ARC Centre of Excellence in Population Ageing Research

Working Paper 2011/11

Longevity Risk, Subjective Survival Expectations, and Individual Saving Behavior

Thomas Post and Katja Hanewald *

* Post is Assistant Professor of Finance in the School of Business and Economics at Maastricht University. Hanewald is a Senior Research Associate in the School of Risk and Actuarial at the University of New South Wales and an Associate Investigator at the ARC Centre of Excellence in Population Ageing Research.

This paper can be downloaded without charge from the ARC Centre of Excellence in Population Ageing Research Working Paper Series available at www.cepar.edu.au

Longevity Risk, Subjective Survival Expectations, and Individual Saving Behavior

Thomas Post · Katja Hanewald

August-10-2011

Abstract Theoretical studies suggest that unexpected changes in future survival probabilities, that is, longevity risk, are important determinants of individuals' decision making about consumption, saving, allocation of assets, and retirement timing. Based on a data set that matches subjective survival expectations and savings indicators from the Survey of Health, Ageing and Retirement in Europe (SHARE) with life table data from the Human Mortality Database this study provides first empirical evidence that individuals are aware of longevity risk. The observed awareness of longevity risk translates into an increased dispersion of saving outcomes, which indicates that disagreement effects impact the underlying decision-making process. We do not find that awareness of longevity risk results in a clear increase in precautionary savings, the savings reaction thus differs from what theory suggests would be an optimal response.

Keywords longevity risk, subjective survival expectations, forecast dispersion, saving behavior

JEL classifications D14, D84, D91, H31, J11

Thomas Post (contact author): Maastricht University and Netspar, contact: Maastricht University, School of Business and Economics, Department of Finance, Tongersestraat 53, 6211 LM Maastricht, The Netherlands, phone: +31 43 38 83859; fax: +31 43 38 84875; e-mail: t.post@maastrichtuniversity.nl.

Katja Hanewald: University of New South Wales, Australian School of Business, School of Actuarial Studies, Sydney, New South Wales 2052, Australia, phone: +61 2 9385 4744; fax: +61 2 9385 1883; e-mail: k.hanewald@unsw.edu.au.

This paper uses data from SHARE release 2.3.0. SHARE data collection in 2004-2007 was primarily funded by the European Commission through its 5th and 6th framework programmes (project numbers QLK6-CT-2001-00360; RII-CT- 2006-062193; CIT5-CT-2005-028857). Additional funding by the US National Institute on Aging (grant numbers U01 AG09740-13S2; P01 AG005842; P01 AG08291; P30 AG12815; Y1-AG-4553-01; OGHA 04-064; R21 AG025169) as well as by various national sources is gratefully acknowledged (see http://www.share-project.org for a full list of funding institutions).

The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° PIEF-GA-2009-254548. For their comments and suggestions we would like to thank Carole Bernard, Stefano DellaVigna, Dimitris Georgarakos, Dan Goldstein, Arvid Hoffmann, Bertrand Melenberg, John Lynch, Peter Schotman, Martin Wersing, and the conference and seminar participants at: International Congress on Insurance: Mathematics and Economics, Annual Conference of the German Insurance Science Association, CRC 649 Workshop on Demographic Risk, CRC 649 Annual Conference, Annual Boulder Summer Conference on Consumer Financial Decision Making, Maastricht University, World Risk and Insurance Economics Congress, the Annual Congress of the European Economic Association, CIRANO Conference on Longevity Risk, Netspar International Pension Workshop, and Workshop on Annuities, Life Insurance and Bequest at ETH Zurich, Annual Colloquium of Superannuation Researchers. Part of this work was completed while the second author was visiting the Department of Demography at University of California, Berkeley, whose hospitality and stimulating research environment are gratefully acknowledged.

1. Introduction

For the past several decades, the industrialized world has experienced rapid improvements in life expectancy and survival rates. The annual rates of these improvements exhibit considerable variations, as illustrated in Figure 1 for the survival rates of males and females aged 65. The erratic paths of the survival rates reflect the underlying complex interaction of mortality determinants such as medical innovation, nutrition habits, or environmental factors(e.g., weather and climate) whose progress and impact over time are clearly non-deterministic. The resulting unexpected changes in survival rates are commonly referred to as longevity risk or stochastic mortality.

-- Figure 1 here --

Theoretical studies suggest that longevity risk is an important determinant of individual decisions regarding consumption and saving (Levhari and Mirman, 1977; Cocco and Gomes, 2009; De Nardi, French, and Jones, 2009), asset allocation (Menoncin, 2008; Cocco and Gomes, 2009; Post, 2009; Stevens, 2009; Horneff, Maurer, and Rogalla, 2010; Schulze and Post, 2010; Cheng and Han, 2011), and retirement timing (Cocco and Gomes, 2009). These studies extend the life-cycle model with lifespan uncertainty pioneered by Yaari (1965) by assuming that individuals base their economic decisions on expected survival probabilities and, in addition, consider the uncertainty surrounding expected survival probabilities. The presence of longevity risk is shown to increase individuals' savings as a form of self-insurance against longevity shocks (Cocco and Gomes, 2009), induce the use of longevity bonds as hedging instruments (Menoncin, 2008; Cocco and Gomes, 2009), and increase investment in deferred annuities (Post, 2009; Stevens, 2009; Horneff, Maurer, and Rogalla, 2010).

In this article, we test whether individuals are aware of longevity risk and, if so, whether this awareness affects their actual saving behavior. To this end, we analyze survey data on subjective survival expectations and savings indicators elicited from more than 30,000 individuals in the Survey of Health, Ageing and Retirement in Europe (SHARE) and corresponding life table data from the Human Mortality Database (University of California; Berkeley, and Max Planck Institute for Demographic Research, 2009).

We provide first empirical evidence for the growing theoretical literature that analyzes individual decision making under longevity risk. Our results indicate awareness of longevity risk among SHARE respondents. Furthermore, respondents are found also to act on their awareness of longevity risk. However, the impact on saving behavior is mostly due to forecaster disagreement effects and does not result in a clear increase in precautionary savings. The savings reaction thus differs from what theory suggests an optimal response. These findings have important implications for policy and regulation design. Many developed countries have undergone a shift from pay-as-you-go to individually managed defined contribution (DC) pension plans. The success of plans that emphasize individual responsibility for retirement savings crucially depends on individuals making informed decisions based on a correct assessment of the involved risks, including longevity risk. Our findings on saving behavior highlight that communication and education regarding longevity risk should be improved. The remainder of the article is structured as follows. Awareness of longevity risk is analyzed in Section 2. Saving behavior is studied in Section 3. Section 4 provides robustness checks. Section 5 summarizes the results and concludes.

2. Longevity Risk Awareness

2.1 Methodology

The SHARE survey contains subjective point forecasts of individuals' survival probabilities. Such estimates have been shown to be informative with respect to the mean of objective survival probabilities. Similar to their objective counterparts, subjective survival estimates exhibit differentials according to, for example, age, gender, health, and socioeconomic status (Hamermesh, 1985; Hurd and McGarry, 1995; Mirowsky and Ross, 2000; Khwaja, Sloan, and Chung, 2007; Popham and Mitchell, 2007; Delavande and Rohwedder, 2008). Subjective estimates are found to match the shape of survival curves according to actual life tables, although they exhibit some underestimation at younger ages and some overestimation at older ages (Hamermesh, 1985; Elder, 2007; Hurd, Rohwedder, and Winter, 2009). Furthermore, subjective estimates have predictive power for individuals' actual survival (Hurd, McFadden, and Gan, 1998; Hurd and McGarry, 2002; Siegel, Bradley, and Kasl, 2003; Winter, 2008), for the development of aggregate survival rates (Hamermesh, 1985; Perozek, 2008), and for economic decisions regarding consumption, savings, bequests, and the timing of claiming retirement benefits (Coile et al., 2002; Gan et al., 2004; Hurd, Smith, and Zissimopoulos, 2004; Bloom et al., 2007; Delavande and Willis, 2008, Salm, 2010).

To study individuals' awareness of longevity risk, we test whether subjective survival probabilities elicited in SHARE are also informative with respect to the uncertainty surrounding the development of objective survival rates. For this, we relate the dispersion in individuals' point forecasts to the uncertainty observed in objective mortality data. A similar approach is taken in a large number of empirical studies that use the dispersion of point forecasts as a proxy for uncertainty regarding economic variables. These include macroeconomic variables such as inflation, unemployment, and GDP growth rates (Cukierman and Wachtel, 1979; Levi and Makin, 1979, 1980; Mullineaux, 1980; Makin; 1982; Brenner and Landskroner, 1983; Zarnowitz and Lambros, 1987; Rich, Raymond, and Butler, 1992; Bomberger, 1996; Hahm and Steigerwald, 1999; Hayford, 2000; Giordani and Söderlind, 2003; Vuchelen, 2004; Rich and Tracy, 2006; Bloom, Floetotto, and Jaimovich, 2009; Engelberg, Manski, and Williams, 2009; Bachmann, Elstner, and Sims, 2010; Lahiri and Sheng, 2010), financial analyst forecast variables such as such as firm earnings, stock returns, corporate bond spreads, and real estate performance (Ajinkya and Gift, 1985; Imhoff and Lobo, 1992; Barron et al., 1998; Gebhardt, Lee, and Swaminathan, 2001; Doukas, Kim, and Pantzalis, 2006; Zhang, 2006a, 2006b; McAllister, Newell, and Matysiak, 2008; Barron, Stanford, and Yu, 2009; Güntay and Hackbarth, 2010), and the demand for consumer goods (Fisher and Raman, 1996; Gaur et al., 2007; Fuss and Vermeulen, 2008). Generally, these empirical studies find a positive relationship between the volatility of a forecast variable and the dispersion in the point forecasts. Experimental studies confirm this result (Harvey, 1995; Harvey, Ewart, and West 1997; Du and Budescu, 2007).

The successful application of forecast dispersion as a proxy for the uncertainty of an underlying forecast variable in a large number of studies and research fields provides the foundation for our first research hypothesis:

> *Hypothesis 1*: If individuals are aware of longevity risk, then the dispersion of subjective survival forecasts should be wider when uncertainty of the underlying survival rates is higher.

We test this hypothesis by examining whether the dispersion observed in survival rate given in actual life table data from the Human Mortality Database corresponds to the forecast dispersion observed in responses elicited in SHARE.

2.2 Data, Sample Selection, and Generated Variables

2.2.1 Subjective Survival Expectations—SHARE

The Survey of Health, Ageing and Retirement in Europe (SHARE) is a rich micro-level data set covering a large number of European countries. We use Wave 2 of SHARE, which includes data collected in 2006 and 2007 for Austria, Belgium, Czechia, Denmark, France, Germany, Greece, Ireland, Italy, the Netherlands, Poland, Spain, Sweden, and Switzerland. We omit Greece and Ireland from our analysis because the Human Mortality Database does not contain data for Greece, and SHARE is missing wealth and income variables for Ireland (as of August 2011). The resulting sample is comprised of 30,038 individual cases.

To elicit survival expectations, individuals in SHARE are asked the following question: "What are the chances that you will live to be age T or more?" The target age T is chosen conditional on the respondent's current age, x, as given in Table 1 (Hurd, Rohwedder, and Winter, 2009) and the response range is between 0 and 100. Due to this survey design, individuals are asked for age-specific survival probabilities referring to different forecast horizons ($T-x$).

-- Table 1 here --

We rescale the responses so that they range from 0 to 1 and treat them as probabilities (Hurd and McGarry, 2002). After removing those respondents who did not answer the survival expectation question, as well as those cases where the target age variable given in the data set did not comply with the definition given in Table 1, 26,497 valid cases remain for analysis. Descriptive statistics for the selected sample are given in Table 2; variables are defined in Table 3.

-- Tables 2-3 here --

2.2.2 Objective Mortality Data—Human Mortality Database

The Human Mortality Database provides harmonized mortality data for 37 countries. For the countries in our sample, we use gender- and age-specific time series for one-year central death rates starting in 1950 (1956 for Germany; 1958 for Poland). To match subjective survival probability estimates and their dispersion with objective counterparts, we estimate the parameters of the Lee-Carter (1992) mortality model. The Lee-Carter model is a well-established framework for probabilistic mortality forecasting, which has been applied to several European countries (see Tuljapurkar, Li, and Boe, 2000; Koissi, Shapiro, and Högnäs, 2006; Debón, Montes, and Puig, 2008; Denuit, 2009). According to the Lee-Carter model, the log of the central death rate $m_{x,t}$ for age x at time t is given by:

$$\ln(m_{x,t}) = a_x + b_x k_t + \varepsilon_{x,t}. \tag{2.1}$$

With this model, a series of full mortality tables is defined by the age-specific constants a_x and b_x, and the time-varying mortality index k_t, which is a random variable (for simplicity's sake, country and gender indices are suppressed). Following Lee and Carter (1992), Lee (2000), and Cocco and Gomes (2009), k_t is models as a random walk with drift:

$$k_t = k_{t-1} + \theta + e_t\ , \tag{2.2}$$

where e_t is normally distributed with E[e_t] = 0 and Std[e_t] = σ_e. The one-period survival probability for age x at time t, $p_{x,t}$, is approximated by Equation (3.3) (Cairns, Blake, and Dowd, 2008).

$$p_{x,t} = 1 - m_{x,t} / (1 + 0.5 m_{x,t}) \tag{2.3}$$

The parameters of the Lee-Carter model are estimated separately for males and females between ages 30 and 100 in each country using the *R* package *Demography* by Hyndman et al. (2008). We adapt to the multi-period forward-looking nature of SHARE responses by using the estimates of the Lee-Carter model to calculate forecasts for multi-period survival rates E($p_{x,t,T-x}$) that take into account both the trends in survival probability change and the specific survey year (2006 or 2007). Likewise, we use the Lee-Carter model to calculate the corresponding standard deviations of the multi-period survival rates Std($p_{x,t,T-x}$).

