Saving Regret:

Procrastination and Unexpected Shocks

Axel Börsch-Supan
MEA, TUM and NBER

Tabea Bucher-Koenen
ZEW, MEA and NETSPAR

Michael D. Hurd
RAND, NBER and NETSPAR

Susann Rohwedder*
RAND and NETSPAR

February 2020

ABS
boersch-supan@mea.mpisoc.mpg.de
Max Planck Institute for Social Law and Social Policy
Amalienstraße 33, 80799 Munich, Germany
TBK
tabea.bucher-koenen@zew.de
Zentrum für Europäische Wirtschaftsforschung
L 7, 1, 68161 Mannheim, Germany
MDH
mhurd@rand.org
RAND Corporation, 1776 Main Street, Santa Monica, CA, 90407-2138
**SR: Susann Rohwedder is corresponding author.*
susannr@rand.org
RAND Corporation, 1776 Main Street, Santa Monica, CA, 90407-2138

Abstract

We define saving regret as the wish in hindsight to have saved more earlier in life. We measured saving regret in the U.S. in a survey of those aged 60-79 and found that it is strongly related to financial position, suggesting the measure's validity. Some 58% express saving regret. We investigate two main causes of saving regret: procrastination along with other psychological traits, and the role of shocks, both positive and negative. Persons with traits associated with procrastination express saving regret about as often as those without those traits. Shocks accumulated over a lifetime such as unemployment, health and divorce explain much more of the variation. More than 50 percent of the respondents recall experiencing such shocks which suggests that uncertainty and the lack of complete insurance are empirically important for wealth determination.

Introduction and Literature

A large body of literature advocates paternalistic nudging to foster saving, especially to provide for old age (Thaler 1994; Laibson 1997, 1998; Thaler and Sunstein 2003, 2009; Lewis 2008; Chetty et al. 2014). One prominent justification for these approaches is the belief that many people procrastinate when it comes to saving decisions and that individuals' preferred choice, in hindsight, would be to have saved more than they actually did.

There is little empirical evidence on the saving behavior that individuals wished they had chosen in hindsight, nor do we know much about how strongly procrastination affects regret over past saving decisions. To fill this empirical gap, we fielded a survey in the RAND American Life Panel. We asked persons aged 60 to 79 whether they would have saved differently earlier in their lives if they could redo their spending and saving. We realize that it is easy for respondents to *wish* they had saved more: no difficult action such as reducing consumption is required. We have taken care in our survey design to reduce such "cheap talk," and one goal of our analyses of the data is to establish the face validity of our regret measures by relating them to other measures that reflect the actual financial situation. Thus, we measured wealth, income, living standard, psychological and social factors; we found that saving regret varies plausibly with those characteristics. For example, high-wealth and high-income people have below-average levels of saving regret.

To address directly the role of procrastination we asked respondents to evaluate themselves on their planning behavior and motivations. Several questions asked directly about procrastination, such as "*How often do you put things off you should do but aren't really interested in?*" Other questions asked about time horizon or discounting, such as "*Do you agree or disagree with the following statements? People should do what they like today rather than putting it off until tomorrow.*" In total, we posed 19 self-assessments.

Overall 58.5 percent of the population aged 60 to 79 wished they had saved more. However, when we related the likelihood of expressing saving regret to the psychometric variables such as measures of procrastination and additional similar psychological

factors, we found that they had limited explanatory power for saving regret. That is, although population levels of saving regret are high, individuals who characterize themselves as procrastinators have about the same level of regret as those who do not. A main conclusion from our evidence on saving regret and its correlates is that our psychometric variables measuring personality traits associated with procrastination contribute relatively little to the explained variation in saving regret, and there are few consistent patterns in how regret varies with them. In particular, direct measures of procrastination have very little explanatory power for regret.

An alternative explanation for the rather high levels of saving regret has to do with shocks. We asked respondents whether during their lifetimes they had experienced negative surprises that caused their finances to turn out worse than expected. Similarly we asked them about positive shocks. We particularly wanted respondents to think about unexpected events rather than bad (or good) events that were fully anticipated.[1] We found that more than half of the respondents had a negative shock such as unemployment, health shock, or divorce. Less than half had a positive shock. Whether someone had a shock has substantial explanatory power for saving regret. The results point to a major role for shocks, the magnitude of their effects and the uncertainty people may have about their probability distributions.

Saving decisions are made in an uncertain environment. A body of research suggests that depending on the domain many individuals are able to form subjective probabilities that have predictive power for the (future) actual outcomes.[2] But, even if individuals correctly assess the probability of facing a major shock and save optimally, in a world with imperfect insurance, those who experience negative shocks may wish, after the fact, that they had saved more because of being under-insured.

In other domains, however, individuals may lack information or the motivation to form beliefs about the likelihood of some or even most adverse events such as the lifetime risk of prolonged unemployment, divorce, or a health shock. In that case,

[1] Of course, individuals may probabilistically anticipate a stochastic event, but unless the subjective probability is close to one, the realization will have a surprise component.
[2] See Hurd (2009) for a review.

working out an optimal saving plan and the appropriate insurance is difficult if not impossible. Such individuals are also likely to express saving regret should they experience a negative shock.

The difficulty of managing the complexities of intertemporal decisions and the inherent uncertainties may be aggravated for some by lack of financial knowledge and relevant cognitive skills such as the ability to think probabilistically. Indeed, we document that saving regret is correlated with indicators of suboptimal financial decision making, such as a short financial planning horizon, low financial literacy, and difficulties with the laws of probabilities.

There are thus many potential reasons why individuals express saving regret at older ages. Apart from cheap talk, the reasons may be procrastinating behavior or the effect of a shock. In turn, shock-related saving regret may be due to the benefit of hindsight after the realization of a shock, due to the lack of information or motivation to form beliefs about adverse shocks, or due to the lack of financial knowledge and relevant cognitive skills that would have resulted in better outcomes. These reasons are not mutually exclusive. One aim of this paper is to separate these reasons as far as our data permit.

A better understanding of the role of shocks in saving decisions is important since the lifetime risk of consequential negative events is sizeable: estimates from the NLSY79 of the population-based observed risks show that baby boomers experienced an average of 5.6 periods of unemployment from age 18 to age 48 and had an almost 70 percent likelihood of experiencing at least three periods of unemployment during that span (U.S. Bureau of Labor Statistics 2018). The probability of divorce within 20 years after first marriage was 48 percent for women and 44 percent for men in 2006-2010 (Copen et al. 2012). We know of no data on individuals' subjective beliefs about the lifetime likelihood of such major adverse life events,[3] but one piece of evidence is that individuals tend to be overly optimistic with respect to their own health risks (Weinstein 1980;

[3] The recent OECD "Risks that matter" survey (OECD 2018) emphasizes the main life-course risks (unemployment, divorce, disability) but does not provide subjective probabilities for these events.

Dunning, Heath and Suls 2004).

Misperceptions of the probabilities of important events and/or an underestimation of the consequences of the events have been studied in the psychology literature. *Over-optimism* is "expecting future outcomes that are better than reasonably likely" (Shepperd, Pogge, and Howell 2017) and is documented widely beginning with Weinstein (1980). When individuals update their beliefs more in response to good news than to bad news, they may fail to prepare for potential future problems or take too much risk.

Jefferson, Bortolotti, and Kuzmanovic (2017) point to the *illusion of control*, which is an exaggerated belief in one's capacity to control independent, external events, and to the *better than average effect* (also called the superiority illusion), which is the perception of oneself, one's past behavior, and one's lasting features as more positive than is the case. Thus, even if individuals know in principle that risks are present, they may underestimate the probability that a negative event will happen to them personally either because they have a superiority illusion, or because they hold unrealistic beliefs about their level of control over external events.

Overconfidence and related phenomena may also increase an individual's propensity to underestimate the probability of shocks and/or the negative consequences of the shocks. Literature reviews conducted by Barberis and Thaler (2003) and Dunning, Heath and Suls (2004) found that overconfidence can lead an individual to think incorrectly that they can control both the occurrence and the consequences of a shock, thus leading them to assign too little likelihood to very costly outcomes.

There is a large literature on whether households have under saved. In the U.S. where public pension benefits are relatively low and private pensions are increasingly of the defined contribution type, many economists argue that households under save (Laibson et al.1998; Madrian and Shea 2001; Poterba, Venti, and Wise 2011; Stanford Center on Longevity 2016). But, this view is not undisputed. Scholz, Seshadri, and Khitatrakun (2006) argue that 80 percent of U.S. households are saving at least as much as an augmented life-cycle model would predict, and that the saving gap for the remaining 20 percent is small. Hurd and Rohwedder (2012) estimate that 75 percent of retirees have sufficient savings to reach the end of their lives with positive wealth. Börsch-Supan et al.

(2001), Brugiavini and Padula (2001), and Kitamura, Takayama, and Arita (2003) have argued that the older cohorts in Germany, Italy, and Japan, respectively, have actually *over saved,* given the generous public pension levels that these cohorts can still enjoy.

While our data do not allow us to measure the extent of under or over saving, the large proportion of individuals who wished they had saved more signals that there may be reasons to worry about saving adequacy. However, identifying these reasons is not a straightforward task since whether asset levels are adequate at retirement does not, by itself, indicate the relative importance of procrastination or shocks. This has been pointed out by Gabaix and Laibson (2017) who provide a model in which personal characteristics such as patience or procrastination and prediction errors about future shocks can lead to observationally equivalent behavioral outcomes. A contribution of this paper is that we have obtained indicators for procrastination and life-time shocks which permit us to separate the two explanations, potentially distinguishing these causes for low wealth at retirement.

This distinction matters for public policy. If the root cause is shocks accompanied by misperceptions of the likelihood of the shocks, the preferred policy course might involve information and education to help individuals better assess the probability of major life-course events. Another option would be to strengthen social insurance against unemployment and work disability. However, if the root cause is procrastination, more appropriate policies would likely involve automatic enrollment in retirement accounts or even mandatory saving programs. Since these causes are not mutually exclusive, a policy mix may be optimal.

This paper also provides evidence about an appropriate way to model saving decisions. The life-cycle hypothesis of Modigliani and Brumberg (1954) is the most widely used model to describe how people make such decisions. It has been extended to include uncertainty about income and mortality (Skinner 1988; Yaari 1965). An early alternative model is based on myopia and time inconsistency (Strotz 1955; Phelps and Pollak 1968; Pollak 1968) and has later been framed as a model of insufficient self-control (Thaler and Shefrin 1981; O'Donoghue and Rabin 1999; Rabin 2013a & b) and of hyperbolic discounting (Laibson 1997, 1998). Our finding of wide-spread saving regret is

compatible with a life-cycle model augmented by the presence of major life-course shocks which cannot be insured and also by prediction errors or even an inability to form coherent probability distributions of the shocks.

I. Theoretical Framework

Our analysis of the data is guided by the framework depicted in Figure 1, which illustrates two broad sets of mechanisms (represented by the arrows B and C) governing the accumulation of wealth at older ages. Accumulated wealth, in turn, is an important determinant of saving regret (represented by Arrow A).

One set of mechanisms (Arrow B) illustrates how psychological factors, which are relatively stable over time ("personality"),[4] affect wealth. Some of these factors, such as conscientiousness and planning time horizon, may be labelled "positive" because they lead to positive lifetime outcomes, while others, such as impulsiveness, may be labelled "negative" because they lead to negative outcomes. Psychological factors influence how consistently decisions are made; how consistently plans are followed; whether people procrastinate or not; whether they invest in financial literacy (Bucher-Koenen and Lusardi 2011; Lusardi and Mitchell 2014); and how well they are informed about Social Security benefits (Chan and Stevens 2008; Lamla and Gasche 2013) and life expectancy (Smith, Taylor, and Sloan 2001). Psychological factors are also important determinants of life-cycle choices such as education, career and savings rates, and therefore of accumulated wealth at older ages. Psychological factors may also have a direct effect on the way individuals perceive their current economic situation (Arrow D), e.g., an

[4] Personality has been found to be largely rank-order stable in later adulthood (Deary et al. 2000; Anusic and Schimmack 2016; Roberts and DelVecchio 2000; Cobb-Clark and Schurer 2012; Lucas and Donnellan 2011), that means that while personality may change somewhat with age, the ranking of individuals in the population will be preserved so that those who scored high along some factor will continue to score high relative to others. There is some evidence, however, that certain major life events can affect personality (Löckenhoff et al. 2009; Specht, Egloff and Schmukle 2011). Yet, Cobb-Clark and Schurer (2012) found that intra-individual changes in personality are generally unrelated to adverse life events and small in magnitude.

optimistic individual may see less reason for regret than a pessimistic individual with the same amount of wealth.

[Figure 1 about here]

The second set of determinants of old-age wealth (Arrow C) represents external factors or events that impinge on individuals, particularly positive or negative "shocks." Unanticipated shocks on the individual level might include, for example, unemployment, health problems, and divorce. They may be unanticipated due to lack of knowledge (e.g., insufficient information about Social Security and pension benefits) or computational ability (e.g., low level of cognition and/or numeracy). They may be probabilistically anticipated but the actual realization is a shock. Such shocks affect wealth in positive and negative ways and, thus, via wealth, affect the prevalence of saving regret. It is less clear whether shocks directly affect regret after an individual takes the shock-induced change in wealth into account (represented by the dashed Arrow E).

