Subjective Survival Beliefs, Cognitive Skills and Investments in Risky Assets

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Motivation

The stock-holding puzzle is a well-known problem in economics.

Economists attempt to explain it by proposing different solutions, like participation costs (Vissing-Jorgensen (2002)), financial literacy (Van Rooij, Lusardi and Alessie (2011)) or behavioral approaches.

A less explored explanation is the time horizon (Spaenjers and Spira (2015)): stock returns follow a mean reverting process, i.e., they are safer in the long term but may display negative results in short periods.

In this paper, we investigate individual self-perceived life expectancy as another possible explanation of the stock-holding puzzle and study how it relates to financial literacy.

Contribution

We combine a reduced-form analysis and a structural life-cycle model:

Step 1 we document the role of survival believes on the decision to invest in risky assets, keeping constant cognitive abilities (as a proxy for financial literacy)

Step 2 we do a mediation analysis exercise to assess the portion of cognitive skills' effect on financial market participation driven by survival beliefs

Step 3 we calibrate a structural life-cycle model to disentangle the **direct (entry costs)** and **indirect (survival beliefs)** effects of cognitive skills on stock market participation and to quantify the role of inaccurate life expectations

Data

We use data from the English Longitudinal Study on Ageing (ELSA), a biennial longitudinal study about English people aged 50+.

ELSA respondents answer to the following - subjective survival believes - questions:

What are the chances that you will live to be ..X.. or more?

where X is a specific *target age* that depends on respondents current age as follow

Age	Target Age
≤ 65	75
66 - 69	80
70 - 74	85
75 - 79	90
80 - 84	95
85 - 90	100

Variables of interest

- *participation* is one if the household holds risky assets and zero otherwise. Risky assets include shares, bonds, stocks and shares ISAs or life insurance ISAs
- *cognitive skills* obtained by applying PCA to a set of indicators including memory tests, numeracy tests and financial literacy questions
- *(in)accuracy* of subjective survival probability

