

The Economic Importance of Financial Literacy: Theory and Evidence[†]

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This paper undertakes an assessment of a rapidly growing body of economic research on financial literacy. We start with an overview of theoretical research, which casts financial knowledge as a form of investment in human capital. Endogenizing financial knowledge has important implications for welfare, as well as policies intended to enhance levels of financial knowledge in the larger population. Next, we draw on recent surveys to establish how much (or how little) people know and identify the least financially savvy population subgroups. This is followed by an examination of the impact of financial literacy on economic decision making in the United States and elsewhere. While the literature is still young, conclusions may be drawn about the effects and consequences of financial illiteracy and what works to remedy these gaps. A final section offers thoughts on what remains to be learned if researchers are to better inform theoretical and empirical models as well as public policy. (JEL A20, D14, G11, I20, J26)

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1. Introduction

Financial markets around the world have become increasingly accessible to the “small investor,” as new products and financial services grow widespread. At the onset of the recent financial crisis, consumer credit and mortgage borrowing had burgeoned. People who had credit cards or subprime mortgages were in the historically unusual position of being able to decide how much they wanted to borrow. Alternative financial

services including payday loans, pawn shops, auto title loans, tax refund loans, and rent-to-own shops have also become widespread.¹ At the same time, changes in the pension landscape are increasingly thrusting responsibility for saving, investing, and decumulating wealth onto workers and retirees, whereas in the past, older workers relied mainly on Social Security and employer-sponsored defined benefit (DB) pension plans in retirement. Today, by contrast, Baby Boomers mainly have defined contribution (DC) plans and Individual Retirement Accounts (IRAs) during their working years. This trend toward disintermediation is increasingly requiring people to decide how much to save and where to invest and, during retirement, to take on responsibility for careful decumulation so as not to outlive their assets while meeting their needs.²

Despite the rapid spread of such financially complex products to the retail marketplace, including student loans, mortgages, credit cards, pension accounts, and annuities, many of these have proven to be difficult for financially unsophisticated investors to master.³ Therefore, while these developments have their advantages, they also impose on households a much greater responsibility to borrow, save, invest, and decumulate their assets sensibly by permitting tailored financial contracts and more people to access credit. Accordingly, one goal of this paper is to offer an assessment of how well-equipped today's households are to make these complex financial decisions. Specifically we focus on *financial literacy*, by which we mean peo-

ples' ability to process economic information and make informed decisions about financial planning, wealth accumulation, debt, and pensions. In what follows, we outline recent theoretical research modeling how financial knowledge can be cast as a type of investment in human capital. In this framework, those who build financial savvy can earn above-average expected returns on their investments, yet there will still be some optimal level of financial ignorance. Endogenizing financial knowledge has important implications for welfare, and this perspective also offers insights into programs intended to enhance levels of financial knowledge in the larger population.

Another of our goals is to assess the effects of financial literacy on important economic behaviors. We do so by drawing on evidence about what people know and which groups are the least financially literate. Moreover, the literature allows us to tease out the impact of financial literacy on economic decision making in the United States and abroad, along with the costs of financial ignorance. Because this is a new area of economic research, we conclude with thoughts on policies to help fill these gaps; we focus on what remains to be learned to better inform theoretical/empirical models and public policy.

2. *A Theoretical Framework for Financial Literacy*

The conventional microeconomic approach to saving and consumption decisions posits that a fully rational and well-informed individual will consume less than his income in times of high earnings, thus saving to support consumption when income falls (e.g., after retirement). Starting with Modigliani and Brumberg (1954) and Friedman (1957), the consumer is posited to arrange his optimal saving and decumulation patterns to smooth marginal utility over his lifetime. Many studies have shown how

¹ See Lusardi (2011) and FINRA Investor Education Foundation (2009, 2013).

² In the early 1980's, around 40 percent of U.S. private-sector pension contributions went to DC plans; two decades later, almost 90 percent of such contributions went to retirement accounts (mostly 401(k) plans; Poterba, Venti, and Wise 2008).

³ See, for instance, Brown, Kapteyn, and Mitchell (forthcoming)

such a life cycle optimization process can be shaped by consumer preferences (e.g., risk aversion and discount rates), the economic environment (e.g., risky returns on investments and liquidity constraints), and social safety net benefits (e.g., the availability and generosity of welfare schemes and Social Security benefits), among other features.⁴

These microeconomic models generally assume that individuals can formulate and execute saving and spend-down plans, which requires them to have the capacity to undertake complex economic calculations and to have expertise in dealing with financial markets. As we show in detail below, however, few people seem to have much financial knowledge. Moreover, acquiring such knowledge is likely to come at a cost. In the past, when retirement pensions were designed and implemented by governments, individual workers devoted very little attention to their plan details. Today, by contrast, since saving, investment, and decumulation for retirement are occurring in an increasingly personalized pension environment, the gaps between modeling and reality are worth exploring, so as to better evaluate where the theory can be enriched, and how policy efforts can be better targeted.

Though there is a substantial theoretical and empirical body of work on the economics of education,⁵ far less attention has been devoted to the question of how people acquire and deploy financial literacy. In the last few years, however, a few papers have begun to

examine the decision to acquire financial literacy and to study the links between financial knowledge, saving, and investment behavior (Delavande, Rohwedder, and Willis 2008; Jappelli and Padula 2013; Hsu 2011; and Lusardi, Michaud, and Mitchell 2013).⁶ For instance, Delavande, Rohwedder, and Willis (2008) present a simple two-period model of saving and portfolio allocation across safe bonds and risky stocks, allowing for the acquisition of human capital in the form of financial knowledge (à la Ben-Porath 1967, and Becker 1975). That work posits that individuals will optimally elect to invest in financial knowledge to gain access to higher-return assets: this training helps them identify better-performing assets and/or hire financial advisers who can reduce investment expenses. Hsu (2011) uses a similar approach in an intrahousehold setting where husbands specialize in the acquisition of financial knowledge, while wives increase their acquisition of financial knowledge mostly when it becomes relevant (such as just prior to the death of their spouses). Jappelli and Padula (2013) also consider a two-period model but additionally sketch a multiperiod life cycle model with financial literacy endogenously determined. They predict that financial literacy and wealth will be strongly correlated over the life cycle, with both rising until retirement and falling thereafter. They also suggest that, in countries with generous Social Security benefits, there will be fewer incentives to save and accumulate wealth and, in turn, less reason to invest in financial literacy.

⁴ For an older review of the saving literature see Browning and Lusardi (1996); recent surveys are provided by Skinner (2007) and Attanasio and Weber (2010). A very partial list of the literature discussing new theoretical advances includes Cagetti (2003); Chai et al. (2011); De Nardi, French, and Jones (2010); French (2005); French (2008); Gourinchas and Parker (2002); Aguiar and Hurst (2005, 2007); and Scholz, Seshadri, and Khitatrakun (2006).

⁵ Glewwe (2002) and Hanushek and Woessmann (2008) review the economic impacts of schooling and cognitive development.

⁶ Another related study is by Benitez-Silva, Demiralp, and Liu (2009) who use a dynamic life cycle model of optimal Social Security benefit claiming against which they compare outcomes to those generated under a sub-optimal information structure where people simply copy those around them when deciding when to claim benefits. The authors do not, however, allow for endogenous acquisition of information.

Each of these studies represents a useful theoretical advance, yet none incorporates key features now standard in theoretical models of saving—namely borrowing constraints, mortality risk, demographic factors, stock market returns, and earnings and health shocks. These shortcomings are rectified in recent work by Lusardi, Michaud, and Mitchell (2011, 2013), which calibrates and simulates a multiperiod dynamic life cycle model where individuals not only select capital market investments, but also undertake investments in financial knowledge. This extension is important in that it permits the researchers to examine model implications for wealth inequality and welfare. Two distinct investment technologies are considered: the first is a simple technology that pays a fixed low rate of return each period ($\bar{R} = 1 + \bar{r}$), similar to a bank account, while the second is a more sophisticated technology providing the consumer access to a higher stochastic expected return, $\tilde{R}(f_t)$, which depends on his accumulated level of financial knowledge. Each period, the stock of knowledge is related to what the individual had in the previous period minus a depreciation factor: thus $f_{t+1} = \delta f_t + i_t$, where δ represents knowledge depreciation (due to obsolescence or decay) and gross investment in knowledge is indicated with i_t . The stochastic return from the sophisticated technology follows the process $\tilde{R}(f_{t+1}) = \bar{R} + r(f_{t+1}) + \sigma_\varepsilon \varepsilon_{t+1}$ (where ε_t is a $N(0, 1)$ iid shock and σ_ε refers to the standard deviation of returns on the sophisticated technology). To access this higher expected return, the consumer must pay both a direct cost (c) and a time and money cost (π) to build up knowledge.⁷

⁷ This cost function is assumed to be convex, though the authors also experiment with alternative formulations, which do not materially alter results. Kézdi and Willis (2011) also model heterogeneity in beliefs about the stock market, where people can learn about the statistical process governing stock market returns, reducing transactions

Prior to retirement, the individual earns risky labor income (y) from which he can consume or invest so as to raise his return (R) on saving (s) by investing in the sophisticated technology. After retirement, the individual receives Social Security benefits, which are a percentage of preretirement income.⁸ Additional sources of uncertainty include stock returns, medical costs, and longevity. Each period, therefore, the consumer's decision variables are how much to invest in the capital market, how much to consume (C), and whether to invest in financial knowledge.

Assuming a discount rate of β and η_o , η_y , and ε , which refer, respectively, to shocks in medical expenditures, labor earnings, and rate of return, the problem takes the form of a series of Bellman equations with the following value function $V_d(s_t)$ at each age as long as the individual is alive ($p_{e,t} > 0$):

$$\begin{aligned} V_d(s_t) = & \max_{c_t, i_t, \kappa_t} n_{e,t} u(c_t/n_{e,t}) \\ & + \beta p_{e,t} \int_\varepsilon \int_{\eta_y} \int_{\eta_o} V(s_{t+1}) dF_e \\ & \times (\eta_o) dF_e(\eta_y) dF(\varepsilon). \end{aligned}$$

The utility function is assumed to be strictly concave in consumption and scaled using the function $u(c_t/n_t)$, where n_t is an equivalence scale capturing family size which changes predictably over the life cycle; and by education, subscripted by e . End-of-period assets (a_{t+1}) are equal to labor earnings plus the returns on the previous period's saving plus transfer income (tr), minus consumption and costs of investment in knowledge (as long as investments are positive; i.e., $\kappa > 0$).

costs for investments. Here, however, the investment cost was cast as a simplified flat fixed fee per person, whereas Lusardi, Michaud, and Mitchell (2013) evaluate more complex functions of time and money costs for investments in knowledge.

⁸ There is also a minimum consumption floor; see Lusardi, Michaud, and Mitchell (2011, 2013).

Accordingly,

$$a_{t+1} = \tilde{R}_\kappa(f_{t+1})(a_t + y_{e,t} + tr_t - c_t - \pi(i_t) - c_d I(\kappa_t > 0)).^9$$

After calibrating the model using plausible parameter values, the authors then solve the value functions for consumers with low/medium/high educational levels by backward recursion.¹⁰ Given paths of optimal consumption, knowledge investment, and participation in the stock market, they then simulate 5,000 life cycles allowing for return, income, and medical expense shocks.¹¹

Several key predictions emerge from this study. First, endogenously determined optimal paths for financial knowledge are hump shaped over the life cycle. Second, consumers invest in financial knowledge to the point where their marginal time and money costs of doing so are equated to their marginal benefits; of course, this optimum will depend on the cost function for financial knowledge acquisition. Third, knowledge profiles differ across educational groups because of peoples' different life cycle income profiles.

Importantly, this model also predicts that inequality in wealth and financial knowledge will arise endogenously without having to rely on assumed cross-sectional differences in preferences or other major changes to the theoretical setup.¹² Moreover, differences in wealth across education groups also arise endogenously; that is, some population

subgroups optimally have low financial literacy, particularly those anticipating substantial safety net income in old age. Finally, the model implies that financial education programs should not be expected to produce large behavioral changes for the least educated, since it may not be worthwhile for the least educated to incur knowledge investment costs given that their consumption needs are better insured by transfer programs.¹³ This prediction is consistent with Jappelli and Padula's (2013) suggestion that less financially informed individuals will be found in countries with more generous Social Security benefits (see also Jappelli 2010).

Despite the fact that some people will rationally choose to invest little or nothing in financial knowledge, the model predicts that it can still be socially optimal to raise financial knowledge for everyone early in life, for instance by mandating financial education in high school. This is because even if the least educated never invest again and let their knowledge endowment depreciate, they will still earn higher returns on their saving, which generates a substantial welfare boost. For instance, providing pre-labor market financial knowledge to the least educated group improves their wellbeing by an amount equivalent to 82 percent of their initial wealth (Lusardi, Michaud, and Mitchell 2011). The wealth equivalent value for college graduates is also estimated to be substantial, at 56 percent. These estimates are, of course, specific to the calibration, but the approach underscores that consumers would benefit from acquiring financial knowledge early in life even if they made no new investments thereafter.

In sum, a small but growing theoretical literature on financial literacy has made strides

⁹ Assets must be non-negative each period and there is a nonzero mortality probability as well as a finite length of life.

¹⁰ Additional detail on calibration and solution methods can be found in Lusardi, Michaud, and Mitchell (2011, 2013).

¹¹ Initial conditions for education, earnings, and assets are derived from Panel Study of Income Dynamics (PSID) respondents age 25–30.

¹² This approach could account for otherwise “unexplained” wealth inequality discussed by Venti and Wise (1998, 2001).

¹³ These predictions directly contradict at least one lawyer's surmise that, “[i]n an idealized first-best world, where all people are far above average, education would train every consumer to be financially literate and would motivate every consumer to use that literacy to make good choices” (Willis 2008).

in recent years by endogenizing the process of financial knowledge acquisition, generating predictions that can be tested empirically, and offering a coherent way to evaluate policy options. Moreover, these models offer insights into how policymakers might enhance welfare by enhancing young workers' endowment of financial knowledge. In the next section, we turn to a review of empirical evidence on financial literacy and how to measure it in practice. Subsequently, we analyze existing studies on how financial knowledge matters for economic behavior in the empirical realm.

3. Measuring Financial Literacy

Several fundamental concepts lie at the root of saving and investment decisions as modeled in the life cycle setting described in the previous section. Three such concepts are: (i) *numeracy and capacity to do calculations related to interest rates*, such as compound interest; (ii) *understanding of inflation*; and (iii) *understanding of risk diversification*. Translating these into easily measured financial literacy metrics is difficult, but Lusardi and Mitchell (2008, 2011a, 2011c) have designed a standard set of questions around these ideas and implemented them in numerous surveys in the United States and abroad.

Four principles informed the design of these questions. The first is *Simplicity*: the questions should measure knowledge of the building blocks fundamental to decision making in an intertemporal setting. The second is *Relevance*: the questions should relate to concepts pertinent to peoples' day-to-day financial decisions over the life cycle; moreover, they must capture general, rather than context-specific, ideas. Third is *Brevity*: the number of questions must be kept short to secure widespread adoption; and fourth is *Capacity to differentiate*, meaning that questions should differentiate financial knowledge to permit comparisons across people.

These criteria are met by the three financial literacy questions designed by Lusardi and Mitchell (2008, 2011a), worded as follows:

- 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; do not know; refuse to answer.]
- 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; do not know; refuse to answer.]
- Do you think that the following statement is true or false? "Buying a single company stock usually provides a safer return than a stock mutual fund." [true; **false**; do not know; refuse to answer.]

