Determinants and Life-Cycle Effects of Survival Ambiguity

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CEPR European Conference on Household Finance
September, 2025

Motivation

- Households' subjective expectations about future events are central to understanding intertemporal decision-making (D'Acunto and Weber, 2024)

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- **Subjective survival beliefs** are important determinants of savings decisions and retirement preparedness (e.g., Heimer et al., 2019; Yakoboski et al., 2023; Foltyn and Olsson, 2024)
- Most economic research assumes that individuals hold **precise subjective probabilities**, though this may often not be the case (Knight 1921; Ellsberg, 1961; Giustinelli et al., 2022)
- No evidence on the extent, determinants or effects of *individual* **uncertainty about subjective survival probabilities**, i.e., "**survival ambiguity**"

The paper in a nutshell

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4. Can we explain this empirical finding? $\rightarrow$ We develop a life-cycle model with survival ambiguity that explains the evidence and quantifies the underlying forces

Survey & Experiment

Measuring Survival Ambiguity

- Ambiguity in (survival) beliefs measured separately from risk and ambiguity preferences (Izhakian, 2020)
- Within-individual survival ambiguity:

$$\begin{aligned}\mho^2[p] &= \int E[\phi(p)]\,Var[\phi(p)]\,dp \\ &= Var[p]\end{aligned}$$

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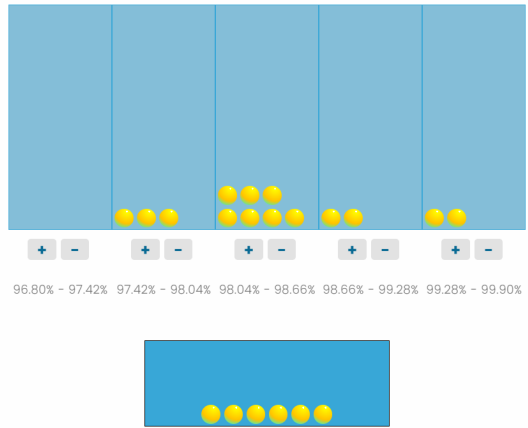
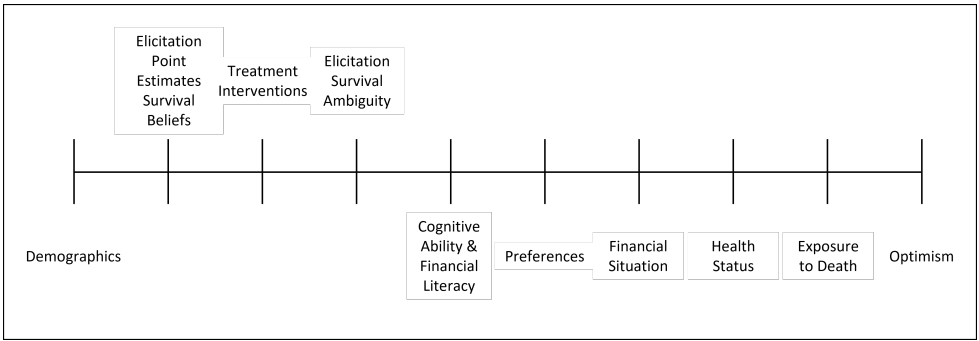
Application: *Bins-and-balls* procedure (Delavande and Rohwedder, 2008)

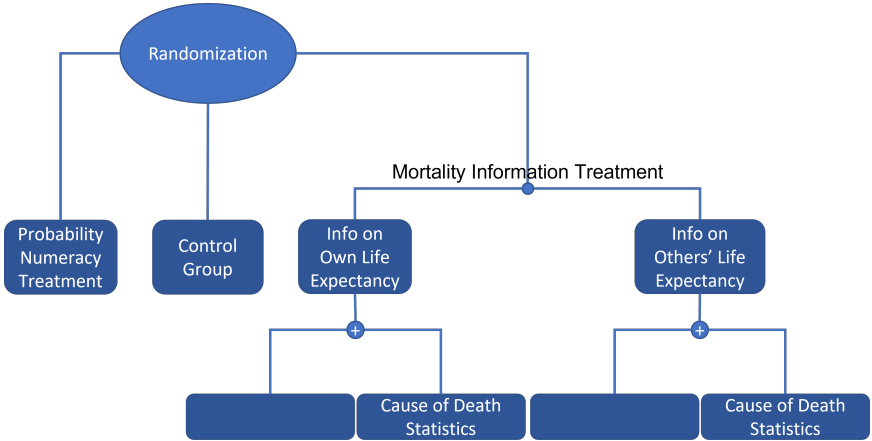


Survey Structure

- Surveyed with Qualtrics Panels between Aug and Oct 2022
- N = 12,833; representing US population wrt. age (20-80), gender, income and ethnicity

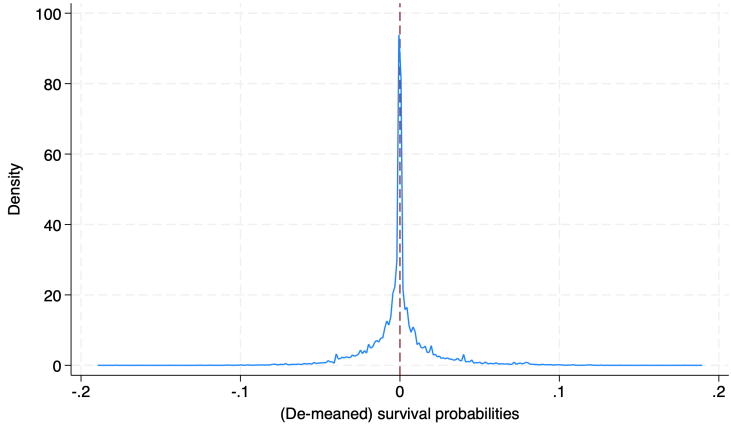


The Treatments



Determinants of Survival Ambiguity

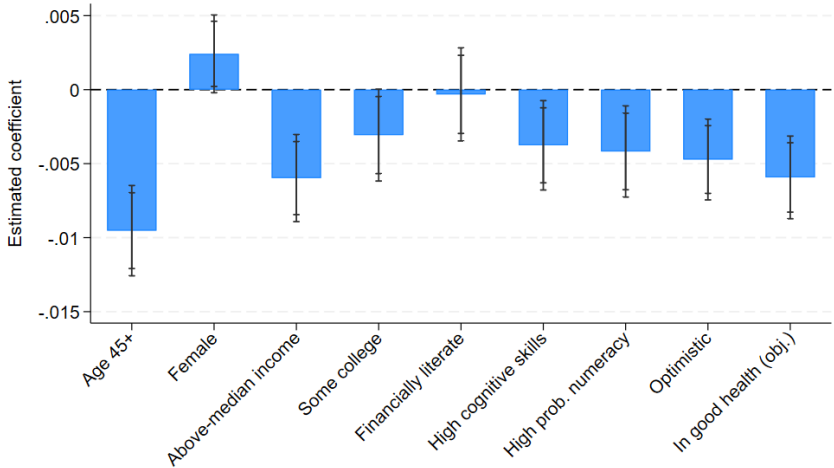
Key facts: Cross-sectional distribution of subjective survival probabilities