Both types of deviations from a simple life-cycle model interact. Individuals with a preponderance of positive traits are likely to pursue behaviors that increase the probability of positive events and reduce the probability of negative events (Arrow F).[5] By virtue of accumulating higher savings, such individuals are better able to buffer the effects of negative shocks on wealth (Arrow C). However, the effects of shocks can lead to changes in personality (Arrow G), so causality can run in both directions.[6,7]

The theoretical framework illustrates how an individual could deviate from the conventional life-cycle model.

1. The individual procrastinates, i.e., sets up a life plan according to the life-cycle model but then fails to execute this plan by postponing saving in favor of higher consumption. Such a self-control problem constitutes a form of time-inconsistent

[5] See for example Hampson (2017) for a review of the relationship between personality and health.
[6] Reverse causality may also be present in the mechanisms that are represented by arrows B and C. For example, being wealthy may reduce the size and probability of shocks by living in a healthier environment (Currie et al. 2015).
[7] See Bleidorn, Hopwood and Lucas (2018) for an overview of the psychology literature and empirical findings on life events and personality change.

behavior which persists over time and leads to saving regret in hindsight.

2. The individual faces uncertainty over the future income path. He or she could underestimate the probability of shocks that cause deviations from the average income path.[8] While the precautionary saving motive would increase saving in the face of uncertainty, underestimating the probability and the effect of shocks will yield lower than optimal savings levels, which individuals then regret at older ages. An extension is that the individual may not have well-formed probabilities of the shocks, and so is not able to formulate an approximation to an optimal saving plan and the appropriate insurance. But even when individuals properly assess the probabilities of shocks, when insurance is incomplete those experiencing shocks are likely to express regret.

The first type of deviation, procrastination, can be modeled according to Thaler and Shefrin (1981) as a continuing game between current and future self, where the immediate future is discounted more strongly relative to the present than two equally distant events further in the future. The current self at age j maximizes the objective function

$$(1) \qquad \max \{ u(c_j) + \delta \cdot \beta \cdot \sigma_j \cdot \hat{V}(z_{j+1}) \}$$

by choosing current consumption c_j, subject to a budget constraint and his or her beliefs $\hat{V}(z_{j+1})$ about the behavior of the future self for the future state described by z_{j+1}. $u(c_j)$ is the instantaneous utility function. Intertemporal discounting has three elements: β is the pure time discount factor. In addition, the parameter $0 \leq \delta \leq 1$ expresses the extent of shortsightedness or present bias. Complete myopia corresponds to $\delta=0$. In this extreme case, households focus on current utility only and ignore future utility. Finally, households discount future utility with their unconditional survival probability σ_j, expressing the uncertainty about the time of death. The value function $\hat{V}(z)$ for future

[8] There could also be shocks to assets. For illustrative purposes we focus in the model on shocks to the income path.

beliefs is computed recursively by

$$(2) \qquad \hat{V}(z_j) = u(\hat{c}_j) + \beta \cdot \sigma_j \cdot \hat{V}(z_{j+1}) \,.$$

Note that the present bias δ of the current self does not appear in the value computation. The future self who is at age $j + 1$ will solve the standard program

$$(3) \qquad \max \left\{ u(\hat{c}_{j+1}) + \beta \cdot \sigma_{j+1} \cdot \hat{V}(z_{j+2}) \right\}$$

by choosing future consumption $\hat{c}_{j+1}$.[9]

This model of procrastination has three key features: (a) the addition of a present bias parameter δ which discounts the immediate future in addition to the standard discount factor β and mimics hyperbolic discounting; (b) the distinction between the present bias δ of the current self from the belief that the future self has no present bias; and, consequently, (c) the distinction between actual consumption behavior c_j from beliefs about future consumption behavior $\hat{c}_{j+1}$. The conflict between preferences and future beliefs may occur for various reasons such as the monetary and cognitive costs of decision making; we therefore refrain from calling such behavior "irrational."

The second deviation from the conventional life-cycle model, mis-estimation of the probability of shocks, affects the expected budget constraint. We assume that households expect an exogenously given age-specific wage income w until retirement age R and will then receive a public pension b. With probability p, there will be a shock with effect S at time J that puts the household on a higher or lower income path for the ages $j>J$. Hence, expected disposable non-asset income y_j is

$$(4) \qquad \begin{aligned} y_j &= w && \text{for } j=0,\ldots,J \\ y_j &= w + pS && \text{for } j=J+1,\ldots,R\text{-}1 \\ y_j &= b && \text{for } j \geq R. \end{aligned}$$

[9] In the language of O'Donoghue and Rabin (1999), this is a "naïve" hyperbolic household.

Denoting total assets by $a_{t,j}$, maximization of the household's intertemporal utility is subject to a dynamic budget constraint given by

(5) $$a_{j+1} = a_j(1 + r_j) + y_j - c_j$$

The literature on precautionary saving shows that a_R is a monotonically increasing function of pS for $S<0$, i.e., the probability times the effect of a shock that permanently reduces current income.[10]

We summarize the predictions of the model. A procrastinating person has a low value of δ. The literature on present bias shows that a_R is a monotonically increasing function of the parameter δ and thus that person will have low wealth at retirement.[11] Such a person will have saving regret. There is no need for uncertainty in the model.

Someone with a value of δ of 1.0 is not a procrastinator. Operating under uncertainty with incomplete insurance, such a person may correctly estimate the probability of a (negative) shock and engage in the proper amount of buffer stock saving. If the person is unlucky, he or she will have low wealth at retirement but whether the person has saving regret depends on the level of rationality: A fully rational person will not have regret because the saving was optimal, given the information and insurance mechanism available at the time. However, many people may not be that rational and they will use the benefit of hindsight when evaluating the saving choice *ex post,* and then express regret. Underestimation of the probability of a (negative) shock or of the effects of the shock will lead to the same predictions: a fully rational person will not have saving regret (but will express regret about not knowing the true distribution or the effects of the shock), but probably few persons are that "hyper"-rational and we would expect that those experiencing negative shocks, whether or not they correctly assessed the probabilities of the shocks, would express regret.

Both a high present bias (low δ; procrastination) and an underestimation of the

[10] Leland (1968); Skinner (1988); Kimball (1990); Aiyagari (1994); Lusardi (1998).
[11] Strotz (1955); Phelps and Pollak (1968); Pollak (1968); Thaler (1994); Laibson (1997, 1998); Angeletos et al. (2001); Madrian and Shea (2001); Choi et al. (2002); Rabin (2013a,b); DellaVigna and Malmendier (2006).

probability of shocks or their effects (low *pS*) can lead to saving regret. And in both cases, wealth level at retirement, a_R, is depressed. If we only have data on a_R, but not the savings history and the relevant subjective and objective probabilities of shocks, we cannot identify how much of a (regretted) low level of a_R is due to high present bias (low δ) and how much is due to an underestimation of the probabilities and the effect of future shocks (low *pS)*.[12] This paper uses data on indicators associated with present bias δ and direct questions about actual shocks *S* to shed light on the question of whether regret over low levels of a_R is due to procrastination or shocks.

II. Data and Methods

A. The Sample

Our data come from the RAND American Life Panel (ALP). The ALP maintains a sample of about 6,000 respondents who are interviewed regularly over the Internet. To avoid selection due to lack of Internet access, any participant without such access was provided a laptop or an Internet service subscription. The sample is representative of the U.S. population when applying weights. It has been recruited in several waves over time. Seventy-five percent of the respondents were recruited using probability-based sampling, while 25 percent were recruited through other efforts (Pollard and Baird 2017).

We designed ALP survey 455, which was fielded from August through December 2016.[13] The sample was restricted to those aged 60 or older and the survey was administered only in English. A total of 2,391 ALP panel members were selected to participate; 1,728 completed the survey during the field period, corresponding to a response rate of 72.3 percent. Of these, 90 percent pertain to the probability sample. We confined our analytical sample to those aged 60 to 79 to reduce bias due to differential mortality. On average, participants in the sample are 68 years old.[14] The sample size used for our analysis is about 1,590 observations and varies slightly, depending on the

[12] This corresponds to Gabaix and Laibson (2017).
[13] In order to validate our results, we fielded a second survey about one and a half years later, see Subsection IV.B.
[14] Sample statistics are displayed in the Appendix Table A1.

covariates used from earlier ALP waves.

B. Questionnaire and Measuring Saving Regret

The questionnaire began with items on socio-demographic and economic characteristics, a battery of questions on psychological factors, including procrastinating behavior, and a set of questions about respondents' assessment of their income and living standards. We asked respondents about negative and positive shocks experienced earlier in life. Only after that did we ask households whether – looking back to when they were around 45 years old – they would have saved more, about the same, or less earlier in their lives if they were given the chance to re-do their saving and spending. See Appendix A for more details on the variables and for the exact wording of critical questions.

Psychometrics. These measures were derived from the General Procrastination Scale (GPS) described and validated by Tuckman (1991).[15] We asked respondents to evaluate themselves along several dimensions, such as a self-assessment on their general and financial planning behavior and motivations. Several questions asked directly about procrastination, such as "*How often do you put things off you should do but aren't really interested in?*" Other questions asked about time horizon or discounting, such as "*Do you agree or disagree with the following statements? People should do what they like today rather than putting it off until tomorrow.*" In total, we posed 19 self-assessments, but in this paper we reduced the number analyzed to 12 because some had little independent explanatory power for saving regret.

Measuring Positive and Negative Income Shocks. We asked respondents if they experienced unexpected positive or negative shocks during their lives. We asked about negative shocks in the following way:

Sometimes people have negative surprises earlier in life that cause their finances to turn out worse than expected. Did any of the following happen to you? Please check all that apply.

We listed nine negative shocks such as unemployment or a large health expense;

[15] An overview of several GPS variants is given by Ferrari et al. (1995) and a general survey of procrastination concepts by Steel (2007).

respondents could check all that apply.

A similar question was posed about positive shocks. We listed six positive shocks such as earned more than expected or received an inheritance.

Measuring Saving Regret. The specific wording was:

Again please think back to when you were around 45 years old. Suppose you could re-do your spending and saving from then to now, would you…

> *Spend less and save more over the years?*
> *Spend and save about the same over the years?*
> *Spend more and save less over the years?*

If respondents answered that they wished they had saved more, there was a follow-up question asking for the categories of goods they would have spent less on. They were also given the opportunity to revise their previous answer and choose *"No way I could have cut spending. I could not have saved more."*

To investigate the importance of question wording and framing of the response categories we administered at random a slightly modified version to half the sample that omitted the reminder that "saving more" comes at the cost of "spending less." The answer categories read in that case: *Save more over the years? / Save about the same over the years? / Save less over the years?* This unframed version lead to a 5.7 ppts higher fraction expressing they wished to have saved more. In the analyses presented in this paper we pool the responses from the two response formats.

III. Results

A. Prevalence of Saving Regret

We did not use the word "regret" in the survey itself, but we will refer to the expression of wishing to have saved more as "having saving regret" as it appears in hindsight. The percentage of those having saving regret was 63.6 percent. We probed respondents who had expressed saving regret to tell us which spending categories would have been targets for reduction in spending earlier in life. The most frequently mentioned

targets for spending cuts earlier in life were "car" and "vacation" among men, and "clothing" and "vacation" among women. We let them revise their earlier answer if they could not think of a spending category they could have reduced. Consequently 8 percent of those who voiced saving regret revised their answer, leading to a reduction in the observed levels of saving regret by 5.1 percentage points.

Saving regret was far from universal: More than a third of the respondents are satisfied with their saving decisions earlier in life (34.7 percent before revision and 39.8 percent after revision); a very small fraction would have saved less if they could re-do their earlier life (1.7 percent).

B. Saving Regret by Socio-Demographic, Health, and Financial Status

Overall, the correlations between saving regret and socio-demographic and financial variables are strong and exhibit plausible patterns. This is documented in Table 1. Column 4 reports the fraction reporting saving regret after revision. Using results for saving regret before the revision changes the level of regret but not the patterns of correlation. We focus all subsequent analysis on saving regret *after* taking into account the revisions.

[Table 1 about here]

The fraction reporting that they should have saved more was higher for those who are younger; have separated or divorced; and have a low socio-economic status measured in terms of education, wealth or income. Respondents self-reporting fair or poor health and memory problems also expressed saving regret more often. We note that, even among those in the highest wealth quartile, 38.9 percent expressed saving regret; among those in the lowest wealth quartile, 71.9 percent did so.

C. Personal Characteristics and Psychological Factors

As described in Section I, our analysis is guided by a broad classification into two sets of mechanisms governing wealth at older ages. This subsection presents the first set, which includes personal traits that are usually assumed to be relatively stable over time (Arrow B in Figure 1). The underlying conjecture is that saving regret could emerge from individuals' inability to plan ahead and save sufficiently for their old age. This type of behavior would be related to procrastination, the inability to motivate oneself to take

action, and/or lack of financial literacy. Table 2 displays how saving regret is related to personal psychological characteristics. The questions on psychological factors were asked before the saving regret question in the course of the interview or in earlier ALP waves that were targeted at financial planning horizon and financial literacy.