The first question measures numeracy, or the capacity to do a simple calculation related to compounding of interest rates. The second question measures understanding of inflation, again in the context of a simple financial decision. The third question is a joint test of knowledge about "stocks" and "stock mutual funds" and of risk diversification, since the answer to this question depends on knowing what a stock is and that a mutual fund is composed of many stocks. As is clear from the theoretical models described earlier, many decisions about retirement savings must deal with financial markets. Accordingly, it is important to understand knowledge of the stock market, as well as differentiate between levels of financial knowledge.

Naturally, any given set of financial literacy measures can only proxy for what individuals need to know to optimize behavior

TABLE 1
FINANCIAL LITERACY PATTERNS IN THE UNITED STATES

Panel A. Distribution of responses to financial literacy questions

	Responses			
	Correct	Incorrect	DK	Refuse
Compound interest	67.1%	22.2%	9.4%	1.3%
Inflation	75.2%	13.4%	9.9%	1.5%
Stock risk	52.3%	13.2%	33.7%	0.9%

Panel B. Joint probabilities of answering financial literacy questions correctly

	All 3 responses correct	Only 2 responses correct	Only 1 response correct	No responses correct
Proportion	34.3%	35.8%	16.3%	9.9%

Note: DK = respondent indicated “don’t know.”

Source: Authors’ computations from 2004 HRS Planning Module

in intertemporal models of financial decision making.¹⁴ Moreover, measurement error is a concern, as well as the possibility that answers might not measure “true” financial knowledge. These issues have implications for empirical work on financial literacy, to be discussed below.

3.1 Empirical Evidence of Financial Literacy in the Adult Population

The three questions above were first administered to a representative sample of U.S. respondents aged 50 and older, in a special module of the 2004 Health and Retirement Study (HRS).¹⁵ Results, summarized in table 1, indicate that this older U.S. population is quite financially illiterate: only about half could answer the simple 2 percent calculation and knew about inflation,

and only one third could answer all three questions correctly (Lusardi and Mitchell 2011a). This poor showing is notwithstanding the fact that people in this age group had made many financial decisions and engaged in numerous financial transactions over their lifetimes. Moreover, these respondents had experienced two or three periods of high inflation (depending on their age) and witnessed numerous economic and stock market shocks (including the demise of Enron), which should have provided them with information about investment risk. In fact, the question about risk is the one where respondents answered disproportionately with “Do not know.”

These same questions were added to several other U.S. surveys thereafter, including the 2007–2008 National Longitudinal Survey of Youth (NLSY) for young respondents (ages 23–28) (Lusardi, Mitchell, and Curto 2010); the RAND American Life Panel (ALP) covering all ages (Lusardi and Mitchell 2009); and the 2009 and 2012

¹⁴ See Huston (2010) for a review of financial literacy measures.

¹⁵ For information about the HRS, see <http://hrsonline.isr.umich.edu/>.

National Financial Capability Study (Lusardi and Mitchell 2011d).¹⁶ In each case, the findings underscore and extend the HRS results in that, for all groups, the level of financial literacy in the U.S. was found to be quite low.

Additional and more sophisticated concepts were then added to the financial literacy measures. For instance, the 2009 and 2012 National Financial Capability Survey included two items measuring sophisticated concepts such as asset pricing and understanding of mortgages/mortgage payments. Results revealed additional gaps in knowledge: for example, data from the 2009 wave show that only a small percentage of Americans (21 percent) knew about the inverse relationship between bond prices and interest rates (Lusardi 2011).¹⁷ A pass/fail set of 28 questions by Hilgert, Hogarth, and Beverly (2003) covered knowledge of credit, saving patterns, mortgages, and general financial management, and the authors concluded that most people earned a failing score on these questions as well.¹⁸ Lusardi, Mitchell, and Curto (forthcoming) also examine a set of questions measuring financial sophistication, in addition to basic financial literacy, and found that a large majority of older respondents are not financially sophisticated. Additional surveys have also examined financial knowledge in the context of debt. For example, Lusardi and Tufano (2009a, 2009b) examined “debt literacy” regarding interest compounding and found

that only one-third of respondents knew how long it would take for debt to double if one were to borrow at a 20 percent interest rate. This lack of knowledge confirms conclusions from Moore’s (2003) survey of Washington state residents, where she found that people frequently failed to understand interest compounding along with the terms and conditions of consumer loans and mortgages. Studies have also looked at different measures of “risk literacy” (Lusardi, Schneider, and Tufano 2011). Knowledge of risk and risk diversification remains low even when the questions are formulated in alternative ways (see, Kimball and Shumway 2006; Yoong 2011; and Lusardi, Schneider, and Tufano 2011). In other words, all of these surveys confirm that most U.S. respondents are not financially literate.

3.2 *Empirical Evidence of Financial Literacy among the Young*

As noted above, it would be useful to know how well-informed people are at the start of their working lives. Several authors have measured high school students’ financial literacy using data from the Jump\$tart Coalition for Personal Financial Literacy and the National Council on Economic Education. Because those studies included a long list of questions, they provide a rather nuanced evaluation of what young people know when they enter the workforce. As we saw for their adult counterparts, most high school students in the U.S. receive a failing financial literacy grade (Mandell 2008; National Council on Economic Education 2005). Similar findings are reported for college students (Chen and Volpe 1998; and Shim et al. 2010).

3.3 *International Evidence on Financial Literacy*

The three questions mentioned earlier and that have been used in several surveys in the United States have also been used in several national surveys in other countries.

¹⁶ Information on the 2009 and 2012 National Financial Capability Study can be found here: <http://www.usfinancialcapability.org/>.

¹⁷ Other financial knowledge measures include Kimball and Shumway (2006), Lusardi and Mitchell (2009), Yoong (2011), Hung, Parker, and Yoong (2009), and the review in Huston (2010). Related surveys in other countries examined similar financial literacy concepts (see, the Dutch Central Bank Household Survey, which has investigated and tested measures of financial literacy and financial sophistication, Alessie, van Rooij, and Lusardi 2011).

¹⁸ Similar findings are reported for smaller samples or specific population subgroups (see Agnew and Szykman 2011; Utkus and Young 2011).

Table 2 reports the findings from the twelve countries that have used these questions and where comparisons can be made for the total population.¹⁹ For brevity, we only report the proportion of correct and “do not know” answers to each question and for all questions.

The table highlights a few key findings. First, few people across countries can correctly answer three basic financial literacy questions. In the United States, only 30 percent can do so, with similar low percentages in countries having well-developed financial markets (Germany, the Netherlands, Japan, Australia, and others), as well as in nations where financial markets are changing rapidly (Russia and Romania). In other words, low levels of financial literacy found in the United States are also prevalent elsewhere, rather than being specific to any given country or stage of economic development. Second, some of what adult respondents know is related to national historical experience. For example, Germans and Dutch are more likely to know the answer to the inflation question, whereas many fewer people do in Japan, a country that has experienced deflation. Countries that were planned economies in the past (such as Romania and Russia) displayed the lowest knowledge of inflation. Third, of the questions examined, risk diversification appears to be the concept that people have the most difficulty grasping.

¹⁹ The Central Bank of Austria has used these questions to measure financial literacy in ten countries in Eastern Europe and we report the findings for Romania, where financial literacy has been studied in detail (Beckmann 2013). These questions have also been fielded in Mexico and Chile (Hastings and Tejada-Ashton 2008; Hastings and Mitchell 2011; Behrman et al. 2012), India, and Indonesia (Cole, Sampson, and Zia 2011). They have also been used to measure financial literacy among Sri Lankan entrepreneurs (de Mel, McKenzie, and Woodruff 2011) and a sample of U.S.-based migrants from El Salvador (Ashraf et al. 2011). We do not report the estimates for these countries because they do not always work with representative samples of the population or use samples that can be compared with the statistics reported in table 2.

Virtually everywhere, a high share of people respond that they ‘do not know’ the answer to the risk diversification question. For instance, in the United States, 34 percent of respondents state they do not know the answer to the risk diversification question; in Germany 32 percent and the Netherlands 33 percent do so; and even in the most risk-savvy countries of Sweden and Switzerland, 18 percent and 13 percent respectively, report that they do not know the answer to the risk diversification question.

The Organization for Economic Co-operation and Development (OECD) has been a pioneer in highlighting the lack of financial literacy across countries. For example, an OECD report in 2005 documented extensive financial illiteracy in Europe, Australia, and Japan, among others.²⁰ More recently, Atkinson and Messy (2011, 2012) confirmed the patterns of financial illiteracy mentioned earlier in the text across 14 countries at different stages of development in four continents, using a harmonized set of financial literacy as in the three questions that were used in many countries.²¹

The goal of evaluating student financial knowledge around the world among the young (high school students) has recently been taken up by the OECD’s Programme for International Student Assessment (PISA),²² which in 2012 added a module on financial literacy to its review of proficiency in mathematics, science, and reading. Accordingly, 15-year-olds around the world will be able to be compared with regard to

²⁰ Researchers have also examined answers to questions on mathematical numeracy in the England Longitudinal Survey of Ageing (ELSA; Banks and Oldfield 2007), and in the Survey of Health, Ageing, and Retirement in Europe (SHARE; Christelis, Jappelli, and Padula 2010).

²¹ Their survey uses eight financial literacy questions and focuses on fundamental concepts including the three main concepts discussed earlier.

²² For more information on the Financial Literacy Framework in PISA, see: <http://www.oecd.org/pisa/pisaproducts/46962580.pdf>

TABLE 2
COMPARATIVE STATISTICS ON RESPONSES TO FINANCIAL LITERACY QUESTIONS AROUND THE WORLD

Authors	Country	Year of data	Interest rate			Inflation			Risk Diversification			All 3 correct	At least 1 don't know	Number of Observations
			Correct	DK	Correct	DK	Correct	DK	Correct	DK				
Lusardi and Mitchell (2011)	USA	2009	64.9%	13.5%	64.3%	14.2%	51.8%	33.7%	30.2%	42.4%	1,488			
Alessie, Van Rooij, and Lusardi (2011)	Netherlands	2010	84.8%	8.9%	76.9%	13.5%	51.9%	33.2%	44.8%	37.6%	1,665			
Bucher-Koenen and Lusardi (2011)	Germany	2009	82.4%	11.0%	78.4%	17.0%	61.8%	32.3%	53.2%	37.0%	1,059			
Sekita (2011)	Japan	2010	70.5%	12.5%	58.8%	28.6%	39.5%	56.1%	27.0%	61.5%	5,268			
Agnew, Bateman, and Thorp (2013)	Australia	2012	83.1%	6.4%	69.3%	13.0%	54.7%	37.6%	42.7%	41.3%	1,024			
Crossan, Feslier, and Hurnard (2011)	N. Zealand	2009	86.0%	4.0%	81.0%	5.0%	27.0%	2.0%*	24.0%*	7.0%	850			
Brown and Graf (2013)	Switzerland	2011	79.3%	2.8%*	78.4%	4.2%*	73.5%*	13.0%*	50.1%*	16.9%*	1,500			
Formero and Monticone (2011)	Italy	2007	40.0%*	28.2%*	59.3%*	30.7%*	52.2%*	33.7%*	24.9%*	44.9%*	3,992			
Almenberg and Säve-Söderbergh (2011)	Sweden	2010	35.2%*	15.6%*	59.5%	16.5%	68.4%	18.4%	21.4%*	34.7%*	1,302			
Arrondei, Debbich, and Savignac (2013)	France	2011	48.0%*	11.5%*	61.2%	21.3%	66.8%*	14.6%*	30.9%*	33.4%*	3,616			
Klapper and Panos (2011)	Russia	2009	36.3%*	32.9%*	50.8%*	26.1%*	12.8%*	35.4%*	3.7%*	53.7%*	1,366			
Beckmann (2013)	Romania	2011	41.3%	34.4%	31.8%*	40.4%*	14.7%	63.5%	3.8%*	75.5%*	1,030			

Note: * indicates questions that have slightly different wording than the baseline financial literacy questions enumerated in the text.

their financial knowledge. In so doing, PISA has taken the position that financial literacy should be recognized as a skill essential for participation in today's economy.

3.4 *Objective versus Subjective Measures of Financial Literacy*

Another interesting finding on financial literacy is that there is often a substantial mismatch between peoples' *self-assessed knowledge* versus their *actual knowledge*, where the latter is measured by correct answers to the financial literacy questions posed. As one example, several surveys include questions asking people to indicate their self-assessed knowledge, as indicated by the following question used in the United States and also in the Netherlands and Germany:

- On a scale from 1 to 7, where 1 means very low and 7 means very high, how would you assess your overall financial knowledge?

Even though actual financial literacy levels are low, respondents are generally rather confident of their financial knowledge and, overall, they tend to overestimate how much they know (table 3). For instance, in the 2009 U.S. Financial Capability Study, 70 percent of respondents gave themselves score of 4 or higher (out of 7), but only 30 percent of the sample could answer the factual questions correctly (Lusardi 2011). Similar findings were reported in other U.S. surveys and in Germany and the Netherlands (Bucher-Koenen et al. 2012). One exception is Japan, where respondents gave themselves low grades in financial knowledge. In other words, though actual financial literacy is low, most people are unaware of their own shortcomings.

3.5 *Financial Literacy and Framing*

Peoples' responses to survey questions cannot always be taken at face value, a

point well-known to psychometricians and economic statisticians. One reason, as noted above, is that financial literacy may be measured with error, depending on the way questions are worded. To test this possibility, Lusardi and Mitchell (2009) and van Rooij, Lusardi, and Alessie (2011) randomly asked two groups of respondents the same risk question, but randomized their order of presentation. Thus half the group received format (a) and the other half format (b), as follows:

- Buying a company stock usually provides a safer return than a stock mutual fund. True or false?

OR

- Buying a stock mutual fund usually provides a safer return than a company stock. True or false?

They found that people's responses were, indeed, sensitive to how the question was worded in both the U.S. American Life Panel (Lusardi and Mitchell 2009) and the Dutch Central Bank Household Survey (DHS; van Rooij, Lusardi, and Alessie 2011). For example, fewer DHS respondents responded correctly when the wording was *'buying a stock mutual fund usually provides a safer return than a company stock'*; conversely, the fraction of correct responses doubled when shown the alternative wording: *'buying a company stock usually provides a safer return than a stock mutual fund.'* This was not simply due to people using a crude rule of thumb (such as always picking the first as the correct answer), since that would generate a lower rather than a higher percentage of correct answers for version (a). Instead, it appeared that some respondents did not understand the question, perhaps because they were unfamiliar with stocks, bonds, and mutual funds. What this means is that some answers judged to be "correct" may instead

TABLE 3
COMPARATIVE STATISTICS ON RESPONSES TO SELF-REPORTED FINANCIAL LITERACY

Authors	Country	Dataset	1–2	3	4	5	6	7	Average score
Authors' calculations	USA	NFCS 2012	3.9%	5.2%	14.9%	33.2%	26.1%	13.6%	5.1
Lusardi (2011)	USA	NFCS 2009	7.5%	6.0%	16.2%	32.3%	20.2%	17.5%	5
Lusardi and Tufano (2009a)	USA	TNS Global 2007	4.9%	7.7%	19.5%	31.9%	18.9%	10.7%	4.9
Authors' calculations on data from Lusardi and Mitchell (2009)*	USA*	ALP 2009*	5.3%	11.6%	27.2%	34.7%	16.7%	4.4%	4.6
Bucher-Koenen, Lusardi, Alessie and van Rooij (2012)	Netherlands	DHS 2010	7.3%	10.9%	23.0%	32.0%	23.4%	3.5%	4.6
Bucher-Koenen, Lusardi, Alessie and van Rooij (2012)	Germany	SAVE 2009	8.3%	14.2%	23.0%	32.2%	15.6%	6.8%	4.5
Sekita (2011)*	Japan*	SLPS 2010*	71%*	23.3%*		5.6%*			

Note: This table reports respondents' answers to the question: "On a scale from 1 to 7, where 1 means very low and 7 means very high, how would you assess your overall financial knowledge?"