Variables of interest - Inaccuracy

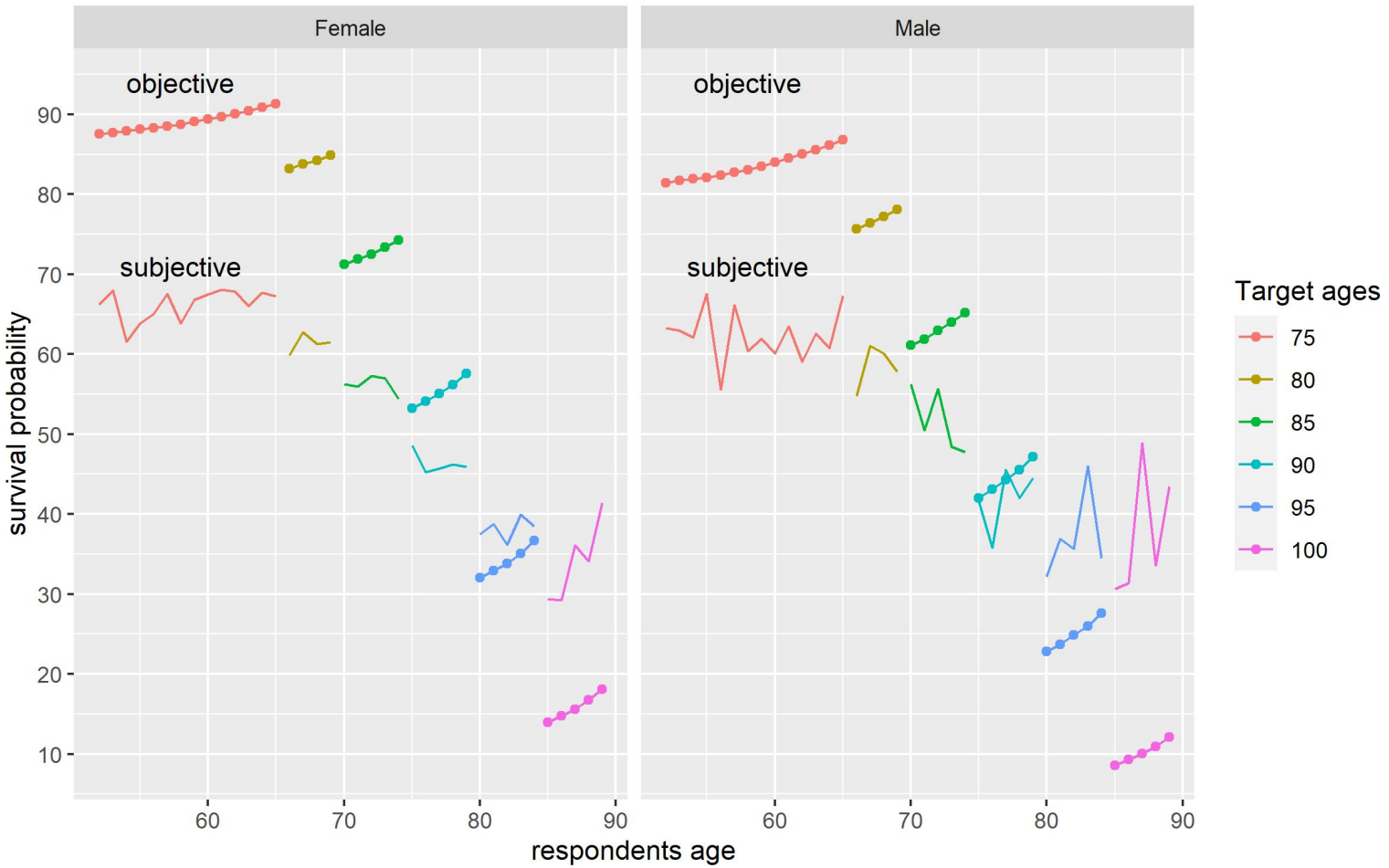
We define

$$
\begin{aligned}
accuracy &= \begin{cases} \frac{subjective_i}{objective_i} & \text{if } \frac{subjective_i}{objective_i} < 1 \\ 1 & \text{if } \frac{subjective_i}{objective_i} \geq 1 \end{cases} \\
inaccuracy &= \frac{1 - accuracy}{\sigma_{accuracy}}
\end{aligned} \tag{1}
$$

inaccuracy captures the degree of respondents' underestimation of survival beliefs, comparing their answers to the ONS objective survival tables.

Survival expectation

Figure: Subjective and objective survival probabilities by target age and gender. ELSA waves 6, 7 and 8 and ONS life tables 2012, 2014 and 2016.



Participation

Table: Sample descriptive statistics by Participation

	All	Non Stockholders	Stockholders
females	50,5%	58,8%	45,1%
age	69,2	69,3	69,1
couples	60,0%	47,0%	68,4%
low edu	35,9%	50,1%	26,8%
mid edu	42,4%	38,3%	45,1%
high edu	21,7%	11,6%	28,2%
Income (weekly)	£ 389,9	£ 280,4	£ 474,4
cognition (mean)	0,137	-0,328	0,436
cognition (sd)	1,457	1,509	1,340
inaccuracy (mean)	0,841	1,000	0,740
inaccuracy (sd)	1,000	1,094	0,920
n Obs	4288	1676	2612

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Inaccuracy & Participation

We estimate the following regression:

$$participation_i = \alpha_0 + \alpha_1 inaccuracy_i + \alpha_2 cogn\_skills_i + \beta' X + e$$

where X are demographic controls including a 2^{nd} order age polynomial, gender, hh type (single or couple), presence of child(ren) in the hh, income quartiles, education, employment status and a health measure.