[Table 2 about here]

Responses to the items in Table 2, Panel A, were permitted in five categories: strongly disagree, disagree, neither agree or disagree, agree, or strongly agree. Because of (almost) empty cells or little difference in outcomes between some of the categories, we have aggregated the two disagree categories into one category, and the two agree categories into one. In four of the five items in Panel A, the frequencies of saving regret are not monotonic in the response categories. For example, the percentage expressing regret among those that (strongly) disagreed with the statement "life is about having fun" is 60.8 percent, the percentage among those who neither agreed or disagreed is 52.3 percent, and the percentage among those who (strongly) agreed is 60.5 percent. The one item exhibiting monotonicity is "do what you like today," where the variation between the low and high categories is about seven percentage points. This corresponds approximately to the variation in average regret between wealth quartiles one and two (Table 1), but is considerably less than the variation between quartiles three and four.

In Panel B, five out of seven items display non-monotonicity. Among the two items that show a gradient, the item "put off difficult things" has little variation across the first two response categories, which comprise 93 percent of the sample. The item "put things off you should do" exhibits substantial variation between "never" and the other categories, but just 5 percent of respondents never "put things off." It is worth noting that the item "give up before starting" has considerable variation in average saving regret across the three categories that comprise 99.5 percent of the sample, even if the remaining 0.5 percent do not follow the same pattern. Particularly the first two categories display considerable discriminatory power: approximately half the sample is in each category, and the average saving regret varies by 6.4 percentage points.

We conclude that there is quite limited and scattered systematic variation in saving regret with the psychometric variables. Furthermore, the items in Panel B would,

according to their plain language, address procrastination; yet, among the seven items, there is really only one that suggests procrastination leads to saving regret.[16]

D. Supporting Skills for Optimal Financial Decision Making

Optimal financial decision making requires several supporting skills, such as planning for the future, financial literacy and some mastery of probabilities (Hung et al. 2009). People who are deficient in these skills may be more likely to express saving regret, because of their lower ability to manage the complexities of intertemporal decisions and the inherent uncertainties.

We merged information from other ALP waves about the financial planning horizon (N= 1,207), financial literacy (N=921), and probability numeracy (N=1,056) (see Table 3).[17]

[Table 3 about here]

Respondents have substantially different financial planning horizons: 4.4 percent stated that they do not plan and 14.7 percent only planned for the next couple of months. Yet, 16.3 percent of respondents planned for the next five to ten years and 11.9 percent for more than ten years. The financial planning horizon and saving regret are significantly correlated. Saving regret was highest among respondents who stated that they do not have a financial plan (68 percent) or who only planned for the next few months (64.8 percent). It declines monotonically with the length of the planning horizon: among respondents with a planning horizon that exceeds ten years, 50.8 percent expressed having saving regret.

The relationship between saving regret and financial literacy is also strong. Respondents who scored highest on financial literacy (i.e. they answered all three financial literacy questions correctly) had significantly lower saving regret (55.6 percent) compared to those who scored low on financial literacy (74.0 percent).

Individuals' ability to think probabilistically may also affect their propensity to experience saving regret via a mechanism of more realistic buffer stock saving. The

[16] We also used the Big 5 personality traits (neuroticism, extroversion, agreeableness, conscientiousness, openness) as an alternative to the psychometric scales, see Subsection IV.D.
[17] See Appendix A for the list of questions used to construct the financial literacy and probability numeracy scales.

bottom panel of Table 3 shows the variation in saving regret by a measure of probability numeracy, which is the number of correct answers respondents gave to four questions about the laws of probability. For most of the population (90% of those with data), saving regret was lower among those who scored higher on numeracy, lending support to this hypothesis.

E. Unanticipated Shocks

The second set of determinants of old-age wealth (Arrow C in Figure 1) is the collection of external impingements on the individual, particularly positive or negative shocks. We asked respondents to think about surprises, so that even those persons who had well-formed subjective probabilities of the events would report a shock provided they were not certain. In addition, some of these shocks may be hard to anticipate either in their likelihood of occurring or in the financial burden they might cause.

The shocks queried and the responses are displayed in Table 4. Fifty-six percent of respondents reported a shock with negative financial consequences ('any negative shock') and 44 percent reported a shock with positive financial consequences ('any positive shock'). About 22 percent experienced health limitations to their work, 13.8 percent incurred large health expenses, 14.9 percent experienced unemployment and 11.8 percent, a divorce or separation. For almost 20 percent of our sample, investments turned out better than expected, and almost 15 percent received an inheritance. It should be noted that the frequencies of these events are not necessarily the population lifetime frequencies because we asked respondents about events that caused their finances to turn out worse or better than expected. Some spells of unemployment, for example, may have had little effect on finances and so would not have been reported. Nonetheless, the lifetime frequency is substantial.

[Table 4 about here]

The prevalence of saving regret was much higher among those who experienced a negative shock and substantially lower among those who experienced a positive shock. This was particularly pronounced for those who suffered from unemployment (77.3 percent express regret) or a work-limiting health problem (79.4 percent express regret) or whose earnings were less than expected for other reasons (75.9 percent with regret). All

negative shocks, except death in the family, show a highly significant relationship with saving regret.

In contrast, saving regret was substantially reduced among those whose earnings turned out to be higher than expected (52.8 percent have saving regret), those whose investments did better than expected (36.4 percent express regret), and those who received an inheritance (46.0 percent with regret).

There is a modest negative correlation between having a positive shock and having a negative shock (Table 5, Panel A). Among those who did not experience a negative shock, 48 percent experienced a positive shock; among those who experienced a negative shock, 41 percent experienced a positive shock. Some 23 percent experienced both positive and negative shocks.

[Table 5 about here]

Panel B shows the corresponding percentage with saving regret. The variation is substantial: 73.4 percent of those with a negative shock but not a positive shock (33.2 percent of the population) expressed regret while just 36.2 percent of those with a positive shock but not a negative shock (21.1 percent of the population) expressed regret. Thus, unexpected positive and negative shocks are discriminatory in predicting saving regret for about half the population.

F. Multivariate Analysis

We estimated linear probability models where the outcome was whether saving regret was reported. We combined versions A and B of the saving regret question (Section II.B) and applied revisions if respondents decided to do so. The explanatory variables were demographics, income, and wealth quartiles, psychological factors, and indicator variables for negative and positive shocks.

Table 6 shows extracts from two specifications, one that excludes the wealth quartiles and one that includes them in order to separate the effects represented by Arrows A, B, and C in Figure 1.[18] Following the idea that saving regret should be increasing in some of the psychological variables and decreasing in others, they are entered as scalars. We find

[18] See Appendix Table A2 for complete results.

that only two of the variables are significant at the 1 percent level in both specifications and two others are marginally significant in model 1 but not in model 2. A change in "Works best under pressure" from "neither agree nor disagree" to "agree" would change the frequency of expressing regret by 0.037. "Do what you like today" is significant only at the 10 percent level when not including the wealth variables. This item is not very discriminatory because 79 percent of the population (strongly) agrees. Among the variables that are more directly interpretable as expressing procrastination, the item "Put off things you should do" is not very discriminatory: 77 percent of the sample said they put off things "some time," and 16 percent "most of the time." A movement between those categories is associated with an increase in regret of 0.046. The effect is marginally significant when not controlling for wealth. "Try several tasks, don't complete many" is associated with an increase in regret by 0.053, but is also not very discriminatory as 89 percent of the sample is in the first two categories. Other seemingly direct measures of the tendency to procrastinate such as "put off difficult things" have only small and insignificant predictive power for the expression of regret.

[Table 6 about here]

Having had a negative shock increases the probability of expressing regret by 0.145 or 0.132, and having had a positive shock reduces that probability by 0.131 or 0.114. Both are quite discriminatory in the population: 56 percent had a negative shock and 44 percent a positive shock. Having had only a positive shock rather than a negative shock changes the probability of expressing regret by about 25 percentage points. This difference is about the same as the difference between being in the top wealth quartile rather than the second wealth quartile (see Table 1). When the shocks are entered individually, the most important negative shock involves health problems that limit the ability to work and unemployment, while the most important positive shock is having had good investments (see Table A2 Columns 3 and 4).

IV. Discussion

Having presented our main results, in this section we will bring in additional data to

help interpret the results. In particular we will give empirical evidence aimed at (A) establishing the validity of our measure of saving regret by showing the relationship between regret and indicators of economic outcomes; (B) measuring the intensity of regret about saving decisions and compare saving regret with regret about other life choices; (C) relating saving regret to measures of uncertainty; (D) finding the important correlates (in terms of explanatory power) of saving regret. Our discussion will include robustness checks and corroborating evidence.

A. Face Validity vs. "Cheap Talk"

It is easy for respondents to wish they had saved more: no difficult action such as reducing consumption is required. Perhaps this question is similar to asking whether respondents would like to have more wealth, in which case we would expect 100 percent affirmation. Affirmation in the survey of the desire to have saved more, however, was substantially less, about 58.5 percent. We aimed to reduce "cheap talk" in our survey through our probing design. While probing and giving respondents the opportunity to revise their initial responses resulted in a lower prevalence of saving regret, the prevalence of revisions (8 percent of those expressing regret) was small relative to the initial prevalence of saving regret.

A valid measure of saving regret should be related to wealth. Consider two similarly situated individuals who think back to an earlier age, and who in retrospect think of a similar (optimal) target saving rate. The first achieved that target rate and so when asked about redoing his or her saving would not desire to do so; the second did not achieve that target rate and would express a desire to do so. The achieved wealth of the first would be greater than the second. We found that regret was strongly related to economic position, especially wealth itself (Table 1). We found similar, albeit weaker, correlations with income. The stronger correlation with wealth than with income is to be expected because, of course, wealth itself is a measure of prior saving.

Possibly stronger evidence of validity is to compare variation across persons having regret with other self-assessed measures of saving relative to actual needs or expectations of needs. In the context of asking about negative shocks, we included an item "saved less than expected." We did not include this item in Table 4 because it is not itself an external

shock, although it could be the result of one or more external shocks. Some 15 percent of the sample reported saving less than expected and 18 percent reported saving more than expected. These seem like rather low rates of saving less or more than expected, but we note that, when querying about shocks, we asked about surprises that caused "their finances to turn out worse than expected," or "better than expected," which we interpret to mean that the shock made a meaningful difference. Of the 15 percent who stated that they saved less than expected, 82 percent expressed saving regret. Of the 18 percent who saved more than expected, 40.5 percent expressed saving regret. An obvious question is, why would someone who saved more than expected have regret? A possible answer is that their expectations were flawed: when the saving was underway, the respondent did not have an accurate idea of the wealth levels that would be required 15 or 20 years in the future. Or perhaps their saving plan was flawed because they did not understand the frequency of shocks and/or the consequences of shocks.

We asked our respondents whether their present income is sufficient for their present needs (Table 7 – Panel A). Overall, 43.9 percent reported that income is always sufficient to meet present needs; yet, 44.5 percent of that group wished they had saved more. This finding also points to the role of uncertainty. Whether present income is sufficient for present needs is known largely from day-to-day experience. But the amount of wealth needed for future spending needs is uncertain. We addressed that issue by asking whether respondents' financial resources are adequate for future needs (Table 7 – Panel B). Notably, about 23 percent answered either "uncertain" or "don't know," reflecting the difficulty of predicting future needs due to uncertainties about both future shocks and future tastes for consumption over a long retirement period. About 23 percent said that their financial resources are not enough or not nearly enough to meet future needs, and around 80 percent of these respondents had saving regret. We therefore find the same very strong relationship between adequate resources and saving regret. Yet, among those with "more than enough" financial resources to meet future needs, some 31 percent still wished they had saved more.

[Table 7 about here]

A more direct measure of uncertainty is the subjective probability of running out of

money queried as "*What are the chances that you will run out of money sometime in the future?*" Table 7 – Panel C shows the subjective probability of running out of money and saving regret. The subjective probability is divided into bins of width 25 percent probability (except for the focal point of exactly 50 percent). In the lowest bin (0-24 percent), which comprises 44 percent of the sample, 47 percent reported saving regret. Even among those with this relatively small self-assessed chances of running out of money, almost half express regret. One may interpret this as rather direct evidence of the role of risk and of the desire to be protected against risky (bad) outcomes.

Additional evidence about the role of risk comes from the variation in the subjective probability of running out of money as a function of the subjective evaluation of the adequacy of financial resources (Panel B). The average subjective probability increased monotonically as the assessment worsened (Figure 2). Among those who stated that their economic resources were more than enough to meet future needs, the average subjective probability of running out of money was 14%. One might think that the subjective probability should be zero, but the open-ended comments showed the effects of uncertainty: *We are fine now but, if one of us should need long-term care….* (paraphrased for brevity).

[Figure 2 about here]

An additional indicator of the relationship between saving regret and the achieved economic situation is subjective well-being with respect to the economic situation. A remarkable 77 percent of our respondents are satisfied or neutral with respect to their economic situation (Table 7 – Panel D). Among the dissatisfied respondents, 80 percent expressed saving regret, compared to only 24 percent among the very satisfied.

Social Security is an important income source for most retired persons, so expectations about the benefit level should be an important determinant of saving. We asked respondents who are receiving Social Security to compare their benefit level with expectations. The distribution of answers is shown in Table 7 – Panel E. There was a general tendency for individuals to overestimate their Social Security benefits: the sum of "a bit less" than expected and "a lot less" is 32.4 percent whereas the sum of "a bit more"

than expected and "a lot more" is 10.2 percent. There is a monotonic relationship between overestimation of Social Security benefits and saving regret, and the level of regret in the top categories is substantially greater than in the other categories.