* Note that the question posed in Lusardi and Mitchell (2009) is different and asks the following: "How would you assess your understanding of economics (on a 7-point scale; 1 means very low and 7 means very high)?" In Japan, respondents were asked whether they think that they know a lot about finance on a 1–5 point scale (Sekita 2011).

be attributable to guessing. In other words, analysis of the financial literacy questions should take into account the possibility that these measures may be noisy proxies of true financial knowledge levels.²³

4. Disaggregating Financial Literacy

To draw out lessons about which people most lack financial knowledge, we turn next to a disaggregated assessment of the data. In what follows, we briefly review evidence by age and sex, race/ethnicity, income and employment status, and other factors of interest to researchers.

4.1 Financial Literacy Patterns by Age

The theoretical framework sketched above implies that the life cycle profile of financial literacy will be hump-shaped, and survey data confirm that financial literacy is, in fact, lowest among the young and the old.²⁴ This is a finding which is robust across countries and we report a selected set of countries in figure 1.

Of course with cross-sectional data, one cannot cleanly disentangle age from cohort effects, so further analysis is required to identify these clearly, and below we comment

²³ In the 2008 HRS, the financial literacy questions were modified to assess the sensitivity of peoples' answers to the way in which the questions were worded. Results confirmed sensitivity to question wording, especially for the more sophisticated financial concepts (Lusardi, Mitchell, and Curto forthcoming). Behrman et al. (2012) developed a financial literacy index employing a two-step weighting approach, whereby the first step weighted each question by difficulty and the second step applied principal components analysis to take into account correlations across questions. Resulting scores indicated how financially literate each individual was in relation to the average and to specific questions asked. The results confirmed that the basic financial literacy questions designed by Lusardi and Mitchell (2011a) receive the largest weights.

²⁴ Earlier we made mention of the widespread lack of financial and economic knowledge among high school and college students. At the other end of the work life, financial literacy also declines with age, as found in the 2004 HRS module on financial literacy on people age 50+ and in many other countries (Lusardi and Mitchell 2011a, 2011c).

further on this point (figure 1a). Nevertheless, it is of interest that older people give themselves very high scores regarding their own financial literacy, despite scoring poorly on the basic financial literacy questions (Lusardi and Mitchell 2011a; Lusardi and Tufano 2009a) and not just in the United States, but other countries as well (Lusardi and Mitchell 2011c). Similarly, Finke, Howe, and Huston (2011) develop a multidimensional measure of financial literacy for the old and confirm that, though actual financial literacy falls with age, peoples' confidence in their own financial decision-making abilities actually *increases* with age. The mismatch between actual and perceived knowledge might explain why financial scams are often perpetrated against the elderly (Deevy, Lucich, and Beals 2012).

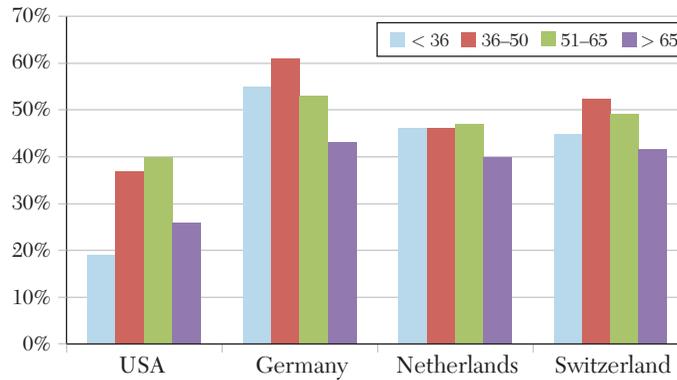
4.2 Financial Literacy Differences by Sex

One striking feature of the empirical data on financial literacy is the large and persistent gender difference described in figure 1b. Not only are older men generally more financially knowledgeable than older women, but similar patterns also show up among younger respondents as well (Lusardi, Mitchell, and Curto 2010; Lusardi and Mitchell 2009; Lusardi and Tufano 2009a, 2009b). Moreover, these gaps persist across both the basic and the more sophisticated literacy questions (Lusardi, Mitchell, and Curto forthcoming; Hung, Parker, and Yoong 2009).

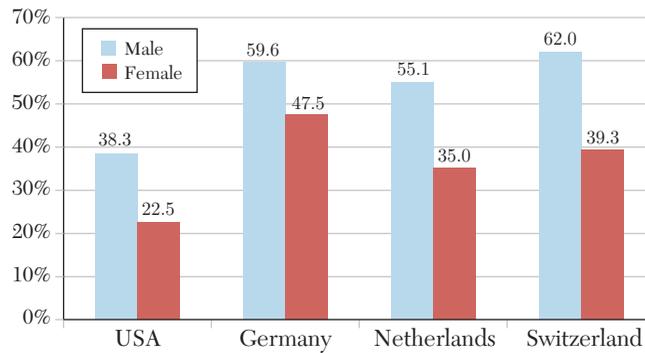
One twist on the differences by sex, however, is that while women are less likely to answer financial literacy questions correctly than men, they are also far more likely to say they 'do not know' an answer to a question, a result that is strikingly consistent across countries (figure 1b).²⁵ This awareness of their own

²⁵ While statistics are only reported for four countries in figure 1b, the prevalence of "do not know" responses by women is found in all of the twelve countries listed in table 2.

Panel 1A. By age group
(percent providing correct answers to all three financial literacy questions)



Panel 1B. By sex
(percent providing correct answers to all three financial literacy questions)



(percent responding “do not know” at least once to any of the three financial literacy questions)

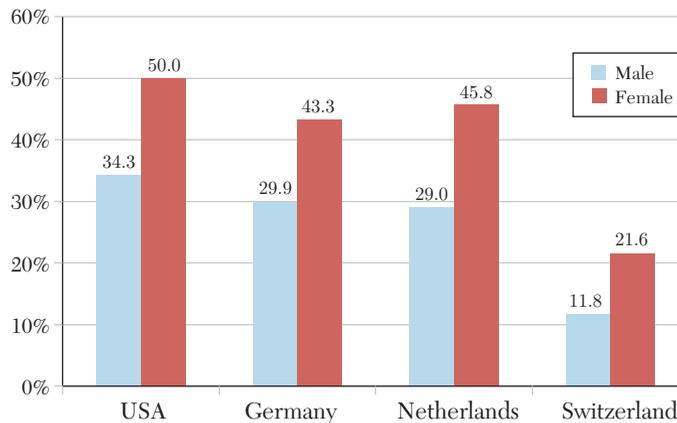


Figure 1. Financial Literacy across Demographic Groups (Age, Sex, and Education)

Panel 1C. Financial literacy by education group
(percent providing correct answers to all three financial literacy questions)

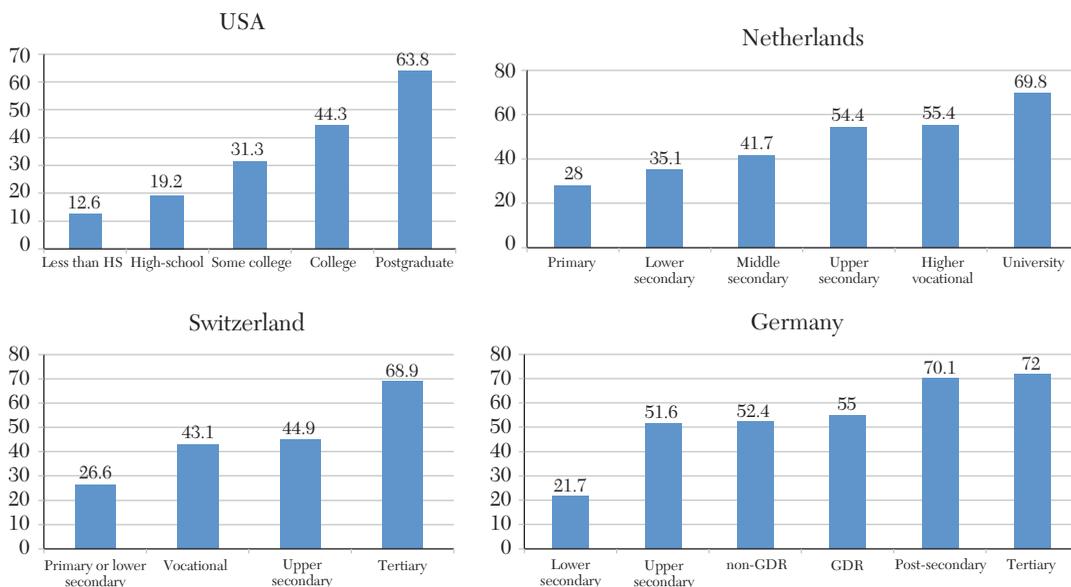


Figure 1. Financial Literacy across Demographic Groups (Age, Sex, and Education) *Continued*

lack of knowledge may make women ideal targets for financial education programs.

Because these sex differences in financial literacy are so persistent and widespread across surveys and countries, several researchers have sought to explain them. Consistent with the theoretical framework described earlier, Hsu (2011) proposed that some sex differences may be rational, with specialization of labor within the household leading married women to build up financial knowledge only late in life (close to widowhood). Nonetheless, that study did not explain why financial literacy is also lower among single women in charge of their own finances. Studies of financial literacy in high school and college also revealed sex differences in financial literacy early in life (Chen and Volpe 2002; Mandell

2008).²⁶ Other researchers seeking to explain observed sex differences concluded that traditional explanations cannot fully account for the observed male/female knowledge gap (Fonseca et al. 2012; Bucher-Koenen et al. 2012). Fonseca et al. (2012) suggested that women may acquire or “produce” financial literacy differently from men, while Bucher-Koenen et al. (2012) pointed to a potentially important role for self-confidence that differs by sex. Brown and Graf (2013) also showed that sex differences are not due

²⁶ It may be possible but untested so far that women, for example young ones, expect they would have someone later in life (a husband or companion) to take care of their finances.

to differential interest in finance and financial matters between women and men.

To shed more light on women's financial literacy, Mahdavi and Horton (2012) examined alumnae from a highly selective U.S. women's liberal arts college. Even in this talented and well-educated group, women's financial literacy was found to be very low. In other words, even very well educated women are not particularly financially literate, which could imply that women may acquire financial literacy differently from men. Nevertheless this debate is far from closed, and additional research will be required to better understand these observed sex differences in financial literacy.

4.3 *Literacy Differences by Education and Ability*

As illustrated in figure 1c, there are substantial differences in financial knowledge by education: specifically, those without a college education are much less likely to be knowledgeable about basic financial literacy concepts, as reported in several U.S. surveys and across countries (Lusardi and Mitchell 2007a, 2011c). Moreover, numeracy is especially poor for those with low educational attainment (Christelis, Jappelli, and Padula 2010; Lusardi 2012).

How to interpret the finding of a positive link between education and financial savvy has been subject to some debate in the economics literature. One possibility is that the positive correlation might be driven by cognitive ability (McArdle, Smith, and Willis 2009), implying that one must control on measures of ability when seeking to parse out the separate impact of financial literacy. Fortunately, the NLSY has included both measures of financial literacy and of cognitive ability (i.e., the Armed Services Vocational Aptitude Battery). Lusardi, Mitchell, and Curto (2010) did find a positive correlation between financial literacy and cognitive ability among young NLSY respondents, but they also showed that cognitive factors did

not fully account for the variance in financial literacy. In other words, substantial heterogeneity in financial literacy remains even after controlling on cognitive factors.

4.4 *Other Literacy Patterns*

There are numerous other empirical regularities in the financial literacy literature that are, again, persistent across countries. Financial savvy varies by income and employment type, with lower-paid individuals doing less well and employees and the self-employed doing better than the unemployed (Lusardi and Tufano 2009a; Lusardi and Mitchell 2011c). Several studies have also reported marked differences by race and ethnicity, with African Americans and Hispanics displaying the lowest level of financial knowledge in the U.S. context (Lusardi and Mitchell 2007a, 2007b, 2011b). These findings hold across age groups and many different financial literacy measures (Lusardi and Mitchell 2009). Those living in rural areas generally score worse than their city counterparts (Klapper and Panos 2011). These findings might suggest that financial literacy is more easily acquired via interactions with others, in the workplace or in the community.²⁷ Relatedly, there are also important geographic differences in financial literacy; for example, Fornero and Monticone (2011) report substantial financial literacy dispersion across regions in Italy and so does Beckmann (2013) for Romania. Bumcrot, Lin, and Lusardi (2013) report similar differences across U.S. states.

The literature also points to differences in financial literacy by family background. For instance, Lusardi, Mitchell, and Curto (2010) linked financial literacy of 23–28-year-old NLSY respondents to characteristics of the households in which they grew up,

²⁷ This might also help account for the sex differences mentioned above, since in many cultures, men are more likely than women to interact daily with financially knowledgeable individuals.

controlling for a set of demographic and economic characteristics. Respondents' financial literacy was also significantly positively correlated with parental education (in particular, that of their mothers), and whether their parents held stocks or retirement accounts when the respondents were teenagers. Mahdavi and Horton (2012) reported a connection between financial literacy and parental background; in this case, fathers' education was positively associated with their female children's financial literacy.²⁸ In other words, financial literacy may well get its start in the family, perhaps when children observe their parents' saving and investing habits, or more directly by receiving financial education from parents (Chiteji and Stafford 1999; Li 2009; Shim et al. 2009).

Other studies have noted a nationality gap in financial literacy, with foreign citizens reporting lower financial literacy than the native born (Brown and Graf 2013). Others have found differences in financial literacy according to religion (Alessie, van Rooij, and Lusardi 2011) and political opinions (Arrondel, Debbich, and Savignac 2013). These findings may also shed light on how financial literacy is acquired.

To summarize, while financial illiteracy is widespread, it is also concentrated among specific population subgroups in most countries studied to date. Such heterogeneity in financial literacy suggests that different mechanisms may be appropriate for tracking the causes and possible consequences of the shortfalls. In the United States, those facing most challenges are the young and the old, women, African-Americans, Hispanics, the least educated, and those living in rural areas. To date, these differences have not been fully accounted for, though the theoretical

framework outlined above provides guidelines for explaining some of these.

5. *How Does Financial Literacy Matter?*²⁹

We turn next to a discussion of whether and how financial literacy matters for economic decision making.²⁹ Inasmuch as individuals are increasingly being asked to take on additional responsibility for their own financial well-being, there remains much to learn about these facts. And as we have argued above, when financial literacy itself is a choice variable, it is important to disentangle cause from effect. For instance, those with high net worth who invest in financial markets may also be more likely to care about improving their financial knowledge, since they have more at stake. In what follows, we discuss research linking financial literacy with economic outcomes, taking into account the endogeneity issues as well.