2.3 Calculation of the Dispersion Measures and Descriptive Results

Survival rates vary with sociodemographic factors such as age, gender, and income and it is thus intuitive to expect some dispersion in the survival expectations of respondents who are heterogeneous with respect to these factors. Since we are interested only in the response dispersion caused by uncertainty over the survival rate, we subdivide the sample into groups of individuals who can be expected to have homogenous survival rates. To do so, we use all available information from the Human Mortality Database: age, gender, country, and, in addition, marital status ("couple") from the SHARE data set.[1] Other factors, such as income, which are not available in the Human Mortality Database but in the SHARE data set and known to have an impact on survival rates and, possibly, on the response dispersion are incorporated as control variables in the regression analyses.

For every age-gender-country-couple group, we calculate the standard deviation of the response values within this group. To enable meaningful comparisons, especially between different age groups, we normalize these standard deviations by the corresponding group-specific mean. That is, as in Doukas, Kim, and Pantzalis's (2006), the coefficient of variation is chosen as the final measure of dispersion. We adopt an analogous approach for the objective survival probability forecasts. The coefficient of variation is calculated based on the predictions for $E(p_{x,t,T-x})$ and $Std(p_{x,t,T-x})$ from the Lee-Carter mortality model. Group-level summary statistics for the data including the dispersion measures are provided in Table 4.

-- Table 4 here --

Figure 2 plots the dispersion in the objective survival probability forecasts against the dispersion in the subjective estimates. The scatter plot gives a first indication that there is a positive relationship between the two: a greater dispersion in the subjective survival estimates tends to coincide with a greater dispersion in the objective survival rate data.

-- Figure 2 here --

2.4 Regression Analyses of Longevity Risk Awareness

Using the grouped data described above, we regress the dispersion of individuals' subjective survival estimates on the dispersion observed in actual survival rates. We control for key demographic characteristics and other factors potentially affecting the dispersion in subjective survival estimates. We estimate the following OLS regression model:

[1] Grouping according to marital status is crucial because key economic covariates such as income and net worth are reported as household-level aggregates. Thus, individual respondents living in a partnership appear to be wealthier since both partners' entries for these variables refer to the combined wealth amount.

$$SUB\_DISP_j = \alpha + \beta OBJ\_DISP_j + \boldsymbol{\delta}^T \mathbf{z}_j + \varepsilon_j \,, \qquad (2.4)$$

where SUB_DISP_j is the measure of dispersion of subjective survival probabilities in the age-gender-country-couple-specific group j, OBJ_DISP_j is the dispersion of the objective future survival rate for group j (estimated from the Lee-Carter model), and $\mathbf{z}_j$ is a vector of group-specific control variables. In addition to the variables used for grouping, we include sociodemographic control variables that have been shown to explain mortality differentials, as well as controls related to respondents' abilities to perform estimation tasks. With respect to mortality-related controls, we include net worth, income, education, self-perceived health, grip strength, and smoking behavior (e.g., Hamermesh, 1985; Smith, Taylor, and Sloan, 2001; Hurd and McGarry, 2002; Brown, 2003; Elder, 2007; Andersen-Ranberg et al., 2009; Sullivan and von Wachter, 2009).[2] Controls related to respondents' estimation ability include variables measuring cognitive abilities (education, numeracy score, ability to recall words) (e.g., Hill, Perry, and Willis, 2004), as well as possible tendencies toward making biased predictions (optimism and risk aversion) (e.g., Bassett and Lumsdaine, 1999; Kézdi and Willis, 2003; Hill, Perry, and Willis, 2004). For each of these variables, we calculate a group-specific measure of dispersion and include this measure in Equation (2.4) as a control variable.[3] In this way, we control for the possibility that heterogeneity in these factors causes additional dispersion of subjective survival probability estimates within a group. Furthermore, we include the forecast horizon and squared forecast horizon in the set of control variables. This controls for possible nonlinearities not yet captured by the normalization of the survival probability dispersions that is implemented through the coefficient of variation.

Results for three model variants of Equation (2.4) are given in Table 5. Model (1) includes all control variables that do not exhibit within-group variation (because they define the groups). Model (2) introduces the variables that control for within-group variation and that are available for the majority of respondents. Model (3) includes the full set of control variables, leading to a reduced sample size due to a considerable number of missing observations for the "grip strength," "smoke now," and "risk aversion" control variables.

-- Table 5 here --

[2] A body mass index measure is not included, since there are too many missing values (56% of the sample).

[3] Depending on whether it is relative differences (scale variables such as income net worth) or absolute differences (most ordinal variables such as numeracy score and some scale variables such as risk aversion) that are more informative, either the coefficient of variation or the standard deviation is used as the dispersion measure.

The results for all three models reveal that the dispersion in the subjective survival estimates of SHARE respondents is positively and strongly significantly related to the dispersion in objective survival probabilities. The dispersion in subjective survival estimates increases significantly with age (age, age^2), possibly reflecting a decrease in cognitive abilities, as pointed out by Elder (2007) in his analysis of survival expectation levels. The estimation results of Model (1) indicate that married respondents and males have a lower dispersion in subjective survival estimates. Neither effect is present in Models (2) and (3) and thus should be interpreted with caution. Differences in group size have no impact on the dispersion. Adding socioeconomic, cognitive, and other control variables that account for survival rate dispersion unrelated to longevity risk in Models (2) and (3) improves the model fit as measured by the R^2, while the coefficient for the dispersion in objective survival probabilities remains positive and strongly significant.

In conclusion, results of the regression analysis that controls for key variables related to the dispersion in the objective survival probabilities (e.g., age, gender, wealth, income, health), cognitive abilities (e.g., age, numeracy, recall), and possible estimation biases (optimism, risk aversion) confirm the findings of the univariate analysis: the data exhibit a significant and positive relationship between the dispersion in objective survival probabilities and the dispersion in subjective estimates. This finding supports *Hypothesis 1* as it is an indication that the SHARE respondents are aware of longevity risk.

2.5 Analysis of the Level of the Estimation Errors

In this section we analyze the level of the estimation error, which is the difference between the subjective and the objective survival probability estimate for each respondent. This analysis is an important prerequisite for the subsequent analysis of the saving behavior. Since saving decisions are based on a prognosis of the level of survival rates, that is, on a prognosis of the lifespan, level errors potentially have an impact on saving outcomes. Previous literature establishes a relationship between the estimation error in survival probability estimates and individual characteristics. An important factor is age: younger people tend to underestimate actual survival rates; older people tend to overestimate them (e.g., Hamermesh, 1985; Elder, 2007; Hurd, Rohwedder, and Winter, 2009). Related to this observation are the findings from the literature on financial analyst forecast dispersion literature showing that greater objective uncertainty is associated with larger levels of estimation errors (see, e.g., Zhang, 2006a). We thus investigate whether the dispersion of objective rates plays a role with respect to the level of the survival probability estimation error.

We use two alternative measures of the respondent's estimation error ("estimation error" and "absolute estimation error", see Table 3). Both measures are defined in relative terms; again, this is done to enable comparison of each group's estimates on a similar scale. The first measure defines the estimation error as the difference between the subjective and the objective estimate of the survival probability, divided by the objective probability. This measure distinguishes between positive and negative deviations of subjective estimates from the objective probabilities. On average, positive and negative values can cancel out within one group, and thus the second measure defines the estimation error as the absolute (positive) value of the difference between the subjective and objective estimates of the survival probability, divided by the objective probability. As expected, the second measure tends to be larger on average (see Table 4).

Using the first measure, we confirm with our data the effect of age on the estimation errors as in the above-cited demographic studies: higher age leads to more optimism about one's survival prospects (results not shown). To identify a possible effect of the dispersion of objective survival rates on the level of estimation error , we estimate the following regression model:

$$EST\_ERR\_LEVEL_j = \alpha + \beta OBJ\_DISP_j + \boldsymbol{\delta}^{\mathrm{T}}\mathbf{z}_j + \varepsilon_j. \qquad (2.5)$$

Model (2.5) uses the same set of control variables as Model (2.4). However, we now include the control variables in their levels, instead of in their dispersion, because we are measuring an effect on a (error) level variable.

The regression results for the estimation error and the absolute estimation error yield significant and positive coefficients for the dispersion of objective survival rates. However, the estimation results are highly sensitive to outliers and standard diagnostic tests reject the normality assumption for the regression residuals. Taking the logarithm of the estimation error, which is possible only for the (always positive absolute estimation error, however, yields a stable model and gives a more linear relationship. The regression results for the logarithm of the absolute estimation error are provided in Table 6.

-- Table 6 here --

With respect to age (and age^2), we find a U-shaped impact on the absolute estimation error from age 57 (Model (1)) or age 52 (Model (2)) onward that partly confirms the positive age effect established in the demographic literature. Note, however, that in this setup, in which we look at absolute error, the effects of the sociodemographic control variables should not be compared with demographic studies on mortality differentials, as these include negative and positive error values in their analysis, but with studies that look at *absolute* forecast precision as, for example, in the financial analyst forecast literature. With respect to the main goal of the regression analysis, we find a significant positive effect of the objective dispersion on the level of the estimation error. This accords well with the effects documented in the financial analyst literature (Zhang, 2006a). Furthermore, smaller estimation errors are associated with being female, being wealthier in terms of income and net worth, having more grip strength, and being a nonsmoker.

3. Longevity Risk and Individual Saving Behavior: Forecaster Uncertainty versus Disagreement

3.1 Methodology

The results of Section 2.4 evidence a positive relationship between the dispersion in objective survival data and the dispersion in individuals' subjective survival expectations. Building on findings from the literature on forecast dispersion, we argue that this is evidence that individuals are aware of longevity risk.

Methodologically, dispersion in point forecasts may reflect both forecasters' perceived uncertainty underlying the forecast variable as well as disagreement among forecasters (who may feel confident about their estimate) (e.g., Zarnowitz and Lambros, 1987; Barron et al., 1998; Giordani and Söderlind, 2003; Engelberg, Manski, and Williams, 2009; Barron, Stanford, and Yu, 2009; Lahiri and Sheng, 2010).

To better understand the drivers of survival probability dispersion, we use data on SHARE respondents' saving behavior and follow a systematic testing procedure. This analysis addresses the question whether respondents are not only aware of but also act on the existence of longevity risk, that is, whether they adjust their saving behavior in response to their awareness of longevity risk.

Previous theoretical findings show that both a longer expected lifespan (Bloom et al., 2007, Cocco and Gomes, 2009; Salm, 2010) and a higher perceived uncertainty regarding the distribution of this lifespan (Cocco and Gomes, 2009) increase savings.[4,5] We utilize these findings to discriminate between forecaster uncertainty and disagreement as follows.

We expect that individuals who are more uncertain than others about their survival rate will have higher self-insurance savings in comparison to less uncertain individuals. Thus, if forecast dispersion reflects uncertainty, similar amounts of forecast dispersion should translate into similar saving levels, that is, we expect no dispersion in savings levels. For different amounts of forecast dispersion, however, we expect to observe different savings levels.

If, however, forecast dispersion does not reflect individuals' uncertainty about their subjective survival rates, but disagreement in opinion, we expect quite opposite effects. Disagreement about survival prospects among individuals will lead to differences in their individual savings levels. That is, the higher the disagreement as measured by the dispersion in point forecasts, the higher should be the dispersion of savings among individuals, but there should be no effect on the average level of savings.[6]

Based on these arguments, we formulate three mutually exclusive research hypotheses:

> *Hypothesis 2*: If uncertainty in objective survival probability causes uncertainty in individuals regarding their individual survival rate expectation, but no disagreement between individuals, then higher forecast dispersion will be related to higher savings levels, but not to higher savings dispersion.

[4] The impact of partially insurable (background) risk on savings is analyzed, for example, in Carroll (1997); Elmendorf and Kimball (2000); Courbage and Rey (2007); Menegatti (2009).

[5] A further impact of longevity risk on behavior could be expected with respect to private annuitization decisions. Private annuitization among SHARE respondents is, however, very rare. Only 3.5% of respondents report positive private annuity income, resulting in too few cases for meaningful econometric analyses. Furthermore, the expected effect of an increase in longevity risk on annuitization levels is ambiguous (Schulze and Post, 2010), making identification of effects difficult.

[6] Only if there is a general bias in the level of survival prospect estimation related to objective uncertainty, would there be an effect on the average savings level. Building on the results of Section 2.5, we control for this effect.

Hypothesis 3: If uncertainty in objective survival probability causes disagreement between individuals, but individuals are certain about their survival rate expectation, then higher forecast dispersion will related to higher savings dispersion, but not to higher savings levels.

Hypothesis 4: If uncertainty in objective survival probability causes both forecast uncertainty and disagreement between individuals with respect to subjective survival expectations, then higher forecast dispersion will be related to both higher savings levels and higher savings dispersion.

Figure 3 summarizes the conceptual framework underlying *Hypotheses 2–4*.