Overall, we obtained a very consistent picture. The majority of our respondents (53.5 percent) said that they have enough resources to meet future needs, and even more were satisfied with their economic situation. Saving regret was strongly related to the present financial situation, the adequacy of an individual's resources for future needs, and the subjective probability of running out of money. While we cannot entirely rule out the presence of "cheap talk," the consistent pattern of correlations with measures of economic status demonstrates the face validity of our regret measure.

B. Intensity of regret

The psychological literature on experienced regret (Valenti, Libby, and Eibach 2011)[19] provides little guidance to judge whether our measure of the prevalence of saving regret is large or small; whether individuals who express saving regret feel strongly about the regret; whether the reports are stable over time; and how reliable they are. To address these issues, we launched a second survey. We fielded the second survey in the ALP about one and a half years after the first, partly to the same people and partly to other people. The total sample was 1,376, and the overlap between the two surveys was 1,198 respondents. We asked respondents about the intensity of their regret:

How strongly do you wish you could redo your spending and saving?
(1 – very strongly, 2- strongly , 3- somewhat strongly, 4- not at all strongly)

The prevalence of saving regret in the second survey for respondents of the same age range (60-79) was almost the same as in the first survey: 56.8 percent expressed regret after revision in the second survey compared with 58.5 percent after revision in the first survey. As far as longitudinal consistency is concerned, 77.3 percent gave the same

[19] *Experienced regret* is a different concept from *anticipatory regret.* The latter is the base for a theory of *ex ante* decision making (Loomes and Sugden 1982). The theory of anticipatory regret was created in parallel to prospect theory (Kahneman and Tversky 1979). Croy, Gerrans, and Speelman (2015) apply anticipatory regret theory to describe retirement savings intentions in Australia. Muermann, Mitchell and Volkman (2006) examine the effect of anticipatory regret in the context of investment behavior and the role of guarantees in DC pension plans.

answer to the main saving regret question in both surveys; 12.2 percent reported saving regret in the earlier survey and said they "would save about the same" in the later survey; and 8.9 percent reported they would "save about the same" in the earlier survey but reported saving regret in the later survey.

In the second wave of data collection in which we asked respondents about the intensity of their regret, 41 percent categorized their saving regret as "very strong," 27 percent as "strong," 24 percent as somewhat strong, and only 7.8 percent as "not strong at all." Thus, about two-thirds of those expressing regret felt their regret strongly. Were we to characterize the population prevalence of regret as those feeling strongly or very strongly, the level would be about 40 percent.

C. Saving Regret and Uncertainty

Some evidence for the role of risk is apparent in the age pattern of whether people have enough resources to meet future needs (Figure 3). Among those in their early 60s, about 30 percent stated they had not enough or not nearly enough; among those in their late 70s, fewer than 15 percent made such an affirmation. Besides possible cohort effects and the resolution of employment uncertainty, desired consumption at older ages may be less than anticipated because non-health care spending and health are complements (Börsch-Supan and Stahl 1991). If people do not anticipate this complementarity, they may find their savings when they reach their late 70s to be adequate in distinction to expectations when they were in their early 60s.

[Figure 3 about here]

An alternative explanation in the context of difficult-to-know and changing uncertainties is that the risk environment changed since an individual's choices were initially made. Many may now think that Social Security is genuinely risky whereas it may have been viewed as safe 10 to 20 years ago; Medicare is facing funding problems; the provision of long-term care has become more expensive and perhaps more risky due to an increased probability of extreme longevity; in a world of defined contribution pensions, individuals must manage risky investments and choose a rate of drawdown of wealth in the face of changing longevity; and people have had fewer children who can act as intra-family insurance. Some additional evidence about the importance of risk is that saving regret is

high at the time of or shortly before retirement but is much lower at older ages. A possible explanation is the resolution of uncertainty and changes in consumption patterns as respondents age.

D. Potential Causes of Saving Regret

The multivariate regressions reported in Table 6 can be used to decompose the variance in saving regret with respect to four groups of variables: demographics, wealth, psychometric indicators for procrastination and related psychological factors, and indicators for positive and negative shocks whose probability and effect may have been underestimated (Figure 4). The surprising result is that the psychometric variables related to psychological factors are able to explain only 1.6 percent of the total variance in saving regret, while each of the other variable groups explains substantially higher fractions of the variance than the psychological factors and is highly significant.

[Figure 4 about here]

An alternative specification is to enter the psychometric variables as a set of dummy variables for each answer category (see Table A2, Column 8) or other groups of answer categories than those shown in Table 6. However, the goodness of fit was not significantly improved (or even decreased). We also replaced our set of psychometric variables by the "Big 5" measures of personality (John and Srivastava 1999).[20] Saving regret was significantly higher among individuals with high values on the agreeableness scale and lower for individuals with high values of openness. However, the overall explanatory power of the Big 5 was relatively low; they did not perform significantly better than the other psychometric scales.

There are several ways in which uncertainty can lead to saving regret. First, *ex ante*, individuals may adequately assess the probabilities of various shocks, but remain unable to fully insure against them. Among those who experienced the negative outcome, increased buffer stock saving would have increased overall utility. The expression of regret would then be natural even among those who undertook the correct *ex ante* saving plan. Second, individuals may correctly estimate the mean of the distribution of outcomes

[20] The "Big 5" core dimensions of personality are openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism. Results of our analysis are available upon request.

such as the mean of the distribution of the costs of unemployment. However, they may underestimate the variance of the distribution. More generally, they may underestimate the number and magnitude of the various uncertainties in life. On reaching retirement, those who experienced negative outcomes would likely express saving regret (due to too little buffer-stock saving) but this regret would be due to a lack of knowledge about the distribution of uncertain outcomes. Third, because of changes in the environment, the actual distribution of positive and negative shocks might be different from the *ex-ante* distribution. In this situation, individuals might have correctly engaged in buffer-stock saving, given the existing distribution of outcomes, but the level of saving might be inadequate due to increases in uncertainty.

The relationship between saving regret and experienced shocks that we have documented does not allow us to distinguish between the ways in which uncertainty can lead to regret. A type of data outside of our study that may shed light on the issue is subjective probability data. Such data can reveal whether the measured probabilities of individuals are "rational" in the sense that they conform to historical frequencies or that they are predictive on average of realized outcomes. The literature on these types of evaluations finds substantial heterogeneity across domains. For example, the average subjective probability of a one-year stock market gain as expressed in the HRS is much below historical averages; yet, the average subjective probability of working past age 62 or 65 as expressed by workers in their early 50's is close to the realized employment rate at those ages (Hurd 2009). Similarly, there is substantial heterogeneity across persons in the ability to use and express subjective probabilities. However, for the types of lifetime shocks of interest in this paper, such assessments are likely to be unsatisfactory because of the weak and unknown link between the historical frequencies and the process of generating outcomes in the future.

V. Summary and Conclusions

Our survey found fairly high levels of saving regret, with most individuals feeling strongly about this regret. Although we cannot rule out the occurrence of "cheap talk" in

the surveys, we assert that the variation with observable measures of well-being establishes face validity.

A first conclusion is that we found only modest evidence for a relationship between our measures of procrastination and the desire to re-optimize saving. Our psychometric variables are jointly significant and they contribute to the explained variation in saving regret, but their explanatory power is relatively low, the patterns of the variation are inconsistent, and they do not match well an ex-ante description of procrastination.

A second conclusion is that unexpected shocks explain much more of the variation, and their associations with saving regret have a consistent pattern. The failure to anticipate negative shocks both as to their probability and to their effects, may point to a large relative importance of the lack of information. The effect of shocks may be further aggravated if some people lack the supporting skills for optimal financial decision making.

Distinguishing among the causes of saving regret matters for public policy. If the root cause were found to be procrastination, the appropriate policy mix should emphasize mandatory saving programs or paternalistic nudging such as automatic enrollment in retirement plans. If the root cause were found to be unanticipated shocks whose probabilities and effects have been underestimated or that have been difficult to manage, preferred policies would include information and education to help people better anticipate, understand and manage the effects of changes in the environment. Given the difficulty of accurately forecasting external changes and changing uncertainties, another element of the policy mix would be broader and deeper social insurance.

Acknowledgements

We thank Laura Carstensen, Margie Lachmann, Andrew Parker, Lee Ross, and participants of workshops held at the NBER, the Michigan Retirement Research Center and NETSPAR for helpful discussions. Joanna Carroll and Jessica Hayes provided excellent programming assistance. Hurd and Rohwedder gratefully acknowledge funding from the National Institute on Aging (P01 AG008291) for research support and data collection. Additional funding for data collection came from the Max Planck Society.

References

Aiyagari, S Rao. 1994. "Uninsured Idiosyncratic Risk and Aggregate Saving." *The Quarterly Journal of Economics* 109 (3):659-684.

Angeletos, George-Marios, David Laibson, Andrea Repetto, Jeremy Tobacman, and Stephen Weinberg. 2001. "The Hyperbolic Consumption Model: Calibration, Simulation, and Empirical Evaluation." *Journal of Economic Perspectives* 15 (3):47-68.

Anusic, Ivana, and Ulrich Schimmack. 2016. "Stability and Change of Personality Traits, Self-Esteem, and Well-Being: Introducing the Meta-Analytic Stability and Change Model of Retest Correlations." *Journal of Personality and Social Psychology* 110 (5):766.

Barberis, Nicholas, and Richard Thaler. 2003. "A Survey of Behavioral Finance." *Handbook of the Economics of Finance* 1:1053-1128.

Bleidorn, Wiebke, Christopher J Hopwood, and Richard E Lucas. 2018. "Life Events and Personality Trait Change." *Journal of Personality* 86 (1):83-96.

Börsch-Supan, Axel, Anette Reil-Held, Ralf Rodepeter, Reinhold Schnabel, and Joachim Winter. 2001. "The German Savings Puzzle." *Research in Economics* 55 (1):15-38.

Börsch-Supan, Axel, and Konrad Stahl. 1991. "Life Cycle Savings and Consumption Constraints." *Journal of population economics* 4 (3):233-255.

Brugiavini, Agar, and Mario Padula. 2001. "Too Much for Retirement? Saving in Italy." *Research in Economics* 55 (1):39-60.

Bucher-Koenen, Tabea, and Annamaria Lusardi. 2011. "Financial Literacy and Retirement Planning in Germany." *Journal of Pension Economics & Finance* 10 (4):565-584.

Chan, Sewin, and Ann Huff Stevens. 2008. "What You Don't Know Can't Help You: Pension Knowledge and Retirement Decision-Making." *The Review of Economics and Statistics* 90 (2):253-266.

Chetty, Raj, John N Friedman, Søren Leth-Petersen, Torben Heien Nielsen, and Tore Olsen. 2014. "Active vs. Passive Decisions and Crowd-Out in Retirement Savings Accounts: Evidence from Denmark." *The Quarterly Journal of Economics* 129 (3):1141-1219.

Choi, James J, David Laibson, Brigitte C Madrian, and Andrew Metrick. 2002. "Defined Contribution Pensions: Plan Rules, Participant Choices, and the Path of Least Resistance." *Tax Policy and the Economy* 16:67-113.

Cobb-Clark, Deborah A, and Stefanie Schurer. 2012. "The Stability of Big-Five Personality Traits." *Economics Letters* 115 (1):11-15.

Copen, Casey E, Kimberly Daniels, Jonathan Vespa, and William D Mosher. 2012. "First Marriages in the United States: Data from the 2006-2010 National Survey of Family Growth. National Health Statistics Reports. Number 49." *National Center for Health Statistics*.

Croy, Gerry, Paul Gerrans, and Craig P Speelman. 2015. "A Mediating Role for Anticipated Regret in Predicting Retirement Savings Intention Between Groups with (without) Past Behaviour." *Australian Journal of Psychology* 67 (2):87-96.

Currie, Janet, Lucas Davis, Michael Greenstone, and Reed Walker. 2015. "Environmental Health Risks and Housing Values: Evidence from 1,600 Toxic Plant Openings and Closings." *American Economic Review* 105 (2):678-709.

Deary, Ian J, Lawrence J Whalley, Helen Lemmon, JR Crawford, and John M Starr. 2000. "The Stability of Individual Differences in Mental Ability from Childhood to Old Age: Follow-up of the 1932 Scottish Mental Survey." *Intelligence* 28 (1):49-55.

DellaVigna, Stefano, and Ulrike Malmendier. 2006. "Paying Not to Go to the Gym." *American Economic Review* 96 (3):694-719.

Dunning, David, Chip Heath, and Jerry M Suls. 2004. "Flawed Self-Assessment: Implications for Health, Education, and the Workplace." *Psychological Science in the Public Interest* 5 (3):69-106.

Ferrari, Joseph R, Judith L Johnson, and William G McCown. 1995. *Procrastination and Task Avoidance: Theory, Research, and Treatment*: Springer Science & Business Media.

Gabaix, Xavier, and David Laibson. 2017. Myopia and Discounting. National Bureau of Economic Research.

Hampson, Sarah. (2017). "Personality and Health," *Oxford Research Encyclopedia of Psychology*. December. DOI: 10.1093/acrefore/9780190236557.013.121

Hung, Angela A, Andrew M Parker, and Joanne Yoong. 2009. "Defining and Measuring Financial Literacy."

Hurd, M. 2009. "Subjective Probabilities in Household Surveys." *Annual Review of Economics* 1:543-562.