5.1 *Financial Literacy and Economic Decisions*

The early economics literature in this area began by documenting the link between financial literacy and several economic behaviors. For example Bernheim (1995, 1998) was among the first to emphasize that most U.S. households lacked basic financial knowledge and that they also used crude rules of thumb when engaging in saving behavior. More recently, Calvet, Campbell, and Sodini (2007, 2009) evaluated Swedish investors' actions that they classified as "mistakes." While that analysis included no direct financial literacy measure, the authors did report that poorer, less educated, and immigrant households (attributes associated with low financial literacy, as noted earlier) were more likely to make financial errors. Agarwal et al. (2009) also focused on

²⁸ Other studies discussing financial socialization of the young include Hira, Sabri, and Loibl (2013) and the references cited therein.

²⁹ For a review of the role of financial literacy in the consumer behavior literature, see Hira (2010).

financial ‘mistakes,’ showing that these were most prevalent among the young and the old, groups which normally display the lowest financial knowledge.

In the wake of the financial crisis of 2008–09, the U.S. federal government has also begun to express substantial concern about another and more extreme case of mistakes, namely where people fall prey to financial scams. As often noted, scams tend to be perpetrated against the elderly, since they are among those with the least financial savvy and often have accumulated some assets.³⁰ A survey of older financial decision-makers (age 60+) indicated that more than half of them reported having made a bad investment, and one in five of those respondents felt they had been misled or defrauded but failed to report the situation (FINRA Investor Education Foundation 2006). As Baby Boomers age, this problem is expected to grow (Blanton 2012), since this cohort is a potentially lucrative target.

Several researchers have examined the relationships between financial literacy and economic behavior. It is much harder to establish a causal link between the two, and we will discuss the issue of endogeneity and other problems in more detail below. Hilgert, Hogarth, and Beverly (2003) uncovered a strong correlation between financial literacy and day-to-day financial management skills. Several other studies, both in the United States and other countries, have found that the more numerate and financially literate are also more likely to participate in financial markets and invest in stocks (Kimball and Shumway

2006; Christelis, Jappelli, and Padula 2010; van Rooij, Lusardi, and Alessie 2011; Yoong 2011; Almenberg and Dreber 2011; Arrondel, Debbich, and Savignac 2012). Financial literacy can also be linked to holding precautionary savings (de Bassa Scheresberg 2013).

The more financially savvy are also more likely to undertake retirement planning, and those who plan also accumulate more wealth (Lusardi and Mitchell 2007a, 2007b, 2011a, 2011d). Some of the first studies on the effects of financial literacy were linked to its effects on retirement planning in the United States. These studies have been replicated in most of the countries covered in table 2, showing that the correlation between financial literacy and different measures of retirement planning is quite robust.³¹ Studies breaking out specific components of financial literacy tend to conclude that what matters most is advanced financial knowledge (for example, risk diversification) and the capacity to do calculations (Lusardi and Mitchell 2011b; Alessie, van Rooij, and Lusardi 2011; Fornero and Monticone 2011; Klapper and Panos 2011; Sekita 2011).

Turning to the liability side of the household balance sheet, Moore (2003) reported that the least financially literate are also more likely to have costly mortgages. Campbell (2006) pointed out that those with lower income and less education (characteristics strongly related to financial illiteracy) were less likely to refinance their mortgages during a period of falling interest rates. Stango and Zinman (2009) concluded that those unable to correctly calculate interest rates out of a stream of payments ended up borrowing

³⁰ In 2011 Americans submitted over 1.5 million complaints about financial and other fraud, up 62 percent in just three years; these counts are also likely understated (FTC 2012). Financial losses per capita due to fraud have also increased over time: the median loss per victim rose from \$218 in 2002 to \$537 in 2011. Similarly the U.S. SEC (2012) warns about scams and fraud and other potential consequences of very low financial literacy, particularly among the most vulnerable groups.

³¹ The link between financial literacy and retirement planning also robust to the measure of financial literacy used (basic versus sophisticated financial knowledge; Lusardi and Mitchell 2009, 2011b), how planning is measured (Lusardi and Mitchell 2007a, 2009, 2011a; Alessie, van Rooij, and Lusardi 2011), and which controls are included in the empirical estimation (van Rooij, Lusardi, and Alessie 2011).

more and accumulating less wealth. Lusardi and Tufano (2009a) confirmed that the least financially savvy incurred high transaction costs, paying higher fees and using high-cost borrowing. In their study, the less knowledgeable also reported that their debt loads were excessive, or that they were unable to judge their debt positions. Similarly, Mottola (2013) found that those with low financial literacy were more likely to engage in costly credit card behavior, and Utkus and Young (2011) concluded that the least literate were also more likely to borrow against their 401(k) and pension accounts.

Moreover, both self-assessed and actual literacy is found to have an effect on credit card behavior over the life cycle (Allgood and Walstad 2013). A particularly well-executed study by Gerardi, Goette, and Meier (2013) matched individual measures of numerical ability to administrative records that provide information on subprime mortgage holders' payments. Three important findings flowed from this analysis. First, numerical ability was a strong predictor of mortgage defaults. Second, the result persisted even after controlling for cognitive ability and general knowledge. Third, the estimates were quantitatively important, as will be discussed in more detail below, an important finding for both regulators and policymakers.

Many high-cost methods of borrowing have proliferated over time, with negative effects for less savvy consumers.³² For instance, Lusardi and de Bassa Scheresberg (2013) examined high-cost borrowing in the United States, including payday loans, pawn shops, auto title loans, refund anticipation loans, and rent-to-own shops. They concluded that the less financially literate were substantially

more likely to use high-cost methods of borrowing, a finding that is particularly strong among young adults (age 25–34) (de Bassa Scheresberg 2013). While most attention has been devoted to the supply side, these studies suggest it may also be important to look at the demand side and the financial literacy of borrowers. The large number of mortgage defaults during the financial crisis has likewise suggested to some that debt and debt management is a fertile area for mistakes; for instance, many borrowers do not know what interest rates were charged on their credit card or mortgage balances (Moore 2003; Lusardi 2011; Disney and Gathergood 2012).³³

It is true that education can be quite influential in many of these arenas. For instance, research has shown that the college educated are more likely to own stocks and less prone to use high-cost borrowing (Haliassos and Bertaut 1995; Campbell 2006; Lusardi and de Bassa Scheresberg 2013). Likewise, there is a very strong positive correlation between education and wealth holding (Bernheim and Scholz 1993). But for our purposes, including controls for educational attainment in empirical models of stock holding, wealth accumulation, and high-cost methods of borrowing does not diminish the statistical significance of financial literacy and, in fact, it often enhances it (Lusardi and Mitchell 2011a; Behrman et al. 2012; van Rooij, Lusardi, and Alessie 2011, 2012; Lusardi and de Bassa Scheresberg 2013). Evidently, general knowledge (education) and more specialized knowledge (financial literacy) *both* contribute to more informed financial decision making. In other words, investment in financial knowledge appears to be a specific form of human capital, rather

³² The alternative financial services (AFS) industry has experienced tremendous growth in the United States: in 2009, the Federal Deposit Insurance Corporation estimated the industry to be worth at least \$320 billion in terms of transactional services (FDIC 2009).

³³ Disney and Gathergood (2012) reported that UK consumer credit customers systematically underestimated the cost of borrowing, while the least financially literate had higher average debt-to-income ratios.

than being simply associated with more years of schooling. Financial literacy is also linked to the demand for on-the-job training (Clark, Matsukura, and Ogawa 2013) and being able to cope with financial emergencies (Lusardi, Schneider, and Tufano 2011).

5.2 *Costs of Financial Ignorance* *Pre-retirement*

In the wake of the financial crisis, many have become interested in the costs of financial illiteracy as well as its distributional impacts. For instance, in the Netherlands, van Rooij, Lusardi, and Alessie (2012) estimate that being in the 75th versus the 25th percentile of the financial literacy index equals around €80,000 in terms of differential net worth (i.e., roughly 3.5 times the net disposable income of a median Dutch household). They also point out that an increase in financial literacy from the 25th to the 75th percentile for an otherwise average individual is associated with a 17–30 percentage point higher probability of stock market participation and retirement planning, respectively. In the United States, simulations from a life-cycle model that incorporates financial literacy shows that financial literacy alone can explain more than half the observed wealth inequality (Lusardi, Michaud, and Mitchell 2013). This result is obtained by comparing wealth-to-income ratios across education groups in models with and without financial literacy, which allows individuals to earn higher returns on their savings. For this reason, if the effects of financial literacy on financial behavior can be taken as causal, the costs of financial ignorance are substantial.

In the United States, investors are estimated to have foregone substantial equity returns due to fees, expenses, and active investment trading costs, in an attempt to “beat the market.” French (2008) calculates that this amounts to an annual total cost of around \$100 billion, which could be avoided

by passive indexing. Since the least financially literate are unlikely to be sensitive to fees, they are most likely to bear such costs. Additionally, many of the financially illiterate have been shown to shun the stock market, which Cocco, Gomes, and Maenhout (2005) suggested imposed welfare losses amounting to four percent of wealth. The economic cost of underdiversification computed by Calvet, Campbell, and Sodini (2007) is also substantial: they concluded that a median investor in Sweden experienced an annual return loss of 2.9 percent on a risky portfolio, or 0.5 percent of household disposable income. But for one in ten investors, these annual costs were much higher, 4.5 percent of disposable income.

Costs of financial ignorance arise not only in the saving and investment arena, but also influence how consumers manage their liabilities. Campbell (2006) reported that suboptimal refinancing among U.S. homeowners resulted in 0.5–1 percent per year higher mortgage interest rates, or in aggregate, \$50–100 billion annually. And as noted above, the least financially savvy are least likely to refinance their mortgages. Gerardi, Goette, and Meier (2013) showed that numerical ability may have contributed substantially to the massive defaults on subprime mortgages in the recent financial crisis. According to their estimates, those in the highest numerical ability grouping had about a 20 percentage point lower probability of defaulting on their subprime mortgages than those in the lowest financial numeracy group.

One can also link “debt literacy” regarding credit card behaviors that generate fees and interest charges to paying bills late, going over the credit limit, using cash advances, and paying only the minimum amount due. Lusardi and Tufano (2009a) calculated the “cost of ignorance,” or transaction costs incurred by less-informed Americans and the component of these costs related to lack of financial knowledge. Their calculation of

expected costs had two components—the likelihood and the costs of various credit card behaviors. These likelihoods were derived directly from empirical estimates using the data on credit card behavior, debt literacy, and a host of demographic controls that include income. They showed that, while less knowledgeable individuals constitute only 29 percent of the cardholder population, they accounted for 42 percent of these charges. Accordingly, the least financially savvy bear a disproportionate share of the costs associated with fee-inducing behaviors. Indeed, the average fees paid by those with low knowledge were 50 percent higher than those paid by the average cardholder. And of these four types of charges incurred by less-knowledgeable cardholders, one-third were incremental charges linked to low financial literacy.

Another way that the financially illiterate spend dearly for financial services is via high-cost forms of borrowing, including payday loans.³⁴ While the amount borrowed is often low (\$300 on average), such loans are made to individuals who have five or more such transactions per year (Ernst, Farris, and King 2004). It turns out that these borrowers also frequently fail to take advantage of other, cheaper opportunities to borrow. Agarwal, Skiba, and Tobacman (2009) studied payday borrowers who also have access to credit cards, and found that two-thirds of their sample had at least \$1,000 in credit card liquidity on the day they took out their first payday loan. This points to a pecuniary mistake: given average charges for payday loans and credit cards and considering a two-week payday loan of \$300, the use of credit cards would have saved these borrowers

substantial amounts—around \$200 per year (and more if they took out repeated payday loans). While there may be good economic reasons why some people may want to keep below their credit card limits, including unexpected shocks, Bertrand and Morse (2011) determined that payday borrowers often labored under cognitive biases, similar to those with low financial literacy (Lusardi and de Bassa Scheresberg 2013).

5.3 *Costs of Financial Ignorance in Retirement*

Financial knowledge impacts key outcomes, including borrowing, saving, and investing decisions, not only during the worklife, but afterwards, in retirement, as well. In view of the fact that people over the age of sixty-five hold more than \$18 trillion in wealth,³⁵ this is an important issue.

Above we noted that financial literacy is associated with greater retirement planning and greater retirement wealth accumulation.³⁶ Hence, it stands to reason that the more financially savvy will likely be better financially endowed when they do retire. A related point is that the more financially knowledgeable are also better informed about pension system rules, pay lower investment fees in their retirement accounts, and diversify their pension assets

³⁵See for instance Laibson (2011).

³⁶See for instance Ameriks, Caplin, and Leahy (2003); van Rooij, Lusardi, and Alessie (2012); and Lusardi and Mitchell (2007a, 2007b; 2009). It is worth noting that education also plays a role, as pointed out by Poterba, Venti, and Wise (2013) who find a substantial association between education and the postretirement evolution of assets. For example, for two-person households, assets growth between 1998 and 2008 was greater for college graduates than for those with less than a high school degree, producing over \$600,000 in assets for the richest quintile, to \$82,000 for the lowest asset quintile. As in the theoretical model described previously, households with different levels of education will invest in different assets, allowing them to earn different rates of return. It remains to be seen whether this is because of differential financial literacy investments, or simply due to general knowledge gleaned through education.

³⁴Americans paid about \$8 billion in finance charges to borrow more than \$50 billion from payday lenders in 2007; the annual interest rates on such loans are often very high, over 400 percent. See Bertrand and Morse (2011) and the references therein.

better (Arenas de Mesa et al. 2008; Chan and Stevens 2008; Hastings, Mitchell, and Chyn 2011).³⁷ To date, however, relatively little has been learned about whether more financially knowledgeable older adults are also more successful at managing their resources in retirement, though the presence of scams among the elderly suggests that this topic is highly policy-relevant.

This is a particularly difficult set of decisions requiring retirees to look ahead to an uncertain future when making irrevocable choices with far-reaching consequences. For instance, people must forecast their (and their partner's) survival probabilities, investment returns, pension income, and medical and other expenditures. Moreover, many of these financial decisions are once-in-a-lifetime events, including when to retire and claim one's pension and Social Security benefits. Accordingly, it would not be surprising if financial literacy enhanced peoples' ability to make these important and consequential decisions.

This question is especially relevant when it comes to the decision of whether retirees purchase lifetime income streams with their assets, since by so doing, they insure themselves against running out of income in old age.³⁸ Nevertheless, despite the fact that this form of longevity protection is very valuable in theory, relatively few payout annuities are purchased in practice in virtually every country (Mitchell, Piggott, and Takayama 2011). New research points to the importance of framing and default effects in this decision process (Agnew and Szkyman

2011; Brown, Kapteyn, and Mitchell forthcoming). This conclusion was corroborated by Brown et al. (2011), who demonstrated experimentally that people valued annuities less when they were offered the opportunity to buy additional income streams, and they valued annuities more if offered a chance to exchange their annuity flows for a lump sum.³⁹ Importantly for the present purpose, the financially savvy provided more consistent responses across alternative ways of eliciting preferences. By contrast, the least financially literate gave inconsistent results and respond to irrelevant cues when presented with the same set of choices. In other words, financial literacy appears to be highly influential in helping older households equip themselves with longevity risk protection in retirement.