-- Figure 3 here --

To test *Hypotheses 2–4*, we estimate two simultaneous equation models, the first for the savings level, the second for the savings dispersion. The simultaneous equation model for the savings level contains the following three equations:

$$SUB\_DISP_j = \alpha_1 + \beta_1 OBJ\_DISP_j + \boldsymbol{\delta}_1^{\mathrm{T}} \mathbf{z}_{1j} + \varepsilon_{1j} \,, \tag{3.1}$$

$$EST\_ERR\_LEVEL_j = \alpha_2 + \beta_2 OBJ\_DISP_j + \boldsymbol{\delta}_2^{\mathrm{T}} \mathbf{z}_{2j} + \varepsilon_{2j} \,, \tag{3.2}$$

$$SAVE\_LEVEL_j = \alpha_3 + \gamma_1 SUB\_DISP_j + \gamma_2 EST\_ERR\_LEVEL_j + \boldsymbol{\delta}_3^{\mathrm{T}} \mathbf{z}_{3j} + \varepsilon_{3j} \,, \tag{3.3}$$

Equation (3.1) reestablishes the link analyzed in Section 2.4, Equation (2.4), between objective and subjective survival expectation dispersion. Similarly, Equation (3.2) incorporates the findings of Section 2.5, where we identified a positive link between objective dispersion and the survival probability estimation error level in Equation (2.5). As indicated previously, this equation for the level of the estimation error is necessary because in Equation (3.3) we want to control for the possibility that even under pure disagreement (*Hypothesis 3*), objective dispersion may lead to some estimation bias with respect to the survival probability level. These estimation errors could also have an impact on saving levels, if individuals are biased with respect to their expected lifetime when planning their savings. Thus, without this control it would be difficult to discriminate between *Hypotheses 2* and *3*. Finally, in Equation (3.3), the overall impact of subjective dispersion and estimation error levels on the savings level is modeled. Again, the vector **z** contains group-specific control variables.

For the savings level in Equation (3.3), we introduce additional control variables that are likely to have an impact on the saving behavior. Specifically, we add the number of children ("children"), an indicator for trust in other people ("trust"), an indicator for the need for savings ("chance living better"), an indicator on respondents' subjective expectations regarding future government pensions ("reduction in pension amount"),[7] and the subjective estimate of the survival probability itself. We expect a positive coefficient for "trust" (Agnew et al., 2007) , and the subjective estimate of the survival probability. A negative impact on the saving behavior is expected for "chance living better" and "reduction in pension amount". The impact of the number of children is less obvious: a positive effect could arise if children induce a bequest motives; a negative effect would result if the household relies on intergenerational risk-sharing. We use two alternative indicators to measure savings: the total net worth of a respondent and the respondent's financial assets (see Table 3 for the definitions). Net worth is a very broad measure of wealth accumulation and includes items such as real estate or cars, which are in part also consumption goods. Financial assets are less comprehensive and avoid the latter issue.

The simultaneous equation model for the savings level is estimated via three-stage least squares (3SLS); the estimation results can be found in Table 7. Results for the model's key equation (Equation (3.3)) show no significant link between the dispersion in survival probability estimates and the amount of financial assets or net worth.

-- Table 7 here --

In a next step, we specify a simultaneous equation model for savings dispersion:

$$SUB\_DISP_j = \alpha_1 + \beta_1 OBJ\_DISP_j + \boldsymbol{\delta}_1^{\mathrm{T}} \mathbf{z}_{1j} + \varepsilon_{1j} , \tag{3.4}$$

$$SAVE\_DISP_j = \alpha_2 + \gamma SUB\_DISP_j + \boldsymbol{\delta}_2^{\mathrm{T}} \mathbf{z}_{2j} + \varepsilon_{2j} , \tag{3.5}$$

Again, we incorporate the relation between objective dispersion and subjective dispersion first described in Equation (2.4), now labeled Equation (3.4).[8] The overall impact of the dispersion of subjective estimates on the dispersion of savings is modeled in Equation (3.5) using the coefficient of variation for net worth or financial assets as the dependent variable. In contrast

[7] Including these control variables reduces the sample size due to missing values.
[8] To obtain a well-specified model, Equation (3.4) does not contain the dispersion in net wealth (or financial assets) that was included but found to be insignificant in Equation (2.4).

to the simultaneous equation model for the savings level, there is no need to include an equation for the estimation error because such an equation would refer to the estimation error dispersion, thus in principle resembling Equation (3.4).[9]

The results of the 3SLS estimation for the simultaneous equation model for savings dispersion vary between the savings indicators (see Table 8): there is a positive and significant link between the dispersion of subjective survival estimates and the dispersion of financial assets, but no significant link between the dispersion of subjective survival estimates and the dispersion of net worth.

-- Table 8 here --

These results lead to two possible conclusions regarding *Hypotheses 2–4*. First, if net worth is the appropriate indicator for savings, all three hypotheses are rejected. This finding would imply that while the subjective survival probability estimation of SHARE respondents is indeed impacted by objective survival rate dispersion, respondents do not act on this at all. If, on the other hand, financial assets are the appropriate indicator for savings, *Hypotheses 2* and *4* are rejected and we can conclude that the impact of longevity risk on respondents' expectations is that it does not lead to uncertainty but to disagreement. Given that net worth encompasses consumption goods, and that the goodness of fit of the simultaneous equation model for savings dispersion that uses net worth as a savings indicator yields a worse fit (see the AIC and BIC in Table 8), we favor the second interpretation of the regression results: SHARE respondents are aware of longevity risk, respondents adjust their savings, but the adjustment is driven by forecaster disagreement (*Hypothesis 3*). Thus, awareness of longevity risk affects savings dispersion, but not average saving levels.

4. Robustness Checks

4.1 The Mortality Model and the Estimation Window

The Lee-Carter model used for predicting objective survival rates and their dispersion is a widely used probabilistic mortality forecasting framework, but it also imposes structural restrictions on the possible development of future mortality rates. For example, shocks to

[9] The level of the estimation error is a deterministic additive transformation of the subjective survival probability

survival rates in a given year are perfectly correlated across age groups due to their common dependence on the realization of the mortality index k_t (compare Equations (2.1) and (2.2)). Furthermore, the parameters of the time series model for k_t are assumed to be constant over time. In this subsection, we test the robustness of our results by relaxing these restrictions. Specifically, we first re-estimate the Lee-Carter model using the country-, gender-, and age-specific time series for one-year central death rates from 1975 onward only (instead of 1950). This shorter period is chosen based on empirical findings that indicate that in the mid-1970s major causes of death changed in most industrialized countries, leading to different annual rates of change in survival rates and different volatilities (see, e.g., Levi et al., 2002; Page, 2001; Hanewald, 2010).

Second, using the original time series starting in 1950, we estimate an alternative mortality model that imposes less structure on the data. We use the following stochastic process for the evolution of multi-period mortality rates over time: $q_{x,t,T\text{-}x} = q_{x,t\text{-}1,T\text{-}x} \cdot r_{x,t,T\text{-}x}$, where $r_{x,t,T\text{-}x}$ follows a lognormal distribution with mean $\mu_{x,T\text{-}x}$ and standard deviation $\sigma_{x,T\text{-}x}$ (again, country and gender indices are suppressed). This model makes no assumptions about the dependency of annual changes in mortality rates on time, age, or cohort. This model is one extreme case of the spectrum of different probabilistic mortality models, whereas the Lee-Carter model is at the other end of the spectrum, and between the two are the various age-period-cohort mortality models discussed in the literature (see, e.g., Cairns, Blake, and Dowd, 2008). We adapt this less restrictive model to the forward-looking nature of SHARE responses by calculating forecasts for $q_{x,t,T\text{-}x}$ (and for multi-period rates of survival $p_{x,t,T\text{-}x}$), the corresponding standard deviations, and the resulting coefficients of variation conditional on the survey year. We estimate the model's parameters $\mu_{x,T\text{-}x}$ and $\sigma_{x,T\text{-}x}$ using data from the Human Mortality Database. To do so, we construct for each time-horizon-age-gender-country-specific group of respondents in the SHARE data a corresponding time series of multi-period mortality rates. The group-level summary statistics for the alternative mortality model calibration are given in Table 9: Column 1 gives the original specification ("Baseline Specification"), Column 2 refers to the Lee-Carter model estimated based on 1975+ mortality data ("Lee-Carter 1975"), and Column 3 refers to the alternative mortality model ("Alternative Mortality Model").

-- Table 9 here --

---

estimate. This transformation does not contribute additional dispersion.

The estimates summarized in Table 9 show that both the estimation window for the Lee-Carter model and the choice of the mortality model decrease the dispersion in the objective survival rates. The two model variants also impact the level of the estimation error: a small increase is observed for the "Lee-Carter 1975+"variant and a decrease under the alternative mortality model. To assess the impact on the dispersion of subjective survival estimates, the regression model introduced in Section 2.4 is re-estimated for the two alternative model specifications; the results are given in Columns 2 and 3 of Table 10.

-- Table 10 here --

The regression results show that the positive and strongly significant relation between the dispersion of subjective survival estimates and the dispersion in the objective rate established in Section 2.4 is robust both to the estimation window for the Lee-Carter model and to the choice of the mortality model. Furthermore, all control variables found to be significant in the original model continue to be significant and have the same sign under both alternative specifications. The same holds true for the regression analysis of the level of the absolute estimation error under the alternative mortality model (Column 3 of Table 11), but not for the shorter estimation window used to estimate the Lee-Carter mortality model. For the more recent mortality data from 1975 onward, the coefficient for the dispersion in objective survival rates is insignificant, which means that there is no effect on the level of absolute estimation error (Column 2 of Table 11).

-- Table 11 here --

Finally, the results of the simultaneous equation models for financial assets as the savings measure under the alternative specifications are given in Columns 2 and 3 of Tables 12 (for the savings level) and 13 (for the dispersion of savings). The regression results confirm the finding of Section 3 that the dispersion of subjective survival expectations is due to disagreement among SHARE respondents.

-- Tables 12-13 here --

4.2 The Dispersion Measure

In Section 2.3, we introduced the coefficient of variation as the measure of dispersion in point forecasts, arguing that the normalization achieved using this measure allows us to better compare different age groups. There are alternative dispersion measures that achieve normalization as well, but vary in their sensitivity to dispersion of the variable of interest in different parts of the distribution. For example, there are the measures of inequality, which were developed to quantity the inequality within an income distribution (Cowell, 1977; Shorrocks, 1980; Atkinson, 1983). To examine the robustness of our results, we employ two commonly used inequality measures that allow the variable of interest to take on zero values: the "half of squared coefficient of variation" and the Gini coefficient. The regression results for the dispersion in point forecasts, the level of the estimation error, and the saving behavior using these two alternative measures yield results similar to those of the original specification with respect to both the number of significant control variables and the sign of coefficients (Regression results are available from the authors on request).

4.3 Focal Responses

Focal-point responses are widely observed in studies that elicit subjective expectations about probabilities: survey responses are often clustered at the 0%, 50%, or 100% level. With respect to survival expectations, this effect is observed in studies based on the U.S. Health and Retirement Survey (e.g., Hurd and McGarry, 1995; Hurd, McFadden and Gan, 1998) and on SHARE (e.g., Hurd, Rohwedder, and Winter, 2009). This phenomenon also occurs in our sample. Table 1 shows that the percentage of respondents with a 50% estimate ranges between 18.7% (Italy) and 31.3% (Poland) over all countries in our sample. For responses that are clustered at either the 0%, 50%, or 100% level, this range is between 37.4% (The Netherlands) and 50.9% (Sweden).

Previous studies take different approaches to the focal response issue. Some studies replace focal responses with imputed values (Bloom et al., 2007; Delavande and Rohwedder, 2008); others consider focal responses as an "index of precision" that measures the respondents' degree of uncertainty (Lillard and Willis, 2001; Kézdi and Willis, 2003; Hill, Perry, and Willis, 2004) or as an indicator of the individual's lack of knowledge regarding the forecast variable (e.g., Bruine de Bruin et al., 2000; Delavande and Rohwedder, 2008; Manski and Molinari, 2010). Following the literature, we examine the robustness of our results by running regressions that exclude focal responses or use imputed values for focal responses, or use the percentage of focal responses as an alternative dependent variable potentially measuring respondents' uncertainty or disagreement.

Table 9 contains group-level summary statistics for the original data set in Column 1 and for modified versions of the data in which the 0%, 50%, and 100% level focal responses are imputed or excluded in Columns 4 and 5, respectively.[10] The regression results for the dispersion of subjective survival estimates based on the samples with either imputed or excluded focal responses are shown in Columns 4 and 5 of Table 10. Previous findings are confirmed: the coefficient on the dispersion in objective survival rates is positive and significant in both models. The third model uses the percentage of focal responses as an alternative dependent variable to test whether focal responses indicate respondents' uncertainty with respect to their survival rate. This model shows a significant and positive coefficient for the dispersion in objective survival rates, but has very low explanatory power (R^2 = 1.6%; see Table 14).

-- Table 14 here --

Results for the level of the estimation error (relevant only for the models with imputed or excluded focal responses) do not confirm the findings obtained in Section 2.4: the link between the dispersion in objective survival rates and the level of the estimation error is positive but not significant (compare Table 11, Columns 4 and 5).

Based on the samples with either imputed or excluded focal responses a significant and positive effect is found for the dispersion in subjective survival estimates on the level of savings (Table 12, Columns 4 and 5). This result differs from the results of all previous regression analyses and indicates uncertainty effects for SHARE respondents. In both model variants, the link between the dispersion of savings and the dispersion of subjective estimates is present (Table 13, Columns 4 and 5), that is, disagreement effects are found as well.