Hurd, Michael D, and Susann Rohwedder. 2012. Measuring Total Household Spending in a Monthly Internet Survey: Evidence from the American Life Panel. National Bureau of Economic Research.

Jefferson, Anneli, Lisa Bortolotti, and Bojana Kuzmanovic. 2017. "What is Unrealistic Optimism?" *Consciousness and Cognition* 50:3-11.

John, Oliver P, and Sanjay Srivastava. 1999. "The Big Five Trait Taxonomy: History, Measurement, and Theoretical Perspectives." *Handbook of Personality: Theory and Research* 2 (1999):102-138.

Kahneman, Daniel, and Amos Tversky. 1979. "Prospect Theory: An Analysis of Decision under Risk." *Econometrica* 47 (2):263-292.

Kimball, Miles S. 1990. "Precautionary Saving in the Small and in the Large." *Econometrica: Journal of the Econometric Society*:53-73.

Kitamura, Yukinobu, Noriyuki Takayama, and Fumiko Arita. 2003. "Household Savings and Wealth Distribution in Japan." In *Life-Cycle Savings and Public Policy*, 149-203. Elsevier.

Laibson, David. 1997. "Golden Eggs and Hyperbolic Discounting." *The Quarterly Journal of Economics* 112 (2):443-478.

Laibson, David. 1998. "Life-cycle Consumption and Hyperbolic Discount Functions." *European Economic Review* 42 (3-5):861-871.

Laibson, David I, Andrea Repetto, Jeremy Tobacman, Robert E Hall, William G Gale, and George A Akerlof. 1998. "Self-Control and Saving for Retirement." *Brookings papers on economic activity* 1998 (1):91-196.

Lamla, Bettina, and Martin Gasche. 2013. "Erwarteter Bezug von Grundsicherung im Alter: Verhaltensunterschiede und Fehleinschätzungen." *Schmollers Jahrbuch* 133 (4):539-562.

Leland, Hayne E. 1968. "Saving and Uncertainty: The Precautionary Demand for Saving." *The Quarterly Journal of Economics*:465-473.

Lewis, Carol. 2008. "Why Barack Obama and David Cameron are Keen to 'Nudge' You." *Times Online, July* 14:2008.

Löckenhoff, Corinna E, Antonio Terracciano, Nicholas S Patriciu, William W Eaton, and Paul T Costa Jr. 2009. "Self-Reported Extremely Adverse Life Events and Longitudinal Changes in Five-Factor Model Personality Traits in an Urban Sample." *Journal of Traumatic Stress: Official Publication of The International Society for Traumatic Stress Studies* 22 (1):53-59.

Loomes, Graham, and Robert Sugden. 1982. "Regret Theory: An Alternative Theory of Rational Choice Under Uncertainty." *The Economic Journal* 92 (368):805-824.

Lucas, Richard E, and M Brent Donnellan. 2011. "Personality Development Across the Life Span: Longitudinal Analyses with a National Sample from Germany." *Journal of Personality and Social Psychology* 101 (4):847.

Lusardi, Annamaria. 1998. "On the Importance of the Precautionary Saving Motive." *The American Economic Review* 88 (2):449-453.

Lusardi, Annamaria, and Olivia S Mitchell. 2014. "The Economic Importance of Financial Literacy: Theory and Evidence." *Journal of Economic Literature* 52 (1):5-44.

Madrian, Brigitte C, and Dennis F Shea. 2001. "The Power of Suggestion: Inertia in 401 (k) Participation and Savings Behavior." *The Quarterly Journal of Economics* 116 (4):1149-1187.

Modigliani, Franco, and Richard Brumberg. 1954. "Utility Analysis and the Consumption Function: An Interpretation of Cross-Section Data." *Franco Modigliani* 1:388-436.

Muermann, Alexander, Olivia S Mitchell, and Jacqueline M Volkman. 2006. "Regret, Portfolio Choice, and Guarantees in Defined Contribution Schemes." *Insurance: Mathematics and Economics* 39 (2):219-229.

OECD. 2018. “Risks That Matter.” Paris: OECD.

O'Donoghue, Ted, and Matthew Rabin. 1999. "Doing it Now or Later." *American Economic Review* 89 (1):103-124.

Phelps, Edmund S, and Robert A Pollak. 1968. "On Second-Best National Saving and Game-Equilibrium Growth." *The Review of Economic Studies* 35 (2):185-199.

Pollak, Robert A. 1968. "Consistent Planning." *The Review of Economic Studies* 35 (2):201-208.

Pollard, Michael S, and Matthew Baird. 2017. *The RAND American Life Panel: Technical Description*: RAND.

Poterba, James M, Steven F Venti, and David A Wise. 2011. "Were They Prepared for Retirement? Financial Status at Advanced Ages in the HRS and AHEAD Cohorts." In *Investigations in the Economics of Aging*, 21-69. University of Chicago Press.

Rabin, Matthew. 2013a. "An Approach to Incorporating Psychology into Economics." *American Economic Review* 103 (3):617-22.

Rabin, Matthew. 2013b. "Incorporating Limited Rationality into Economics." *Journal of Economic Literature* 51 (2):528-43.

Roberts, Brent W, and Wendy F DelVecchio. 2000. "The Rank-Order Consistency of Personality Traits from Childhood to Old Age: A Quantitative Review of Longitudinal Studies." *Psychological bulletin* 126 (1):3.

Scholz, John Karl, Ananth Seshadri, and Surachai Khitatrakun. 2006. "Are Americans Saving "Optimally" for Retirement?" *Journal of Political Economy* 114 (4):607-643.

Shepperd, James A, Gabrielle Pogge, and Jennifer L Howell. 2017. "Assessing the Consequences of Unrealistic Optimism: Challenges and Recommendations." *Consciousness and Cognition* 50:69-78.

Skinner, Jonathan. 1988. "Risky Income, Life Cycle Consumption, and Precautionary Savings." *Journal of Monetary Economics* 22 (2):237-255.

Smith, V Kerry, Donald H Taylor, and Frank A Sloan. 2001. "Longevity Expectations and Death: Can People Predict Their Own Demise?" *American Economic Review* 91 (4):1126-1134.

Specht, Jule, Boris Egloff, and Stefan C Schmukle. 2011. "Stability and Change of Personality Across the Life Course: The Impact of Age and Major Life Events on Mean-Level and Rank-Order Stability of the Big Five." *Journal of Personality and Social Psychology* 101 (4):862.

Stanford Center on Longevity. 2016. "The Sightlines Project: Seeing Our Way to Living Long, Living Well in 21st Century America." (http://sightlinesproject.stanford.edu).

Steel, Piers. 2007. "The Nature of Procrastination: A Meta-Analytic and Theoretical Review of Quintessential Self-Regulatory Failure." *Psychological bulletin* 133 (1):65.

Strotz, Robert Henry. 1955. "Myopia and Inconsistency in Dynamic Utility Maximization." *The Review of Economic Studies* 23 (3):165-180.

Thaler, Richard H. 1994. "Psychology and Savings Policies." *The American Economic Review* 84 (2):186-192.

Thaler, Richard H, and Hersh M Shefrin. 1981. "An Economic Theory of Self-Control." *Journal of political Economy* 89 (2):392-406.

Thaler, Richard H, and Cass R Sunstein. 2003. "Libertarian Paternalism." *American Economic Review* 93 (2):175-179.

Thaler, Richard H, and Cass R Sunstein. 2009. *Nudge: Improving Decisions About Health, Wealth, and Happiness*: Penguin.

Tuckman, Bruce W. 1991. "The Development and Concurrent Validity of the Procrastination Scale." *Educational and psychological measurement* 51 (2):473-480.

U.S. Bureau of Labor Statistics. "National Longitudinal Survey of Youth 1979 (NLSY79)." https://www.bls.gov/nls/nlsy79r25unempbyedu.xlsx, retrieved July 31, 2018.

Valenti, Greta, Lisa K Libby, and Richard P Eibach. 2011. "Looking Back with Regret: Visual Perspective in Memory Images Differentially Affects Regret for Actions and Inactions." *Journal of Experimental Social Psychology* 47 (4):730-737.

Weinstein, Neil D. 1980. "Unrealistic Optimism About Future Life Events." *Journal of Personality and Social Psychology* 39 (5):806.

Yaari, Menahem E. 1965. "Uncertain Lifetime, Life Insurance, and the Theory of the Consumer." *The Review of Economic Studies* 32 (2):137-150.

Tables

Table 1. Saving Regret by Sociodemographic Characteristics

			Saving Regret (After Revision)		
	N	In percent	Mean	Std. Error	T-test
Total	1590	100.0	0.585	0.012	
Female					
0	741	46.6	0.567	0.018	ref
1	849	53.4	0.601	0.017	ns
Age					
60-64	528	33.2	0.649	0.020	ref
65-69	478	30.1	0.634	0.021	ns
70-74	310	19.5	0.549	0.028	***
75-79	274	17.2	0.417	0.037	***
Marital status					
married	997	62.7	0.571	0.016	ref
separated or divorced	278	17.5	0.673	0.026	***
widowed	221	13.9	0.518	0.038	ns
never married	93	5.9	0.622	0.045	ns
Education level					
HS or less	739	46.5	0.607	0.031	ref
some coll or degr	391	24.6	0.652	0.020	ns
BA,BS	223	14.0	0.534	0.026	**
MA etc. to PhD	238	15.0	0.453	0.026	***
Wealth quartiles					
Lowest	211	13.3	0.719	0.035	ref
2	207	13.1	0.659	0.038	ns
3	210	13.2	0.554	0.033	***
Highest	205	12.9	0.389	0.030	***
Missing	756	47.6	0.589	0.018	***
Income quartiles					
Lowest	393	24.7	0.674	0.028	ref
2	404	25.4	0.627	0.027	ns
3	379	23.8	0.568	0.025	***
Highest	389	24.5	0.464	0.021	***
Missing	26	1.6	0.634	0.108	ns
Poor self-reported health					
0	1202	75.6	0.543	0.014	ref
1	388	24.4	0.715	0.026	***
Memory problems					
0	1394	87.7	0.574	0.013	ref
1	196	12.3	0.666	0.038	**

Note: We are reporting the mean and standard error of saving regret, pooling respondents across the two question formats for saving regret (unframed and framed). The t-test refers to a t-test of the indicated category vs. the reference category (ref). ns= not significant, *,**, *** refer to significance at the 10 percent, 5 percent, 1 percent significance level, respectively. Data are weighted.

Table 2: Saving Regret by Psychological Factors

			Saving Regret (After Revision)		
	N	In percent	Mean	Std. Error	T-test
Panel A: Self-confidence and present focus					
Self-confident					
(Strongly) disagree	123	7.8	0.581	0.045	ref
Neither	284	17.9	0.607	0.030	ns
(Strongly) agree	1182	74.4	0.58	0.014	ns
Works best under pressure					
(Strongly) disagree	455	28.6	0.617	0.024	ref
Neither	639	40.2	0.556	0.020	**
(Strongly) agree	496	31.2	0.593	0.021	ns
Do what you like today					
(Strongly) disagree	88	5.5	0.526	0.051	ref
Neither	251	15.8	0.551	0.030	ns
(Strongly) agree	1251	78.7	0.596	0.014	ns
Life about having fun.					
(Strongly) disagree	850	53.5	0.608	0.016	ref
Neither	420	26.4	0.523	0.024	***
(Strongly) agree	320	20.1	0.605	0.029	ns
Avoid unhealthy food or behaviors					
(Strongly) disagree	440	27.7	0.569	0.024	ref
Neither	546	34.3	0.628	0.021	**
(Strongly) agree	604	38.0	0.558	0.020	ns
Panel B: Procrastination and perseverance					
Put off things you should do					
Never	76	4.8	0.459	0.061	ref
Sometimes	1232	77.5	0.589	0.014	**
Most of the time	258	16.2	0.599	0.030	**
Always	24	1.5	0.639	0.096	ns
Give up before starting					
Never	750	47.2	0.547	0.018	ref
Sometimes	760	47.8	0.611	0.018	***
Most of the time	72	4.6	0.711	0.066	***
Always	8	0.5	0.524	0.177	ns
Try several tasks, don't complete many					
Never	564	35.5	0.537	0.021	ref
Sometimes	855	53.8	0.625	0.016	***
Most of the time	132	8.3	0.569	0.043	ns
Always	39	2.4	0.459	0.109	ns
Settle for mediocre results					
Never	715	45.0	0.588	0.018	ref
Sometimes	802	50.4	0.591	0.018	ns
Most of the time	69	4.4	0.471	0.065	*
Always	3	0.2	0.858	0.202	ns

			Saving Regret (After Revision)		
	N	In percent	Mean	Std. Error	T-test
Put off things not good at					
Never	230	14.5	0.585	0.033	ref
Sometimes	1044	65.6	0.574	0.015	ns
Most of the time	293	18.4	0.607	0.030	ns
Always	23	1.5	0.798	0.090	**
Put off difficult things					
Never	697	43.8	0.567	0.019	ref
Sometimes	776	48.8	0.592	0.017	ns
Most of the time	106	6.7	0.620	0.053	ns
Always	11	0.7	0.882	0.144	**
Lose motivation during tasks					
Never	534	33.6	0.601	0.021	ref
Sometimes	993	62.4	0.580	0.016	ns
Most of the time	55	3.5	0.526	0.070	ns
Always	8	0.5	0.579	0.175	ns

Note: We are reporting the mean and standard error of saving regret, pooling respondents across the two question formats for saving regret (unframed and framed). The t-test refers to a t-test of the indicated category vs. the reference category (ref). ns= not significant, *,**, *** refer to significance at the 10 percent, 5 percent, 1 percent significance level, respectively. Data are weighted.

