (2014 & 2017) to elicit consumers' cognitive skills, behavioral biases and preferences (Stango/Zinman, REStud 2023)
- 845 panelists completed both rounds
- The same panelists participated in several surveys:
  - we combine "our" two rounds with the other surveys between 2010 and 2022

Cognitive Skills and Overconfidence

- Cognitive skills: measured by standard tests on
  - general or fluid intelligence
  - numeracy
  - cognitive control/executive function
  - financial literacy

$\Rightarrow$ extract common factor as a summary measure (can also use principal component)

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- Overconfidence:
  1. "oc percentile rank": $\tilde{\mathbb{E}}_i[rank_i] - rank_i$
  2. "oc in both rounds": indicator $= 1$ if above-median oc in both rounds (38%)
  - highly correlated with other measures of overconfidence
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- cognitive skills and overconfidence are persistent (Stango/Zinman)

▸ Table on OC

Financial Situations and Savings Behavior

- financial-situation forecast errors:
  - expected future financial situation vs. actual future financial situation (asked 14 times)
  - financial-situation forecasts are highly correlated with income-growth and spending-growth forecasts
  - forecast errors are persistent within person:
    - learning over time is modest
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- 6 measures of Hand-to-Mouth status (of varying prevalence, severity):
  1. severe financial distress: 28-30% (in both 2014 and 2017)
  2. liquid net worth $< 1/2$ monthly income: 40-47% (in both 2014 and 2017)
  3. difficulty to cover \$2k unexpected expense: 51-53% (2011, 2012, 2018)
  4. lives paycheck-to-paycheck: 56-58% (2012)
  5. HtM summary measure during Covid: 40-44% (9 rounds from May 2020 - July 2022)
  6. lacks precautionary savings: 63-69% (2012 and 2018)

▸ HtM tables

Empirical Findings

We find ...

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(Optimist share oc) / (Optimist share not oc)	Optimism measure	
	$1 = (\text{Prop. Opt. FEs} > 0.5)$	$1 = (\text{Prop. Opt. FEs} \geqslant 0.5)$
Unweighted	1.25	1.20
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... overconfidence positively correlated with our HtM and precautionary savings measures (all 24 correlations are positive, 18 have t-stats $> |2|$) ▸ Table

Why not classical preference heterogeneity?

Others have proposed preference heterogeneity as driver of HtM status:

- patience:
  (Auclert et al., 2020; Aguiar et al., 2021; Kaplan and Violante, 2022; Andreou et al., 2023)
  - even speculated that behavioral biases may be driver of heterogeneity in patience
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but...

- theoretically and quantitatively less attractive ▸ Details
- correlations with key micro variables are weaker ▸ SFC ▸ HtM ▸ OC

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Modelling approach, in words & one slide

- Start with standard HANK setup
  - Heterogeneity only in "luck" ↔ in shock realizations
  - Machinery required to analyze dynamics and equilibria (households, firms, unions, government, markets, prices)
- Add behavioral heterogeneity based on our micro findings:
  - 38% of households overconfident % low-skilled; 62% rational & high-skilled
    - Overconfidence: Over-estimate the probability of reaching good productivity state, under-estimate probability of reaching bad productivity state
      - Productivity ↔ Income ↔ Household financial situation
    - How much oc? OC HHs 1.18 more likely to overestimate future financial situation
- Assess model performance based on ability to match:
  - Micro findings re: HtM prevalence and correlations with overconfidence
  - Key macro statistics

▸ Model details

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Key example of how our model fits the data better

	HANK: CS + OC	Standard HANK	HANK: CS	HANK: OC
	(1)	(2)	(3)	(4)
HtM Share	0.29			
Avg. MPC	0.16			

Our baseline model with heterogeneity in cognitive skills and overconfidence does well in matching (untargeted) moments:

- HtM share of 29% (fits our "strictest" measure of HtM)
- Average MPC of 16% (consensus estimates of quarterly average MPCs: 15-25%)

Model-implied HtM shares and MPCs

	HANK: CS + OC	Standard HANK	HANK: CS	HANK: OC
	(1)	(2)	(3)	(4)
HtM Share	0.29	0.03		
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Standard HANK performs poorly when targeting total wealth in the economy (Kaplan/Violante, 2022)

- HtM share of 3%
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Our model also better fits the wealth distribution

- One way for the standard model to match empirical estimates of the average MPC is to reduce the amount of liquidity in the economy (Kaplan/Violante, 2022)
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  - reflected in too low median wealth to average income: 0.24 (1.5 in the data)