Finally, we replace the coefficient of variation of the subjective estimates with the percentage of focal responses in the two simultaneous equation models for the level and the dispersion of financial assets (Equations (3.1), (3.3), (3.4), and (3.5)) The results for both the savings level

[10] Robustness checks that focus only on the 50% level responses yielded very similar results (available from the authors on request). The imputation of the focal responses follows Delavande and Rohwedder (2008) and is based on the set of socioeconomic and cognitive skill covariates introduced in Section 2.2.

and the dispersion of savings show no significant relationship between the percentage of focal responses and respondents' saving behavior (detailed results are available from the authors on request)—This finding is not surprising, keeping in mind that the model that uses the percentage of focal responses as an indicator of longevity risk awareness has very low explanatory power (Table 14).

In conclusion, with respect to the impact of focal responses we find that the percentage of focal responses is significantly and positively linked to the dispersion in objective survival rates. Therefore, this variable could be viewed as an alternative measure of respondents' uncertainty/disagreement, as suggested by Lillard and Willis (2001). However, the corresponding regression model has very low explanatory power and the percentage of focal responses is not a significant covariate in the regression models for the saving behavior. Instead, the other two model variants that excluded or imputed focal responses better explain observed saving levels. We thus conclude that the percentage of focal responses is not a good indicator of respondents' uncertainty/disagreement regarding survival rates but, instead, an indicator of a "don't know" answer, as suggested, for example, by Bruine de Bruin et al. (2000).

5. Summary and Conclusions

Annual rates of decline in mortality exhibit considerable variation: the so-called longevity risk. A large number of theoretical studies suggests that longevity risk is an important determinant of individuals' decisions about consumption, saving, allocation of assets, and retirement timing. Our analysis of subjective survival expectations elicited in the Survey of Health, Ageing and Retirement in Europe (SHARE) from more than 30,000 individuals in 12 European countries and objective mortality data from the Human Mortality Database reveals that SHARE respondents are aware of longevity risk. This awareness is reflected in the dispersion of respondents' subjective survival probability estimates, which co-varies with the dispersion in actual population survival rates. We furthermore find that the observed awareness of longevity risk translates into an increased dispersion of saving outcomes, indicating that disagreement effects impact the underlying decision-making process.

We performed a number of tests to examine the robustness of our results with respect to the estimation window used to estimate the dispersion in objective survival probabilities, the mortality model, the dispersion measure used, and the treatment of focal responses. The results of these robustness checks confirm that the link between the dispersion in respondents' subjective survival estimates and the dispersion of objective survival rates observed in historical life table data is very robust to alternative specifications, which indicates that SHARE respondents are indeed aware of longevity risk. Furthermore, there is a significant and positive link between the dispersion in point forecasts and the dispersion of savings in all model specifications, indicating disagreement effects among respondents. The evidence for respondents being uncertain about survival rates is weaker: only two model variants used in the robustness checks yield a significant and positive link between the dispersion in point forecasts and savings levels.

This study's findings have particular relevance for the design of pension systems that emphasize individually managed retirement savings. For such policies to be successful it is essential that individuals make informed decisions based on sound expectations about asset returns, returns to human capital, and mortality risks. Our finding that mostly disagreement effects impact how individuals plan their savings in response to longevity risk indicates that individual savings adjustments might not be effective in protecting individuals against the economic risks arising from the uncertainty regarding future survival rates. These results, in combination with the findings of Cocco and Gomes (2009), who show in a theoretical framework that responding to longevity risk with suboptimal investment and insurance choices can imply considerable individual welfare costs, make clear that the question of optimal savings and asset allocation strategies is still an important area for further research. Our results already indicate that communication and education regarding longevity risk need to be improved.

References

Agnew, J. R., Szykman, L. R., Utkus, S. P., and Young, J. A. (2007), Literacy, Trust and 401 (k) Savings Behavior, *Working Paper*, Center for Retirement Research at Boston College.

Atkinson, A. B. (1983), *The Economics of Inequality*, Oxford: Clarendon Press.

Ajinkya, B. B., and Gift, M. J. (1985), Dispersion of Financial Analysts' Earnings Forecasts and the (Option Model) Implied Standard Deviations of Stock Returns, *Journal of Finance*, 40: 1353–1365.

Andersen-Ranberg, K., Petersen, I., Frederiksen, H., Mackenbach, J. P., and Christensen, K. (2009), Cross-National Differences in Grip Strength Among 50+ Year-Old Europeans: Results from the SHARE Study, *European Journal of Ageing*, 6: 227–236.

Bachmann, R., Elstner, S., and Sims, E. R. (2010), Uncertainty and Economic Activity: Evidence from Business Survey Data, *NBER Working Paper Series*, No. 16143.
Barron, O., Kim, O., Lim, S., and Stevens, D. (1998), Using Analysts' Forecasts to Measure Properties of Analysts' Information Environment, *Accounting Review*, 73: 421–433.
Barron, O., Stanford, M., and Yu, Y. (2009), Further Evidence on the Relation Between Analysts' Forecast Dispersion and Stock Returns, *Contemporary Accounting Research*, 26: 329–357.
Bloom, D. E., Canning, D., Moore, M., and Song, Y. (2007), The Effect of Subjective Survival Probabilities on Retirement and Wealth in the United States, in Clark, R. L., Ogawa N., and Mason A. (Eds.), *Population Aging, Intergenerational Transfers and the Macroeconomy*, Cheltenham: Edward Elgar Publishing.
Bloom, N., Floetotto, M., and Jaimovich, N. (2009), Really Uncertain Business Cycles, *Working Paper*, Stanford University.
Bomberger, W. A. (1996), Disagreement as a Measure of Uncertainty, *Journal of Money, Credit and Banking*, 28: 381–392.
Brenner, M., and Landskroner, Y. (1983), Inflation Uncertainties and Returns on Bonds, *Economica*, 50: 463–468.
Brown, J. R. (2003), Redistribution and Insurance: Mandatory Annuitization with Mortality Heterogeneity, *Journal of Risk and Insurance*, 70: 17–41.
Bruine de Bruin, W., Fischhoff, W. B., Millstein, S. G., and Halpern-Felsher, B. L. (2000), Verbal and Numerical Expressions of Probability: "It's a Fifty-Fifty Chance," *Organizational Behavior and Human Decision Processes*, 81: 115–131.
Cairns, A. J. G., Blake, D., and Dowd, K. (2008), Modelling and Management of Mortality Risk: A Review, *Scandinavian Actuarial Journal*, 2008: 79–113.
Carroll, C. D. (1997), Buffer-Stock Saving and the Life Cycle/Permanent Income Hypothesis, *Quarterly Journal of Economics*, 112: 1–55.
Cheng, Y., and Han, X. (2011), Does large volatility help?—stochastic population forecasting technology in explaining real estate price process, *Journal of Population Economics* (forthcoming).
Cocco, J. F., and Gomes, F. J. (2009), Longevity Risk, Retirement Savings, and Financial Innovation, *Journal of Financial Economics* (forthcoming).
Coile, C., Diamond, P., Gruber, J., and Jousten, A. (2002), Delays in Claiming Social Security Benefits, *Journal of Public Economics*, 84: 357–385.
Courbage, C., and Rey, B. (2007), Precautionary Saving in the Presence of Other Risks, *Economic Theory*, 32: 417–424.
Cowell, F. A. (1977) *Measuring Inequality*, Oxford: Philip Allan.
Cukierman, A., and Wachtel, P. (1979), Differential Inflationary Expectations and the Variability of the Rate of Inflation: Theory and Evidence, *American Economic Review,* 69: 595–609.
Debón, A., Montes, F., and Puig, F. (2008), Modelling and Forecasting Mortality in Spain, *European Journal of Operational Research*, 189: 624–637.
Delavande, A., and Rohwedder, S. (2008), Differential Mortality in Europe and the US: Estimates Based on Subjective Probabilities of Survival, *Demography* (forthcoming).
Delavande, A., and Willis, R. J. (2008), Managing the Risk of Life, *Working Paper WP 2007-167*, Michigan Retirement Research Center.
De Nardi, M., French, E., and Jones, J. B. (2009), Life Expectancy and Old Age Savings, *American Economic Review*, 99: 110–115.
Denuit, M. M. (2009), An Index for Longevity Risk Transfer, *Journal of Computational and Applied Mathematics*, 230: 411–417.
Doukas, J., Kim, C., and Pantzalis, C. (2006), Divergence of Opinion and Equity Returns, *Journal of Financial and Quantitative Analysis*, 41: 573–606.

Du, N., and Budescu, D. V. (2007), Does Past Volatility Affect Investors' Price Forecasts and Confidence Judgements? *International Journal of Forecasting*, 23: 497–511.

Elder, T. E. (2007), Subjective Survival Probabilities in the Health and Retirement Study: Systematic Biases and Predictive Validity, *Working Paper WP 2007-159*, Michigan Retirement Research Center.

Elmendorf, D. W., and Kimball, M. S. (2000), Taxation of Labor Income and the Demand for Risky Assets, *International Economic Review*, 41: 801−832.

Engelberg, J., Manski, C. F., and Williams, J. (2009), Comparing the Point Predictions and Subjective Probability Distributions of Professional Forecasters, *Journal of Business & Economic Statistics*, 27: 30−41.

Fisher, M. L., and Raman, A. (1996), Reducing the Cost of Demand Uncertainty Through Accurate Response to Early Sales, *Operations Research*, 44: 87–99.

Fuss, C., and Vermeulen, P. (2008), Firms' Investment Decisions in Response to Demand and Price Uncertainty, *Applied Economics*, 40: 2337–2351.

Gan, L., Gong, G., Hurd, M., and McFadden, D. (2004), Subjective Mortality Risk and Bequest, *NBER Working Paper Series*, No. 10789.

Gaur, V., Kesavan, S., Raman, A., and Fisher, M. L. (2007), Estimating Demand Uncertainty Using Judgmental Forecasts, *Manufacturing & Service Operations Management*, 9: 480–491.

Gebhardt, W. R., Lee, C. M. C., and Swaminathan, B. (2001), Toward an Implied Cost of Capital, *Journal of Accounting Research*, 39: 135–176.

Giordani, P., and Söderlind, P. (2003), Inflation Forecast Uncertainty, *European Economic Review*, 47: 1037–1059.

Güntay, L., and Hackbarth, D. (2010), Corporate Bond Credit Spreads and Forecast Dispersion, *Journal of Banking & Finance*, 34: 2328–2345.

Hahm, J. H., and Steigerwald, D. (1999), Consumption Adjustment Under Time-Varying Income Uncertainty, *Review of Economics and Statistics*, 81: 32–40.

Hanewald, K. (2010), Explaining Mortality Dynamics: The Role of Macroeconomic Fluctuations and Cause of Death Trends, *North American Actuarial Journal* (forthcoming).

Hamermesh, D. S. (1985), Expectations, Life Expectancy, and Economic Behavior, *Quarterly Journal of Economics*, 100: 389–408.

Harvey, N. (1995), Why Are Judgments Less Consistent in Less Predictable Task Situations? *Organizational Behavior and Human Decision Processes*, 63: 247−263.

Harvey, N., Ewart, T., and West, R. (1997), Effects of Data Noise on Statistical Judgement, *Thinking and Reasoning*, 3: 111−132.

Hayford, M. (2000), Inflation Uncertainty, Unemployment Uncertainty, and Economic Activity, *Journal of Macroeconomics*, 22: 315–329.

Hill, D., Perry, M., and Willis, R. J. (2004), Estimating Knightian Uncertainty from Survival Probability Questions on the HRS, *Working Paper*, University of Michigan

Horneff, W., Maurer, R., and Rogalla, R. (2010), Dynamic Portfolio Choice with Deferred Annuities, *Journal of Banking & Finance*, 34: 2652–2664.

Hurd, M. D., McFadden, D. L., and Gan, L. (1998), Subjective Survival Curves and Life Cycle Behavior, in: Wise, D. A. (Ed.), *Inquiries in the Economics of Aging*, Chicago: University of Chicago Press, pp. 259–305.

Hurd, M. D., and McGarry, K. (1995), Evaluation of the Subjective Probabilities of Survival in the Health and Retirement Study, *Journal of Human Resources*, 30, Special Issue on the Health and Retirement Study: Data Quality and Early Results: S268–S292.

Hurd, M. D., and McGarry, K. (2002), The Predictive Validity of Subjective Probabilities of Survival, *Economic Journal*, 112: 966–998.

Hurd, M. D., Rohwedder, S., and Winter, J. (2009), Subjective Probabilities of Survival: An International Comparison, Unpublished manuscript.

Hurd, M. D., Smith, J. P., and Zissimopoulos, J. M. (2004), The Effects of Subjective Survival on Retirement and Social Security Claiming, *Journal of Applied Econometrics*, 19: 761–775.

Hyndman, R. J., Booth, H., Tickle, L., and Maindonald, J. (2008). Demography: Forecasting Mortality and Fertility Data, R Package, available at: http://robjhyndman.com.

Imhoff, E., and Lobo, G. (1992), The Effect of Ex Ante Earnings Uncertainty on Earnings Response Coefficients, *Accounting Review*, 67: 427–439.

Kézdi, G., and Willis, R. (2003), Who Becomes a Stockholder? Expectations, Subjective Uncertainty, and Asset Allocation, *Working Paper 2003-039*, Michigan Retirement Research Center.