Table 3: Saving Regret, Financial Planning, Financial Literacy, and Probability Numeracy

			Saving Regret (After Revision)		
	N	In percent	Mean	Std.Error	T-test
Financial Planning Horizon					
I don't plan	70	4.4	0.680	0.071	ns
Next few months	234	14.7	0.648	0.034	ref
Next year	155	9.7	0.640	0.040	ns
Next few years	299	18.8	0.593	0.029	ns
Next 5-10 years	260	16.3	0.565	0.029	*
Longer than 10 years	189	11.9	0.508	0.034	***
Missing	384	24.1	0.552	0.025	**
Financial Literacy					
0 correct answers	69	4.3	0.747	0.068	ref
1 correct answer	132	8.3	0.737	0.045	ns
2 correct answers	268	16.9	0.687	0.030	ns
3 correct answers	452	28.4	0.556	0.020	***
Missing	669	42.1	0.517	0.020	***
Probability Numeracy					
0 or 1 correct answer	146	9.2	0.505	0.045	ref
2 correct answers	272	17.1	0.659	0.030	***
3 correct answers	491	30.9	0.581	0.021	ns
4 correct answers	147	9.3	0.461	0.033	ns
Missing	534	33.6	0.607	0.024	**

Note: We are reporting the mean and standard error of saving regret, pooling respondents across the two question formats for saving regret (unframed and framed). The t-test refers to a t-test of the indicated category vs. the reference category (ref). ns= not significant, *,**, *** refer to significance at the 10 percent, 5 percent, 1 percent significance level, respectively. Financial planning, financial literacy and numeracy were merged from other ALP surveys. That is why we have missing values for individuals who did not participate in both survey waves. Data are weighted.

Table 4: Saving Regret and Negative/Positive Shocks

	N	In percent	Saving Regret (After Revision)		
			mean	Std.Error	T-test
Negative Shocks					
Health limited work	346	21.7	0.794	0.023	***
Unemployment	238	14.9	0.773	0.026	***
Large health expense	220	13.8	0.681	0.031	***
Large (non-health) expense	213	13.4	0.691	0.031	***
Salary/earnings less than expected	191	12.0	0.759	0.030	***
Divorce or separation	187	11.8	0.744	0.028	***
Death in family	151	9.5	0.606	0.040	ns
Bad investments	134	8.5	0.699	0.036	***
Other	36	2.3	0.698	0.064	ns
Any negative shock	892	56.1	0.684	0.015	***
Positive Shocks					
Good investments	316	19.9	0.364	0.024	***
Respondent salary/earnings more than expected	236	14.9	0.528	0.032	*
Received an inheritance	233	14.7	0.460	0.028	***
Worked more than expected	161	10.1	0.591	0.037	ns
Spouse salary/earnings more than expected	125	7.9	0.478	0.044	**
Other	47	3.0	0.486	0.069	ns
Any positive shock	701	44.1	0.492	0.018	***

Note: We are reporting the mean and standard deviation of savings regret, pooling respondents across the two question formats for saving regret (unframed and framed). The t-test refers to a t-test of those reporting the respective shock vs. those not reporting such a shock. ns= not significant, *,**, *** refer to significance at the 10 percent, 5 percent, 1 percent significance level, respectively. Data are weighted.

Table 5: Saving Regret and the Experience of at Least One Negative/Positive Shock

Panel A: Distribution of Population According to Whether Positive or Negative Shock Was Experienced (Weighted)

	Negative		
Positive	No	Yes	Total
No	22.74	33.19	55.92
Yes	21.14	22.94	44.08
Total	43.87	56.13	100.00

Panel B: Mean Saving Regret According to Positive or Negative Shock (Weighted)

	Negative		
Positive	No	Yes	Total
No	0.548	0.734	0.658
Yes	0.362	0.612	0.492
Total	0.458	0.684	0.585

Note: Data are weighted.

Table 6: Extracts from Regressions. Effect on Probability of Expressing Saving Regret

	Model 1	Model 2
Self confidence and present focus (Scaled 1-5 from "Strongly Disagree" to "Strongly Agree")		
Self-confident	-0.008	-0.002
Works best under pressure	0.037***	0.036***
Do what you like today, don't put it off	0.026*	0.023
Life is about having fun	-0.020	-0.020
Avoid unhealthy food or behaviors	0.011	0.011
Procrastination and perseverance (Scaled 1-4 from "Never" to "Always")		
Put off things you should do	0.046*	0.039
Give up before starting	-0.007	-0.004
Try several tasks, don't complete many	0.053**	0.053**
Settle for mediocre results	-0.024	-0.021
Put off things not good at	-0.011	-0.012
Give up task when difficult	0.026	0.030
Lose motivation during tasks	-0.036	-0.038
Negative Shock	0.145***	0.132***
Positive Shock	-0.131***	-0.114***
Wealth included	No	Yes
Observations	1589	1589
R2	0.117	0.129
F-tests		
Joint significance psychometric scales	F(12,1558) = 2.06 Prob>F = 0.0171	F (12, 1554) = 1.90 Prob>F = 0.0299
Joint significance full model	F(30,1558) = 6.87 prob>F = 0.000	F(34, 1554)=6.76 prob>F = 0.000

Note: Regressions also include demographics (age, sex, marital status, education, race/ethnicity, health, memory, and income). *,**,*** significant at 10 percent, 5 percent and 1 percent, respectively. The full regression results are reported in Appendix C Table A2.

Table 7. Saving Regret and Current and Future Financial Situation

			Saving Regret (After Revision)		
	N	In percent	Mean	Std. Error	T-test
Panel A. Household income is sufficient to meet spending needs each month					
Yes, always	698	43.9	0.445	0.018	ref.
Most of the time	669	42.1	0.671	0.019	***
Rarely or never	223	14.0	0.765	0.031	***
Panel B. Financial resources to meet future needs					
More than enough to meet your future needs	328	20.7	0.310	0.023	ref.
Just enough to meet your future needs	522	32.8	0.589	0.021	***
Not enough to meet your future needs	238	15.0	0.792	0.027	***
Not nearly enough to meet your future needs	132	8.3	0.826	0.036	***
Uncertain	273	17.2	0.617	0.032	***
Don‘t know	96	6.0	0.563	0.061	***
Panel C. Probability of running out of money					
0-24	697	44.1	0.474	0.018	ref.
25-49	324	20.5	0.654	0.028	***
50	262	16.6	0.641	0.031	***
51-74	149	9.4	0.784	0.035	***
75-100	150	9.5	0.677	0.038	***
Panel D. Economic satisfaction					
Very satisfied	171	10.8	0.244	0.029	ref.
Satisfied	723	45.5	0.522	0.018	***
Neither satisfied , nor dissatisfied	334	21.0	0.666	0.027	***
Very dissatisfied/dissatisfied	362	22.7	0.798	0.023	***
Panel E. Social Security receipt compared with expectations (respondents age 65 or older)					
A lot more than you expected	25	2.7	0.464	0.106	ref.
A bit more than you expected	69	7.5	0.552	0.061	ns
About the amount you expected	526	57.5	0.513	0.021	ns
A bit less than you expected	191	20.9	0.658	0.036	*
A lot less than you expected	105	11.5	0.692	0.047	**
Total	916	100.0	0.566	0.016	

Note: The data in Panel E. Social Security receipt compared with expectations are only reported for respondents age 65 and older. Data are weighted.

Figures

Figure 1: Theoretical Framework

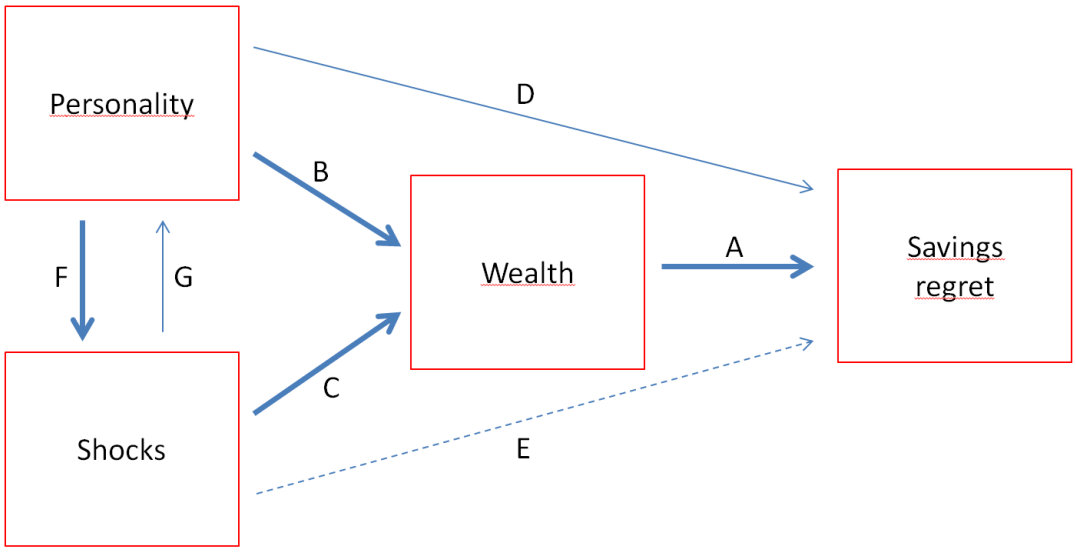
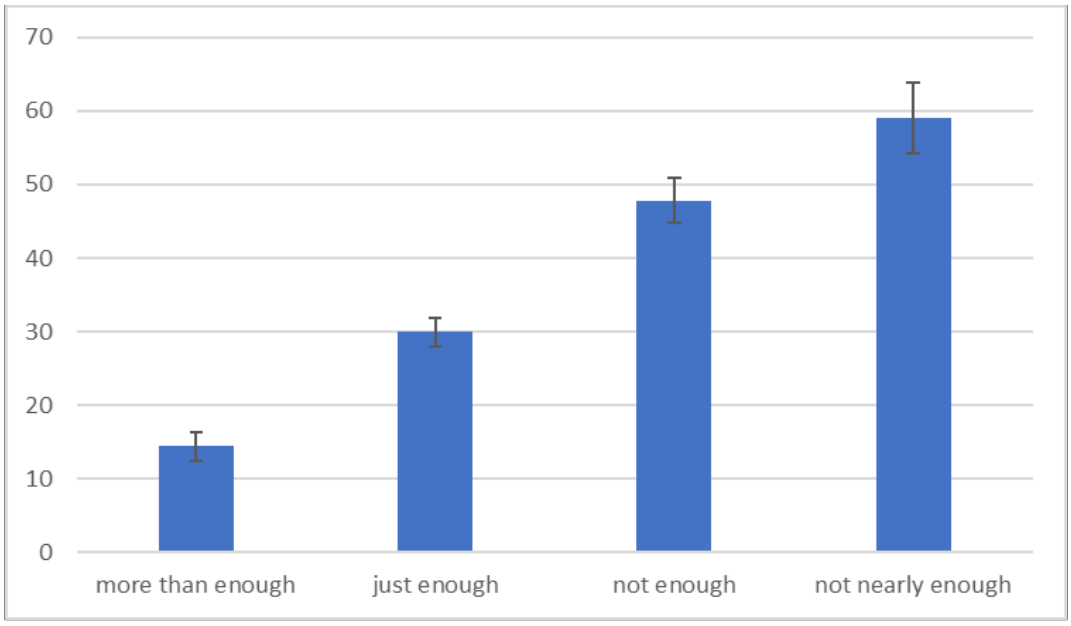
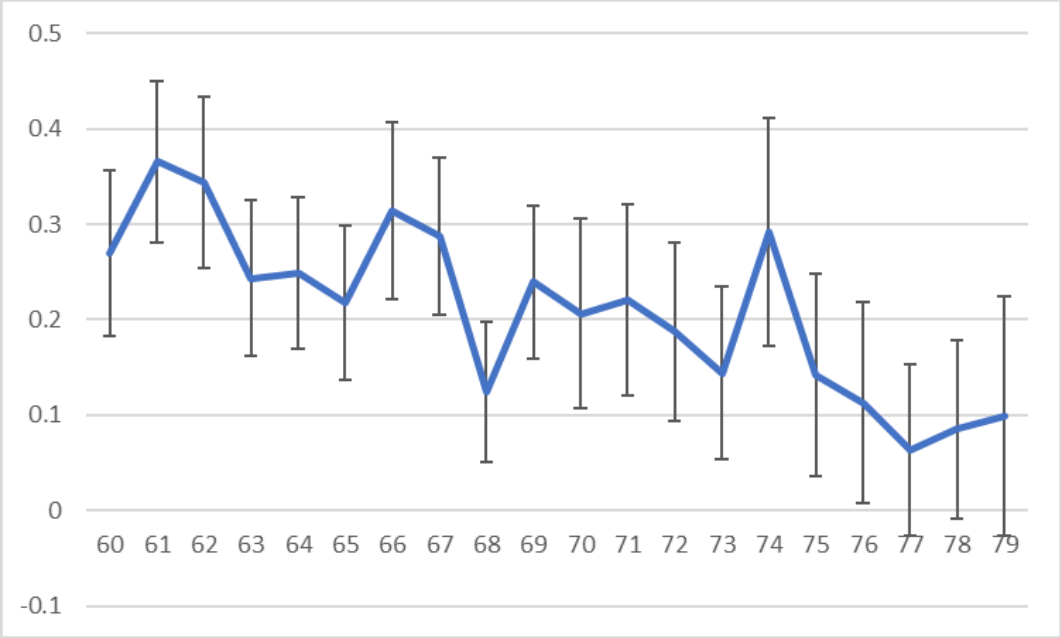