	Dependent variable: Participation	
	inaccuracy	cogn skills
	(1)	(2)
inaccuracy	-0.029***	-0.024***
	(0.007)	(0.007)
cogn skills		0.048***
		(0.005)
controls	*yes*	*yes*
Observations	4,288	4,288

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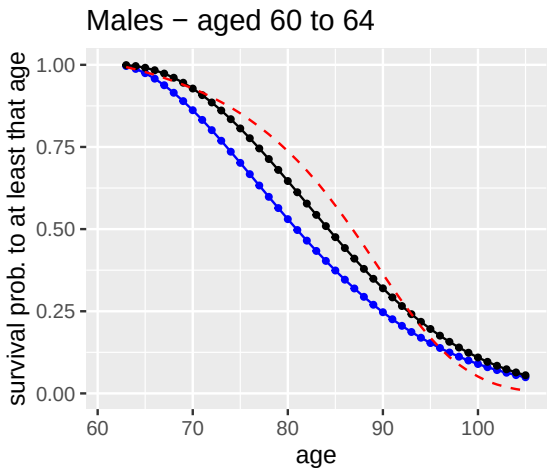
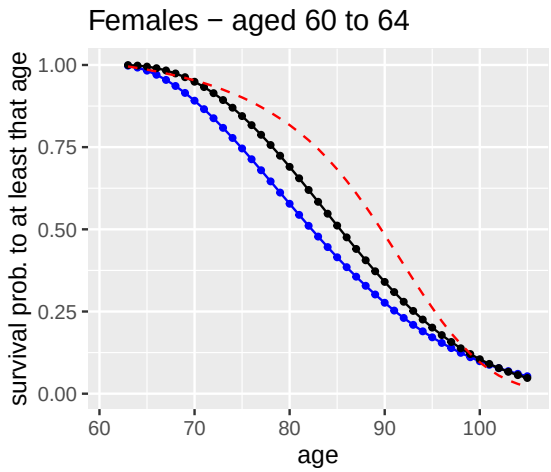
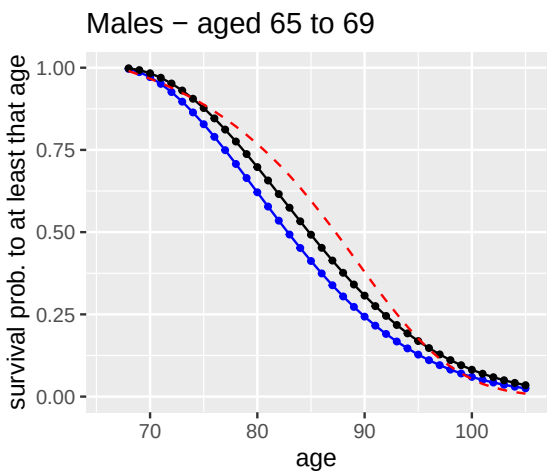
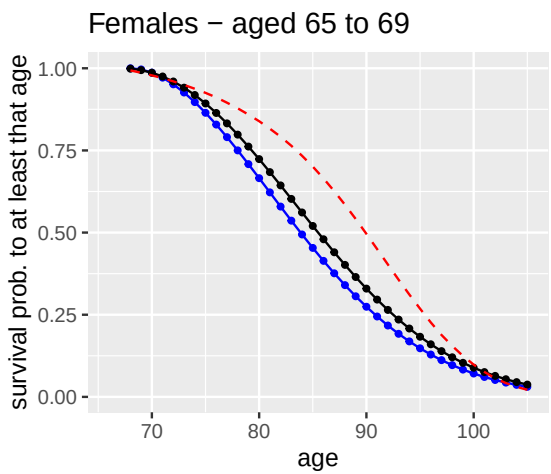
Cognitive skills & Survival expectation









Blue line: low cognitive skills (1^{st} tercile). **Black line**: high cognitive skills ($> 1^{st}$ tercile). **Red line**: ONS life tables.

Cognitive skills & Survival expectation

The correlation between cognitive skills and *inaccuracy* is statistically significant even after controlling for other potential confounding factors.

	Dependent variable: Inaccuracy
cogn skills	-0.064***
	(0.012)
disp opt	-0.289***
	(0.035)
controls	*yes*
Observations	4,288

Note

The effect of *inaccuracy* may be driven by potential confounding factors, like cognitive skills and dispositional optimism (Grevenbrock, Groneck, Ludwig and Zimper (2021))

Both cognitive skills and dispositional optimism contribute to the formation of survival expectations. We are going to focus on the former and we provide evidence that dispositional optimism does not systematically vary across cognitive skills levels.