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  - reflected in too low median wealth to average income: 0.24 (1.5 in the data)
- Our model resolves this issue: median wealth to income ratio of 1.4
- Plus: relatively good fit of (untargeted) wealth inequality statistics:
  - top 10% wealth share of 45% vs. 49% in the data
  - bottom 50% wealth share of 3% vs. 2% in the data

▸ Relationship with discount factor heterogeneity ▸ Extensions

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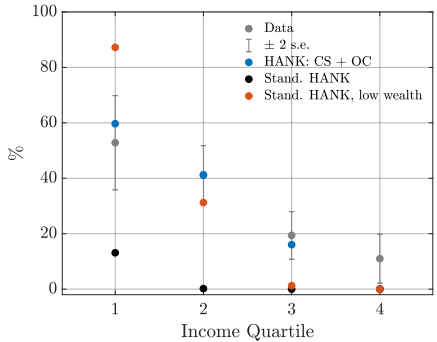
Policy implication 1:
Targeting on income mis-targets financially constrained households



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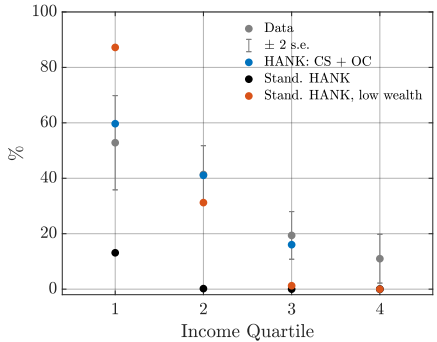

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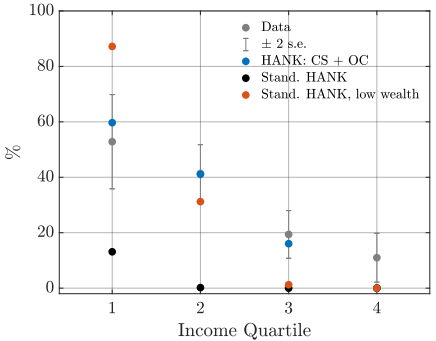

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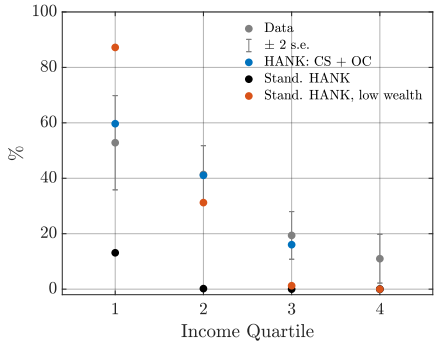

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- the distribution of HtM (and MPCs) matters!

Policy implication 2: Income-targeted transfers are less stimulating

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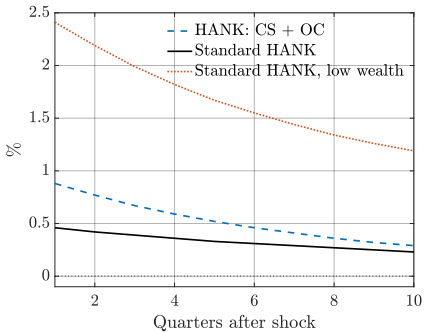

Where are these differences coming from?

1. average MPC vs. average MPC of transfer recipients (HtM-income distribution)
2. relaxation of precautionary-savings channel is dampened (also matters in stationary equilibrium)

Policy implication 3: Social insurance is less distortionary

- we now consider minimum income benefits

$\Rightarrow$ reduce precautionary savings motive...

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- we now consider minimum income benefits

$\Rightarrow$ reduce precautionary savings motive... especially for rational households

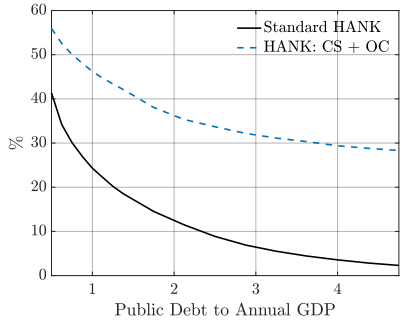
	HANK: CS + OC (1)	Standard HANK (2)	Standard HANK, low wealth (3)
HtM Share	0.29	0.03	0.30
Avg. MPC	0.16	0.04	0.16
Bottom50W	2.7%	12.8%	3.0%
Real rate	4%	4%	4%
HtM Share with PI	0.32	0.093	0.40
Avg. MPC with PI	0.15	0.060	0.26
Bottom50W with PI	1.6%	9.2%	1.3%
Real rate with PI	5.0%	5.5%	6.9%

$\Rightarrow$ crowding-out effects of income insurance are dampened in model with overconfidence