Figure 2. Subjective Probability of Running Out of Money According to Whether Financial Resources Are Enough to Meet Future Spending Needs (N=1,283)



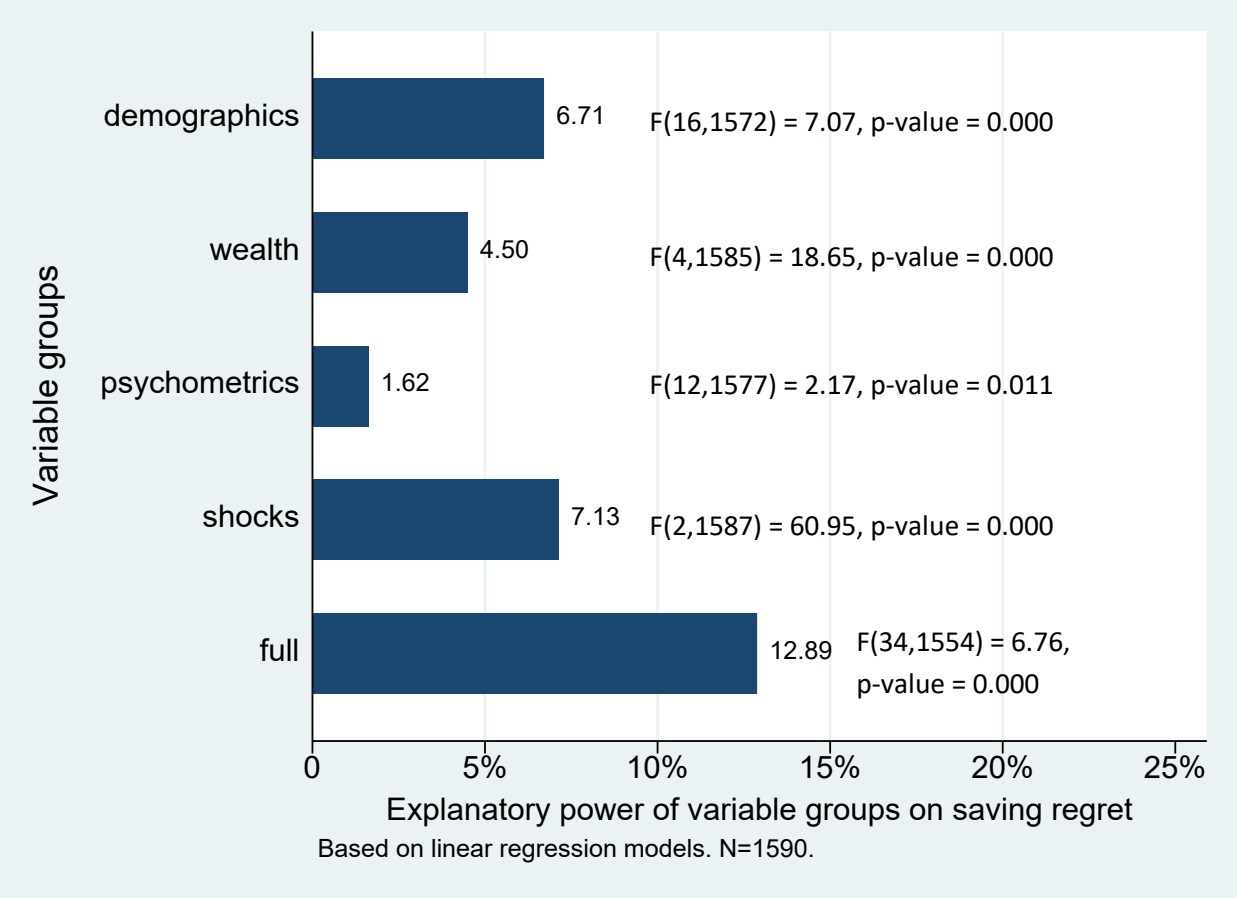
Note: Bands refer to 95 percent confidence intervals. Data are weighted. See Table 7, Panel B, for the distribution of responses on whether financial resources are enough to meet future spending needs.

Figure 3. Percent with Financial Resources Not Enough or Not Nearly Enough by Age (N=1,590)



Note: Bands refer to 95 percent confidence intervals. Data are weighted.

Figure 4. Variance Decomposition: R-Squared, F-Statistic and P-Values



Note: The full model refers to the model specified in Table 6 “Model 2”. The other models are defined by including only the respective variable groups as explanatory variables.

Appendix: For Online Publication

A. Variables and Survey Questions

Variable	Survey Question /Coding
Saving regret	
Wish saved more (before revision)	Indicator if respondent wished to have saved more (version a) / spend less and saved more (version b) over the years
Wish saved more (after revision)	Wish saved more set to 0 if respondents answered "No way I could have cut spending. I could not have saved more."
Sociodemographic characteristics	
Age	respondent age in years
Female	respondent gender
Married or marriage-like relationship	respondent household status
High school or less	indicator for respondents education
(some) College education	indicator for respondents education
Bachelor's degree	indicator for respondents education
Master's degree of higher	indicator for respondents education
Households assets	Total household assets in $US
Household income	Total household income in $US
Black	indicator for respondent race/ethnicity
Hispanic	indicator for respondent race/ethnicity
Poor self rated health	Indicator if respondents rates own health as poor
Poor self rated memory	Indicator if respondent rates own memory as poor
Positive and negative shocks	
Negative shocks	Sometimes people have negative surprises earlier in life that cause their finances to turn out worse than expected. Did any of the following happen to you? Please check all that apply:
Health limited work	indicator if respondents experienced this shock
Large health expense	indicator if respondents experienced this shock
Unemployment	indicator if respondents experienced this shock
Salary/earnings less than expected	indicator if respondents experienced this shock
Bad investments	indicator if respondents experienced this shock
Divorce or separation	indicator if respondents experienced this shock
Death in family	indicator if respondents experienced this shock
Large (non-health) expense	indicator if respondents experienced this shock
Other	indicator if respondents experienced this shock
Positive shocks	Sometimes people have positive surprises earlier in life that help their finances turn out better than expected. Did any of the following happen to you? Please check all that apply:
Respondent salary/earnings more than expected	indicator if respondents experienced this shock

Variable	Survey Question /Coding
Spouse salary/earnings more than expected	indicator if respondents experienced this shock
Worked more than expected	indicator if respondents experienced this shock
Good investments	indicator if respondents experienced this shock
Received an inheritance	indicator if respondents experienced this shock
Other	indicator if respondents experienced this shock
Any negative shock	indicator if respondent experienced any negative shock
Any positive shock	indicator if respondent experienced any positive shock
Psychometric variables	
Self-confidence and present focus	Evaluated on a five-point Likert scale: Strongly disagree/disagree/neither/agree/strongly agree
Self-confident	I am a self-confident person.
Works best under pressure	I am a person who works best under pressure.
Do what you like today.	Do you agree or disagree with the following statements? "People should do what they like today rather than putting it off until tomorrow"
Life is about having fun	Do you agree or disagree with the following statements? "Life is about having fun and spending all affordable money on that"
Avoid unhealthy food or behaviors.	Do you agree or disagree with the following statements? "For the sake of my health, I stay away from unhealthy foods or behaviors that I might enjoy"
Procrastination and perseverance	
Put off things you should do	How often do you put things off you should do but aren't really interested in? Never/Sometimes/Most of the time/Always
Give up before starting	How often do you give up before you start a task because you don't know where to start? Never/Sometimes/Most of the time/Always
Try several tasks, don't complete many	How often do you try to do several things at once, not completing many? Never/Sometimes/Most of the time/Always
Settle for mediocre results	How often do you settle for mediocre results when you could do better? Never/Sometimes/Most of the time/Always
Put off things not good at	How often do you put things off you are not good at? Never/Sometimes/Most of the time/Always
Give up task when difficult	How often do you give up a task when it gets difficult? Never/Sometimes/Most of the time/Always
Lose motivation during tasks	How often do you lose motivation in the middle of a task? Never/Sometimes/Most of the time/Always
Probability Numeracy	Score ranging from 0 to 4 depending on the number of correctly answered numeracy questions: First, suppose this bowl has 10 white balls and no red balls. You will be asked to draw one ball without looking. On a scale from 0 percent to 100 percent, what is the percent chance that the ball you draw is red?

Variable	Survey Question /Coding
	Now suppose that the bowl has 7 white balls and 3 red balls. You will be asked to draw one ball without looking. What is the percent chance that the ball you draw is white?
	Imagine that the weather report tells you that the chance it will rain tomorrow is 70 percent. Assuming the weather report accurately reports the chance of rain, what is the chance it will NOT rain tomorrow?
	Imagine that whether it rains in your town and whether it rains in Paris are unrelated. The chance that it will rain in your town tomorrow is 50 percent. The chance that it will rain in Paris is also 50 percent. What is the chance that it will rain both in your town and in Paris tomorrow?
Financial literacy	Score ranging from 0 to 3 depending on the number of correct answers to the financial literacy questions:
Interest rate	Suppose you had $100 in a savings account and the interest rate was 2 percent per year. After 5 years, how much do you think you would have in the account if you left the money to grow: [more than $102, exactly $102, less than $102? Don't know.]
Inflation	Imagine that the interest rate on your savings account was 1 percent per year and inflation was 2 percent per year. After 1 year, would you be able to buy: [more than, exactly the same as, or less than today with the money in this account? Don't know.]
Investment risk	Do you think that the following statement is true or false? "Buying a single company stock usually provides a safer return than a Unit Trust. [True, False, Don't know.]
Financial planning horizon	Financial planning horizon: next few months/ next year/ next few years/ next 5-10 years/ longer than 10 years/ I don't plan
HH total income sufficient	Is [fill for total income] sufficient to meet your spending needs each month? Yes, always/ Most of the time / Rarely/ Never
HH resources for future financial needs	And now a view into the future: Taking into consideration all of your household's wealth and future income and comparing them to your needs in the future, do you think that your household's total financial resources are…? More than enough to meet your future needs/ Just enough to meet your future needs/ Not enough to meet you future needs/ Not nearly enough to meet your future needs/ Uncertain/ Don't know
Probability of running out of money	What are the chances that you will run out of money sometime in the future? Please click a point on the scale. [Rabge 0 … 100]
Economic condition satisfaction	How satisfied are you with your overall economic situation? Very satisfied/satisfied/neither/dissatisfied/very dissatisfied
Respondent actual vs expected income from Social Security	When you received Social Security income for the first time, did you receive…? A lot more than expected/ a bit more than expected/ about the amount you expected/ a bit less than expected/ a lot less than expected

B Summary Statistics

Table A1. Summary Statistics

	N	Mean	SD	Min	Max
Wish saved more (before revision)	1590	0.636	0.481	0	1
Wish saved more (after revision)	1590	0.585	0.493	0	1
Age	1590	68.0	5.6	60	79
Female	1590	0.534	0.499	0	1
Married or marriage-like relationship	1589	0.619	0.486	0	1
High school or less	1590	0.465	0.499	0	1
(some) College education	1590	0.246	0.431	0	1
Bachelor's degree	1590	0.140	0.347	0	1
Master's degree of higher	1590	0.150	0.357	0	1
Households assets	815	542858	1085240	-250000	1.33E+07
Household income	1570	55375	75282	0	2000000
Black	1590	0.096	0.294	0	1
Hispanic	1590	0.101	0.301	0	1
Poor self-rated health	1590	0.244	0.429	0	1
Poor self-rated memory	1590	0.123	0.329	0	1
Negative shocks: health limited work	1590	0.217	0.413	0	1
Negative shocks: large health expense	1590	0.138	0.345	0	1
Negative shocks: unemployment	1590	0.149	0.357	0	1
Negative shocks: salary/earnings less than expected	1590	0.120	0.325	0	1
Negative shocks: bad investments	1590	0.085	0.278	0	1
Negative shocks: divorce or separation	1590	0.118	0.323	0	1
Negative shocks: death in family	1590	0.095	0.294	0	1
Negative shocks: large (non-health) expense	1590	0.134	0.341	0	1
Negative shocks: other	1590	0.023	0.149	0	1
Positive shocks: respondent salary/earnings more than expected	1589	0.149	0.356	0	1
Positive shocks: spouse salary/earnings more than expected	1589	0.079	0.270	0	1
Positive shocks: worked more than expected	1589	0.101	0.302	0	1
Positive shocks: good investments	1589	0.199	0.399	0	1
Positive shocks: received an inheritance	1589	0.147	0.354	0	1
Positive shocks: other	1590	0.029	0.169	0	1
Any negative shock	1590	0.561	0.496	0	1
Any positive shock	1590	0.441	0.497	0	1
Psychometric scales					
Self-assessment: self-confident	1590	3.854	0.838	1	5
Self-assessment: works best under pressure	1590	3.024	0.977	1	5
Financial-view: do what you like today	1590	3.954	0.828	1	5
Financial-view: life about having fun	1590	2.557	1.053	1	5
Financial-view: avoid unhealthy food or behaviors	1590	3.138	0.981	1	5

Motivation: put off things you should do	1590	2.144	0.500	1	4
Motivation: give up before starting	1590	1.583	0.603	1	4
Motivation: try several tasks, don't complete many	1590	1.777	0.697	1	4
Motivation: settle for mediocre results	1590	1.598	0.583	1	4
Motivation: put off things not good at	1590	2.069	0.619	1	4
Motivation: put off difficult things	1590	1.642	0.636	1	4
Motivation: lose motivation during tasks	1590	1.709	0.554	1	4
Probability Numeracy	1173	2.565	0.981	0	4
Financial literacy	983	2.198	0.946	0	3
Financial planning horizon	1202	3.187	1.495	1	6
HH total income sufficient	1590	1.731	0.774	1	4
HH resources for future financial needs	1590	3.047	2.024	1	9
Probability of running out of money	1581	33.644	26.4219	0	100
Economic condition satisfaction	1590	3.404	1.033	1	5
Respondent actual vs expected income from Social Security	1115	3.314	0.887	1	5

C Full results from Multivariate Regressions

We ran linear regressions where the dependent variable is saving regret ("wish I had saved more" with framed and unframed versions combined and revisions included). The number of observations varies slightly depending on the covariates included.