Much more must be learned about how peoples' financial decision-making abilities change with age, and how these are related to financial literacy. For instance, Agarwal et al. (2009) reported that the elderly pay much more than the middle-aged for 10 financial products;⁴⁰ the 75-year-olds in their sample paid about \$265 more per year for home equity lines of credit than did the 50-year-olds. How the patterns might vary by financial literacy is not yet known, but it might be that those with greater baseline financial knowledge are better able to deal with financial decisions as they move into the second half of their lifetimes.⁴¹

³⁹ These findings are not attributable to differences in individuals' subjective life expectancies, discount rates, risk aversion, borrowing constraints, political risk, or other conventional explanations (Brown et al. 2011).

⁴⁰ These include credit card balance transfers; home equity loans and lines of credit; auto loans; credit card interest rates; mortgages; small business credit cards; credit card late-payment fees; credit card over-limit fees; and credit card cash-advance fees.

⁴¹ This could be particularly important inasmuch as Korniotis and Kumar (2011) find that cognitive decline is fastest with age for the less educated, lower earners, and minority racial/ethnic groups.

³⁷ Gustman, Steinmeier, and Tabatabai (2010) note that financial knowledge is not the same thing as cognitive functioning, since the latter is not associated with greater knowledge of retirement plan rules.

³⁸ Several authors have also linked financial literacy and knowledge about retirement saving. For instance, Agnew et al. (2007) show that employees who were the least financially knowledgeable were 34 percent less likely to participate voluntarily, and 11 percent less likely to be automatically enrolled, in their company's 401(k) plan.

5.4 *Coping with Endogeneity and Measurement Error*

Despite an important assembly of facts on financial literacy, relatively few empirical analysts have accounted for the potential endogeneity of financial literacy and the problem of measurement error in financial literacy alluded to above. In the last five years or so, however, several authors have implemented instrumental variables (IV) estimation to assess the impact of financial literacy on financial behavior, and the results tend to be quite convincing. To illustrate the ingenuity of the instruments used, table 4 lists several studies along with the instruments used in their empirical analysis. Some of the descriptive evidence on financial literacy discussed earlier may explain why these instruments may be anticipated to predict financial literacy.

It is useful to offer a handful of comments on some of the papers with particularly strong instruments. Christiansen, Joensen, and Rangvid (2008) used the opening of a new university in a local area—arguably one of the most exogenous variables one can find—as instrument for knowledge, and they concluded that economics education is an important determinant of investment in stocks. Following this lead, Klapper, Lusardi, and Panos (2012) used the number of public and private universities in the Russian regions and the total number of newspapers in circulation as instruments for financial literacy. They found that financial literacy affected a variety of economic indicators including having bank accounts, using bank credit, using informal credit, having spending capacity, and the availability of unspent income. Lusardi and Mitchell (2009) instrumented financial literacy using the fact that different U.S. states mandated financial education in high school at different points in time and they interacted these mandates with state expenditures on

education. Behrman et al. (2012) employed several instruments, including exposure to a new educational voucher system in Chile, to isolate the causal effects of financial literacy and schooling attainment on wealth. Their IV results showed that both financial literacy and schooling attainment were positively and significantly associated with wealth levels.

Van Rooij, Lusardi, and Alessie (2011) instrumented financial literacy with the financial experiences of siblings and parents, since these were arguably not under respondents' control, to rigorously evaluate the relationship between financial literacy and stock market participation. The authors reported that instrumenting greatly enhanced the measured positive impact of financial literacy on stock market participation. These instruments were also recently used by Agnew, Bateman, and Thorp (2013) to assess the effect of financial literacy on retirement planning in Australia. Bucher-Koenen and Lusardi (2011) used political attitudes at the regional level in Germany as an instrument, arguing that free-market oriented supporters are more likely to be financially literate, and the assumption is that individuals can learn from others around them. The study by Arrondel, Debbich, and Savignac (2013) also shows some differences in financial literacy across political affiliation.

Interestingly, in all these cases, the IV financial literacy estimates always prove to be larger than the ordinary least squares estimates (table 4). It might be that people affected by the instruments have large responses, or there is severe measurement error, but on the other hand, it seems clear that the noninstrumented estimates of financial literacy may underestimate the true effect.

Despite these advances, one might worry that other omitted variables could still influence financial decisions in ways that could bias results. For example, unobservables such

TABLE 4
INSTRUMENTAL VARIABLE (IV) ESTIMATION OF THE EFFECT OF FINANCIAL LITERACY ON BEHAVIOR

Authors	Country	Year of data	Instrument	Effect size compared to OLS	IV Statistically significant
Christiansen, Schröter Jøensen, and Rangvid (2008)	Denmark	1997–2001	The authors instrument financial sophistication by using the opening of a university as an exogenous shock that induces more high school graduates in the surrounding county to choose an economics education.	Larger than OLS	Yes
Lusardi and Mitchell (2009)	USA	2009	The authors instrument financial sophistication by using information on U.S. states mandates in high school financial education and state expenditures on education. They also interact the mandate variable with age to discern whether the effect grows over the life cycle.	Larger than OLS	Yes
Fomero and Monticone (2011)	Italy	2006	The authors instrument financial sophistication by using cost of learning and acquiring financial knowledge and information. Specifically, they use information on whether a household member has a degree in economics or whether one household member uses a computer (either at home, at work, or elsewhere).	Larger than OLS	Yes
Bucher-Koenen and Lusardi (2011)	Germany	2009	The authors instrument financial sophistication by using exposure to financial literacy, specifically, the author builds two instruments on the following information: rank in Japanese attitudes at the regional level as they are expected to be linked to financial knowledge.	Larger than OLS	Yes
Sekita (2011)	Japan	2010	The author uses level of Japanese language ability as an instrument for financial literacy. Specifically, the author builds two instruments on the following information: rank in Japanese language class when the respondent was 15 years old, and average language ability in the prefecture where the respondent lives.	Larger than OLS	Yes
Van Rooij, Lusardi and Alessie (2012)	Netherlands	2005	The authors use information on the financial education that respondents acquired in school and they use it as an instrument for financial sophistication. Specifically, they use information on how much of their education was devoted to economics (a lot, some, little, or hardly at all).	Larger than OLS	Yes
Alessie, Van Rooij and Lusardi (2011)	Netherlands	2010	The authors instrument financial sophistication by using financial experiences of respondents' siblings and parents.	Larger than OLS	Yes
Klapper, Lusardi, and Panos (2012)	Russia	2008–2009	The authors use the number of newspapers in circulation per two-digit region (both regional and national) and the total number of universities per two-digit region (both public and private).	Larger than OLS	Yes
Behrman, Mitchell, Soo, and Bravo (2012)	Chile	2006	The authors use three sets of instruments: age-dependent variables, family background factors, and respondent personality traits. For example, they use respondents' exposure to national schooling voucher policy changes and pension fund marketing efforts to instrument for level of schooling and financial literacy.	Larger than OLS	Yes
Arrondel, Majdi, and Savignac (2012)	France	2011	The authors instrument respondents' financial sophistication by using information on parents' financial literacy and controlling for potential inheritance of financial portfolios.	Larger than OLS	Yes
Agnew, Bateman, and Thorp (2013)	Australia	2012	The authors instrument financial sophistication by using financial experiences of respondents' siblings and parents.	Larger than OLS	Yes

as discount rates (Meier and Sprenger 2013), IQ (Grinblatt, Keloharju, and Linnainmaa 2011), or cognitive abilities could influence saving decisions and portfolio choice (Delavande, Rohwedder, and Willis 2008; Korniotis and Kumar 2011). If these cannot be controlled for, estimated financial literacy impacts could be biased. However, Alessie, van Rooij, and Lusardi's (2011) work using panel data and fixed-effects regression as well as IV estimation confirmed the positive effect of financial literacy on retirement planning, and several studies, as mentioned earlier (Gerardi, Goette, and Meier 2013), account explicitly for cognitive ability. Nevertheless, they show that numeracy has an effect above and beyond cognitive ability.

A different way to parse out the effects of financial literacy on economic outcomes is to use a field experiment in which one group of individuals (the treatment group) is exposed to a financial education program and their behavior is then compared to that of a second group not thus exposed (the control group). Yet even in countries with less developed financial markets and pension systems, financial literacy impacts are similar to those found when examining the effect of financial literacy on retirement planning and pension participation (Lusardi and Mitchell 2011c). For example, Song (2011) showed that learning about interest compounding produces a sizeable increase in pension contributions in China. Randomized experimental studies in Mexico and Chile demonstrated that more financially literate individuals were more likely to choose pension accounts with lower administrative fees (Hastings and Tejada-Ashton 2008; Hastings and Mitchell 2011; Hastings, Mitchell, and Chyn 2011). More financially sophisticated individuals in Brazil were also less affected by their peers' choices in their financial decisions (Bursztyn et al. 2012).

The financial crisis has also provided a laboratory to study the effects of financial literacy against a backdrop of economic shocks.

For example, when stock markets dropped sharply around the world, investors were exposed to large losses in their portfolios. This, combined with much higher unemployment, has made it even more important to be savvy in managing limited resources. Bucher-Koenen and Ziegelmeier (2011) examined the financial losses experienced by German households during the financial crisis and confirmed that the least financially literate were more likely to sell assets that had lost value, thus locking in losses.⁴² In Russia, Klapper, Lusardi, and Panos (2012) found that the most financially literate were significantly less likely to report having experienced diminished spending capacity and had more available saving. Additionally, estimates from different time periods implied that financial literacy better equips individuals to deal with macroeconomic shocks.

Given this evidence on the negative outcomes and costs of financial illiteracy, we turn next to financial education programs to remedy these shortfalls.

6. *Assessing the Effects of Financial Literacy Programs*

Another way to assess the effects of financial literacy is to look at the evidence on financial education programs whose aims and objectives are to improve financial knowledge. Financial education programs in the United States and elsewhere have been implemented over the years in several different settings: in schools, workplaces, and libraries, and sometimes population subgroups have been targeted. As one example, several U.S. states mandated financial education in high school at different points in time, generating "natural experiments" utilized by Bernheim, Garrett, and Maki (2001), one of the earliest studies in this literature. Similarly,

⁴² Part of this behavior could also be due to liquidity constraints.

financial education in high schools has recently been examined in Brazil and Italy (Bruhn, Legovini, and Zia 2012; Romagnoli and Triflidis 2013). In some instances, large U.S. firms have launched financial education programs (Bernheim and Garrett 2003, Clark and D'Ambrosio 2008, and Clark, Morrill, and Allen 2012a, 2012b). Often the employer's intention is to boost defined benefit pension plan saving and participation (Duflo and Saez 2003, 2004; Lusardi, Keller, and Keller 2008; Goda, Manchester, and Sojourner 2012). Programs have also been adopted for especially vulnerable groups, such as those in financial distress (Collins and O'Rourke 2010).

Despite the popularity of the programs, only a few authors have undertaken careful evaluations of the impact of financial education programs. Rather than detailing or reviewing the existing literature,⁴³ here we instead draw attention to the key issues which future researchers must take into account when evaluating the effectiveness of financial education programs.⁴⁴ We also highlight key recent research not reviewed in prior surveys.

A concern emphasized above in section 2 is that evaluation studies have sometimes been conducted without a clear understanding of how financial knowledge is developed. That is, if we define financial literacy as a form of human capital investment, it stands to reason that some will find it optimal to invest in financial literacy while others will not. Accordingly, if a program were to be judged based on specific behavioral changes

such as increasing retirement saving or participation in retirement accounts, it should be recognized that the program is unlikely, both theoretically and practically, to change everyone's behavior in the same way.⁴⁵ For example, a desired outcome from a financial education program might be to boost saving. Yet for some, it may not be optimal to save; for others, it might be rational to reduce debt. Hence, unless an evaluator focused on the household portfolio problem including broader saving measures, a program might (incorrectly) be judged a failure.

A related concern is that, since such a large portion of the population is not financially knowledgeable about even the basic concepts of interest compounding, inflation, and risk diversification, it is unlikely that short exposure to financial literacy training would make much of a dent in consumers' decision-making prowess. For this reason, offering a few retirement seminars or sending employees to a benefit fair can be fairly ineffective (Duflo and Saez 2003, 2004). Additionally, few studies have undertaken a careful cost-benefit analysis, which should be a high priority for future research.

The evidence reported previously also shows there is substantial heterogeneity in both financial literacy and financial behavior, so that programs targeting specific groups are likely to be more effective than one-size-fits-all financial education programs. For example, Lusardi, Michaud, and Mitchell (2013) show theoretically that there is substantial heterogeneity in individual behavior, implying that not everyone will gain from financial education. Accordingly, saving will optimally be zero (or negative) for some, and financial education programs in this case would not be expected to change that behavior. In other words, one should

⁴³ See for instance Collins and O'Rourke (2010); Gale, Harris, and Levine (2012); Hastings, Madrian, and Skimmyhorn (2012); Hathaway and Khatiwada (2008); Lusardi and Mitchell (2007b); Lyons et al. (2006); and Martin (2007). Hira (2010) provides a broad overview of research on financial education over a long time span.

⁴⁴ Two good discussions by Fox, Bartholomae, and Lee (2005) and Lyons and Neelakantan (2008) highlight the limitations of existing financial education program evaluations.

⁴⁵ Moreover, practitioner discussions often refer to "financial capability," a term often identified with behavior change rather than knowledge.

not expect a 100 percent participation rate in financial education programs. In this respect, the model delivers an important prediction: in order to change behavior, financial education programs must be targeted to specific groups of the population, since people have different preferences and economic circumstances.

As in other fields of economic research, program evaluations must also be rigorous if they are to persuasively establish causality and effectiveness. As noted by Collins and O'Rourke (2010), the "golden rule" of evaluation is the experimental approach in which a "treatment" group exposed to financial literacy education is compared with a "control" group that is not (or that is exposed to a different treatment). Thus far, as noted above, few financial educational programs have been designed or evaluated with these standards in mind, making it difficult to draw inferences. A related point is that confounding factors may bias estimated impacts unless the evaluation is carefully structured. As an example, we point to the debate over the efficacy of teaching financial literacy in high school, a discussion that will surely be fed by the new financial literacy module in the 2012 PISA mentioned above. Some have argued against financial education in school (e.g., Willis 2008), drawing on the findings from the Jump\$tart Coalition for Personal Financial Literacy (Mandell 2004, 2008). The Jump\$tart studies concluded that students scored no better in financial literacy tests even if they attended school in states having financial education; in fact, in some cases, Mandell (1997, 2008) found that they scored even worse than students in states lacking these programs. Yet subsequent analyses (Walstad, Rebeck, and MacDonald 2010) pointed out that this research was incomplete as it did not account for course content, test measurement, teacher preparation, and amount of instruction. These points were underscored by Tennyson and

Nguyen (2001) who revisited the Jump\$tart data by looking more closely at state education requirements for personal finance education. They concluded that when students were mandated to take a financial education course, they performed much better than students in states with no personal finance mandates. Accordingly, there is reason to believe that mandating personal finance education may, in fact, be effective in increasing student knowledge—but only when it requires significant exposure to personal finance concepts.

It is likewise risky to draw inferences without knowing about the quality of teaching in these courses. For instance, Way and Holden (2009) examined over 1,200 K–12 teachers, prospective teachers, and teacher education faculty representing four U.S. census regions, along with teachers' responses to questions about their personal and educational backgrounds in financial education. Almost all of the teachers recognized the importance of and need for financial education, yet fewer than one-fifth stated that they were prepared to teach any of the six personal finance concepts normally included in the educational rubrics. Furthermore, prospective teachers felt least competent in the more technical topics, including risk management and insurance, as well as saving and investing. Interestingly, these are also the concepts that the larger adult population struggles with, as noted above. That study concluded that state education mandates appeared to have no effect on whether teachers took courses in personal finance, taught the courses, or felt competent to teach such a course, consistent with the fact that the states mandating high school financial education did not necessarily provide or promote teacher training in the field.