- How imprecise are individuals' subjective survival probabilities? On average, they deviate by $\simeq$ 6pp from their own mean probability

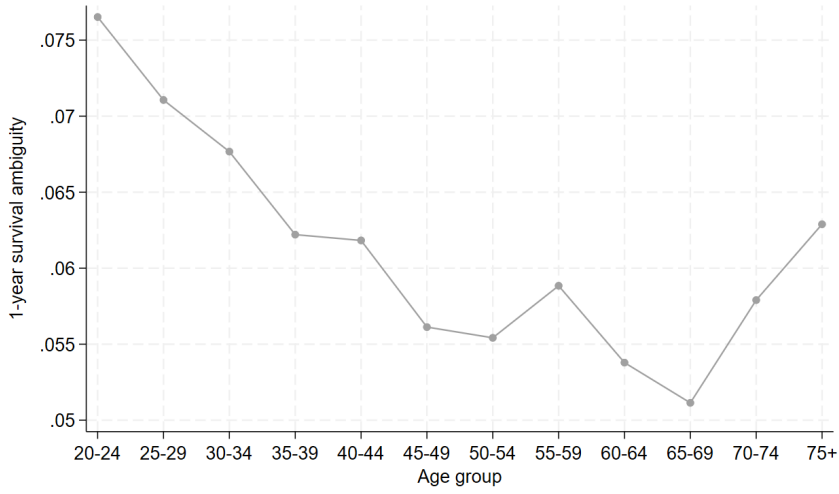
▸ Descriptives SA ▸ Correlation 1-, 2-, 10- year SA ▸ Patterns SA ▸ Density SA

Key facts: Determinants of Survival Ambiguity

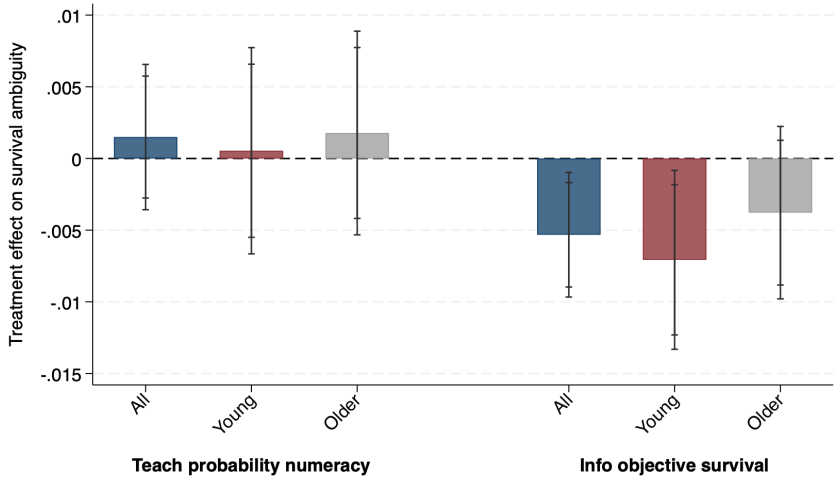


▸ Full reg. results 1-, 2-, 10 year SA ▸ Robustness

Key facts: Survival Ambiguity by Age



Experimental Results



▸ Balance on observables ▸ Joint test ▸ TE own vs. others ▸ TE all

Survival Ambiguity and Savings Decisions

Survival Ambiguity and Savings Decisions

	Savings rate
	(1)
Survival ambiguity	-0.0929***
	(0.0290)
Demographics	Yes
Observations	7,831

Survival Ambiguity and Savings Decisions

	Savings rate	
	(1)	(2)
Survival ambiguity	-0.0929***	-0.0877***
	(0.0290)	(0.0277)
Demographics	Yes	Yes
Health indicators	No	Yes
Observations	7,831	7,793

Survival Ambiguity and Savings Decisions

	Savings rate		
	(1)	(2)	(3)
Survival ambiguity	-0.0929***	-0.0877***	-0.103***
	(0.0290)	(0.0277)	(0.0276)
Demographics	Yes	Yes	Yes
Health indicators	No	Yes	Yes
Sophistication scores	No	No	Yes
Observations	7,831	7,793	7,793

Survival Ambiguity and Savings Decisions

	Savings rate			
	(1)	(2)	(3)	(4)
Survival ambiguity	-0.0929***	-0.0877***	-0.103***	-0.0927***
	(0.0290)	(0.0277)	(0.0276)	(0.0289)
Demographics	Yes	Yes	Yes	Yes
Health indicators	No	Yes	Yes	Yes
Sophistication scores	No	No	Yes	Yes
Life/death experiences	No	No	No	Yes
Observations	7,831	7,793	7,793	7,378

Survival Ambiguity and Savings Decisions

	Savings rate				
	(1)	(2)	(3)	(4)	(5)
Survival ambiguity	-0.0929***	-0.0877***	-0.103***	-0.0927***	-0.0906***
	(0.0290)	(0.0277)	(0.0276)	(0.0289)	(0.0288)
Demographics	Yes	Yes	Yes	Yes	Yes
Health indicators	No	Yes	Yes	Yes	Yes
Sophistication scores	No	No	Yes	Yes	Yes
Life/death experiences	No	No	No	Yes	Yes
Risk factors	No	No	No	No	Yes
Observations	7,831	7,793	7,793	7,378	7,378

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Survival ambiguity	-0.0929***	-0.0877***	-0.103***	-0.0927***	-0.0906***	-0.115***
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Demographics	Yes	Yes	Yes	Yes	Yes	Yes
Health indicators	No	Yes	Yes	Yes	Yes	Yes
Sophistication scores	No	No	Yes	Yes	Yes	Yes
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Risk factors	No	No	No	No	Yes	Yes
Preferences	No	No	No	No	No	Yes
Observations	7,831	7,793	7,793	7,378	7,378	6,760

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- We show omitted variable bias is unlikely to confound the estimated relationships (using Oster, 2019)