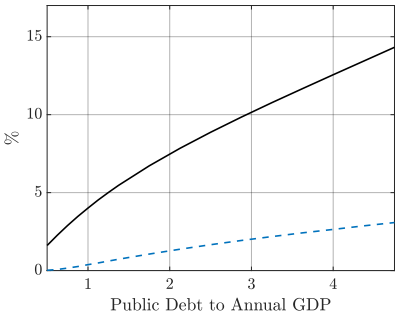
- less savings to begin with, value insurance less

Policy implications 4: Incentivizing self-insurance is less efficient

(a) HtM share



(b) Wealth share bottom 50%



- extra liquidity mainly goes to rational households
- HtM share in our model remains high and wealth share of bottom 50% low
- low-wealth households are systematically different and respond less to changes in their precautionary-savings motive

Optimal government debt level

- Higher debt: more insurance but higher distortionary taxes
- Utilitarian social welfare function: average expected discounted lifetime utility

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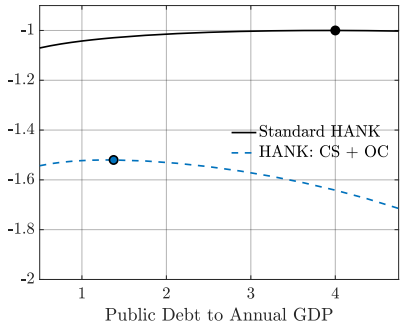

$\Rightarrow$ optimal debt level substantially lower in our model

Summary

- New U.S. evidence-based linkage: persistent overconfidence about household financial condition $\leftrightarrow$ persistent financial constraints/distress
- Accounting for heterogeneity in overconfidence in an otherwise state-of-the-art quantitative macro fluctuations model:
  - Improves fit to micro and macro data
  - Produces several novel implications for fiscal, stabilization, and social insurance policy
- Complements work on aspirations; on financial stress and its effects on cognition

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Literature IV

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Relationship to Sergeyev et al. 2024 (SLG)

Empirical differences:

- Only Covid-time could lead to overestimation of importance of stress

Differences of models:

- SLG also provide a theory how certain households are more likely to be HtM yet require two changes to the standard model

  1. financial stress as a direct utility cost with costs decreasing in wealth and
  2. "naive" households neglect these costs in the future ⇒ save less and end up in "poverty traps".

- Beliefs are key for both but two important differences:

  1. We have direct micro evidence to discipline our belief parameters wheras SLG use share of naive households as free parameter to target financial constraints households.
  2. In their model, sophisticated households are counterfactually never HtM

- They do not share our focus matching key moments for HANK models (Their model does not match average MPC and average wealth simultaneously, HtM income distribution,...)
- Fiscal policy exercise: SLG focus on labor supply channel of lump-sum transfers vs. our focus on targeted transfers and insurance fiscal policies ▸ back

Cognitive skills, overconfidence and HtM status

	CS rank: cf		1=Oc both rounds		Oc pctile rank		Row var., unw.	Row var., w.
	Unw.	W.	Unw.	W.	Unw.	W.	Pop. share	Pop. share
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Severe financial distress	-0.335	-0.287	0.176	0.273	0.194	0.180	0.277	0.305
s.e.	0.040	0.073	0.059	0.119	0.039	0.078	0.016	0.035
N	841	841	813	813	813	813	813	813
Low net worth	-0.397	-0.368	0.250	0.198	0.226	0.086	0.397	0.468
s.e.	0.038	0.061	0.057	0.097	0.041	0.073	0.018	0.032
N	788	788	760	760	760	760	760	760
paycheck-to-paycheck, 2012	-0.292	-0.503	0.151	0.008	0.154	0.168	0.588	0.560
s.e.	0.065	0.083	0.099	0.238	0.074	0.121	0.031	0.077
N	263	263	255	255	255	255	255	255
paycheck-to-paycheck, COVID	-0.383	-0.275	0.224	0.204	0.301	0.292	0.400	0.437
s.e.	0.020	0.021	0.053	0.090	0.049	0.079		
N	527	527	516	516	516	516	516	516
1=(Lacks prec. savings)	-0.300	-0.304	0.112	0.086	0.181	0.188	0.634	0.718
s.e.	0.070	0.123	0.101	0.162	0.071	0.105	0.030	0.043
N	272	272	262	262	262	262	262	262
Difficult covering 2k	-0.398	-0.426	0.230	0.314	0.222	0.253	0.512	0.590
s.e.	0.041	0.060	0.065	0.093	0.050	0.069		
N	499	499	485	485	485	485	485	485

Note: CS = cognitive skills, measured as the common factor of four standard tests; OC= overconfidence re: relative performance in a cognitive skills test (see Section 2.1 for details). Weighted estimates use the sampling probability for the last SZ module. In Columns 5 and 6, we use Obviously Related Instrumental Variables to account for measurement error by having the two measurements of o/c rank (taken in 2014 and 2017) instrument for each other (Gillen et al. (2019); Stango and Zinman (2023)).