It would also be valuable to further investigate whether the knowledge scores actually measured what was taught in school and whether students self-selected into

the financial education classes. Walstad, Rebeck, and MacDonald (2010) used a quasi-experimental setup to assess a well-designed video course covering several fundamental concepts for both students and teachers. The test they employed was aligned with what was taught in school, and it measured students' initial levels of understanding of personal finance so as to capture improvements in financial knowledge. Results indicated a significant increase in personal finance knowledge among the "treated" students, suggesting that carefully crafted experiments can and do detect important improvements in knowledge. This is an area that would benefit from additional careful evaluative research (Collins and O'Rourke 2010).

Compared to the research on schooling, evaluating workplace financial education seems even more challenging. There is evidence that employees who attended a retirement seminar were much more likely to save and contribute to their pension accounts (Bernheim and Garrett 2003). Yet those who attended such seminars could be a self-selected group, since attendance was voluntary; that is, they might already have had a proclivity to save.

Another concern is that researchers have often little or no information on the content and quality of the workplace seminars. A few authors have measured the information content of the seminars (Clark and D'Ambrosio 2008; Lusardi, Keller, and Keller 2008) and conducted pre- and post-evaluations to detect behavioral changes or intentions to change future behavior. Their findings, including in-depth interviews and qualitative analysis, are invaluable for shedding light on how to make programs more effective. One notable recent experiment involved exposing a representative sample of the U.S. population to short videos explaining several fundamental concepts, including the power of interest compounding, inflation, and risk

diversification—all topics that most people fail to comprehend (Heinberg et al. 2010). Compared to a control group who did not receive such education, those exposed to the informational videos were more knowledgeable and better able to answer hypothetical questions about saving decisions.⁴⁶ While more such research is needed, when researchers target concepts using carefully-designed experiments, they are more likely to detect changes in knowledge and behavior critical for making financial decisions.

A related challenge is that it may be difficult to evaluate empirically how actual workers' behavior changes after an experimental treatment of the type just discussed. Goda, Manchester, and Sojourner (2012) asked whether employee decisions to participate in and contribute to their company retirement plan were affected by information about the correlation between retirement savings and postretirement income. Since the computation involves complex relationships between contributions, investment returns, retirement ages, and longevity, this is an inherently difficult decision. In that study, employees were randomly assigned to control and treatment groups; the treatment group received an information intervention while nothing was sent to the control group. The intervention contained projections of the additional account balance and retirement income that would result from additional hypothetical contribution amounts, customized to each employee's current age. Results showed that the treatment group members were more likely than the control group to boost their

⁴⁶ The difference in the knowledge of risk diversification, tax benefits of retirement accounts, and the benefits of employers' matches between the two groups (measured by the proportion of correct answers) was on the order of 10 percentage points. While these videos were targeted to young adults, older respondents who viewed them also increased knowledge and capacity to correctly answer questions concerning saving decisions (Heinberg et al. 2010).

pension contributions and contribution rates; the increase was an additional 0.17 percent of salary. Moreover, the treatment group felt better informed about retirement planning and was more likely to have figured out how much to save. This experiment is notable in that it rigorously illustrates the effectiveness of interventions—even low-cost informational ones—in increasing pension participation and contributions.⁴⁷

Very promising work assessing the effects of financial literacy has also begun to emerge from developing countries. Frequently analysts have focused on people with very low financial literacy and in vulnerable subgroups which may have the most to gain. Many of these studies have also used the experimental method described above, now standard in development economics research. These studies contribute to an understanding of the mechanisms driving financial literacy, as well as economic advances for financial education program participants. One example, by Carpena et al. (2011), sought to disentangle how financial literacy programs influence financial behavior. The authors used a randomized experiment on low-income urban households in India who underwent a five-week comprehensive video-based financial education program with modules on savings, credit, insurance and budgeting. They concluded that financial education in this context did not increase respondent numeracy, perhaps not surprisingly given that only four percent of respondents had a secondary education. Nevertheless, financial education did positively influence participant awareness of and attitudes toward financial products and financial planning tools.

In a related study, Cole et al. (2013) found that demand for rainfall insurance was higher in villages where individuals were

more financially literate. Cai, de Janvry, and Sadoulet (2013) showed that lack of financial education was a major constraint on the demand for weather insurance in rural China and that financial training could significantly improve take-up rates. Moreover, Song (2011) showed that when Chinese farmers were taught about interest compounding, it produced a sizeable increase in pension contributions.⁴⁸ This is encouraging given the evidence, even in developing countries, of lack of knowledge about interest compounding and the preliminary results on teaching this concept using videos.

In sum, while much effort has been devoted to examining the effectiveness of financial education programs in a variety of settings, relatively few studies have been informed by either a suitable theoretical model or a carefully-designed empirical approach. And since the theory predicts that not everyone will invest in financial knowledge, it is unreasonable to expect all ‘treated’ by a program will dramatically change their behavior. Moreover, a short program that is not tailored to specific groups’ needs is unlikely to make much difference. For these reasons, future analysts would do well to emulate the more recent rigorous field experiments that trace how both knowledge and behavior changes result from additional purpose-designed financial information and training.

7. *Implications and Discussion*

As we have shown, a relatively parsimonious set of questions measuring basic concepts such as interest compounding, inflation, and risk diversification has now become the starting point for evaluating levels of financial literacy around the world.

⁴⁷ A discussion of successful strategies to improve financial literacy and financial education programs is provided in Crossan (2011)

⁴⁸ For as broad perspective on how financial education programs can be made more effective in developing countries see Holzmann (2011).

Using these questions, researchers have demonstrated that low levels of financial knowledge are pervasive, suggesting that it will be quite challenging to provide the tools to help people function more effectively in complex financial and credit markets requiring sophisticated financial decision making. While research in this field continues to spread, it seems clear that there are likely to be important benefits of greater financial knowledge, including savvier saving and investment decisions, better debt management, more retirement planning, higher participation in the stock market, and greater wealth accumulation. Though it is challenging to establish a causal link between financial literacy and economic behavior, both instrumental variables and experimental approaches suggest that financial literacy plays a role in influencing financial decision making, and the causality goes from knowledge to behavior.

Much work remains to be done. Very importantly, there has been no carefully-crafted cost-benefit analysis indicating which sorts of financial education programs are most appropriate, and least expensive, for which kinds of people. Some research from developing countries speaks to this point, comparing educational treatments with other approaches such as simplifying decisions (Cole, Sampson, and Zia 2011; Drexler, Fischer, and Schoar 2010), but this remains a high priority area. In any event, the estimated aggregate costs of financial illiteracy point to possibly high returns, especially in the areas of consumer debt and debt management.

A related issue has to do with which sorts of problems are best suited to remedying through financial education, versus removing choice options from consumers' menus altogether or simplifying the options that people face. In this vein, Thaler and Sunstein (2010) have emphasized the importance of devoting careful attention to the design of the

environments in which people make choices, or the so-called "choice architecture." An important example arises in the context of employer-provided pensions, which in the past left it to individual employees to decide whether to save and how to invest their defined contribution contributions. When employers automatically enroll workers into these plans rather than let them opt in, this can dramatically increase pension participation (from less than 40 to close to 90 percent, as reported in one of the seminal work in this area, i.e., Madrian and Shea 2001). Several other studies also note that automatic enrollment leads to large and persistent increases in pension participation (Choi, Laibson, and Madrian 2004; Choi et al. 2006; Thaler and Benartzi 2004) and better diversified portfolios (Mitchell and Utkus 2012).

Moreover, in the wake of the recent financial crisis, attention has been increasingly devoted to methods of protecting people from their own financial illiteracy and inability to make informed financial decisions. The fact that unsophisticated consumers may not appreciate and take advantage of the many opportunities offered by complex financial markets leaves them at the mercy of scams (Deevy, Lucich, and Beals 2012) and in turn, has given rise to protective legislation. For instance the Dodd-Frank Act of 2010, establishing the U.S. Consumer Financial Protection Bureau, had as a key goal the development of a government entity that could better protect consumers and specify uniform standards for financial products.⁴⁹ Campbell et al. (2011) recently reviewed the theoretical and empirical consumer protection literature, making a case for consumer financial regulation. As they noted, in a system of individual responsibility where

⁴⁹ Among other things, the Bureau's mandate is to promote financial education and monitor financial markets for new risks to consumers; see <http://www.consumerfinance.gov/the-bureau/>.

individuals must make important economic decisions instead of having governments and employers do so centrally, it will be important to reduce search costs, for example via standardized and centralized information. Similarly, for contracts or decisions that people engage in infrequently (such as buying a home or saving for retirement) and where there are few chances to learn from experience, it may be useful to structure the information provided and make it easily understood.

The debate about the role of regulation versus financial education is still ongoing. In our view, it would be useful to enhance cross-fertilization between behavioral economics and its focus on choice architecture and the group proposing to educate people about financial basics; that is, it need not be an “either/or” choice. Similarly, regulation and financial education are not necessarily substitutes, as they can also complement each other.⁵⁰ As Thaler, Sunstein, and Balz (2010) note, “[C]hoice architects do not always have the best interests of the people they are influencing in mind.” Moreover, expanding automatic enrollment to the decumulation phase by implementing automatic annuitization of pensions upon retirement (a topic of current policy debate) might be deleterious to those having to cut consumption during their work lives and render some ineligible for government benefit programs after retirement (such as Medicaid or Supplemental Security Income). Likewise, pension plan sponsors have tended to establish very low saving targets in their default autoenrollment arrangements, fearing that employees might not participate in their plans if the default contribution rates were high. For instance, autoenrollment contribution rates for new

hires in the paper by Madrian and Shea (2001) mentioned earlier, were set at three percent of salary, whereas a six percent contribution rate would have entitled workers to receive a 50 percent employer match. In that setting, the low default saving rate did not prod workers to take full advantage of the employer match.⁵¹ Moreover, the three percent default set by the firm was taken by employees as a signal of a “suggested target” saving level, since many of them reduced their contributions to three percent, even if they had saved more previously. Additional examples of people treating the default as an employer-endorsed target include Beshears et al. (2012), who showed that workers tended to stick to the “wrong” default for long periods of time. Interestingly, those likely to do so were disproportionately low income and less educated, those likely to be the least financially literate.

The human capital approach to financial literacy suggests that there will be substantial heterogeneity in both financial knowledge and economic behavior, so it is unlikely that any one default rate or environment will enhance well-being for everyone. Thus, if workers are carrying credit card debt or high-interest mortgages, it may be more sensible to pay off these debts rather than raise their pension contributions. Similarly, borrowing from one’s 401(k) plan may be more cost-effective for financially strapped households, versus taking out higher-cost debt elsewhere (Lu, Mitchell, and Utkus 2010). And of course, only about half of the U.S. workforce is employed at firms that offer pensions, so the remaining several million employees without pensions would not benefit from automatic enrollment.

⁵⁰ For instance, the Director of the Consumer Financial Protection Bureau, Richard Cordray, has been a strong supporter of financial education in high school and in the workplace.

⁵¹ Note, however, that when left to their own devices, many employees simply fail to enroll in pensions and hence fail to exploit the employer match *at all*, if or when one is available.

If, as argued previously, saving decisions are very complex, one way to help people save may be to find ways to simplify those decisions. For example, it could be useful to find ways to move people to action. Such a strategy is analyzed by Choi, Laibson, and Madrian (2004), who studied the effects of Quick Enrollment, a program that gave workers the option of enrolling in the employer-provided saving plan by opting into a preset default contribution rate and asset allocation. Here, and unlike the default scenario, workers had a choice of whether or not to enroll, but the decision was much simplified, as they did not need to set their contribution rates or decide how to allocate their assets.

Another approach designed to simplify the decision to save and, in addition, motivate employees to make an active choice involves a planning aid distributed to new hires during employee orientation (Lusardi, Keller, and Keller 2008). This planning aid broke down the process of enrolling in supplementary pensions into several small steps, describing to participants what they needed to do to be able to enroll online. It also provided several pieces of information to help overcome barriers to saving, such as describing the low minimum amount of income employees can contribute (in addition to the maximum) and indicating the default fund that the employer has chosen for them (a life-cycle fund). While the program evaluation was not performed in an experimental setting, the study provided several useful insights. The qualitative data collected reveals important heterogeneity across employees, even within the same firm. Results also showed that economic incentives such as employer matches or tax advantages need not exhaust the list of options to induce people to save. The authors also concluded that employees were more prone to decision making at some times rather than others. For example, starting a new job is a good time to think about

saving, often because people must make decisions about their pension contributions.

In the developing-country context, more work is also needed to assess whether simplification can help uneducated individuals make better financial decisions. This can include using simple financial instruments, such as checking accounts, to more complex contracts, such as insurance, and decisions related to entrepreneurial activities. Early research has been promising: Drexler, Fischer, and Schoar (2010) showed that a simplified rule-of-thumb training program enhanced business practices and outcomes among microentrepreneurs in the Dominican Republic. Kast, Meier, and Pomeranz (2012) also found that self-help peer groups and text messaging boosted employee saving patterns in Chile.

An alternative method of enhancing peoples' performance in an increasingly financially complex world might be to outsource the job, by relying on financial advice. Some have argued it is not feasible or even desirable to make everyone be a financial expert (Willis 2008, 2011). Of course, financial education programs do not turn ordinary consumers into experts, just as courses on literature do not make students into professional writers. Also, individuals must make many financial decisions not requiring professional advice, from opening checking accounts to paying credit cards. Yet some decisions, such as saving for retirement and making investment choices, do require rather sophisticated knowledge, so turning to advisors could be desirable in those cases. In the United States, at least, only a small fraction of households currently consults financial advisors, bankers, certified public accountants, or other such advice professionals, with most still relying on informal sources of advice (Mitchell and Smetters 2013). Even among those who indicate they might be willing to use professional investment advice, two-thirds state that they would probably implement only those recom-

mentations that were in line with their own ideas (Employee Benefit Research Institute 2007). In other words, financial advice might not have a large impact if individuals fail to seek out and act on the recommendations of their advisors.

Additionally, there are many different types of “advice professional” credentials, each regulated by different private and/or public sector entities. Accordingly, it may be difficult or even impossible for consumers to determine whether the quality of advice provided is accurate, suitable, and consistent with their own goals. For instance, advisor compensation structures are sometimes not well aligned with household interests. And those least likely to be knowledgeable may also face obstacles in identifying good advice sources: for example, Collins (2011) and Finke (2013) argued that financial literacy and financial advice are complements rather than substitutes.⁵²

Relatively little is known about the effects of financial advice and whether it can improve financial decision making. Some preliminary evidence suggests that financial counseling can be effective in reducing debt levels and delinquency rates (Agarwal et al. 2011; Collins and O’Rourke 2010; Elliehausen, Lundquist, and Staten 2007; and Hirad and Zorn 2002). In practice, however, most people continue to rely on the help of family and friends for their financial decisions.