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- We show omitted variable bias is unlikely to confound the estimated relationships (using Oster, 2019)
- Robust to using different measures of savings and individual uncertainty about survival probabilities
- Survival ambiguity explains more of the variation in savings than subjective survival probabilities

Select. on Unobs. | Robust. I | Robust. II | Robust. III | Robust. 2-yr SA | Robust. 10-yr SA | Expl. var. | Annuit./LTC

Effect of Survival Ambiguity on Savings by Ambiguity Preference

	Past savings rate		Planned savings rate		Wealth-to-income ratio	
	Ambiguity averse	Not ambiguity averse	Ambiguity averse	Not ambiguity averse	Ambiguity averse	Not ambiguity averse
	(1)	(2)	(3)	(4)	(5)	(6)
Survival ambiguity	-0.106***	-0.068	-0.109***	-0.009	-10.98***	-1.23
	(0.038)	(0.045)	(0.041)	(0.049)	(3.508)	(4.926)
Demographics	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,861	2,970	4,753	2,852	5,433	3,422

Effect of Survival Ambiguity on Savings by Age Groups

	Past savings rate		Planned savings rate		Wealth-to-income ratio	
	< 60	≥ 60	< 60	≥ 60	< 60	≥ 60
	(1)	(2)	(3)	(4)	(5)	(6)
Survival ambiguity	-0.118***	-0.0360	-0.0816**	-0.0318	-7.744**	-5.533
	(0.0373)	(0.0445)	(0.0414)	(0.0466)	(3.245)	(5.874)
Demographics	Yes	Yes	Yes	Yes	Yes	Yes
	5,411	2,420	5,375	2,230	6,147	2,708

A life-cycle model with survival ambiguity

Model overview

- Can we rationalize the empirical evidence on the effects of survival ambiguity on savings behavior?

  $\Rightarrow$ We incorporate survival ambiguity in an otherwise standard state-of-the-art life-cycle model of consumption and portfolio choice (baseline close to Heimer et al., 2019)

- Key novelty: allow for ambiguity in survival beliefs – separately from risk and from ambiguity preferences (drawing from Bommier, 2017, and Izhakian, 2017, 2020)
  - In each period, households have subjective expectations over the distribution of the probability to survive in the next period
  - Households are risk (CRRA) and ambiguity averse (CRAA): ambiguity preferences are defined by preferences over mean-preserving spreads in probabilities

The optimization problem with survival ambiguity

$$
\begin{aligned}
V_t(A_t, X_t) \quad = \quad & \max_{c,\alpha_t} \left\{ u(C_t) + \beta \left[E[p_t] \left(1 + \frac{\Upsilon''(E[P_t])}{\Upsilon'(E[P_t])} Var[p_t] \right) V_{t+1}(A_{t+1}, X_{t+1}) \right. \right. \\
& \left. \left. + E[1-p_t] \left(1 - \frac{\Upsilon''(E[P_t])}{\Upsilon'(E[P_t])} Var[1-p_t] \right) b(A_{t+1}) \right] \right\}
\end{aligned}
$$

$$
E[p_t] = \int \phi(p_t) d\xi \quad \text{and} \quad E[P_t] = \int P_t d\xi
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Var[p_t] = \int \left(\phi(p_t) - E[p_t]^2 \right) d\xi
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- Interpretation: both the extent of ambiguity in survival beliefs and the degree of ambiguity aversion (separately) affect perceived survival chances

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$$\left.\left. + E[1-p_t] \left(1 - \frac{\Upsilon''(E[P_t])}{\Upsilon'(E[P_t])} Var[1-p_t] \right) b(A_{t+1}) \right] \right\}$$

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- Interpretation: both the extent of ambiguity in survival beliefs and the degree of ambiguity aversion (separately) affect perceived survival chances
- Main model implication: an ambiguity averse individual, i.e., ($\frac{\Upsilon''(E[P_t])}{\Upsilon'(E[P_t])} < 0$), with ambiguous survival beliefs, i.e., ($Var[p_t] > 0$), assigns lower weight to their chance of survival
  $\Rightarrow$ greater survival ambiguity induces individuals to save less during the accumulation stage

Model estimation

1. First-step parameters from the data (e.g., earnings process, demographics) or previous estimates in the literature (e.g., coeff. of relative risk aversion, strength bequest motive)
   - Age-profile of subjective survival probabilities $E[P_t]$ and their variance $Var[p_t]$ estimated using the 1-, 2-, and 10-year measures elicited with our survey
2. Estimate discount factor β and coefficient of relative ambiguity aversion ρ using SMM
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	W/out survival ambiguity	With survival ambiguity
β	0.844	0.892
	(0.003)	(0.006)
ρ		3.494
		(0.032)

▸ Est. survival chances w/ and w/out SA

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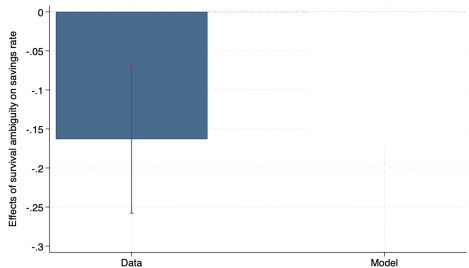

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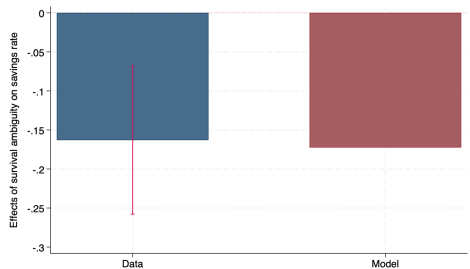
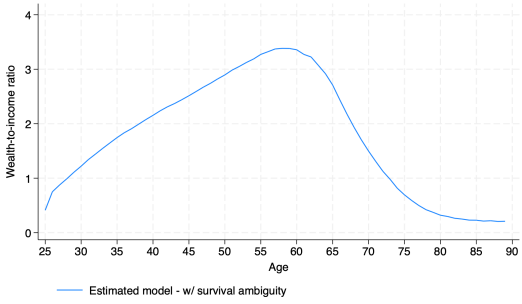
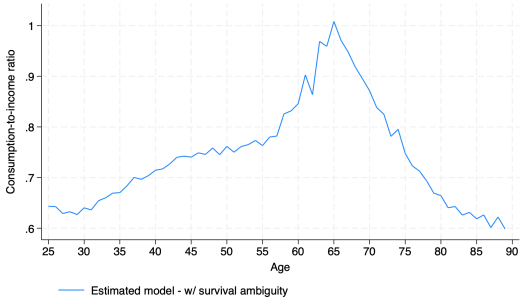