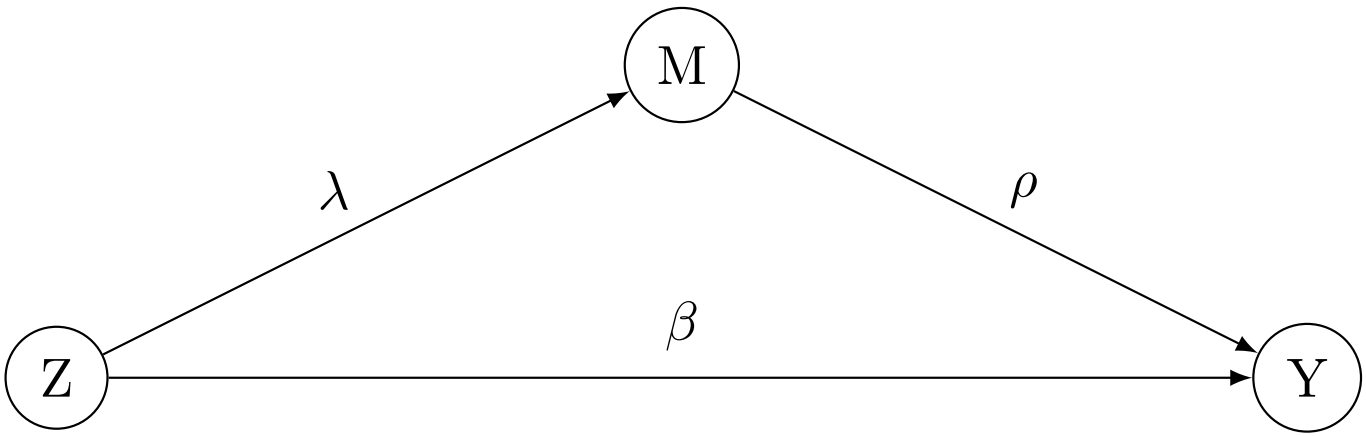
▸ Disp Optimism

Mediation analysis

Cognitive skills may affect *participation* through two channels:

- direct effect of cognition (participation costs)
- indirect effect through inaccuracy of survival beliefs

We use a mediation analysis approach to investigate how much of the effect of cognitive skills on participation (β) is driven by inaccuracy ($\lambda \cdot \rho$).



▸ Mediation

Mediation analysis

The fraction of β explained by *inaccuracy* is therefore $\frac{\rho\lambda}{\beta}$.

We obtain a 95% bootstrapped confidence interval for $\frac{\hat{\rho}\hat{\lambda}}{\hat{\beta}}$ equal to (0.01,0.051). Thus, about 3% of *cognitive skills* effect on participation is due to *inaccuracy*.

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Life Cycle Model

Main features:

- two types of assets (risky and non risky)
- two types of agents (high and low cognitive skills)
- subjective survival probabilities → heterogeneous by gender and cognitive type
- financial market participation costs → heterogeneous by cognitive type
- uncertainty in pre-retirement income

Life Cycle Model

$$\max_{c_t, s_t} E_t \left[\sum_{t=50}^{100} \beta^t S_t \frac{c_t^{1-\gamma}}{1-\gamma} \right]$$

subject to:

- budget constraint:

$$c_{t+1} + s_{t+1} + a_{t+1} + k^f(I_{t+1}, I_t) = (1 + r^s_{t+1})s_t + (1 + r)a_t + y_{t+1}$$

- borrowing and short-sale constraints:$a_t \geq 0$ and $s_t \geq 0$

where,

- S_t represents subjective survival probabilities
- s_t and a_t are amounts of wealth invested in risky and risk-free asset with respective returns r^s_t and r.
- k^f are financial mkt participation costs

Life Cycle Model

Participation costs are defined following Cocco (2005) as

$$k^f(I_{t+1}, I_t) = \begin{cases} 0 & \text{if } I_{t+1} = 0 \\ k^f & \text{if } I_{t+1} = 1 \text{ and } I_t = 0 \end{cases}$$

where $I_t = (s_t > 0)$ is an indicator function, Entry costs k^f vary by cognitive skill type.