▸ back

Persistent overconfidence: prevalence and relationship to income

	Overconfident in both survey rounds?			
	Yes Unweighted	No Unweighted	Yes Weighted	No Weighted
Population share	0.34		0.38	
	(0.02)		(0.04)	
Mean Income	51,182$	79,765$	42,035$	77,145$
N	817	817	817	817

Note: Standard errors in parentheses. Weighted estimates use the sampling probability for the last SZ module.

▸ back

Subjective financial condition forecasts are strongly positively correlated with income forecasts

	Forecasted probability of increase in:			
	Nominal income		Real income	
	Unweighted	Weighted	Unweighted	Weighted
	(1)	(2)	(3)	(4)
1= Optimistic forecast of sfc	0.00487	0.00484	0.00576	0.00546
s.e.	(0.00015)	(0.00020)	(0.00018)	(0.00024)
N	15,047	15,047	15,049	15,049
N panelists	3057	3057	3056	3056

Notes: Each column presents results from a single OLS regression of the row variable on the column variable and a constant. Standard errors, clustered on panelist, in parentheses. Weighted estimates use the ALP sampling probability weight for each observation. Income forecasts in percentage point units, so e.g., a point estimate of 0.005 indicates a 1/2 percentage point increase in sfc optimism per 1 pp increase in the probability of an income increase. SFC forecast optimism is indicated by responding to the question "Now looking ahead - do you think that a year from now you will be better off financially, or worse off, or just about the same as now?" with "Will be better off".

Household financial condition forecasts and forecast errors tilt optimistic

Panel A. All forecasts, unweighted	Realization this year			
Forecast last year	Better	Same	Worse	Total
Better	0.10	0.13	0.04	0.27
Same	0.06	0.45	0.10	0.61
Worse	0.01	0.05	0.07	0.12
Total	0.16	0.63	0.21	1
Panel B. July 2009 & 2010, unweighted	Realization this year			
Forecast last year	Better	Same	Worse	Total
Better	0.06	0.16	0.05	0.28
Same	0.05	0.40	0.15	0.60
Worse	0.01	0.05	0.07	0.12
Total	0.12	0.61	0.27	1
Panel C. July 2009 & 2010, weighted	Realization this year			
Forecast last year	Better	Same	Worse	Total
Better	0.07	0.18	0.05	0.30
Same	0.04	0.38	0.14	0.56
Worse	0.01	0.07	0.06	0.14
Total	0.12	0.63	0.25	1

Note: Cells report sample proportions. Forecasts: "Now looking ahead - do you think that a year from now you will be better off financially, or worse off, or just about the same as now?" Response options: Will be better off/About the same/Will be worse off. Realizations: "We are interested in how people are getting along financially these days. Would you say that you are better off or worse off financially than you were a year ago?" Response options: Better off/About the same/Worse off. Weighted estimates use sampling probabilities from the realization survey(s), which are correlated 0.90 and 0.93 with the weight from the paired forecast survey. Sample size is 21,586 in Panel A, 1,679 in Panels B and C, and 1,882 in Panels D and E.

Household financial condition forecasts and forecast errors tilt optimistic

Panel D. January 2015 & 2016, unweighted	Realization this year			
Forecast last year	Better	Same	Worse	Total
Better	0.10	0.14	0.04	0.28
Same	0.06	0.47	0.08	0.61
Worse	0.01	0.05	0.06	0.12
Total	0.17	0.66	0.18	1
Panel E. January 2015 & 2016, weighted	Realization this year			
Forecast last year	Better	Same	Worse	Total
Better	0.11	0.13	0.03	0.27
Same	0.05	0.50	0.08	0.63
Worse	0.01	0.04	0.05	0.10
Total	0.17	0.67	0.16	1

Note: Cells report sample proportions. Forecasts: "Now looking ahead - do you think that a year from now you will be better off financially, or worse off, or just about the same as now?" Response options: Will be better off/About the same/Will be worse off. Realizations: "We are interested in how people are getting along financially these days. Would you say that you are better off or worse off financially than you were a year ago?" Response options: Better off/About the same/Worse off. Weighted estimates use sampling probabilities from the realization survey(s), which are correlated 0.90 and 0.93 with the weight from the paired forecast survey. Sample size is 21,586 in Panel A, 1,679 in Panels B and C, and 1,882 in Panels D and E.