▸ Est. survival chances w/ and w/out SA

Model-predicted effects of survival ambiguity

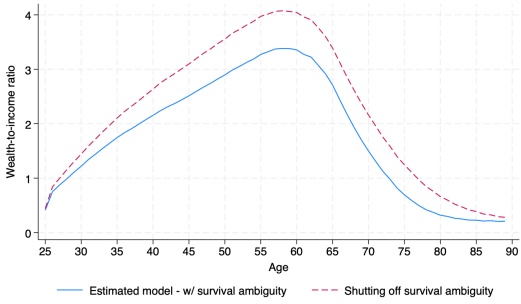


Wealth



Consumption

Model-predicted effects of survival ambiguity



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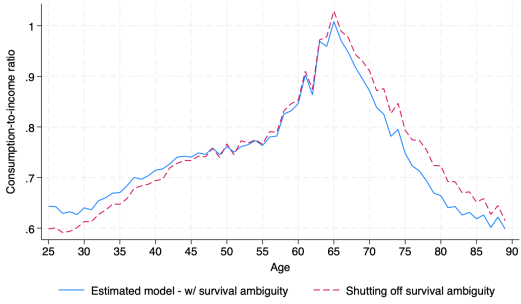

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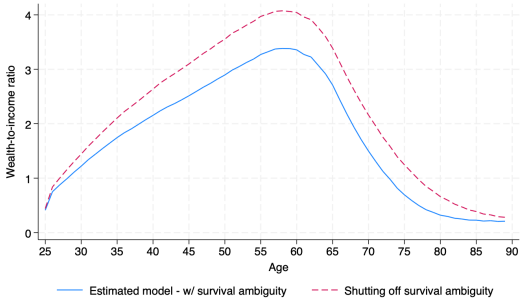
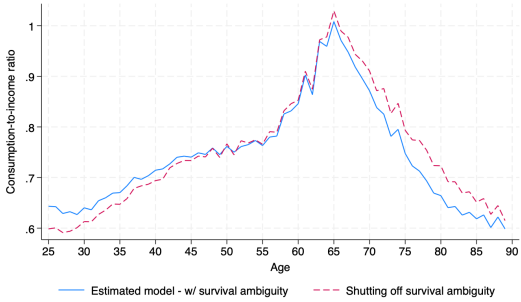
Model-predicted effects of survival ambiguity



Wealth



Consumption

- Model-predicted **policy implications**: a simple **informational intervention** about mortality prospects (decreasing survival ambiguity by 10%) **increases retirement wealth by** $\simeq 4\%$.

Conclusion

Conclusion

- We provide first evidence on the extent of individual survival ambiguity and its patterns over the life-cycle and across sub-groups of the population
- We find that limited knowledge about objective survival prospects is a significant determinant of survival ambiguity, especially among younger individuals
- Survival ambiguity contributes to undersaving among the young and reduces consumption during retirement beyond the effect of subjective survival probabilities
- What have we learned: Survival ambiguity represents a previously unexplored determinant of financial well-being
- Policy implications: Information campaigns about objective survival chances can improve retirement security by reducing individuals' survival ambiguity

Thank You for Your Attention

Respondent Characteristics (1)

	N	Mean	SD	Median
Demographics				
Age	12833	46.313	16.438	45
Female	12833	0.521	0.500	0
Married	12833	0.551	0.497	1
Unemployed	12833	0.206	0.405	0
Retired	12833	0.204	0.403	0
Number of household members	11752	2.751	1.672	2
Number of kids	12267	1.501	1.476	1
Hispanic	12833	0.103	0.304	0
Race: White	12785	0.779	0.415	1
Race: Black or African-American	12785	0.129	0.335	0
Race: American Indian or Alaska Native	12785	0.012	0.110	0
Race: Asian	12785	0.045	0.207	0
Race: Native Hawaiian or Pacific Islander	12785	0.003	0.057	0
Race: Other	12785	0.031	0.175	0
Optimism	12833	2.195	0.803	2.1667

Respondent Characteristics (2)

	N	Mean	SD	Median
Education				
Primary school or high school	12767	0.344	0.475	0
College	12767	0.232	0.422	0
Bachelor	12767	0.228	0.419	0
Master or PhD	12767	0.196	0.397	0
Financials				
Household income	12100	80270.893	265076.672	50000
(Log) Household income	12100	10.426	1.922	10.8198
Past Saving rate	9282	0.206	0.245	.1
Planned Saving rate	9124	0.259	0.249	.2
Wealth-to-income ratio	10750	193.069	9807.138	1.1333
Political Orientation				
Democrat	12091	0.460	0.498	0
Republican	12091	0.320	0.466	0
Other	12091	0.220	0.414	0

Respondent Characteristics (3)

	N	Mean	SD	Median
Sophistication				
Financial literacy score	12833	1.715	1.056	2
Cognitive ability score	12833	0.373	0.737	0
Probability numeracy score	12833	1.906	1.299	2
Mortality probability numeracy	12833	0.696	0.460	1
Has studied economics or finance in high school	12264	0.427	0.495	0
Preferences				
Subjective risk aversion: 1	11322	0.239	0.427	0
Subjective risk aversion: 2	11322	0.237	0.425	0
Subjective risk aversion: 3	11322	0.359	0.480	0
Subjective risk aversion: 4	11322	0.165	0.371	0
Patience: Very Patient	12222	0.212	0.409	0
Patience: Patient	12222	0.507	0.500	1
Patience: Impatient	12222	0.201	0.401	0
Patience: Very Impatient	12222	0.080	0.272	0
Ambiguity averse	12833	0.592	0.491	1
Ambiguity neutral	12833	0.169	0.375	0
Ambiguity seeking	12833	0.239	0.427	0

Descriptive statistics of subjective survival probabilities and survival ambiguity

	N	Mean	SD	Median
Subjective one year survival probability	12833	87.233	19.832	98.4
Subjective two year survival probability	12833	86.242	20.173	96.3
Subjective ten year survival probability	12833	78.263	24.856	86.5
One year survival ambiguity	12805	0.062	0.070	.0343475
Two year survival ambiguity	12814	0.060	0.067	.0333067
Ten year survival ambiguity	12812	0.064	0.065	.0428836

Back to Back

Correlation matrix for 1-year, 2-year and 10-year survival ambiguity

	1-year survival ambiguity	2-year survival ambiguity	10-year survival ambiguity
1-year survival ambiguity	1.00		
2-year survival ambiguity	0.73	1.00	
10-year survival ambiguity	0.61	0.73	1.00
N	12,795		