8. *Conclusions and Remaining Questions*

In the wake of the global financial crisis, policymakers around the world have expressed deep concern about widespread lack of financial knowledge. Efforts are also underway to fill these gaps with specific programs to “identify individuals who are most in need of financial education and the best

ways to improve that education” (OECD 2005). The U.S. President’s Advisory Council on Financial Literacy (PACFL 2008) noted that “far too many Americans do not have the basic financial skills necessary to develop and maintain a budget, to understand credit, to understand investment vehicles, or to take advantage of our banking system. It is essential to provide basic financial education that allows people to better navigate an economic crisis such as this one.” Former U.S. Federal Reserve Board Chairman Ben Bernanke (2011: 2) has similarly opined:

In our dynamic and complex financial marketplace, financial education must be a life-long pursuit that enables consumers of all ages and economic positions to stay attuned to changes in their financial needs and circumstances and to take advantage of products and services that best meet their goals. Well-informed consumers, who can serve as their own advocates, are one of the best lines of defense against the proliferation of financial products and services that are unsuitable, unnecessarily costly, or abusive.

Despite policy agreement on the need to fill these gaps, analysts and policymakers have much to learn about the most cost-effective ways to build financial knowledge in the population at large. The literature to date has showed that many people around the world are financially illiterate, as we have sketched here. Econometric models and experiments have done much to confirm the causal impact of financial literacy on economic decision making, and to separately identify this effect from other factors, including education and cognitive ability. Research on efforts to enhance financial literacy suggest that some interventions work well, but additional experimental work is critical to control for endogeneity and confirm causality.

Several key tasks remain. First, theoretical models of saving and financial decision making must be further enriched to incorporate

⁵² A detailed analysis of the issues surrounding financial advice appears in Mitchell and Smetters (2013).

the fact that financial knowledge is a form of human capital. Second, efforts to better measure financial education are likely to pay off, including gathering information on teachers, training programs, and material covered. Third, outcomes beyond what have been studied to date are likely to be of interest, including borrowing for student loans, investment in health, reverse mortgage patterns, and when to claim Social Security benefits—decisions that all have far-reaching economic consequences. Additional experimental research would be useful, to learn more about the directions of causality between financial knowledge and economic well-being, though the early results offered here are promising. While the costs of raising financial literacy are likely to be substantial, so too are the costs of being liquidity-constrained, overindebted, and poor.

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SIMPLIFYING CHOICES IN DEFINED CONTRIBUTION RETIREMENT PLAN
DESIGN

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ABSTRACT

In view of the growth and popularity of defined contribution pensions, along with the government's growing attention to retirement plan costs and investment choices provided, it is important to understand how people select their retirement plan investments. This paper shows how employees in a large firm altered their fund allocations when the employer streamlined its pension fund menu and deleted nearly half of the offered funds. Using administrative data, we examine the changes in plan participant investment choices that resulted from the streamlining and how these changes might affect participants' eventual retirement wellbeing. We show that streamlined participants' new allocations exhibited significantly lower within-fund turnover rates and expense ratios, and we estimate this could lead to aggregate savings for these participants over a 20-year period of \$20.2M, or in excess of \$9,400 per participant. Moreover, after the reform, streamlined participants' portfolios held significantly less equity and exhibited significantly lower risks by way of reduced exposures to most systematic risk factors, compared to their non-streamlined counterparts.

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Simplifying Choices in Defined Contribution Retirement Plan Design

Working Americans have increasingly relied on employment-based defined contribution (DC) retirement plans as the more traditional defined benefit (DB) pensions have declined over the past 50 years.¹ A distinguishing feature of DC plans in the U.S. is that participants must decide how much to contribute and where to invest their retirement assets, instead of holding the employer responsible for plan investments. Employees make these decisions within the menu of investment options offered by plan sponsors, and employers often automatically enroll participants into ‘default’ investments if people do not elect an option. Recent research in social psychology has argued that too many choices may create confusion, resulting in poorly-informed consumer decisions.

Relatively little is known about how changing the fund lineup can shape employee investment choices in DC plans.² We seek to fill this gap using administrative data provided by a plan sponsor. The information enables us to examine how participants contributed to a menu of funds and what happened to their fund allocations, along with the costs and risks of the resulting portfolios, as a result of a firm-wide DC plan streamlining effort. In all, the plan menu in the firm was reduced considerably, with almost half of the funds deleted from the lineup. This streamlining process was intended to simplify the fund menu, but it is important to note that the average characteristics of the menu of offered funds (e.g., expense ratio, within-fund turnover, systematic

¹ The US Department of Labor (2014) reports that in 1975, 74% of all participants in private sector plans were covered by DB plans; by 2012, only 6% of participants were in DB pensions.

² Various researchers have explored other aspects of plan design and participant behavior, including participation, contribution rates, and investment of employer stock; see for instance Choi et al., (2004), Mitchell and Utkus (2006), and Huberman et al. (2007). Additionally, prior analyses describe how participants who are automatically enrolled end up allocating their DC savings (Madrian and Shea, 2001).

and idiosyncratic risk) were the same before and after the streamlining. In addition, this simplification made possible a more coherent categorization or ‘tiering’ of the retained funds.

We examine plan participants’ investment choices prior to and after the streamlining event and evaluate what happened to participant fund allocations, risk exposure, and costs as a result of the reform. First, we explore what types of individuals held the deleted funds and how (if at all) they differed from other participants. Based on participant holdings on June 30, 2012, just before the changes were announced in July 2012, we define the holders of these deleted funds as the *streamlined* participants, and their counterparts as the *non-streamlined* participants. Second, we evaluate how streamlined participants responded to the changes, and how they reallocated their retirement assets after the reform. Third, we show how the streamlining process affected participants’ portfolio turnover, risk, and expenses.

We find that participants subject to the streamlining proved to be older, more likely to be male, and higher-income; they also held higher balances in riskier funds and lower balances in safer balanced/target date funds. Participants holding the deleted funds either (a) reallocated their money to funds kept in the lineup in advance of the deadline to maintain a similar pre- and post-streamlining allocation, or (b) were defaulted into Target Date Funds (TDFs) resulting in an allocation containing, on average, safer assets. Only 9% of the streamlined participants (N=211) elected the new brokerage window (taking only 0.4% of their assets). Post-streamlining, the streamlined participants adjusted their portfolio holdings, ending up with fewer funds, significantly lower within-fund turnover rates, and lower expense ratios. Based on reasonable assumptions, these portfolio adjustments could lead to potential accumulated savings for these participants over a 20-year period of \$20.2M, or more than \$9,400 per participant. Also, after the reform and relative

to the non-streamlined participants, streamlined participants' portfolios generally exhibited lower diversifiable/idiosyncratic risk and less exposure to systematic/non-diversifiable risk factors.

In what follows, we first offer a brief literature review, followed by a discussion of our data and descriptive statistics. We then use multivariate regression models to estimate differences in the changes in portfolio characteristics and risks for participants affected by the streamlining compared to those who were not, controlling for several participant attributes. We conclude with thoughts on how a streamlining intervention such as this might shape employees' eventual retirement wellbeing.

1. Related Prior Literature

Financial economics suggests that participants in a pension plan should rationally focus on their own portfolios' risk-return profiles independent of the number of funds in their pension plan menu. Yet Benartzi and Thaler (2001) suggested that plan participants actually followed a naïve diversification approach, investing $1/n$ of their assets in each of the n funds made available in the menu. Similarly suboptimal investment decisions were reported by Tang, Mitchell, Mottola, and Utkus (2010) who showed that even when plan sponsors offered a sufficiently diversified (efficient) menu of funds, participants regularly selected inadequately-diversified portfolios given their selected level of risk.

In addition, recent research in social psychology has argued that too many choices can create confusion and distraction, resulting in poorly-informed consumer decisions (e.g., Iyengar and Lepper, 2000). In the context of DC fund menus, Iyengar, Huberman, and Jiang (2004) asked whether such "choice overload" affected participant decisions in the 401(k) environment. They used a 2001 cross-section of data on 649 DC plans managed by the Vanguard Group to determine

whether participation rates were lower in plans when more funds were on the menu. They found that, for every 10 additional funds on a menu, participation dropped two percent. While most of the plans examined had 10-30 options, participation rates were actually highest for those with 10 or fewer options.

In a follow-up analysis using the same dataset, Huberman and Jiang (2006) explored fund *investment patterns* rather than *participation rates*. There, conditional on participation, the authors concluded that (p. 763) “the number of funds used, typically between three and four, is not sensitive to the number of funds offered by the plans, which ranges from 4 to 59. A participant’s propensity to allocate contributions to equity funds is not very sensitive to the fraction of equity funds among offered funds.” They also reported that (p 765) “Once plans offer an abundance of choices (more than 10 funds), there is no correlation between equity allocation and exposure.” Ultimately the authors concluded that plan sponsors need not be overly concerned about the length of the plan menu, as long as a reasonable diversity of options was included.

In a related study, Brown, Liang, and Weisbenner (2007) employed SEC 11-k filings on 891 plans from 1991-2000. The panel nature of their dataset permitted the authors to use fixed-effect regressions which confirmed that (p. 1995) “the number of equity and bond options in the 401(k) plan is an important predictor of contributions to equity and bond funds, respectively, even after accounting for firm-level fixed effects.” They also found that, over the time period they examined, most funds added to 401(k) plans were expensive, actively-managed equity funds, resulting in higher average portfolio expenses and lower average portfolio performance. They concluded that (p. 2006) “the choice of investment options to make available in an individual accounts program is likely to have a first-order effect on the portfolio allocations that individuals make.”

In a more recent study, Morrin, Inman, Broniarczyk, Nenkov, and Reuter (2012) examined how employees covered by the Oregon University System DC plan altered their behavior when their plan menu was expanded from 10 to 19 fund choices. Both before and after the expansion, the default was a money market fund. When the smaller menu was offered, 21% defaulted to the money fund, while with the larger menu, 34% defaulted. Accordingly, the authors concluded that offering more funds (p 548) “may be overwhelming for many investors.” Of those who did make an election, participants selected on average 37% (3.7 funds) of the funds from the 10-fund menu, and 27% (5.3) from the 19-fund menu. While those results did not support the 1/n heuristic, they were consistent with perhaps a weaker form of the heuristic whereby increasing the number of offered funds led participants to hold more funds. Moreover, the authors (p. 547) concluded that it is sensible for plan sponsors to offer a sufficient variety of choices, but there is a need to “clearly categorize the options to help the [participants] perceive the set of offerings at a higher, more abstract level. Partitioning the funds may enhance asset class diversification while not reducing (and actually increasing) the total number of funds invested in. Subjectively grouping funds by asset class is more likely to assist novice investors than expert investors in their financial decision making.”

In sum, research to date has provided mixed conclusions about how the number and mix of DC fund options influences investment patterns in retirement accounts, and little to no evidence on how differences in the fund options affect costs and risks of participant portfolios.³ Moreover, no study has yet examined how participants react to a rather substantial *reduction* of retirement plan investment choices. In what follows, we explore these issues with a unique new administrative

³ See also Beshears et al. (2013) who evaluated how a simple saving rate and asset allocation protocol in a DC plan affects the probability of participating and contribution rates conditional on participation; they did not, however, look at asset allocation patterns.

dataset that permits us to follow investor behavior before and after a substantial streamlining in the fund menu and document the effects of the reform on the costs and risks associated with participants' portfolios.

2. The Setting

The employer we study is a large US nonprofit institution. Like its peers, it has long offered a DC structure to cater to participants' retirement saving needs on a pre-tax basis. Prior to 2013, the plan included almost 90 mutual funds in the investment menu, ranging from equity to target date to bond index funds, as well as REIT, commodity, and other sector funds. Cognizant of the growing literature on choice overload (see references in section 1), the firm's investment committee in 2011 determined that a shorter list of offered funds would be easier to administer, explain, and rationalize, compared to the prior menu.

To this end, the committee streamlined the plan menu and constructed a four-tiered structure for the remaining funds. Participants who had invested in the funds that would be eliminated from the menu would be allowed to reallocate their assets and contributions to any other fund in the menu, and anyone who did not move his assets out of the funds to be deleted would have his assets automatically transferred to the age-appropriate Target Date Fund (TDF).⁴ Alternatively, participants who elected to do so could move their assets to a new self-directed brokerage account within the plan which would give them access to not only the closed funds, but also thousands of other mutual funds.

⁴ This was defined as the TDF with the target date closest to the year the participant would attain age 65. Under the Pension Protection Act of 2006, the US Department of Labor permits TDFs as QDIAs (qualified default investment alternatives) that can be used for participants who do not elect their own investment mix.

The result was the elimination of 39 funds from the initial lineup, based on the funds' expense ratios and the number of participants and aggregate amount invested in each fund.⁵ Remaining funds were allocated across a new four-tier structure, where each successive tier would afford participants additional choice. Tier 1, selected as the default tier for participants not actively electing an investment mix, included 13 low-cost Target Date Funds. Additional tiers offered increasing flexibility of choice for participants seeking to make more customized and sophisticated allocations. Tier 2 included four indexed funds: Money Market, U.S. Diversified Stocks, U.S. Bonds, and Diversified International Stocks. Tier 3 included 32 funds arranged into separate "risk" categories illustrated in more detail in Table 1. The range of categories included: small/mid/large-cap and value/growth stock funds; small/mid/large-cap international stock funds; short/intermediate/long-maturity and Treasury/corporate bond funds; balanced funds; and a passive equity REIT fund to provide access to the real estate asset class. Tier 4 constituted the brokerage account.

[Table 1 here]

The plan sponsor announced its streamlined fund lineup in July 2012, with an implementation date of mid-October 2012. In addition to a newsletter sent to all participants, the employer created a custom website, broadcasted online webinars, sent targeted emails, held participant meetings, and sent hard copy mail to explain the changes.

3. Data and Descriptive Statistics

⁵ In results not reported here (available on request) we find that the average characteristics of the menu of offered funds (e.g., expense ratios, within-fund turnover rates, and systematic and idiosyncratic risk) were not significantly different before versus after the streamlining.

To analyze the change in behavior post- versus pre-streamlining, we obtained access to information on the retirement plan account balances and periodic contributions of all the (identity-censored) participants. Our administrative dataset included information on contributions, balances, and asset allocation prior to the streamlining, defined in our analysis below as end-June 2012, and after the change, defined as end-December 2012. To this file we appended information from public sources (via ticker and CUSIP numbers) for each fund's equity fraction and style (bond, balanced, stock, etc.), as well as monthly return histories. The fund administrator also provided individual demographic information on participants' age, sex, education (highest degree from graduate school versus less than graduate school), and, from external sources, imputed household income (assigned according to the participant's zip codes, where low <\$50K, middle \$50-100K, and high >\$100K).⁶

Using the participant balance and contribution data, we identify participants whose holdings were directly affected by the streamlining. Specifically, we separate participants into a Streamlined group – those participants who held funds at end-April 2012 that were subsequently deleted due to streamlining – and a Non-Streamlined group. Additionally, we separate the streamlined participants into two subgroups: “Plan-Defaulted & Streamlined” are the streamlined participants who took no action after the announced streamlining and were defaulted by the Plan into an age-appropriate TDF at the October deadline; and “Not-Plan-Defaulted & Streamlined” are the streamlined participants who exchanged out of the deleted funds prior to the October deadline.

To illustrate how the reform worked, we begin by reviewing descriptive statistics on the balances in the retained and deleted funds by risk category, and we also compare key attributes of

⁶ These were derived from data supplied to the plan administrator from IXI Corporation and derived from zip+4 Census tract information. (See <http://www.ixicorp.com/products-and-services/customer-targeting-and-scoring/wealthcomplete/>)

participants and their retirement plan investments as of end-June 2012 (our baseline). Table 2 reports aggregate balances held in retained and deleted funds by risk category, where of the almost \$1 billion invested at end-June 2012, most of the assets (80%) were held in retained funds. Overall, 20% of the total assets were in funds that were subsequently deleted; of those, about 60% had been in equity (stock, balanced, or international) funds, 24% in alternatives/sector funds, and 14% in bond funds (with the remainder in money market funds).