Household financial condition forecast errors are persistent

	Forecast error this survey			
FCE previous survey	Optimist	Realist	Pessimist	Total
Optimist	0.10	0.09	0.01	0.19
Realist	0.08	0.61	0.04	0.73
Pessimist	0.01	0.04	0.03	0.08
Total	0.18	0.74	0.07	1

Note: Sample is 10,546 forecast error pairs from 2,469 panelists. Here we require $\geqslant 2$ forecast-realization pairs per panelist and only include realizations of "about the same", to allow for the sharpest feasible test of persistence, by holding realizations constant and allowing for forecast errors in either direction (thereby minimizing measurement error from censoring).

Household financial condition forecast learning?

Panel A. First forecast - realization pair	Realization this year			
Forecast last year	Better	Same	Worse	Total
Better	0.09	0.16	0.06	0.31
Same	0.05	0.40	0.12	0.57
Worse	0.01	0.05	0.06	0.12
Total	0.15	0.61	0.23	1
Panel B. Last forecast - realization pair	Realization this year			
Forecast last year	Better	Same	Worse	Total
Better	0.10	0.13	0.04	0.28
Same	0.06	0.46	0.09	0.61
Worse	0.01	0.05	0.06	0.11
Total	0.17	0.65	0.18	1

Note: Sample includes only the 3073 panelists with multiple forecast-realization pairs.

Pairwise correlations between persistent overconfidence about cognitive skills and persistent optimistic forecast errors

	1 = oc both rounds		oc percentile rank		Mean(row var)	
	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
	(1)	(2)	(3)	(4)	(5)	(6)
1=(Prop. opt. FEs $>$ 0.5)	0.120	0.037	0.098	0.077	0.299	0.270
s.e.	0.078	0.129	0.054	0.086		
N	462	462	462	462	462	462
1=(Prop. opt. FEs $\geqslant$ 0.5)	0.120	0.035	0.109	0.080	0.400	0.380
s.e.	0.075	0.127	0.054	0.095		
N	462	462	462	462	462	462
Prop. opt. FEs	0.063	0.011	0.093	0.104	0.403	0.390
s.e.	0.059	0.094	0.053	0.085		
N	462	462	462	462	462	462

Note: Overconfidence re: relative performance in a cognitive skills test. Forecast errors re: household financial condition. Weighted estimates use the mean of each panelist's: (sample probably weight from the last SZ module, mean sampling weight across the survey(s) with the realization component of the forecast error(s) used here). In Columns (3) and (4), we use Obviously Related Instrumental Variables to account for measurement error by having the two measurements of o/c rank (taken in 2014 and 2017) instrument for each other (Gillen et al. (2019), Stango and Zinman (2023)). We do not take the same approach to the overconfidence indicator in Columns (1) and (2), because measurement error-IV does not work well on misclassification error. Fully non-IV correlations estimated using tetrachoric or Pearson.

Pairwise correlations between persistent optimism about financial condition and HtM measures, using all data for non-SZ modules

	Proportion optimistic forecast errors 1=(⩾ 0.5)		1=(> 0.5)				Row variable pop. share	
	Unw.	Weighted	Unw.	Weighted	Unw.	Weighted	Unw.	Weighted
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1=(lives paycheck-to-paycheck c. 2012)	0.143	0.207	0.137	0.133	0.138	0.168	0.482	0.495
s.e.	0.048	0.069	0.051	0.070	0.038	0.053	0.015	0.022
N	1068	1068	1068	1068	1068	1068	1068	1068
Lives paycheck-to-paycheck, COVID era	0.185	0.160	0.168	0.105	0.153	0.103	0.382	0.386
s.e.	0.037	0.049	0.039	0.053	0.030	0.030		
N	1086	1086	1086	1086	1086	1086		
1=(Lacks precautionary savings in 2012 and 2018)	0.338	0.317	0.340	0.309	0.297	0.271	0.355	0.385
s.e.	0.051	0.067	0.053	0.069	0.038	0.054	0.016	0.022
N	864	864	864	864	864	864	864	864
1=(Lacks precautionary savings in 2012 or 2018)	0.364	0.336	0.385	0.332	0.363	0.347	0.581	0.615
s.e.	0.050	0.064	0.052	0.068	0.038	0.054	0.017	0.021
N	864	864	864	864	864	864	864	864
Difficulty covering $2k emergency expense	0.166	0.143	0.189	0.151	0.162	0.120	0.476	0.515
s.e.	0.030	0.042	0.031	0.043	0.023	0.033		
N	2480	2480	2480	2480	2480	2480		

Note: Here we combine all the data we have on sfc forecast errors and HtM measures. Weighted estimates using the mean sampling weight across all sfc realizations per panelist.