Back to Back

Respondent Health Characteristics (1)

	N	Mean	SD	Median
Subjective health state				
Excellent	12645	0.181	0.385	0
Very good	12645	0.282	0.450	0
Fair	12645	0.177	0.382	0
Poor	12645	0.048	0.213	0
Health related behavior				
Currently smoking: yes	12627	0.301	0.459	0
Ever smoked: yes	12557	0.530	0.499	1
BMI				
Underweight	12833	0.057	0.233	0
Normal	12833	0.171	0.377	0
Overweight	12833	0.320	0.466	0
Obese	12833	0.452	0.498	0

Respondent Health Characteristics (2)

	N	Mean	SD	Median
Diagnoses				
High blood pressure	12833	0.286	0.452	0
Hypertension	12833	0.132	0.338	0
Diabetes	12833	0.146	0.353	0
High blood sugar	12833	0.079	0.269	0
Cancer	12833	0.042	0.201	0
Lung disease	12833	0.043	0.203	0
Heart issue	12833	0.064	0.245	0
Stroke	12833	0.026	0.160	0
Psychiatric problems	12833	0.132	0.338	0
Depression	12833	0.184	0.387	0
Alzheimer	12833	0.005	0.073	0
Dementia	12833	0.009	0.095	0
Arthritis	12833	0.142	0.349	0
Weakened immune system	12833	0.052	0.222	0
Cholesterol	12833	0.143	0.350	0
Osteoporosis	12833	0.038	0.191	0
Other	12833	0.098	0.297	0
Good health (obj)	12833	0.372	0.483	0

Respondent Health Characteristics (2)

	N	Mean	SD	Median
Health related experiences				
Mother alive	12472	0.602	0.490	1
Father alive	12240	0.499	0.500	0
Grandmother alive	12367	0.224	0.417	0
Grandfather alive	11939	0.206	0.405	0

Determinants of (1-Year, 2-Year, and 10-Year) Survival Ambiguity

	(1)		(2)		(3)	
	1-Year survival ambiguity		2-Year survival ambiguity		10-Year survival ambiguity	
1-Year survival probability	-0.000***	(0.000)				
2-Year survival probability			-0.000***	(0.000)		
3-Year survival probability					-0.000***	(0.000)
Age 45+	-0.010***	(0.002)	-0.008***	(0.002)	-0.009***	(0.001)
Female	0.002	(0.001)	0.004**	(0.001)	0.003*	(0.001)
Above-median income	-0.006***	(0.002)	-0.004**	(0.001)	-0.003*	(0.001)
Some college	-0.003	(0.002)	-0.004**	(0.002)	-0.002	(0.001)
Financially literate	-0.000	(0.002)	0.001	(0.002)	0.004*	(0.001)
High cognitive skills	-0.004*	(0.002)	-0.002	(0.001)	0.002	(0.001)
High prob. numeracy	-0.004**	(0.002)	-0.001	(0.001)	0.002	(0.001)
High mortality prob. numeracy	-0.002	(0.002)	-0.001	(0.001)	-0.002	(0.001)
Optimistic	-0.005***	(0.001)	-0.004***	(0.001)	-0.004***	(0.001)
In good health (subj.)	-0.002	(0.002)	-0.000	(0.002)	0.000	(0.002)
In good health (obj.)	-0.006***	(0.001)	-0.006***	(0.001)	-0.008***	(0.001)
Hispanic	-0.004	(0.002)	-0.000	(0.002)	-0.002	(0.002)
Race: White	0.002	(0.002)	0.002	(0.002)	0.002	(0.002)
Race: Black or Afr.-Americ.	0.004	(0.003)	0.004	(0.003)	0.000	(0.003)
Married	-0.001	(0.002)	-0.002	(0.001)	-0.003*	(0.001)
Number of HH members	0.000	(0.000)	0.001	(0.000)	0.001	(0.000)
Number of kids	0.000	(0.000)	-0.000	(0.000)	0.000	(0.000)
Retired	0.003	(0.002)	0.002	(0.002)	-0.001	(0.002)
Unemployed	-0.001	(0.002)	-0.002	(0.002)	-0.001	(0.002)
Region	X		X		X	
Constant	0.083***	(0.008)	0.076***	(0.009)	0.082***	(0.016)
N	11,037		11,046		11,043	
r2	0.036		0.028		0.022	

Back to Back

T-tests for Test of Random Allocation to Treatment Arms

	(1) Baseline vs. Treatment 2	(2) Baseline vs. Treatment 3	(3) Baseline vs. Treatment 4	(4) Baseline vs. Treatment 5	(5) Baseline vs. Treatment 6
Female	0.0172	-0.00390	0.0207	-0.0123	-0.00518
	(1.36)	(-0.25)	(1.36)	(-0.81)	(-0.34)
Age	0.635	0.112	0.882*	0.197	-0.0225
	(1.52)	(0.22)	(1.75)	(0.39)	(-0.04)
Race: White	0.00660	0.0111	-0.00718	-0.0145	-0.0153
	(0.62)	(0.86)	(-0.57)	(-1.15)	(-1.22)
Race: Black or African-American	-0.00227	0.00491	0.00278	0.0187*	0.00414
	(-0.26)	(0.47)	(0.27)	(1.85)	(0.40)
Race: American Indian or Alaska Native	-0.00326	0.00130	0.00143	-0.000784	0.000978
	(-1.11)	(0.39)	(0.44)	(-0.23)	(0.30)
Race: Asian	0.000179	-0.0184***	0.00399	-0.00490	0.00884
	(0.03)	(-2.75)	(0.65)	(-0.78)	(1.47)
Race: Native Hawaiian or Pacific Islander	-0.000566	0.000419	0.000457	0.000519	0.00172
	(-0.36)	(0.23)	(0.26)	(0.29)	(1.04)