We added covariates stepwise. Model (1) and model (2) are the same models as reported in Table 6. Model (1) includes demographic controls (age, gender, marital status, education, income, race/ethnicity, health and memory problems), the psychometrics scales, and two indicators for any positive or negative shock. We add wealth quartiles in model (2). In models (3) and (4) we add all positive and negative shocks individually. Models (5), (6) and (7) include controls for numeracy, financial planning horizon and financial literacy, respectively. Since these variables are matched from earlier waves we include indicators if the variables are missing. In model (8) all psychometric indicators are added to the model as dummy variables.

Table A2: Multivariate regressions of saving regret (OLS)

	(1) **Without Wealth**	(2) **With Wealth**	(3) **With Ind. Shocks Without Wealth**	(4) **With Ind. Shocks With Wealth**	(5) **With Numera-cy**	(6) **With Financial Planning**	(7) **With Financial Literacy**	(8) **With Psycho Ind.**
Age (ref: age 60 to 64)								
Age 65 to 69	-0.017	-0.012	-0.011	-0.007	-0.013	-0.009	-0.013	-0.045
	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.033)
Age 70 to 74	-0.060*	-0.055	-0.063*	-0.059*	-0.055*	-0.052	-0.058*	-0.064
	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.034)	(0.040)
Age 75 to 79	-0.162***	-0.154***	-0.144***	-0.141***	-0.146***	-0.169***	-0.171***	-0.182***
	(0.041)	(0.041)	(0.042)	(0.042)	(0.042)	(0.042)	(0.047)	(0.058)
Female	-0.024	-0.023	-0.021	-0.020	-0.028	-0.017	-0.027	-0.001
	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.030)
Spouse	-0.025	-0.034	-0.015	-0.024	-0.030	-0.032	-0.033	-0.031
	(0.026)	(0.026)	(0.028)	(0.028)	(0.026)	(0.026)	(0.026)	(0.031)
Education (ref: less than college)								
Some college	0.038	0.040	0.035	0.036	0.036	0.035	0.042	0.062
	(0.037)	(0.036)	(0.037)	(0.037)	(0.037)	(0.036)	(0.037)	(0.047)
Bachelor's degree	-0.013	0.003	-0.015	-0.004	0.009	-0.002	0.009	0.071
	(0.041)	(0.041)	(0.042)	(0.042)	(0.042)	(0.041)	(0.042)	(0.052)
Master's degree of higher	-0.075*	-0.061	-0.089**	-0.078*	-0.045	-0.065	-0.053	-0.027
	(0.043)	(0.043)	(0.043)	(0.043)	(0.044)	(0.043)	(0.043)	(0.054)
Income (ref: 1 Q)								
Income 2 Q	-0.002	-0.004	-0.004	-0.006	-0.002	-0.005	-0.001	-0.013
	(0.039)	(0.039)	(0.039)	(0.039)	(0.039)	(0.039)	(0.039)	(0.049)
Income 3 Q	0.009	0.024	0.015	0.029	0.021	0.028	0.032	0.032
	(0.038)	(0.038)	(0.038)	(0.038)	(0.038)	(0.038)	(0.039)	(0.047)
Income 4 Q	-0.057	-0.028	-0.038	-0.013	-0.029	-0.027	-0.021	-0.001
	(0.039)	(0.040)	(0.039)	(0.040)	(0.040)	(0.040)	(0.040)	(0.048)
Income missing	-0.138	-0.147	-0.159	-0.165	-0.147	-0.163	-0.135	-0.069
	(0.110)	(0.109)	(0.109)	(0.108)	(0.109)	(0.109)	(0.110)	(0.125)
Black	0.055	0.043	0.056	0.046	0.046	0.044	0.038	0.052
	(0.049)	(0.049)	(0.049)	(0.049)	(0.049)	(0.049)	(0.050)	(0.065)
Hispanic	0.095*	0.085*	0.079	0.072	0.081	0.089*	0.079	0.056
	(0.050)	(0.050)	(0.050)	(0.050)	(0.050)	(0.050)	(0.050)	(0.061)
Fair or poor health	0.076**	0.067**	0.064*	0.057	0.074**	0.070**	0.069**	0.037
	(0.034)	(0.034)	(0.036)	(0.036)	(0.034)	(0.034)	(0.034)	(0.044)
Memory problems	-0.049	-0.053	-0.060	-0.064	-0.053	-0.051	-0.055	-0.025
	(0.044)	(0.043)	(0.044)	(0.043)	(0.043)	(0.043)	(0.043)	(0.054)
	0.055	0.043	0.056	0.046	0.046	0.044	0.038	-0.013

	(1) **Without Wealth**	(2) **With Wealth**	(3) **With Ind. Shocks Without Wealth**	(4) **With Ind. Shocks With Wealth**	(5) **With Numera-cy**	(6) **With Financial Planning**	(7) **With Financial Literacy**	(8) **With Psycho Ind.**
Psychological factors								
Self confident	-0.008	-0.002	-0.006	-0.001	-0.001	-0.002	-0.001	
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	
Works best under pressure	0.037***	0.036***	0.039***	0.037***	0.034***	0.036***	0.036***	
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	
Do what you like today	0.026*	0.023	0.027*	0.024	0.023	0.023	0.020	
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	
Life about having fun	-0.020	-0.020	-0.016	-0.016	-0.021*	-0.021*	-0.021	
	(0.013)	(0.013)	(0.013)	(0.012)	(0.013)	(0.013)	(0.013)	
Avoid unhealthy food or behaviors	0.011	0.011	0.012	0.012	0.011	0.010	0.011	
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	
Put off things you should do	0.046*	0.039	0.038	0.033	0.037	0.040	0.039	
	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	
Give up before starting	-0.007	-0.004	-0.004	-0.002	-0.003	-0.003	-0.004	
	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	
Try several tasks, don't complete many	0.053**	0.053**	0.047**	0.047**	0.054**	0.052**	0.053**	
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	
Settle for mediocre results	-0.024	-0.021	-0.020	-0.017	-0.019	-0.019	-0.021	
	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	
Put off things not good at	-0.011	-0.012	-0.008	-0.008	-0.012	-0.011	-0.013	
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	
Put off difficult things	0.026	0.030	0.020	0.024	0.031	0.028	0.028	
	(0.026)	(0.026)	(0.026)	(0.025)	(0.026)	(0.026)	(0.026)	
Lose motivation during tasks	-0.036	-0.038	-0.024	-0.026	-0.038	-0.041	-0.038	
	(0.027)	(0.027)	(0.027)	(0.026)	(0.027)	(0.027)	(0.027)	
Any negative shock	0.145***	0.132***			0.133***	0.130***	0.133***	0.129***
	(0.025)	(0.025)			(0.025)	(0.025)	(0.025)	(0.033)
Any positive shock	-0.131***	-0.114***			-0.114***	-0.114***	-0.111***	-0.089***
	(0.026)	(0.026)			(0.026)	(0.026)	(0.026)	(0.034)
Wealth (ref: 1Q)								
Wealth Q2		-0.002		-0.012	-0.003	-0.000	0.002	-0.015
		(0.053)		(0.053)	(0.053)	(0.053)	(0.053)	(0.065)
Wealth Q3		-0.062		-0.064	-0.061	-0.061	-0.056	-0.024
		(0.049)		(0.049)	(0.049)	(0.050)	(0.050)	(0.060)
Wealth Q4		-0.199***		-0.182***	-0.197***	-0.194***	-0.187***	-0.159**
		(0.052)		(0.052)	(0.051)	(0.052)	(0.052)	(0.062)
Wealthmissing		-0.079*		-0.073*	-0.075*	-0.098**	-0.081*	-0.073
		(0.042)		(0.043)	(0.042)	(0.045)	(0.044)	(0.055)
Negative shocks:								
Health limited work			0.088**	0.081**				
			(0.034)	(0.034)				
Large health expense			0.041	0.044				
			(0.036)	(0.036)				
Unemployment			0.079**	0.072**				
			(0.034)	(0.034)				
Salary/earnings less than expected			0.018	0.017				
			(0.038)	(0.037)				
Bad investments			0.077*	0.087**				
			(0.040)	(0.040)				
Divorce or separation			0.070**	0.064*				
			(0.035)	(0.035)				
Death in the family			-0.059	-0.056				
			(0.042)	(0.042)				
Large (non-health) expense			0.037	0.032				
			(0.035)	(0.035)				
Other negative shock			0.147**	0.151**				
			(0.067)	(0.067)				

	(1) **Without Wealth**	(2) **With Wealth**	(3) **With Ind. Shocks Without Wealth**	(4) **With Ind. Shocks With Wealth**	(5) **With Numera-cy**	(6) **With Financial Planning**	(7) **With Financial Literacy**	(8) **With Psycho Ind.**
Positive shocks:								
Respondent salary/earnings more than expected			0.016	0.017				
			(0.035)	(0.035)				
Spouse salary earning more than expected			-0.096**	-0.101**				
			(0.046)	(0.046)				
Worked more than expected			0.045	0.046				
			(0.039)	(0.039)				
Good investments			-0.186***	-0.157***				
			(0.029)	(0.030)				
Received an inheritance			-0.059*	-0.055*				
			(0.031)	(0.031)				
Other positive shock			-0.128*	-0.131**				
			(0.066)	(0.066)				
Probability Numeracy (ref: 0 or 1 correct answer)								
2 correct					0.034			
					(0.052)			
3 correct					0.033			
					(0.048)			
4 correct					-0.068			
					(0.057)			
Numeracy missing					-0.027			
					(0.049)			
Financial planning horizon (ref: next few months)								
Next year						0.038		
						(0.052)		
Next few years						0.048		
						(0.044)		
Next 5-10 years						0.064		
						(0.045)		
Longer than 10 years						-0.055		
						(0.049)		
I do not plan						0.029		
						(0.079)		
Finplan missing						0.076		
						(0.046)		
Financial literacy (ref: 0 correct answers)								
1 correct							0.097	0.191
							(0.088)	(0.120)
2 correct							0.061	0.165
							(0.081)	(0.112)
3 correct							0.006	0.101
							(0.080)	(0.111)
Missing							0.049	0.124
							(0.081)	(0.112)
Psychological factors (ref. "neither)								
Self confidence (disagree)								0.007
								(0.064)
Self confidence (agree)								-0.003
								(0.039)
Works best under pressure (disagree)								-0.008
								(0.037)
Works best under pressure (disagree)								0.067**
								(0.032)
Do what you like today (disagree)								-0.014
								(0.065)
Do what you like today (agree)								0.022
								(0.039)
Life about having fun (disagree)								0.040
								(0.034)
Life about having fun (agree)								0.036
								(0.043)

	(1) **Without Wealth**	(2) **With Wealth**	(3) **With Ind. Shocks Without Wealth**	(4) **With Ind. Shocks With Wealth**	(5) **With Numera-cy**	(6) **With Financial Planning**	(7) **With Financial Literacy**	(8) **With Psycho Ind.**
Avoid unhealthy food or behaviors (disagree)								-0.059
								(0.036)
Avoid unhealthy food or behaviors (agree)								-0.040
								(0.033)
Psychological factors (ref: never/sometime)								
Put off things you should do. (most of the time/always)								0.065*
								(0.039)
Give up before starting. (most of the time/always)								0.038
								(0.087)
Try several tasks, don't complete many. (most of the time/always)								0.048
								(0.051)
Settle for mediocre results. (most of the time/always)								-0.019
								(0.086)
Put off things not good at (most of the time/always)								-0.025
								(0.041)
Put off difficult things. (most of the time/always)								0.042
								(0.074)
Lose motivation during tasks. (most of the time/always)								-0.127
								(0.091)
Constant	0.361***	0.420***	0.338***	0.398***	0.417***	0.402***	0.389***	0.919**
	(0.131)	(0.134)	(0.131)	(0.133)	(0.141)	(0.136)	(0.149)	(0.371)
N	1589	1589	1588	1588	1589	1589	1589	1187
R-sq	0.117	0.129	0.140	0.149	0.135	0.136	0.131	0.136