Policy Implications

We aim to use the estimated model to conduct a set of counterfactual experiments:

- impact on participation of reducing the gap in entry costs between low and high cognitive types
- impact on participation of reducing the gap between subjective and objective survival probabilities
- quantify the relative importance of the direct (entry costs) and indirect (accuracy of subjective beliefs) mechanisms through which financial literacy can influence participation decisions

Important to inform the design of public policies aimed at increasing financial literacy of the elderly in an ageing society.

References

Cocco, João F., "Portfolio Choice in the Presence of Housing," *The Review of Financial Studies*, 2005, *18* (2), 535–67.

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Rooij, Maarten CJ Van, Annamaria Lusardi, and Rob JM Alessie, "Financial literacy and retirement planning in the Netherlands," *Journal of economic psychology*, 2011, *32* (4), 593–608.

Spaenjers, Christophe and Sven Michael Spira, "Subjective life horizon and portfolio choice," *Journal of Economic Behavior & Organization*, 2015, *116*, 94–106.

Steptoe, Andrew and Jane Wardle, "Life skills, wealth, health, and wellbeing in later life," *Proceedings of the National Academy of Sciences*, 2017, *114* (17), 4354–4359.

Vissing-Jorgensen, Annette, "Towards an explanation of household portfolio choice heterogeneity: Non-financial income and participation cost structures," Technical Report, Technical report 2002.

Dispositional optimism

Dispositional Optimism: following Steptoe and Wardle (2017), we define Dispositional Optimism as a binary indicator that takes value 1 if the respondent answers with the maximum scores in two optimism items in CASP-19 questions: "I feel that life is full of opportunities" (1 to 4) and "I feel that the future looks good for me" (1 to 4).

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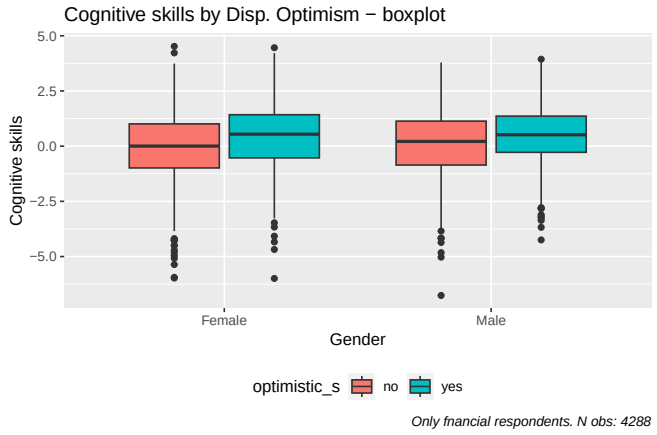
Cognitive skills & Dispositional optimism

Focusing on cognitive skills only might be problematic if dispositional optimism is correlated to them. The figure below suggests it might be the case: more optimistic individuals show (slightly) higher cognition.



However, once controlling for a set of demographics (age, gender, income, education...) the effect of dispositional optimism on cognition in non-significant.

	Dependent variable: cognitive skills
disp optimism	0.034
	(0.043)
controls	*yes*
Observations	4,288

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Mediation

$$\beta: \ participation \ = \alpha + \beta \ cogn\_skills + \Gamma X' + e \tag{2}$$
$$\lambda: \ inaccuracy \ = \tilde{\alpha} + \lambda \ cogn\_skills + \Gamma X' + \epsilon \tag{3}$$
$$\rho: \ participation \ = \bar{\alpha} + \rho \ inaccuracy + \Gamma X' + u \tag{4}$$

thus

$$\beta = \rho\lambda + \frac{Cov(u, cogn\_skills)}{Var(cogn\_skills)} \tag{5}$$

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