Persistent overconfidence: Correlations with cognitive skills

	1 = oc both rounds		oc percentile rank	
	Unweighted	Weighted	Unweighted	Weighted
	(1)	(2)	(3)	(4)
Cognitive skill measures				
Summary: 1st common factor	-0.637	-0.629	-0.770	-0.743
s.e.	0.025	0.050	0.035	0.061
N	817	817	817	817
Summary: 1st principal component	-0.546	-0.542	-0.818	-0.830
s.e.	0.030	0.045	0.032	0.049
N	733	733	733	733
Component: Fluid intelligence	-0.718	-0.734	-1.049	-1.065
s.e.	0.026	0.047	0.026	0.055
N	817	817	817	817
Component: Numeracy	-0.362	-0.453	-0.573	-0.656
s.e.	0.040	0.068	0.046	0.077
N	798	798	798	798
Component: Financial literacy	-0.321	-0.242	-0.467	-0.362
s.e.	0.038	0.087	0.041	0.087
N	813	813	813	813
Component: Executive function	-0.316	-0.407	-0.444	-0.600
s.e.	0.045	0.072	0.052	0.090
N	749	749	749	749

Note: Overconfidence re: relative performance in a cognitive skills test. All cognitive skills measures are percentile ranks. of each of the component measures shown in the table (see Stango and Zinman (2023) for details on component measures). Weighted estimates use the sampling probability for the last SZ module. All cognitive skills measures, and overconfidence percentile rank, use Obviously Related Instrumental Variables to account for measurement error by having the two rank measures (taken in 2014 and 2017) instrument for each other (Gillen et al. (2019), Stango and Zinman (2023)).

▸ back

Pairwise correlations between persistent optimistic forecast errors and patience and risk aversion

	Patience		Risk aversion			
	Unw. (1)	Weighted (2)	Unw. (3)	Weighted (4)	Unw. (5)	Weighted (6)
Panel A. Main sample: Considering all potentially optimistic FCEs						
1=(Prop. optimistic FCEs¿0.5)	-0.051	-0.109	-0.051	-0.119	-0.069	-0.198
s.e.	0.070	0.132	0.059	0.099	0.054	0.089
N	447	447	468	468	465	465
1=(Prop. optimistic FCEs⩾ 0.5)	-0.011	-0.013	-0.056	-0.117	-0.055	-0.146
s.e.	0.071	0.136	0.059	0.104	0.054	0.092
N	447	447	468	468	465	465
Prop. optimistic forecast errors	-0.117	-0.133	-0.087	-0.146	-0.048	-0.157
s.e.	0.072	0.139	0.060	0.108	0.054	0.084
N	447	447	468	468	465	465
Panel B. Other sample: Considering only potentially symmetric FCEs						
1=(Prop. optimistic FCEs¿0.5)	-0.080	-0.087	-0.054	-0.091	-0.094	-0.210
s.e.	0.075	0.133	0.065	0.094	0.058	0.085
N	387	387	403	403	402	402
1=(Prop. optimistic FCEs⩾ 0.5)	-0.003	-0.037	-0.079	-0.144	-0.071	-0.141
s.e.	0.076	0.135	0.063	0.095	0.058	0.101
N	387	387	403	403	402	402
Prop. optimistic forecast errors	-0.086	-0.067	-0.070	-0.060	-0.102	-0.193
s.e.	0.075	0.141	0.065	0.102	0.058	0.091
N	387	387	403	403	402	402

▸ back

Pairwise correlations between persistent HtM measures and patience and risk aversion

	Patience		Risk aversion			
	Unw.	Wtd.	Unw.	Wtd.	Unw.	Wtd.
	(1)	(2)	(3)	(4)	(5)	(6)
1=(Severe financial distress)	-0.014	-0.081	0.107	0.029	0.036	0.077
s.e.	(0.057)	(0.143)	(0.042)	(0.091)	(0.049)	(0.123)
N	780	780	818	818	832	832
1=(Low net worth)	-0.025	-0.073	0.057	0.080	0.136	0.032
s.e.	(0.058)	(0.098)	(0.042)	(0.074)	(0.050)	(0.090)
N	734	734	765	765	778	778
1=(paycheck-to-paycheck c. 2012)	0.062	0.377	0.010	0.069	0.048	-0.157
s.e.	(0.100)	(0.167)	(0.073)	(0.164)	(0.088)	(0.311)
N	233	233	256	256	260	260
paycheck-to-paycheck, COVID era	-0.126	-0.014	0.084	0.051	0.130	0.007
s.e.	(0.073)	(0.120)	(0.051)	(0.075)	(0.057)	(0.098)
N	493	493	516	516	519	519
1=(Lacks prec. saving in 2012 & 2018)	-0.218	-0.186	0.114	0.051	0.068	-0.078
s.e.	(0.083)	(0.127)	(0.070)	(0.114)	(0.077)	(0.140)
N	254	254	264	264	269	269
Difficult covering $2k emerg. expenses	-0.154	-0.039	0.136	0.146	0.108	0.133
s.e.	(0.065)	(0.117)	(0.051)	(0.078)	(0.058)	(0.108)
N	462	462	487	487	491	491