Back to Back

Logit Regressions for Test of Random Allocation to Treatment Arms

	(1) Control	(2) Treatment 1	(3) Treatment 2	(4) Treatment 3	(5) Treatment 4	(6) Treatment 5
Female	0.0260	-0.0738	0.0462	-0.0853	0.0730	0.0463
	(0.63)	(-1.79)	(0.86)	(-1.60)	(1.38)	(0.87)
Age	0.00178	-0.00148	0.00143	-0.00309	0.000175	0.000993
	(1.37)	(-1.14)	(0.85)	(-1.84)	(0.11)	(0.60)
Race: White	-0.0135	-0.0209	-0.00332	-0.00665	0.0632	0.00421
	(-0.11)	(-0.18)	(-0.02)	(-0.04)	(0.41)	(0.03)
Race: Black or African-American	0.0424	0.0334	0.0178	-0.0434	-0.0955	-0.0112
	(0.33)	(0.26)	(0.10)	(-0.26)	(-0.56)	(-0.07)
Race: American Indian or Alaska Native	-0.0427	0.266	-0.144	-0.225	0.0755	-0.147
	(-0.19)	(1.28)	(-0.48)	(-0.76)	(0.27)	(-0.50)
Race: Asian	-0.0340	-0.0619	0.408*	-0.180	0.138	-0.296
	(-0.22)	(-0.41)	(2.17)	(-0.91)	(0.71)	(-1.45)
Race: Native Hawaiian or Pacific Islander	0.111	0.292	-0.0271	-0.117	-0.0544	-0.659
	(0.30)	(0.83)	(-0.05)	(-0.23)	(-0.11)	(-1.07)
Constant	-1.227***	-0.996***	-2.054***	-1.723***	-1.999***	-1.970***
	(-9.49)	(-7.81)	(-12.17)	(-10.53)	(-11.96)	(-11.95)
N	12785	12785	12785	12785	12785	12785
chi2	2.813	9.242	13.19	7.423	6.573	7.852

Back to Back

Test for Selection on Unobservables in Savings regressions

	Panel A: Past savings rate					
	(1)	(2)	(3)	(4)	(5)	(6)
Survival ambiguity coef.	-0.0953	-0.0946	-0.1176	-0.1158	-0.1126	-0.1152
δ		30.69	-3.618	-4.583	-5.946	-6.152
R^2	0.2752	0.3406	0.3669	0.3755	0.3800	0.3887
Observations	6,760	6,760	6,760	6,760	6,760	6,760

	Panel B: Planned savings rate					
	(1)	(2)	(3)	(4)	(5)	(6)
Survival ambiguity coef.	-0.0605	-0.0628	-0.0870	-0.0866	-0.0831	-0.0889
δ		-2.1672	-1.5057	-1.742	-2.100	-2.322
R^2	0.2918	0.3450	0.3717	0.3791	0.3852	0.3970
Observations	6,616	6,616	6,616	6,616	6,616	6,616

Back to Back

Effect of Survival Ambiguity on Savings (Past Savings Rate, Planned Savings Rate, and Wealth-to-Income Ratio)

	Past savings rate		Planned savings rate		Wealth-to-income ratio	
	(1)	(2)	(3)	(4)	(5)	(6)
Survival ambiguity	-0.0928***		-0.0671**		-7.141**	
	(0.0290)		(0.0317)		(2.949)	
CV SA		-0.0523***		-0.0438**		-3.652**
		(0.0158)		(0.0172)		(1.543)
Demographics	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,831	7,831	7,605	7,605	8,855	8,855

Back to Back

Effect of 2-Year Survival Ambiguity on Savings

	Savings as share of household income					
	(1)	(2)	(3)	(4)	(5)	(6)
2-Year survival ambiguity	-0.0811***	-0.0737**	-0.0782***	-0.0735**	-0.0737**	-0.0957***
	(0.0308)	(0.0294)	(0.0293)	(0.0307)	(0.0308)	(0.0320)
Demographics	Yes	Yes	Yes	Yes	Yes	Yes
Health indicators	No	Yes	Yes	Yes	Yes	Yes
Sophistication scores	No	No	Yes	Yes	Yes	Yes
Life/death experiences	No	No	No	Yes	Yes	Yes
Risk factors	No	No	No	No	Yes	Yes
Preferences	No	No	No	No	No	Yes
Observations	7,836	7,798	7,798	7,383	7,383	6,764

Back to Back

Effect of 10-Year Survival Ambiguity on Savings

	Savings as share of household income					
	(1)	(2)	(3)	(4)	(5)	(6)
10-Year survival ambiguity	-0.128***	-0.0979***	-0.0898***	-0.0783**	-0.0742**	-0.0915***
	(0.0325)	(0.0311)	(0.0307)	(0.0320)	(0.0322)	(0.0337)
Demographics	Yes	Yes	Yes	Yes	Yes	Yes
Health indicators	No	Yes	Yes	Yes	Yes	Yes
Sophistication scores	No	No	Yes	Yes	Yes	Yes
Life/death experiences	No	No	No	Yes	Yes	Yes
Risk factors	No	No	No	No	Yes	Yes
Preferences	No	No	No	No	No	Yes
Observations	7,837	7,799	7,799	7,384	7,384	6,765

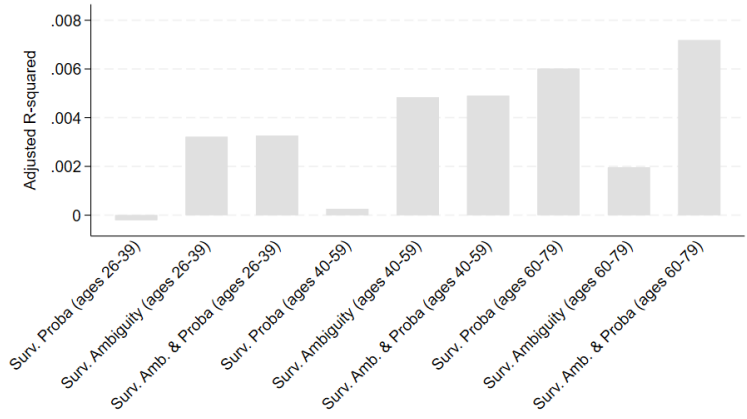
Back to Back

Effect of Survival Ambiguity on Annuities and Long-Term Care Insurance

	(1) Annuity	(2) Annuity	(3) Annuity	(4) LTC	(5) LTC	(6) LTC
Survival ambiguity	-29492.6***	-18612.2**	-16430.8	-7665.1	-108.2	1801.4
	(7891.4)	(8896.4)	(11159.3)	(6836.6)	(7870.0)	(9259.0)
1-Year survival probability		79.44***	32.06		36.76**	38.07*
		(22.49)	(29.89)		(17.66)	(19.80)
Demographics	No	Yes	Yes	No	Yes	Yes
Health indicators	No	No	Yes	No	No	Yes
Sophistication scores	No	No	Yes	No	No	Yes
Life/death experiences	No	No	Yes	No	No	Yes
Risk factors	No	No	Yes	No	No	Yes
Preferences	No	No	Yes	No	No	Yes
Observations	11,399	9,875	8,206	11,399	9,875	8,206