Khwaja A., Sloan F. A., and Chung S. (2007), The Relationship Between Individual Expectations and Behaviors: Evidence on Mortality Expectations and Smoking Decisions, *Journal of Risk and Uncertainty*, 35: 179–201.

Koissi, M.-C., Shapiro, A. F., and Högnäs, G. (2006), Evaluating and Extending the Lee-Carter Model for Mortality Forecasting: Bootstrap Confidence Interval, *Insurance: Mathematics and Economics*, 38: 1–20.

Lahiri, K., and Sheng, X. (2010), Measuring Forecast Uncertainty by Disagreement: The Missing Link, *Journal of Applied Econometrics*, 25: 514–538.

Lee, R. D. (2000), The Lee-Carter Method for Forecasting Mortality, with Various Extensions and Applications, *North American Actuarial Journal*, 4 80–93.

Lee, R. D., and Carter, L. R. (1992). Modeling and Forecasting U.S. Mortality, *Journal of the American Statistical Association*, 87: 659–675.

Levhari, D., and Mirman, L. (1977), Savings and Consumption with an Uncertain Horizon, *Journal of Political Economy,* 85: 265–281.

Levi, F., F. Lucchini, E. Negri, and C. La Vecchia. 2002. Trends in Mortality from Cardiovascular and Cerebrovascular Diseases in Europe and Other Areas of the World, *Heart* 88: 119–124.

Levi, M., and Makin, J. H. (1979), Fisher, Phillips, Friedman and the Measured Impact of Inflation on Interest, *Journal of Finance*, 34: 35–52.

Levi, M., and Makin, J. H. (1980), Inflation Uncertainty and the Phillips Curve: Some Empirical Evidence, *American Economic Review*, 70: 1022–1027.

Lillard, L. A., and Willis, R. J. (2001), Cognition and Wealth: The Importance of Probabilistic Thinking, *Working Paper WP 2001-007*, Michigan Retirement Research Center.

Makin, J. (1982), Anticipated Money, Inflation Uncertainty, and Real Economic Activity, *Review of Economics and Statistics*, 64: 126–134.

Manski, C., and Molinari, F. (2010), Rounding Probabilistic Expectations in Surveys, *Journal of Business and Economic Statistics*, 28: 219–231.

McAllister, P., Newell, G., and Matysiak, G. (2008), Agreement and Accuracy in Consensus Forecasts of the UK Commercial Property Market, *Journal of Property Research*, 25: 1–22.

Menegatti, M. (2009), Precautionary Saving in the Presence of Other Risks: A Comment, *Economic Theory*, 39: 473–476.

Menoncin, F. (2008), The Role of Longevity Bonds in Optimal Portfolios, *Insurance: Mathematics and Economics*, 42: 343–358.

Mirowsky, J., and Ross, C. E. (2000), Socioeconomic Status and Subjective Life Expectancy, *Social Psychology Quarterly*, 63: 133–151.

Mullineaux, D. J. (1980), Unemployment, Industrial Production and Inflation Uncertainty in the United States, *Review of Economics and Statistics*, 62: 163–169.

Page, Y. (2001), A Statistical Model to Compare Road Mortality in OECD Countries, *Accident Analysis and Prevention*, 33: 371–338.
Perozek, M. (2008), Using Subjective Expectations to Forecast Longevity: Do Survey Respondents Know Something We Don't Know? *Demography* 45: 95–113.
Popham, F., and Mitchell, R., (2007), Self-Rated Life Expectancy and Lifetime Socio-Economic Position: Cross-Sectional Analysis of the British Household Panel Survey, *International Journal of Epidemiology*, 36: 58–65.
Post, T. (2009), Individual Welfare Gains from Deferred Life-Annuities Under Stochastic Mortality, *Working Paper*, Maastricht University.
Rich, R. W., Raymond, J. E., and Butler, J. S. (1992), The Relationship Between Forecast Dispersion and Forecast Uncertainty: Evidence from a Survey Data-ARCH Model, *Journal of Applied Econometrics*, 7: 131–148.
Rich, R. W., and Tracy, J. S. (2006), The Relationship Between Expected Inflation, Disagreement, and Uncertainty: Evidence from Matched Point and Density Forecasts, *Federal Reserve Bank of New York Staff Reports*, 253.
Salm, M. (2010), Subjective Mortality Expectations and Consumption and Saving Behaviours Among the Elderly, *Canadian Journal of Economics*: 43: 1040–1057
Schulze, R. N., and Post, T. (2010), Individual Annuity Demand Under Aggregate Mortality Risk, *Journal of Risk and Insurance*, 77: 423–449.
Shorrocks, A. F. (1980), The Class of Additively Decomposable Inequality Measures, *Econometrica*, 48: 613–625.
Siegel, M., Bradley, E. H., and Kasl, S. V. (2003), Self-Rated Life Expectancy as a Predictor of Mortality: Evidence from the HRS and AHEAD Survey, *Gerontology*, 49: 265–271.
Smith, V. K., Taylor, D. H. Jr., and Sloan, F. A. (2001), Longevity Expectations and Death: Can People Predict Their Own Demise? *American Economic Review*, 91: 1126–1134.
Stevens, R. (2009), Annuity Decisions with Systematic Longevity Risk, *Working Paper*, Tilburg University.
Sullivan, D., and von Wachter, T. (2009), Average Earnings and Long-Term Mortality: Evidence from Administrative Data, *American Economic Review*, 99: 133–138.
Tuljapurkar, S., Li, N., and Boe, C. (2000), A Universal Pattern of Mortality Decline in the G7 Countries, *Nature*, 405: 789–792.
University of California, Berkeley (USA), and Max Planck Institute for Demographic Research (Germany) (2009), Human Mortality Database, available at http//: www.mortality.org (data downloaded on May-18-2009).
Vuchelen, J. (2004), Consumer Sentiment and Macroeconomic Forecasts, *Journal of Economic Psychology*, 25: 493–506.
Winter, J. (2008), Expectations and Attitudes, in: Börsch-Supan, A., Brugiavini, A., Jürges, H., Kapteyn, A., Mackenbach, J., Siegrist, J., and Weber, G. (Eds.), *First Results from the Survey of Health, Ageing and Retirement in Europe (2004–2007)—Starting the Longitudinal Dimension*, Mannheim: MEA, pp. 306–311.
Yaari, M. E. (1965), Uncertain Lifetime, Life Insurance, and the Theory of the Consumer, *Review of Economic Studies*, 32: 137–150.
Zarnowitz, V., and Lambros, L. A. (1987), Consensus and Uncertainty in Economic Prediction, *Journal of Political Economy*, 95: 591–621.
Zhang, X. F. (2006a), Information Uncertainty and Analyst Forecast Behavior, *Contemporary Accounting Research*, 23: 565–590.
Zhang, X. F. (2006b), Information Uncertainty and Stock Returns, *Journal of Finance*, 61: 105–136.

Table 1 Forecast target ages T for respondents at different ages

Current age of respondent, x	Target age, T
≤65	75
66–69	80
70–74	85
75–79	90
80–84	95
85–94	100
95–99	105
100–104	110
105+	120

Notes: This table gives the target age T for which respondents in SHARE estimate their survival probability.

Table 2 Descriptive statistics for the SHARE data

	Country																							
	Austria		Belgium		Czechia		Denmark		France		Germany		Italy		Netherlands		Poland		Spain		Sweden		Switzerland	
	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
	N = 1,290		N = 2,923		N = 2,211		N = 2,437		N = 2,321		N = 2,400		N = 2,723		N = 2,415		N = 2,224		N = 1,757		N = 2,414		N = 1,379	
Demographics																								
Age, *x*	66.04	9.60	63.85	10.48	62.86	9.87	63.06	10.50	63.50	10.64	64.09	9.43	64.72	9.55	63.06	9.78	63.11	9.99	65.21	10.58	65.07	10.02	63.98	10.55
Gender	0.59	0.49	0.54	0.50	0.58	0.49	0.55	0.50	0.57	0.50	0.54	0.50	0.54	0.50	0.55	0.50	0.56	0.50	0.54	0.50	0.53	0.50	0.55	0.50
Couple	0.63	0.48	0.75	0.44	0.71	0.46	0.76	0.43	0.72	0.45	0.81	0.39	0.83	0.38	0.80	0.40	0.77	0.42	0.80	0.40	0.77	0.42	0.72	0.45
Education	2.92	1.32	2.80	1.50	2.50	1.11	3.40	1.41	2.58	1.73	3.41	1.06	1.92	1.23	2.83	1.38	2.28	1.29	1.64	1.36	2.78	1.55	2.93	1.17
Children	2.05	1.40	2.13	1.43	1.97	1.01	2.26	1.27	2.22	1.43	1.96	1.26	2.07	1.29	2.36	1.47	2.58	1.53	2.43	1.62	2.35	1.31	2.10	1.38
Health, Cognition, Preferences																								
Self-Perceived Health	3.02	1.03	2.95	1.01	3.33	0.99	2.54	1.15	3.12	1.01	3.18	1.00	3.26	1.08	2.93	1.04	3.85	0.99	3.40	0.96	2.75	1.18	2.56	1.01
Grip Strength	35.20	11.81	35.68	12.25	36.21	11.52	34.91	12.53	34.25	11.93	37.19	11.67	33.15	11.63	36.20	11.52	33.56	11.91	30.61	11.50	36.79	12.21	35.74	11.39
Smoke Now	0.16	0.37	0.19	0.39	0.53	0.50	0.34	0.47	0.17	0.38	0.22	0.42	0.22	0.42	0.26	0.44	0.49	0.50	0.22	0.41	0.18	0.38	0.27	0.44
Numeracy	3.73	1.02	3.41	1.06	3.56	1.04	3.66	1.11	3.32	1.11	3.75	1.07	2.99	1.06	3.75	1.09	2.98	1.09	2.62	1.04	3.71	1.02	3.87	0.96
Recall	5.47	1.98	5.17	1.77	5.09	1.61	5.69	1.71	4.94	1.71	5.60	1.66	4.53	1.81	5.51	1.69	4.36	1.75	3.83	1.71	5.47	1.68	5.43	1.66
Optimism	9.99	2.13	9.61	2.24	9.96	2.18	10.20	1.84	9.32	2.30	10.12	1.91	9.27	2.54	10.11	1.95	8.27	2.55	9.22	2.62	10.14	1.83	10.27	1.79
Risk Aversion	3.80	0.46	3.67	0.58	3.63	0.57	3.40	0.78	3.73	0.56	3.69	0.55	3.82	0.47	3.68	0.61	3.88	0.42	3.90	0.35	3.30	0.95	3.62	0.62
Trust	5.63	2.31	5.28	2.42	5.76	2.23	7.36	2.07	4.61	2.81	5.37	2.39	4.72	2.72	6.35	2.07	5.16	2.63	5.66	2.29	6.58	2.41	6.52	2.19
Economic Indicators PPP adjusted thousand €																								
Income	38.14	238.13	42.74	220.90	20.39	200.83	32.65	24.68	60.88	337.75	33.37	38.33	37.13	247.20	41.29	49.53	37.76	486.46	79.35	563.67	32.82	24.34	40.15	39.47
Financial Wealth	34.29	104.40	99.18	227.13	12.26	20.46	120.03	243.57	66.97	163.51	54.27	89.18	23.07	53.48	83.43	217.24	14.71	321.95	35.62	88.44	90.80	187.54	145.62	281.10
Net Worth	195.23	288.32	344.13	412.66	196.96	636.92	505.22	1,167.90	392.82	705.76	233.30	411.08	296.06	396.51	417.85	1,093.93	76.59	526.17	337.75	651.83	744.72	3,303.54	475.79	1,207.39
Expectations																								
Forecast Horizon (Survival)	14.79	4.04	16.22	4.81	16.38	4.88	16.50	5.04	16.41	5.03	15.58	4.48	15.42	4.45	16.16	4.63	16.40	4.69	15.69	4.64	15.26	4.29	16.11	4.96
Subj. Survival Probabiliy	0.59	0.30	0.58	0.27	0.43	0.28	0.69	0.30	0.62	0.29	0.60	0.31	0.67	0.30	0.66	0.27	0.48	0.30	0.61	0.31	0.62	0.31	0.66	0.28
Focal Response I	0.21	0.41	0.24	0.43	0.31	0.46	0.19	0.39	0.26	0.44	0.23	0.42	0.19	0.39	0.20	0.40	0.31	0.46	0.19	0.39	0.22	0.42	0.23	0.42
Focal Response II	0.43	0.50	0.38	0.49	0.47	0.50	0.49	0.50	0.45	0.50	0.46	0.50	0.45	0.50	0.37	0.48	0.51	0.50	0.42	0.49	0.47	0.50	0.45	0.50
Chance Living Better	0.23	0.26	0.24	0.28	0.27	0.26	0.31	0.33	0.18	0.25	0.19	0.27	0.34	0.29	0.30	0.29	0.28	0.26	0.37	0.28	0.31	0.30	0.27	0.29
Reduction Pension Amount	0.50	0.33	0.35	0.32	0.42	0.34	0.34	0.35	0.53	0.35	0.47	0.42	0.46	0.35	0.42	0.33	0.36	0.32	0.31	0.31	0.51	0.31	0.44	0.37

Notes: This table presents summary statistics for the selected sample of the SHARE data. Summary statistics are based on the unweighted data. N denotes the number of individual respondents, Std denotes the standard deviation. Variables are defined in Table 3.