▸ back

Correlations between overconfidence and patience and risk aversion

	Patience		Risk Aversion			
	Unwtd.	Weighted	Unwtd.	Weighted	Unwtd.	Weighted
	(1)	(2)	(3)	(4)	(5)	(6)
1=Oc both rounds	0.035	-0.011	-0.082	-0.198	0.164	0.242
s.e.	(0.056)	(0.141)	(0.040)	(0.074)	(0.050)	(0.120)
N	758	758	813	813	807	807
Oc percentile rank	0.001	-0.010	-0.146	-0.315	0.237	0.306
s.e.	(0.066)	(0.118)	(0.049)	(0.079)	(0.056)	(0.116)
N	758	758	813	813	807	807

Notes: Weighted estimates use sampling probability from the last SZ module. Discrete measure of overconfidence defined as exhibiting above-median confidence in relative performance on a fluid intelligence test in both 2014 and 2017. Patience is the average savings rate across 24 convex time budget choices. Risk aversion in Columns (3) and (4) is based on the Dohmen et al. (2010) financial risk-taking scale, and in Columns (5) and (6) on the Barsky et al. (1997) lifetime income gamble elicitation. We use Obviously Related Instrumental Variables to account for measurement error in the column variables, and in overconfidence percentile rank, by using the two measures of each (taken in 2014 and 2017) to instrument for each other (Gillen et al., 2019; Stango and Zinman, 2023).

▸ back

Model Overview

Households:

- incomplete markets, idiosyncratic risk, permanent heterogeneity in cognitive skills

Firms:

- representative firm, flexible prices, produces output Y_t using labor N_t: $Y_t = N_t$

Labor unions:

- sticky wages w_t, all households work same number of hours

Government:

- fiscal policy issues bonds B_t, pays interest R_t and raises taxes T_t: $B_t + T_t = R_t B_{t-1}$
- monetary policy keeps real rate constant: $1 + r_t = R_t = 1 + \bar{r}$

Households

Continuum of infinitely-lived households (permanent heterogeneity denoted by g):

$$V_{g,t}\left(b_{t-1}, e_t\right) = \max_{c_t, b_t} \left\{ \frac{c_t^{1-\gamma}}{1-\gamma} - \frac{n_t^{1+\varphi}}{1+\varphi} + \beta \tilde{\mathbb{E}}_{g,t}\Big[V_{g,t+1}\left(b_t, e_{t+1}\right) \Big] \right\}$$

subject to

$$c_t + \frac{b_t}{1+r_t} = b_{t-1} + (1-\tau_t) w_t \bar{e}_g e_t n_t$$

$$b_t \geqslant -\underline{b},$$

- c_t: consumption, n_t: hours worked, τ_t: taxes, b_t: bonds
- average skill level: $\bar{e}_g$ and idiosyncratic productivity e_t
- beliefs: $\tilde{\mathbb{E}}_{g,t}$ ("overconfidence" or "rational")
- Parameters: γ: relative risk aversion, φ: inverse Frisch elasticity of labor supply, β: time discount factor, $\underline{b}$: borrowing limit

Households

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subject to

$$c_t + \frac{b_t}{1+r_t} = b_{t-1} + (1-\tau_t) w_t \bar{e}_g e_t n_t$$

$$b_t \geqslant -\underline{b},$$

- c_t: consumption, n_t: hours worked, τ_t: taxes, b_t: bonds
- average skill level: $\bar{e}_g$ and idiosyncratic productivity e_t
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- Parameters: γ: relative risk aversion, φ: inverse Frisch elasticity of labor supply, β: time discount factor, $\underline{b}$: borrowing limit

Modelling overconfidence

- Productivity states: $e_1 < e_2 < ... < e_J$
- Transition probabilities: $p_{ij} \equiv p(e_{t+1} = e_j | e_t = e_i)$