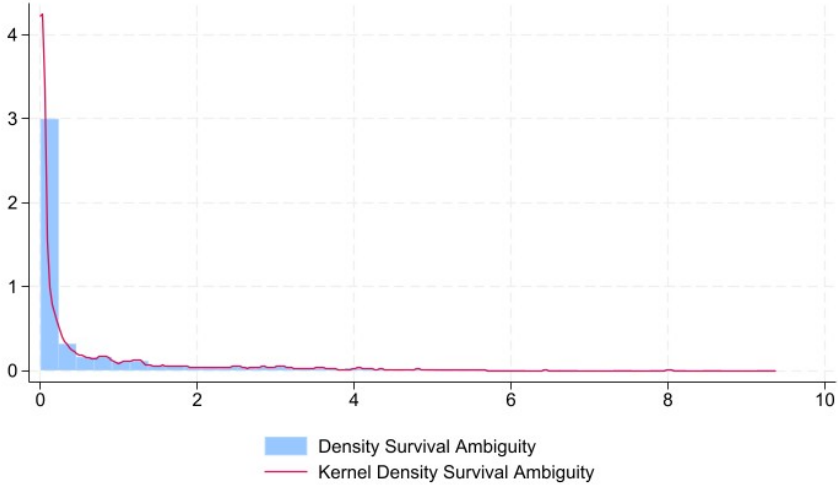
Back to Back

Comparison of R-squared Across Regression Models of Savings Rate



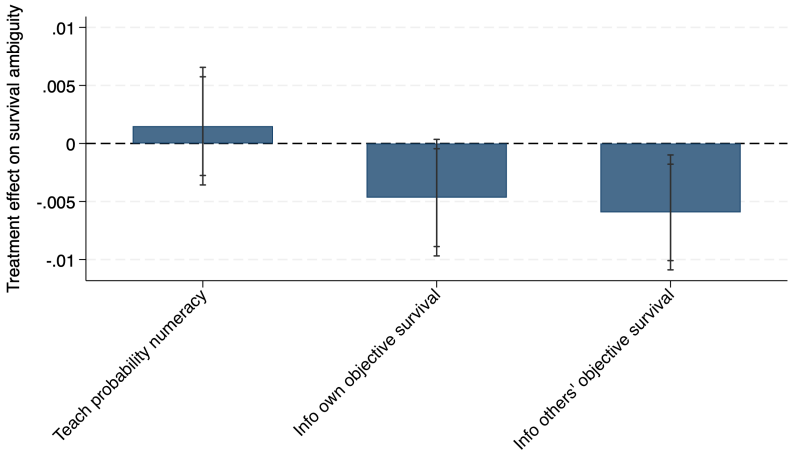
Back to Back

Kernel Density



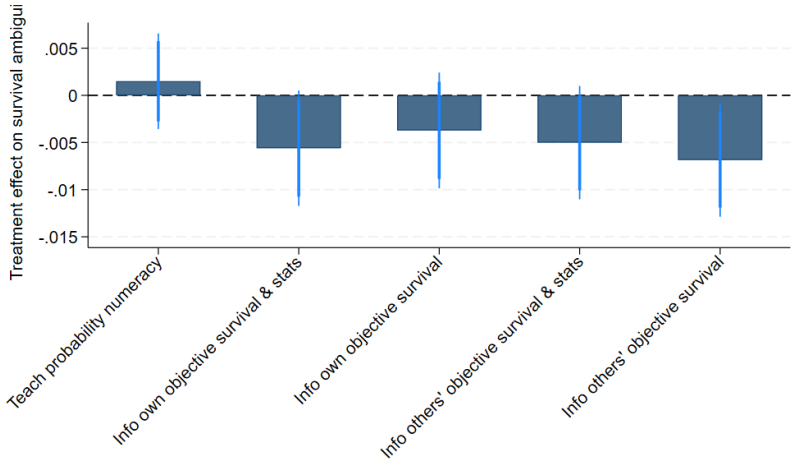
Back to Back

Treatment Effects for 4 groups



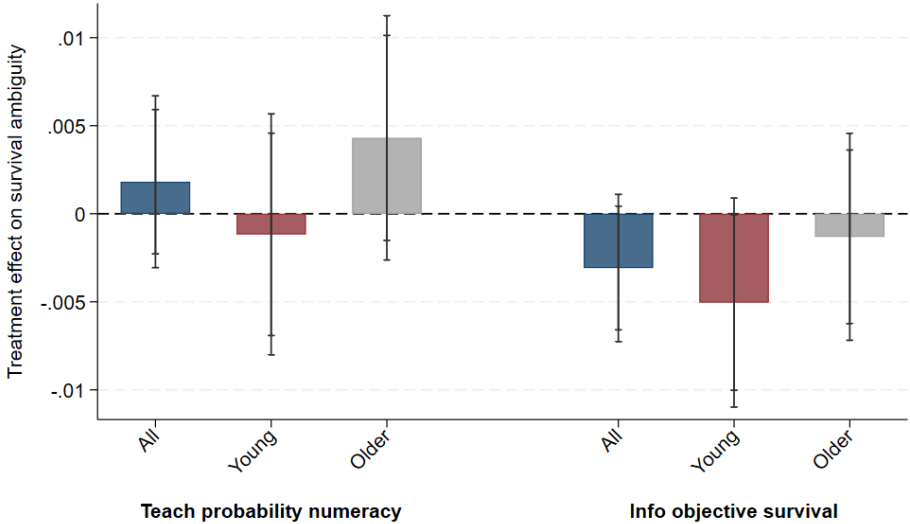
Back to Back

Treatment Effects for 6 groups

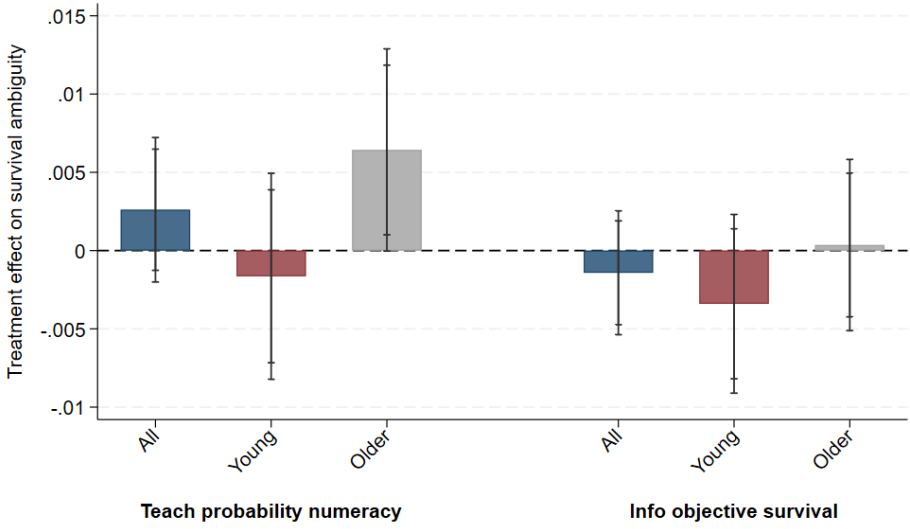


Back to Back

Treatment Effects on 2-Year Survival Ambiguity



Treatment Effects on 10-Year Survival Ambiguity



Participants' compensation

All participants received a baseline compensation for responding to the entire survey. No individual question was incentivized. We paid $43,828 Euro to Qualtrics for data collection, quality checks including attention filters and survey timings as well as participants' compensation. When we inquired about the amount of individual compensation, we received the following response: "Respondents are reimbursed by the specific partner that we use for this project. Respondents will receive an incentive based on the length of the survey, their specific panelist profile, and target acquisition difficulty, amongst other factors. The specific type of rewards vary and may include cash, airline miles, gift cards, redeemable points, and vouchers, all rewards are in line with the US State minimum wage. All our panels are part of ESOMAR, MRS and other internationally recognised bodies and incentives are in line with best practice."

Data collection and randomization

The survey was fielded in two waves. As part of the data collection process, Qualtrics was responsible for the random assignment of participants into the treatment group. After the initial fielding with 6,930 respondents in August 2022 (wave 1), we could not confirm the allocation of participants in the treatment group was random. Therefore, we revisited the randomization algorithm together with the Qualtrics team and re-fielded the survey with 5,903 participants in October 2022 (wave 2). Since the issue with the randomization algorithm is only relevant for the analysis of the experimental module, we use both waves (12,833 participants) for the non-experimental analyses of determinants of survival ambiguity as well as the analyses of the relationship between survival ambiguity and savings behavior. The analyses of the experimental module is based on wave 2, for which we can confirm that the random allocation into the treatment group was implemented correctly (see Table **??**).

Patterns in the distributions of subjective 1-year survival probabilities

Pattern	N	Definition
AllMin	364	equals 1 if all mass is in the lowest interval
AllMax	1,947	equals 1 if all mass is in the highest interval
Bimodal 1 ("Schroedinger's cat")	161	equals 1 if all mass in lowest and highest interval