Table 3 Definition of variables

Variable	Definition
Age	Age of the respondent
Gender	Gender: 0 = male, 1 = female
Couple	Marital status: 0 = married or in partnership, 1 = otherwise
Education	International Standard Classification of Education (ISCED 97): 0 = no education … 6 = Ph.D.
Children	Number of children
Self-Perceived Health	Self-perceived health ("US version"): 1 = excellent … 5 = poor
Grip Strength	Maximum grip strength measurement of hands
Smoke Now	Smoker at the present time: 0 = no, 1 = yes
Numeracy	Numeracy score (mathematical performance): 1 = bad … 5 = good
Recall	Ten-word listening and recall task: number of words recalled by respondent
Optimism	Optimism index: 0 = not optimistic at all … 12 = very optimistic; the index is based on the SHARE depression index which covers 12 dimensions, including depression, pessimism, suicidality, guilt, sleep deprivation, disinterest in activities, irritability, loss of appetite, fatigue, lack of concentration, enjoyment of activities, tearfulness, and hopes for the future
Risk Aversion	Attitude toward taking financial risks: 1 = Take substantial financial risks when expecting to earn substantial returns, 2 = Take above average financial risks when expecting to earn above average returns, 3 = Take average financial risks when expecting to earn average returns, 4 = Not willing to take any financial risks
Trust	Trust in other people: 0 = you can't be too careful … 10 = most people can be trusted
Income	Total purchasing power adjusted net income of household in Euro, including income from employment, self-employment, pensions, invalidity or unemployment benefits, alimony or other private regular payments, long-term care insurance, housing allowances, child benefits, poverty relief, real estate (incl. imputed rents), land or forestry, and capital income
Financial Wealth	Total purchasing power adjusted financial wealth of household in Euro, including bank accounts, government and corporate bonds, stocks, mutual funds, individual retirement accounts, contractual savings for housing, and life insurance policies
Net Worth	Total purchasing power adjusted net worth of household in Euro, including real assets (real estate, share owned of businesses, cars), financial assets (bank accounts, government and corporate bonds, stocks, mutual funds, individual retirement accounts, contractual savings for housing, and life insurance policies) minus the value of mortgages and financial liabilities
Forecast Horizon	Forecast horizon for the estimation of the subjective survival probability = *T* (as defined in Table 1) minus age
Subjective Survival Probability	Response to the question: "What are the chances that you will live to be age *T* or more?" divided by 100: 0–100%
Focal Response I	Variable indicating a focal response: 0 = no focal response, 1 = respondent reports a 50% chance of survival
Focal Response II	Variable indicating a focal responses: 0 = no focal response, 1 = respondent reports a 0%, 50%, or 100% chance of survival
Chance Living Better	Self-rated chance that standard of living will be better 0–100%
Reduction Pension Amount	Self-rated chance that government will reduce pension income 0–100%
Estimation Error	The subjective survival probability minus the objective estimate of the survival probability divided by the objective probability
Absolute Estimation Error	The absolute value of the estimation error
Group Size	Number of respondents in an age-gender-country-couple group

Table 4 Descriptive statistics for the grouped SHARE/Human Mortality Database data

	Country																							
	Austria		Belgium		Czechia		Denmark		France		Germany		Italy		Netherlands		Poland		Spain		Sweden		Switzerland	
	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
	N = 141		N = 167		N = 158		N = 167		N = 164		N = 142		N = 159		N = 160		N = 150		N = 151		N = 166		N = 146	
Group Size	9.00	6.14	17.37	14.59	13.87	11.27	14.48	13.26	13.99	11.27	16.70	14.54	16.99	15.89	14.96	15.02	14.66	12.53	11.45	9.05	14.37	13.44	9.21	6.48
Age, x	67.84	11.60	67.41	12.89	66.15	12.27	66.95	12.87	67.56	13.17	66.65	11.52	66.69	12.39	67.29	12.36	67.32	11.64	67.88	12.22	68.17	12.62	66.92	12.09
Gender	0.52	0.50	0.52	0.50	0.53	0.50	0.53	0.50	0.53	0.50	0.54	0.50	0.53	0.50	0.54	0.50	0.52	0.50	0.54	0.50	0.51	0.50	0.56	0.50
Couple	0.55	0.50	0.53	0.50	0.54	0.50	0.53	0.50	0.55	0.50	0.56	0.50	0.53	0.50	0.54	0.50	0.53	0.50	0.56	0.50	0.54	0.50	0.57	0.50
Forecast Horizon	15.14	4.82	15.86	5.63	16.16	5.82	15.99	5.66	15.70	5.72	15.57	4.94	15.92	5.51	15.71	5.19	15.35	4.73	15.43	4.83	15.44	5.25	15.79	5.17
Subj. Survival Probabiliy	0.55	0.20	0.53	0.17	0.39	0.15	0.60	0.20	0.55	0.17	0.55	0.19	0.62	0.18	0.59	0.18	0.45	0.14	0.57	0.18	0.53	0.22	0.62	0.19
CV Subj. Estimate	0.56	0.35	0.57	0.35	0.74	0.37	0.54	0.34	0.56	0.33	0.59	0.34	0.49	0.29	0.49	0.27	0.69	0.31	0.58	0.33	0.65	0.43	0.46	0.31
CV Obj. Probability	0.03	0.02	0.04	0.02	0.06	0.04	0.04	0.03	0.04	0.03	0.03	0.02	0.04	0.03	0.03	0.02	0.05	0.03	0.05	0.03	0.03	0.02	0.03	0.02
Relative Estimation Error	0.69	2.95	0.96	3.38	0.50	2.41	1.14	3.72	0.37	1.58	0.28	1.38	0.65	2.65	0.92	2.75	1.23	4.39	0.73	2.45	0.49	1.97	0.56	2.14
Relative Abs. Est. Error	1.16	2.88	1.44	3.35	1.25	2.40	1.52	3.73	0.88	1.57	0.81	1.35	1.06	2.59	1.28	2.67	1.82	4.29	1.24	2.43	1.04	2.04	0.95	2.07

Notes: This table gives the summary statistics for the matched SHARE/Human Mortality Database data set. The data is grouped based on age, gender, country, and couple. N denotes the number of groups, Std denotes the standard deviation, and CV denotes the coefficient of variation. All analyses are restricted to groups containing at least two individuals, which results in different numbers of groups for different countries. Variables are defined in Table 3. For the calculation of group-based measures, the SHARE weights are not applied.

Table 5 Longevity risk awareness

Dependent Variable	CV of Group-Specific Subj. Survival Prob. (1)		CV of Group-Specific Subj. Survival Prob. (2)		CV of Group-Specific Subj. Survival Prob. (3)	
	Coef.	Bootstr. std. err.	Coef.	Bootstr. std. err.	Coef.	Bootstr. std. er
Group Size	-0.001	0.001	-0.001	0.001	-0.001	0.001
Age	0.013	0.017	0.016	0.017	-0.013	0.021
Age^2	0.000	0.000	0.000	0.000	0.000	0.000
Gender	0.026	0.014 *	0.012	0.014	0.000	0.014
Couple	-0.033	0.018 *	-0.024	0.018	-0.027	0.017
Forecast Horizon	0.027	0.009 ***	0.025	0.009 ***	0.020	0.011 *
Forecast $Horizon^2$	0.000	0.000	0.000	0.000	0.000	0.000
CV Obj. Prob.	2.507	0.535 ***	2.345	0.536 ***	2.151	0.561 ***
Std Education			-0.024	0.017	-0.035	0.018 **
Std Self-Perc. Health			-0.008	0.025	-0.023	0.028
CV Grip Strength					-0.042	0.107
Std Smoke Now					-0.044	0.038
Std Numeracy			0.037	0.025	0.028	0.026
Std Recall			0.015	0.015	0.016	0.015
Std Optimism			0.033	0.010 ***	0.043	0.010 ***
Std Risk Aversion					0.001	0.023
CV Income			0.000	0.007	-0.005	0.007
CV Net Worth			0.001	0.005	0.002	0.004
Constant	-0.954	0.624	-1.112	0.648 *	0.081	0.767
N	1,871		1,859		1,602	
Adjusted R^2	0.447		0.450		0.487	

Notes: This table gives the results from regressions of the coefficient of variation of group-specific subjective survival probability on the coefficient of variation of objective survival probabilities and a set of control variables. Models are estimated via OLS. Groups are based on age, gender, country, and couple. N denotes the number of groups, Std denotes the standard deviation, and CV denotes the coefficient of variation. Variables are defined in Table 3. Standard errors are calculated using a bootstrap method with 10,000 replications. Age coefficients are jointly significant at the 1% level in all models. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 6 Longevity risk and the estimation error

Dependent Variable	ln(Group-Specific Abs. Estimation Error) (1)			ln(Group-Specific Abs. Estimation Error) (2)		
	Coef.	Bootstr. std. err.		Coef.	Bootstr. std. er	
Group Size	0.001	0.001		0.001	0.001	
Age	-0.219	0.033	***	-0.226	0.035	***
Age^2	0.002	0.000	***	0.002	0.000	***
Gender	-0.238	0.036	***	-0.472	0.075	***
Couple	0.136	0.036	***	0.149	0.036	***
Forecast Horizon	0.207	0.019	***	0.214	0.021	***
Forecast $Horizon^2$	-0.004	0.000	***	-0.005	0.001	***
CV Obj. Prob.	2.966	1.207	**	2.702	1.261	**
Education	0.001	0.022		-0.004	0.024	
Self-Perc. Health	0.039	0.033		0.029	0.033	
Grip Strength				-0.016	0.004	***
Smoke Now				0.208	0.058	***
Numeracy	0.034	0.034		0.049	0.037	
Recall	-0.007	0.023		0.010	0.025	
Optimism	-0.003	0.018		-0.002	0.018	
Risk Aversion				0.026	0.047	
ln(Income)	-0.108	0.022	***	-0.088	0.022	***
ln(Net Worth)	-0.066	0.018	***	-0.062	0.018	***
Constant	3.624	1.238	***	4.090	1.356	***
N	1,859			1,602		
Adjusted R^2	0.788			0.792		

Notes: This table presents the results from regressions of the log of the group-specific absolute estimation error on the coefficient of variation of objective survival probabilities and a set of control variables. Models are estimated via OLS. Groups are based on age, gender, country, and couple. N denotes the number of groups; CV denotes the coefficient of variation. Variables are defined in Table 3. Standard errors are calculated using a bootstrap method with 10,000 replications. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 7 Longevity risk and the saving behavior: the savings level

Dependent Variable	ln(Net Worth)		ln(Financial Assets)	
	Coef.	Bootstr. std. err.	Coef.	Bootstr. std. err.
Age	0.077	0.312	-0.268	0.527
Age^2	0.000	0.002	0.003	0.004
Gender	-0.296	0.283	-0.202	0.443
Couple	0.576	0.127 ***	0.259	0.127 **
Forecast Horizon	0.115	0.076	0.123	0.108
Forecast $Horizon^2$	-0.002	0.003	-0.003	0.004
Education	-0.024	0.059	0.126	0.073 *
Self-Perc. Health	-0.339	0.095 ***	-0.453	0.106 ***
Grip	-0.015	0.014	-0.008	0.022
Smoke Now	-0.122	0.205	-0.438	0.250 *
Numeracy	-0.021	0.112	0.057	0.119
Recall	-0.065	0.050	0.096	0.072
Optimism	-0.010	0.042	0.023	0.057
Risk Aversion	-0.451	0.129 ***	-0.496	0.146 ***
ln(Income)	0.231	0.069 ***	0.487	0.073 ***
Children	-0.028	0.054	-0.220	0.088 **
Trust	0.047	0.038	0.111	0.043 ***
Chance Living Better	0.098	0.239	-0.509	0.315
Reduction Pension Amount	0.078	0.109	0.214	0.156
Sub. Surv. Prob.	-0.902	1.500	-0.513	1.943
CV Sub. Surv. Prob.	-1.299	2.631	-2.631	3.049
ln(Rel. Abs. Est. Error)	-0.805	0.881	-0.358	1.123
Constant	8.482	11.525	13.958	18.718
N	924		924	
AIC	226		1,134	
BIC	515		1,429	

Notes: This table gives the results for the third equation of the simultaneous equation model for the group-specific savings level (Equation (3.3)). The dependent variables are the log of net worth or the log of financial assets. Models are estimated via three-stage least squares. Groups are based on age, gender, country, and couple. N denotes the number of groups, CV denotes the coefficient of variation. Variables are defined in Table 3. Standard errors are calculated using a bootstrap method with 10,000 replications. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 8 Longevity risk and the saving behavior: the dispersion of savings

Dependent Variable	CV Net Worth		CV Financial Assets	
	Coef.	Bootstr. std. err.	Coef.	Bootstr. std. err.
Age	0.524	0.618	-0.069	0.334
Age^2	-0.004	0.005	0.001	0.003
Gender	0.312	0.207	0.040	0.047
Couple	0.418	0.175 **	0.127	0.045 ***
Forecast Horizon	0.047	0.105	0.042	0.052
$\text{Forecast Horizon}^2$	0.000	0.005	-0.002	0.003
Std Education	-0.006	0.228	0.085	0.058
Std Self-Perc. Health	0.330	0.393	-0.221	0.092 **
CV Grip Strength	-0.278	1.280	0.628	0.333 *
Std Smoke Now	0.878	0.565	0.203	0.127
Std Numeracy	0.595	0.317 *	-0.046	0.079
Std Recall	-0.045	0.131	-0.011	0.049
Std Optimism	-0.046	0.122	0.008	0.042
Std Risk Aversion	0.771	0.402 *	-0.125	0.074 *
CV Income	0.245	0.491	0.089	0.030 ***
Std Children	0.105	0.164	0.065	0.046
Std Trust	-0.159	0.099	0.081	0.029 ***
CV Chance Living Better	0.250	0.219	-0.071	0.054
CV Reduction Pension Amount	-0.187	0.147	0.030	0.042
CV Sub. Surv. Prob.	2.029	2.046	1.073	0.429 **
Constant	-19.141	20.468	2.576	11.010
N	924		924	
AIC	2,524		192	
BIC	2,701		370	