Modelling overconfidence

- Productivity states: $e_1 < e_2 < ... < e_J$
- Transition probabilities: $p_{ij} \equiv p(e_{t+1} = e_j | e_t = e_i)$
- Perceived transition probabilities $\tilde{p}_{ij}$:

$$\tilde{p}_{ij} \equiv \begin{cases} \alpha_g p_{ij}, \text{ if } i < j \\ \frac{1}{\alpha_g} p_{ij}, \text{ if } i > j \\ 1 - \sum_{j \neq i} \tilde{p}_{ij}, \text{ if } i = j. \end{cases}$$

- $\alpha_g \geqslant 1$ captures belief accuracy:
  - $\alpha_g \geq 1$: overconfidence $\Rightarrow$ overestimate probability of reaching good states
  - $\alpha_g = 1$: rational

Calibration

Calibrating permanent heterogeneity:

- two groups: 38% low-skilled and overconfident, 62% high-skilled and rational
- $\bar{e}_L = 0.55$ and $\bar{e}_H = 1$ (target relative average incomes of these groups)
- overconfident HHs 1.18 times as likely to overestimate future financial situation
  $\Rightarrow \alpha_L = 2.0$ (and $\alpha_H = 1$)

Calibration

Calibrating permanent heterogeneity:

- two groups: 38% low-skilled and overconfident, 62% high-skilled and rational
- $\bar{e}_L = 0.55$ and $\bar{e}_H = 1$ (target relative average incomes of these groups)
- overconfident HHs 1.18 times as likely to overestimate future financial situation
  $\Rightarrow \alpha_L = 2.0$ (and $\alpha_H = 1$)

Parameter	Description	Value
R	Steady State Real Rate (annualized)	4%
γ	Risk aversion	2
φ	Inverse of Frisch elasticity	2
$\underline{b}$	Borrowing constraint	0
$\frac{\bar{B}}{4\bar{Y}}$	Average wealth to average income	4.1
Idiosyncratic risk		
ρ_e	Persistence of idiosyncratic risk	0.966
σ_e^2	Variance of idiosyncratic risk	0.033

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Model with discount factor heterogeneity

- In theory: model with discount factor heterogeneity can match average MPCs and average wealth if degree of heterogeneity is free parameter
- Yet:
  - models are not equivalent
  - discount factor heterogeneity not supported by data
  - suffer from "missing middle" problem (Kaplan and Violante (2022))
  - fiscal policy implications can differ (e.g. optimal debt level even higher than in rational model)

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Extensions

We consider two extensions:

1. allow for underconfident households
   - data: 11% of consumers are underconfident in both rounds

   $\Rightarrow$ HtM share, average MPC and top 10% wealth share slightly increase (but overall results practically unchanged)

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   - data: 11% of consumers are underconfident in both rounds

   $\Rightarrow$ HtM share, average MPC and top 10% wealth share slightly increase (but overall results practically unchanged)

2. different specification of overconfidence:

$$\tilde{p}_{ij} \equiv \begin{cases} \alpha^{(e_j - e_i)} p_{ij}, & \text{if } i \neq j \\ 1 - \sum_{j \neq i} \tilde{p}_{ij}, & \text{if } i = j. \end{cases}$$

   - average MPC largely unchanged, HtM share somewhat higher

Two-asset model

Introduce second (illiquid) asset k (Kaplan et al., 2018; Bayer et al., 2019; Auclert et al., 2023)

The household's budget constraint now reads:

$$c_t + \frac{b_t}{1+r_t} + k_t = b_{t-1} + (1 + r_t^k)k_{t-1} + (1-\tau_t)w_t \bar{e}_g e_t n_t$$

Asset k can only be adjusted with probability λ

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Calibration targets: total wealth to income, liquid wealth to income, average MPC

Parameter	Description	Value
χ	Capital share	0.318
δ	Depreciation rate	0.0175
λ	Capital market participation rate	0.37
β	Discount factor	0.992

Two-asset model: stationary equilibrium predictions

	2-asset HANK: CS + OC	rational 2-asset HANK	
	(1)	(2)	(3)
		calibrated as (1)	re-calibrated
HtM	0.38	0.23	0.27
Avg. MPC	0.17	0.06	0.15
return gap	2.3%	4.4%	9.3%

- two-asset model with CS + OC matches HtM and MPC estimates
- rational model (with re-calibrated λ) also does well in matching HtM and MPC estimates, but at (unrealistically?) high return gap (Kaplan and Violante, 2022)
- empirical estimates $\approx 5\%$
- our model requires substantially lower return gap (note: no aggregate risk in models $\Rightarrow$ predictions are lower bound)

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