Bimodal 2	1,150	equals 1 if there is more mass in the 1st or the 2nd interval than in the 3rd interval and there is more mass in the 4th or the 5th interval than in the 3rd interval
Bimodal 3	1,501	equals 1 if the average mass per interval is higher in intervals 1 and 2 than in interval 3 and the average mass per interval is higher in interval 4 and 5 than in interval 3

Back to Back

Determinants of Survival Ambiguity

	Survival Ambiguity					
	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample	Allmin	Allmax	Bimodal 1	Bimodal 2	Bimodal 3
1-Year survival probability	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age 45+	-0.010***	-0.009***	-0.009***	-0.009***	-0.008***	-0.008***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Female	0.002	0.002	0.003	0.002	0.003*	0.003
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Above-median income	-0.006***	-0.006***	-0.008***	-0.006***	-0.005***	-0.006***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Some college	-0.003	-0.003	-0.005*	-0.003	-0.003	-0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Financially literate	-0.000	-0.001	-0.002	0.000	0.000	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
High cognitive skills	-0.004*	-0.004**	-0.006**	-0.004*	-0.003	-0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
High prob. numeracy	-0.004**	-0.005**	-0.003	-0.005**	-0.004*	-0.004*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
High mortality prob. numeracy	-0.002	-0.002	-0.001	-0.002	-0.000	-0.000
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Optimistic	-0.005***	-0.005***	-0.003*	-0.004**	-0.004**	-0.004**
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
In good health (subj.)	-0.002	-0.003	-0.001	-0.001	-0.002	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
In good health (obj.)	-0.006***	-0.006***	-0.005**	-0.006***	-0.005***	-0.005***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
N	11,037	10,728	9,364	10,892	10,130	9,808
r2	0.036	0.038	0.035	0.037	0.033	0.032

Back to Back

Effect of Survival Ambiguity on Savings

	Savings as share of household income	
	(1)	(2)
	Full Sample	Full Sample Excluding All Patterns
Survival ambiguity	-0.110***	-0.221***
	(0.0313)	(0.0367)
Controls	Yes	Yes
Observations	9,057	6,361

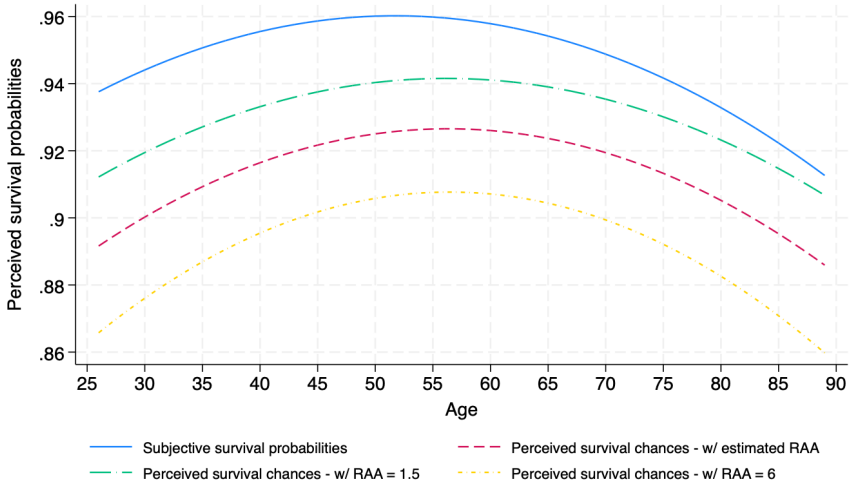
Back to Back

Effect of Survival Ambiguity on Savings

	Savings as share of household income					
	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample	Allmin	Allmax	Bimodal 1	Bimodal 2	Bimodal 3
Survival ambiguity	-0.0920***	-0.113***	-0.147***	-0.0917***	-0.108***	-0.110***
	(0.0312)	(0.0316)	(0.0325)	(0.0320)	(0.0337)	(0.0343)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,057	8,824	7,724	8,942	8,304	8,035

Back to Back

Estimated perceived survival chances with and without survival ambiguity



Back to Back