Notes: This table gives the results for the second equation of the simultaneous equation model for the group-specific savings dispersion (Equation (3.5)). The dependent variables are the coefficient of variation of net worth or the coefficient of variation of financial assets. Models are estimated via three-stage least squares. Groups are based on age, gender, country, and couple. N denotes the number of groups, Std denotes the standard deviation, and CV denotes the coefficient of variation. Variables are defined in Table 3. Standard errors are calculated using a bootstrap method with 10,000 replications. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 9 Descriptive statistics for the grouped data under alternative specifications

	Baseline Specification (1)		Lee-Carter 1975 (2)		Alternative Mortality Model (3)		Focal Responses Imputed (4)		Focal Responses Excluded (5)	
	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
	N = 1,871		N = 1,871		N = 1,871		N = 1,871		N = 1,615	
Group Size	14.00	12.67	14.00	12.67	14.00	12.67	14.00	12.67	8.86	7.41
Age, *x*	67.24	12.32	67.24	12.32	67.24	12.32	67.24	12.32	66.47	11.53
Gender	0.53	0.50	0.53	0.50	0.53	0.50	0.53	0.50	0.56	0.50
Couple	0.54	0.50	0.54	0.50	0.54	0.50	0.54	0.50	0.56	0.50
Forecast Horizon	15.68	5.29	15.68	5.29	15.68	5.29	15.68	5.29	15.70	4.99
Subj. Survival Probabiliy	0.55	0.19	0.55	0.19	0.55	0.19	0.54	0.17	0.55	0.19
CV Subj. Estimate	0.58	0.35	0.58	0.35	0.58	0.35	0.49	0.24	0.48	0.29
Focal Response II	0.45	0.20	0.45	0.20	0.45	0.20	0.00	0.00	0.00	0.00
CV Obj. Probability	0.04	0.03	0.03	0.02	0.04	0.03	0.04	0.03	0.04	0.03
Relative Estimation Error	0.71	2.79	0.74	2.96	0.45	2.05	0.87	3.38	0.49	2.30
Relative Abs. Est. Error	1.21	2.75	1.24	2.92	0.99	2.01	1.28	3.28	0.91	2.20

Notes: This table gives the summary statistics for the matched SHARE/Human Mortality Database data set for alternative specifications. The data is grouped based on age, gender, country, and couple. N denotes the number of groups, Std denotes the standard deviation, and CV denotes the coefficient of variation. Variables are defined in Table 3. Baseline Specification = original model specification introduced in Section 2.2; Lee-Carter 1975 = mortality model estimated using data starting in 1975; Alternative Mortality Model = uses the mortality model introduced in Section 4.1; Focal Responses Imputed = all responses indicating a 0%, 50%, or 100% chance of survival imputed; Focal Responses Excluded = all responses indicating a 0%, 50%, or 100% chance of survival removed from the sample. For the calculation of group-based measures, the SHARE weights are not applied.

Table 10 Longevity risk awareness under alternative model specifications

Dependent Variable	Baseline Specification CV of Group-Specific Subj. Survival Prob. (1)		Lee-Carter 1975 CV of Group-Specific Subj. Survival Prob. (2)		Alternative Mortality Model CV of Group-Specific Subj. Survival Prob. (3)		Focal Responses Imputed CV of Group-Specific Subj. Survival Prob. (4)		Focal Responses Excluded CV of Group-Specific Subj. Survival Prob. (5)	
	Coef.	Bootstr. std. err.	Coef.	Bootstr. std. err.	Coef.	Bootstr. std. err.	Coef.	Bootstr. std. err.	Coef.	Bootstr. std. err.
Group Size	-0.001	0.001	-0.001	0.001	-0.001	0.001 **	0.000	0.000	-0.001	0.001
Age	-0.013	0.021	-0.022	0.022	-0.019	0.021	0.020	0.016	0.052	0.019 ***
Age^2	0.000	0.000	0.000	0.000 *	0.000	0.000 *	0.000	0.000	0.000	0.000 *
Gender	0.000	0.014	-0.014	0.013	-0.021	0.012 *	-0.004	0.011	-0.006	0.014
Couple	-0.027	0.017	-0.025	0.017	-0.021	0.017	-0.034	0.013 ***	-0.010	0.016
Forecast Horizon	0.020	0.011 *	0.028	0.010 ***	0.026	0.010 ***	-0.017	0.009 *	-0.017	0.013
Forecast $Horizon^2$	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000 **	0.001	0.000 ***
CV Obj. Prob.	2.151	0.561 ***	2.161	0.481 ***	3.229	0.462 ***	1.582	0.384 ***	1.560	0.589 ***
Std Education	-0.035	0.018 **	-0.034	0.018 *	-0.032	0.018 *	-0.005	0.013	0.007	0.015
Std Self-Perc. Health	-0.023	0.028	-0.027	0.028	-0.021	0.027	-0.004	0.022	0.009	0.024
CV Grip Strength	-0.042	0.107	-0.040	0.106	-0.044	0.105	0.037	0.074	-0.062	0.086
Std Smoke Now	-0.044	0.038	-0.051	0.038	-0.067	0.037 *	0.018	0.028	-0.001	0.031
Std Numeracy	0.028	0.026	0.028	0.026	0.033	0.026	-0.016	0.022	0.032	0.023
Std Recall	0.016	0.015	0.014	0.015	0.011	0.015	0.006	0.012	-0.001	0.014
Std Optimism	0.043	0.010 ***	0.041	0.010 ***	0.042	0.010 ***	0.041	0.008 ***	0.047	0.008 ***
Std Risk Aversion	0.001	0.023	0.000	0.022	0.007	0.022	-0.010	0.017	-0.017	0.020
CV Income	-0.005	0.007	0.000	0.006	0.004	0.006	-0.002	0.005	-0.011	0.011
CV Net Worth	0.002	0.004	0.001	0.004	0.001	0.003	0.001	0.002	0.001	0.003
Constant	0.081	0.767	0.257	0.788	0.299	0.771	-0.511	0.593	-1.940	0.667 ***
N	1,602		1,602		1,602		1,602		1,316	
Adjusted R^2	0.487		0.492		0.503		0.392		0.373	

Notes: This table gives the results from regressions of the coefficient of variation of group-specific subjective survival probability on the coefficient of variation of objective survival probabilities and a set of control variables for alternative specifications. Models are estimated via OLS. Groups are based on age, gender, country, and couple. N denotes the number of groups, Std denotes the standard deviation, and CV denotes the coefficient of variation. Variables are defined in Table 3. Standard errors are calculated using bootstrap method with 10,000 replications. Baseline Specification = original model specification introduced in Section 2.2; Lee-Carter 1975 = mortality model estimated using data starting in 1975; Alternative Mortality Model = uses the mortality model introduced in Section 4.1; Focal Responses Imputed = all responses indicating a 0%, 50%, or 100% chance of survival imputed; Focal Responses Excluded = all responses indicating a 0%, 50%, or 100% chance of survival removed from the sample. Age coefficients are jointly significant at the 1% level in all models. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 11 Longevity risk and the estimation error for alternative model specifications

Dependent Variable	Baseline Specification ln(Group-Specific Abs. Estimation Error) (1)		Lee-Carter 1975 ln(Group-Specific Abs. Estimation Error) (2)		Alternative Mortality Model ln(Group-Specific Abs. Estimation Error) (3)		Focal Responses Imputed ln(Group-Specific Abs. Estimation Error) (4)		Focal Responses Excluded ln(Group-Specific Abs. Estimation Error) (5)	
	Coef.	Bootstr. std. err.	Coef.	Bootstr. std. err.	Coef.	Bootstr. std. err.	Coef.	Bootstr. std. err.	Coef.	Bootstr. std. err.
Group Size	0.001	0.001	0.001	0.001	0.000	0.001	0.000	0.001	0.007	0.002 ***
Age	-0.226	0.035 ***	-0.232	0.038 ***	-0.341	0.037 ***	-0.232	0.039 ***	-0.067	0.052
Age^2	0.002	0.000 ***	0.002	0.000 ***	0.003	0.000 ***	0.002	0.000 ***	0.001	0.000 ***
Gender	-0.472	0.075 ***	-0.529	0.074 ***	-0.032	0.071	-0.394	0.084 ***	-0.314	0.088 ***
Couple	0.149	0.036 ***	0.158	0.037 ***	0.080	0.033 **	0.142	0.041 ***	0.174	0.046 ***
Forecast Horizon	0.214	0.021 ***	0.244	0.020 ***	0.222	0.018 ***	0.269	0.024 ***	0.208	0.030 ***
$\text{Forecast Horizon}^2$	-0.005	0.001 ***	-0.005	0.001 ***	-0.006	0.001 ***	-0.006	0.001 ***	-0.003	0.001 ***
CV Obj. Prob.	2.702	1.261 **	-0.974	0.933	3.895	0.978 ***	0.430	1.345	0.716	1.633
Education	-0.004	0.024	-0.003	0.025	-0.051	0.026 **	-0.027	0.028	-0.019	0.028
Self-Perc. Health	0.029	0.033	0.030	0.034	0.066	0.034 *	0.057	0.034 *	0.122	0.035 ***
Grip Strength	-0.016	0.004 ***	-0.019	0.004 ***	-0.001	0.004	-0.010	0.005 **	-0.007	0.005
Smoke Now	0.208	0.058 ***	0.256	0.059 ***	0.191	0.054 ***	0.269	0.065 ***	0.232	0.072 ***
Numeracy	0.049	0.037	0.048	0.037	-0.007	0.036	0.043	0.042	0.080	0.046 *
Recall	0.010	0.025	0.016	0.025	0.012	0.024	0.020	0.028	-0.015	0.027
Optimism	-0.002	0.018	0.005	0.018	0.004	0.017	-0.014	0.018	-0.041	0.019 **
Risk Aversion	0.026	0.047	0.019	0.049	-0.013	0.046	0.000	0.058	0.055	0.048
ln(Income)	-0.088	0.022 ***	-0.097	0.022 ***	-0.046	0.021 **	-0.073	0.023 ***	-0.118	0.031 ***
ln(Net Worth)	-0.062	0.018 ***	-0.064	0.021 ***	-0.031	0.018 *	-0.072	0.020 ***	-0.086	0.022 ***
Constant	4.090	1.356 ***	3.952	1.459 ***	7.250	1.438 ***	3.342	1.507 **	-2.055	1.931
N	1,602		1,602		1,602		1,602		1,316	
Adjusted R^2	0.792		0.784		0.764		0.774		0.705	

Notes: This table presents the results from regressions of the log of the group-specific absolute estimation error on the coefficient of variation of objective survival probabilities and a set of control variables for alternative specifications. Models are estimated via OLS. Groups are based on age, gender, country, and couple. N denotes the number of groups; CV denotes the coefficient of variation. Variables are defined in Table 3. Standard errors are calculated using a boot method with 10,000 replications. Baseline Specification = original model specification introduced in Section 2.2; Lee-Carter 1975 = mortality model estimated using data starting in 1975; Alternative Mortality Model = uses the mortality model introduced in Section 4.1; Focal Responses Imputed = all responses indicating a 0%, 50%, or 100% chance of survival imputed; Focal Responses Excluded = all responses indicating a 0%, 50%, or 100% chance of survival removed from the sample. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 12 Longevity risk and the saving behavior: the savings level under alternative specifications

Dependent Variable	Baseline Specification ln(Financial Assets) (1)		Lee-Carter 1975 ln(Financial Assets) (2)		Alternative Mortality Model ln(Financial Assets) (3)		Focal Responses Imputed ln(Financial Assets) (4)		Focal Responses Excluded ln(Financial Assets) (5)	
	Coef.	Bootstr. std. err.	Coef.	Bootstr. std. err.	Coef.	Bootstr. std. err.	Coef.	Bootstr. std. err.	Coef.	Bootstr. std. err.
Age	-0.268	0.527	-0.358	0.537	-0.764	0.825	-0.927	0.744	-0.617	0.639
Age^2	0.003	0.004	0.003	0.004	0.006	0.006	0.007	0.006	0.005	0.005
Gender	-0.202	0.443	-0.188	0.395	-0.041	0.450	0.171	0.383	0.599	0.432
Couple	0.259	0.127 **	0.222	0.122 *	0.190	0.134	0.643	0.261 **	0.621	0.262 **
Forecast Horizon	0.123	0.108	0.145	0.105	0.152	0.184	0.242	0.182	0.172	0.185
$\text{Forecast Horizon}^2$	-0.003	0.004	-0.003	0.004	-0.006	0.007	-0.010	0.007	-0.008	0.006
Education	0.126	0.073 *	0.133	0.073 *	0.173	0.119	0.174	0.091 *	0.091	0.084
Self-Perc. Health	-0.453	0.106 ***	-0.428	0.103 ***	-0.596	0.169 ***	-0.494	0.131 ***	-0.295	0.125 **
Grip	-0.008	0.022	-0.006	0.021	0.000	0.023	-0.005	0.021	0.024	0.022
Smoke Now	-0.438	0.250 *	-0.406	0.245 *	-0.731	0.243 ***	-0.524	0.244 **	-0.594	0.275 **
Numeracy	0.057	0.119	0.046	0.111	0.228	0.141	0.252	0.139 *	0.127	0.126
Recall	0.096	0.072	0.098	0.073	0.023	0.092	-0.035	0.093	0.092	0.080
Optimism	0.023	0.057	0.006	0.060	-0.011	0.061	0.041	0.064	0.128	0.096
Risk Aversion	-0.496	0.146 ***	-0.465	0.154 ***	-0.196	0.202	-0.644	0.152 ***	-0.848	0.175 ***
ln(Income)	0.487	0.073 ***	0.480	0.070 ***	0.460	0.076 ***	0.501	0.082 ***	0.619	0.142 ***
Children	-0.220	0.088 **	-0.206	0.086 **	-0.361	0.096 ***	-0.286	0.101 ***	-0.292	0.114 **
Trust	0.111	0.043 ***	0.119	0.044 ***	0.105	0.043 **	0.014	0.057	0.014	0.050
Chance Living Better	-0.509	0.315	-0.480	0.303	-0.596	0.385	-0.492	0.347	-0.761	0.442 *
Reduction Pension Amount	0.214	0.156	0.240	0.151	0.330	0.217	0.319	0.219	0.357	0.228
Sub. Surv. Prob.	-0.513	1.943	-0.478	1.464	3.172	4.366	15.095	6.768 **	10.209	5.226 *
CV Sub. Surv. Prob.	-2.631	3.049	-3.372	2.813	-6.434	4.027	15.630	7.758 **	12.785	4.868 ***
ln(Rel. Abs. Est. Error)	-0.358	1.123	-0.311	1.125	3.158	1.604 **	-1.069	1.369	-1.412	1.348
Constant	13.958	18.718	16.581	18.726	34.281	28.386	19.673	20.044	10.895	19.444
N	924		924		924		924		744	
AIC	1,134		1,171		1,458		1,379		1,932	
BIC	1,429		1,465		1,752		1,674		2,213	

Notes: This table gives the results for the third equation of the simultaneous equation model for the group-specific savings level (Equation (3.3)) for alternative specifications. The dependent variable is the log of financial assets. Models are estimated via three-stage least squares. Groups are based on age, gender, country, and couple. N denotes the number of groups; CV denotes the coefficient of variation. Variables are defined in Table 3. Standard errors are calculated using a bootstrap method with 10,000 replications. Baseline Specification = original model specification introduced in Section 2.2; Lee-Carter 1975 = mortality data model estimated using data starting in 1975; Alternative Mortality Model = uses the mortality model introduced in Section 4.1; Focal Responses Imputed = all responses indicating a 0%, 50%, or 100% chance of survival imputed; Focal Responses Excluded = all responses indicating a 0%, 50%, or 100% chance of survival removed from the sample.*, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 13 Longevity risk and the saving behavior: the dispersion of savings under alternative specifications

Dependent Variable	Baseline Specification CV Financial Assets (1)		Lee-Carter 1975 CV Financial Assets (2)		Alternative Mortality Model CV Financial Assets (3)		Focal Responses Imputed CV Financial Assets (4)		Focal Responses Excluded CV Financial Assets (5)	
	Coef.	Bootstr. std. err.	Coef.	Bootstr. std. err.	Coef.	Bootstr. std. err.	Coef.	Bootstr. std. err.	Coef.	Bootstr. std. err.
Age	-0.069	0.334	-0.089	0.339	-0.051	0.331	0.015	0.323	-0.022	0.559
Age^2	0.001	0.003	0.001	0.003	0.000	0.002	0.000	0.002	0.000	0.004
Gender	0.040	0.047	0.046	0.045	0.024	0.046	0.037	0.045	0.070	0.043
Couple	0.127	0.045 ***	0.135	0.045 ***	0.110	0.042 ***	0.164	0.050 ***	0.137	0.046 ***
Forecast Horizon	0.042	0.052	0.045	0.052	0.041	0.049	0.037	0.049	0.019	0.087
Forecast $Horizon^2$	-0.002	0.003	-0.002	0.003	-0.001	0.003	-0.001	0.003	-0.001	0.004
Std Education	0.085	0.058	0.100	0.058 *	0.056	0.054	0.061	0.056	0.026	0.053
Std Self-Perc. Health	-0.221	0.092 **	-0.218	0.095 **	-0.223	0.086 ***	-0.208	0.092 **	-0.080	0.077
CV Grip Strength	0.628	0.333 *	0.626	0.339 *	0.634	0.318 **	0.662	0.326 **	0.435	0.306
Std Smoke Now	0.203	0.127	0.207	0.131	0.183	0.120	0.249	0.131 *	0.052	0.105
Std Numeracy	-0.046	0.079	-0.051	0.082	-0.036	0.073	-0.013	0.076	-0.064	0.075
Std Recall	-0.011	0.049	-0.009	0.049	-0.012	0.046	-0.010	0.047	0.014	0.048
Std Optimism	0.008	0.042	-0.001	0.039	0.032	0.036	0.023	0.035	0.003	0.034
Std Risk Aversion	-0.125	0.074 *	-0.115	0.076	-0.143	0.069 **	-0.168	0.062 ***	-0.035	0.062
CV Income	0.089	0.030 ***	0.088	0.030 ***	0.091	0.030 ***	0.086	0.030 ***	0.174	0.056 ***
Std Children	0.065	0.046	0.055	0.045	0.058	0.044	0.071	0.046	0.081	0.041 **
Std Trust	0.081	0.029 ***	0.079	0.029 ***	0.077	0.029 ***	0.085	0.029 ***	0.041	0.030
CV Chance Living Better	-0.071	0.054	-0.068	0.054	-0.085	0.055	-0.080	0.054	-0.073	0.059
CV Reduction Pension Amount	0.030	0.042	0.044	0.041	0.040	0.041	0.025	0.042	0.033	0.053
CV Sub. Surv. Prob.	1.073	0.429 **	1.244	0.391 ***	0.705	0.327 **	1.180	0.421 ***	0.860	0.323 ***
Constant	2.576	11.010	3.213	11.163	1.940	10.921	-0.507	10.677	1.352	18.028
N	924		924		924		924		744	
AIC	192		182		151		34		258	
BIC	370		360		328		212		426	

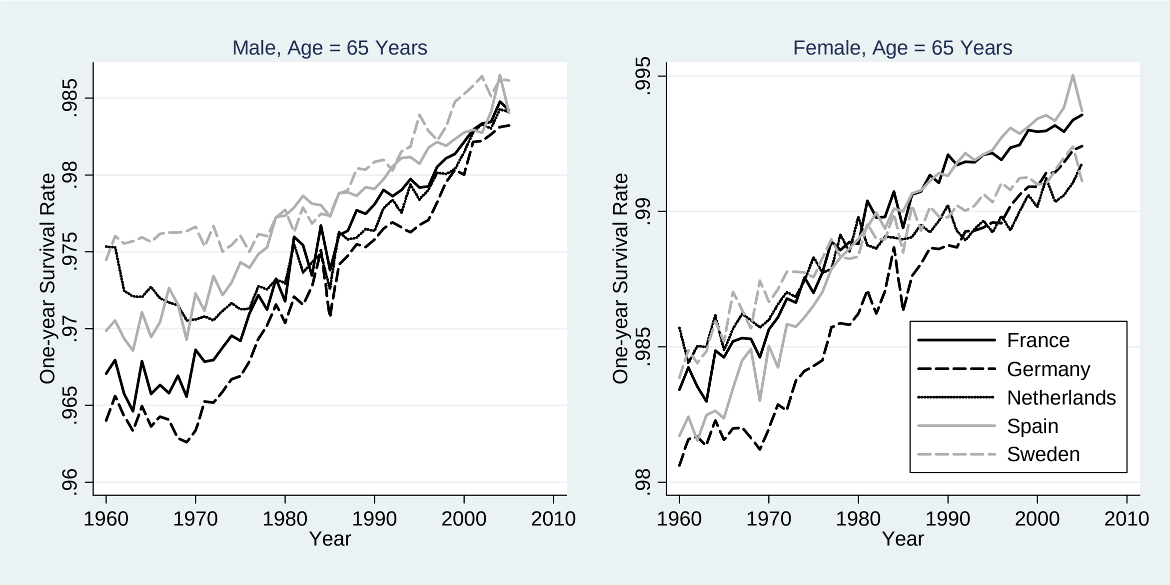
Notes: This table presents the results for the second equation of the simultaneous equation model for the group-specific savings dispersion (Equation (3.5)) for alternative specifications. The dependent variable is the coefficient of variation of financial assets. Models are estimated via three-stage least squares. Groups are based on age, gender, country, and couple. N denotes the number of groups, Std denotes the standard deviation, and CV denotes the coefficient of variation. Variables are defined in Table 3. Standard errors are calculated using a bootstrap method with 10,000 replications. Baseline Specification = original model specification introduced in Section 2.2; Lee-Carter 1975 = mortality model estimated using data starting in 1975; Alternative Mortality Model = mortality model introduced in Section 4.1; Focal Responses Imputed = all responses indicating a 0%, 50%, or 100% chance of survival imputed; Focal Responses Excluded = all responses indicating a 0%, 50%, or 100% chance of survival removed from the sample. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 14 Longevity risk awareness: an alternative proxy

Dependent Variable	% Group-Specific Focal Responses	
	Coef.	Bootstr. std. err.
Group Size	0.000	0.000
Age	-0.014	0.013
Age^2	0.000	0.000
Gender	0.066	0.030 **
Couple	0.002	0.014
Forecast Horizon	-0.009	0.008
Forecast $Horizon^2$	0.000	0.000
CV Obj. Prob.	1.529	0.399 ***
Education	0.003	0.010
Self-Perc. Health	-0.026	0.014 *
Grip Strength	0.002	0.002
Smoke Now	0.018	0.028
Numeracy	0.009	0.015
Recall	-0.008	0.010
Optimism	0.000	0.007
Risk Aversion	-0.034	0.020 *
ln(Income)	-0.012	0.010
ln(Net Worth)	-0.012	0.008
Constant	1.451	0.520 ***
N	1,602	
Adjusted R^2	0.016	

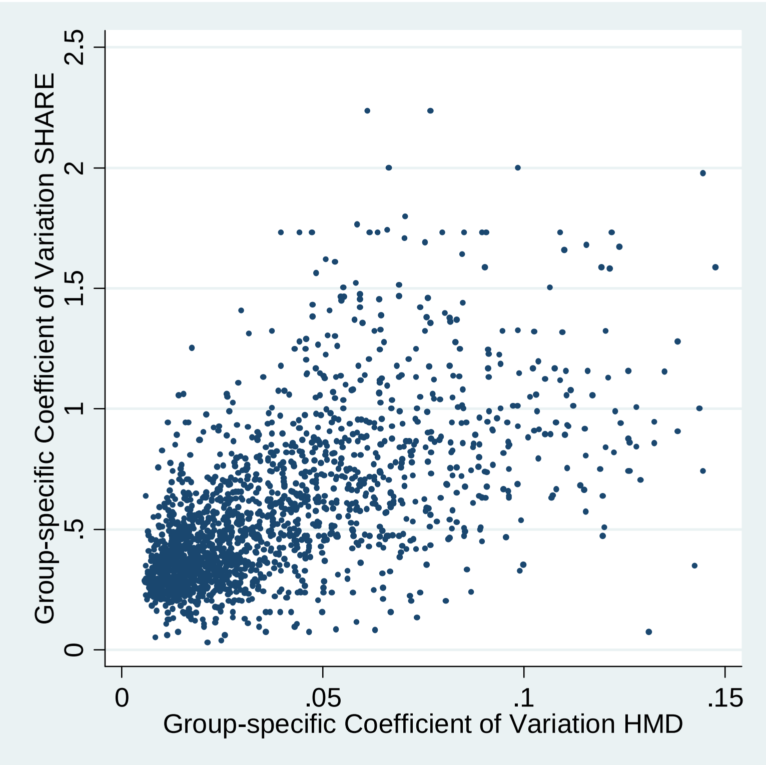
Notes: This table presents the results from regressions of the percentage of group-specific focal responses on the coefficient of variation of objective survival probabilities and a set of control variables. Focal responses encompass all responses indicating a 0%, 50%, or 100% chance of survival. In this model, the control variables are included in their levels because the dependent variable is a level variable as well. The model is estimated via OLS. Groups are based on age, gender, country, and couple. N denotes the number of groups; CV denotes the coefficient of variation. Variables are defined in Table 3. Standard errors are bootstrapped with 10,000 replications. Age coefficients are not jointly significant. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Figure 1 Trends in the mortality decline: one-year realized survival rates



Notes: Mortality data is from the Human Mortality Database.

Figure 2 Longevity risk awareness



Notes: This scatter plot shows the group-specific coefficients of variation of the objective survival probability forecasts based on data from the Human Mortality Database (HMD) versus the group-specific coefficients of variation of the subjective estimates elicited in SHARE. Each point represents one group of individuals with certain characteristics in the dimensions of age, gender, country, and couple.

Figure 3 Conceptual links underlying the research hypotheses related to saving-behavior