[Table 2 here]

In Table 3 we report aggregate dollar balances, the number of total participants, and the number of funds held by all plan participants at end-June 2012 (rightmost column), along with the same information for the streamlined participants (who owned at least one deleted fund) and the non-streamlined participants (who owned no deleted funds). The number of participants in each group was roughly similar (2,238 versus 2,371), but the streamlined group had accumulated almost 60% more in assets (\$603.8 versus \$380.0 million), contributed 30% more on a monthly basis (\$1802 versus \$1356 per participant), and held more funds overall (87 in total versus 47). On average, about one-third of the contributions of the streamlined participants were in funds that were subsequently deleted and two-thirds in retained funds.

[Table 3 here]

A comparison of characteristics for streamlined versus non-streamlined active participants appears in Table 4. The streamlined participants were significantly older, more likely to be male, lived in higher-income households, and were more likely to have earned graduate-level degrees. They also owned three times as many funds (an average of 6.8 versus 2.1) compared to the non-streamlined participants. Regarding asset allocations, Table 5 indicates that the streamlined participants were more likely to contribute directly to stock funds (sector, domestic and

international), while the non-streamlined participants were more likely to obtain equity exposure (indirectly and in more conservative amounts) via significantly larger allocations to target date funds.⁷ As a result, on average, the streamlined participants held portfolios containing more equity exposure.

[Tables 4 and 5 here]

4. Changes in Portfolio Allocations: A First Look

Table 6 reports how participants changed their retirement plan portfolios after the streamlining went into effect. In particular, we compare the allocation of retirement plan assets at two time points: prior to (as of end-June 2012), and after streamlining (as of end-December 2012). Overall, non-streamlined participants kept contributions to their retirement accounts virtually unchanged (column 3). Because these participants were not directly affected by the elimination of funds from the lineup, their persistence in the surviving funds refutes the idea that the reorganization and tiering of the surviving funds might have affected all participants' behavior.⁸

[Table 6 here]

By contrast, streamlining produced statistically significant and economically meaningful changes to allocations made by streamlined participants. To more clearly assess the allocation adjustment process, we separate this group into two sub-samples: (a) those streamlined participants who did not take full advantage of the window between the announcement in July and the deadline

⁷ Given the age profile of the non-streamlined sample, the average equity share of their investment in TDFs was just under 80%.

⁸ Although contributions by non-streamlined participants did increase for stock funds and decrease for "other" funds, the changes were economically tiny (0.4% and 0.1% respectively). In results not reported here, we also find that fund allocations by non-streamlined participants did not change significantly by the end of either 2012 or 2013, in terms of both contributions *and* balances.

for action on October 19 and hence were defaulted by the Plan into age-appropriate target date funds (Plan-Defaulted & streamlined); and (b) those streamlined participants who exchanged out of the deleted funds during the July-October 19 window (Not-Plan-Defaulted & streamlined). The results for both streamlined groups are reported in the first two columns in Table 6. Both types of streamlined participants significantly reduced allocations to stock, sector, and international funds and they shifted contributions mainly to TDFs. The changes were more pronounced, however, for the Plan-Defaulted members of the streamlined sample: their allocations to stock, sector, international, balanced and bond funds fell significantly – by a combined 35.6% reduction in contributions, and their allocations to TDFs rose by 35.3%. By contrast, the Not-Plan-Defaulted streamlined participants significantly decreased allocations to stock, sector and international funds (a combined 17.8% reduction) and significantly increased contributions to TDFs by 13.8%. The Not-Plan-Defaulted group also re-allocated a significant 2% of its contributions to the new brokerage account.⁹ Although we cannot see the transactions in these brokerage accounts, we surmise that this shift in contributions reflects efforts by the Not-Plan-Defaulted group to continue investing in funds now eliminated from the Plan’s menu.¹⁰

⁹ The amount re-allocated to brokerage accounts, \$2.7M, represents a small portion of the plan’s aggregate assets and few participants: only 9% of those holding deleted funds prior to the change subsequently opened a brokerage account following the change. This may be because, at the time the brokerage accounts were announced, restrictions were imposed on the number of exchanges permitted in and out of certain funds each year. Also participants were informed that holdings in the brokerage account would incur special redemption fees of 1% (minimum \$50, maximum \$250) for no-transaction-fee funds; for transaction-fee funds, the participant would be charged \$20 per transaction. These fees were eliminated prior to the actual change. In both cases the minimum investment was \$1,000. Additional loads would depend on the share classes elected by each participant. This lack of participation in brokerage accounts reported here is consistent with broader evidence for DC plans reported in Vanguard (2015).

¹⁰ This large reallocation by both streamlined groups is expected given they were the participants holding the deleted funds. But it is interesting to note that the streamlined participants were also the more active traders – in terms of number of fund exchanges – during the year prior to the announcement of the streamlining. During the period July 2011 to June 2012, the Not-Plan-

Table 7 helps us examine whether the pre- versus post-streamlining re-allocations were different for high versus low household income participants.¹¹ In the Non-Streamlined group there is little evidence of differences by income pre- versus post-streamlining re-allocations; one exception is that low-income members of the Non-Streamlined group were more likely to shift allocations out of bond funds into the other available funds, although the magnitudes are very small (less than 1%). Within the Streamlined group, significant differences in re-allocations between high and low-income participants are mainly in the Plan-Defaulted sub-group. The most interesting finding, both statistically and economically, is that the overall re-allocations *into* TDFs seen in Table 6 prove to be 10% larger, and the re-allocations *out of* stock funds 7.6% larger, for the low-income members of the Plan-Defaulted group. In other words, the streamlining reform had a larger impact on low-income savers, making their portfolios better balanced and less risky than before.

[Table 7 here]

5. Changes in Participant Portfolio Characteristics and Risks: Multivariate Analysis

Next we use multivariate regression analyses to analyze in more detail how the reform shaped changes in the portfolio characteristics and risks of streamlined and non-streamlined participants. To measure these differences, we again separate the streamlined from the non-

Defaulted & streamlined (Plan-Defaulted & streamlined) participants averaged 2.39 (1.9) fund exchanges per month, compared to 0.9 exchanges on average for the Not-Streamlined participants.

¹¹ Recall, from section 3, that the low income group had household income of <\$50K; the middle group \$50-100K; and the high income group >\$100K.

streamlined participants, and we further identify the two sub-groups of streamlined participants with zero-one indicator variables, the *Plan-Defaulted-Streamlined* and the *Not-Plan-Defaulted-Streamlined*. Our analysis also controls for various participant attributes including age and age-squared (to test for possible nonlinear effects); male or female; educational level (graduate degree or not); and high versus low household income. We estimate the change in portfolio characteristics over two intervals: end-June 2012 to end-December 2012 (the same time period analyzed in Tables 6 and 7); and also end-June 2012 to end-December 2013 (a longer interval that allows more time for participants to adjust their portfolio allocations post-streamlining).

5.1 Changes in Portfolio Characteristics

Table 8 compares the effects of the reform on participant portfolio turnover rates, expense ratios, number of funds held, and percentage allocation to stocks, in portfolios held by streamlined versus non-streamlined participants. Panel A (B) reports model estimates for the shorter (longer) post-streamlining period.

[Table 8 here]

Over the shorter interval (Panel 8A), we find that, relative to their unaffected counterparts, Streamlined participants – both those that were Plan-Defaulted and those that were not – experienced significantly greater reductions in portfolio turnover, larger reductions in expense ratios, and a larger decline in the number of funds held. Moreover, these reductions were generally larger for the subset of streamlined participants that were Not-Plan-Defaulted. For example, the reduction in the expense ratio was 6.0 (3.1) bps larger for the Not-Plan-Defaulted (Plan-Defaulted) streamlined participants than for non-streamlined, and the difference of 2.9 bps is significant at the 0.01 level. This last result might be partly due to our inability to observe brokerage window transactions in which these Not-Plan-Defaulted participants might have replicated their prior fund

allocations and associated higher expense ratios. That said, recall that very few Not-Plan-Defaulted participants opened brokerage accounts; and virtually none of the Plan-Defaulted participants.

In contrast to the findings for the other characteristics in Table 8A, the changes in the percentage of the portfolio allocated to stocks over the shorter interval were markedly different for the Not-Plan-Defaulted and the Plan-Defaulted streamlined subsamples relative to their non-streamlined counterparts. Specifically, the Plan-Defaulted streamlined participants significantly *increased* their stock allocations by 1.3% by the end of December 2012, while the Not-Plan-Defaulted streamlined group experienced a statistically and economically significant 4.8% *reduction* in stock allocation as a result of the streamlining. This difference of 6.1% is statistically significant at the 0.01 level, and it is consistent with Table 6 where we found: (a) a significant reduction in stock and sector fund allocations by the Not-Plan-Defaulted streamlined participants; and (b) a significant increased allocation by the Plan-Defaulted streamlined participants to TDFs which contain a much higher percentage of stocks¹² than the more conservative bond and balanced funds which they dropped, post- streamlining.

We also find that the reductions in stock allocations and number of funds held were greater for men than for women, consistent with Barber and Odean's (2001) finding for discount brokerage accounts that individual male investors trade stocks more aggressively than do female investors.

The message of Panel 8B is simple: the changes in portfolio characteristics caused by the reform that were evident over the shorter interval in Panel A largely persisted over the entire 2013 calendar year. The one exception is that, during 2013, the Not-Plan-Defaulted streamlined participants reversed the initial reduction in their stock market exposure, so that by the end of

¹² Sixty percent of the Plan-Defaulted streamlined group was under the age of 60. The average equity percent in the TDFs for this age range is about 86%.

2013, their stock exposure was not significantly different than beforehand. Otherwise, the initial effects of the reform (e.g., lower turnover and expense ratios) were not undone by participant transactions over the subsequent twelve months.

Not only are these effects statistically significant: they are also economically important. That is, the (unconditional) average reduction in the annual expense ratio for the entire streamlined group was 4.0bp (=27.9bp – 23.9bp), or a \$0.242M annual cost savings (based on the pre-streamlining balance for the streamlined group of \$603.8M at end-June 2012). Since the average age of the streamlined participants was 49 in April 2012, if those savings could be achieved on an ongoing basis over 20 years and reinvested at 5% annually, the accumulated benefit would amount to \$8.40M or around \$4,000 per participant. Additionally, the (unconditional) average decline in within-fund annual turnover for the streamlined group was 11.3% (=35.2% – 23.9%). Based on the streamlined group balance of \$603.8M at end-June 2012 and assuming round-trip within-fund transaction costs of 0.50%, this could translate into an annual aggregate cost savings of \$0.341M.¹³ If such savings could be achieved on an ongoing basis over 20 years and reinvested at 5% annually, the accumulated additional benefit would be \$11.8M, or \$5,400 per participant. In total, then, the per-participant savings could be over \$9,400 per participant.

5.2 Changes in Portfolio Risks

We also examine how participant portfolio risks changed by comparing pre- versus post-streamlining positions. To this end, we first estimate the factor-related systematic risks and diversifiable (idiosyncratic) risks for both retained and deleted funds, using a model similar to Fama-French (1993) in which the estimated coefficients measure each fund's exposures to systematic factor risks:

¹³ We compute this as $\$603.8 \times (0.113 \times 2 \times 0.025)$.

$$\tilde{R}_{it} - R_{Ft} = \alpha + b_1(\tilde{R}_{Mt} - R_{Ft}) + b_2SmB_t + b_3HmL_t + b_4WmL_t + b_5Term_t + b_6Def_t + \tilde{e}_{it}$$

Here $\tilde{R}_{it} - R_{Ft}$ refers to the excess return of fund i over the risk-free rate (the one-month Treasury bill rate from Ibbotson Associates); $\tilde{R}_{Mt} - R_{Ft}$ refers to the value-weighted return on all NYSE, AMEX, and NASDAQ stocks (from CRSP) minus the risk-free rate; SmB refers to the difference in the performance of small relative to big stocks; HmL to the difference in performance of value stocks to growth stocks; WmL is a momentum factor premium measuring the difference in performance of past winner and past loser stocks; $Term$ measures the difference between the monthly long-term government bond return (from Ibbotson Associates) and the one-month Treasury bill rate measured at the end of the previous month (from the Center for Research in Security Prices, CRSP); and Def measures the difference between the return on a market portfolio of long-term corporate bonds (the Composite portfolio in the corporate bond module of Ibbotson Associates) and the monthly long-term Treasury bond return. The fund's diversifiable (idiosyncratic) risk is measured as $\sigma(e)$, the standard deviation of the regression residuals. These regressions are estimated using ten years of monthly fund and factor returns.

Having estimated the model parameters representing systematic and idiosyncratic risks, we next compute for each participant the systematic and idiosyncratic risks specific to his own portfolio, using his portfolio weights as of end-June 2012 and end-December 2012. Finally, we regress the post-pre changes in systematic and idiosyncratic risks on *Not-Plan-Defaulted-Streamlined*, *Plan-Defaulted-Streamlined*, and our control variables. Results appear in Table 9, where Panel A (B) reports model estimates for the shorter (longer) post-streamlining period.

[Table 9 here]

Table 9A shows that, as a result of the reform, all streamlined participants' portfolios (both Plan-Defaulted and Not-Plan-Defaulted) generally exhibited significantly greater reductions in

systematic risk relative to the non-streamlined participants. Stated differently, there was a larger reduction in portfolio ‘tilt’ toward most systematic sources of variation for the streamlined participants. There are two exceptions. First, relative to the non-streamlined group, there was a significant *increase* in market beta for the Plan-Defaulted streamlined participants, in contrast to the significant decrease in market beta for the Not-Plan-Defaulted streamlined participants. This tracks the changes in broad stock market exposure for these two streamlined groups shown in Table 8. Second, and again relative to the non-streamlined group, we find a greater *increase* (reduction) in small-cap risk exposure for the Not-Plan-Defaulted (Plan-Defaulted) streamlined participants. The reason for this difference is not entirely clear from Tables 6 and 8 where the stock exposures and allocations are reported with insufficient granularity to differentiate the presence of small- versus large-cap stocks. One possible explanation, though, is that many of the deleted sector and international funds, in which the Not-Plan-Defaulted streamlined group had been invested, had much lower exposures to small-cap risk.

We also find that the reform resulted in a significant reduction in idiosyncratic risk for the streamlined group relative to their non-streamlined peers, and this reduction was even more notable for the Not-Plan-Defaulted members of the streamlined group. Moreover, the reduction in idiosyncratic risk was greater for male versus female participants, as were reductions in exposures to the market and momentum stock risk factors, and the default risk bond factor. These last two findings in the retirement plan setting agree with Barber and Odean’s results (2001) for online brokerage accounts. It is also worth pointing out that many of these changes in risk exposure were most pronounced for participants with larger, versus smaller, portfolio balances.¹⁴

¹⁴ This pattern aligns with results by Calvet, Campbell, and Sodini (2009) who studied Swedish investors; they found that wealthier investors rebalanced toward a riskier share when they altered their portfolios. Yet that analysis was not focused on retirement accounts, as here, however.

As was true for the observed portfolio characteristics discussed above, Table 9B confirms that the Panel A shorter-period portfolio risk changes wrought by the reform persisted over the entire 2013 calendar year. The main exception, consistent with our findings in Table 8B, is that the Not-Plan-Defaulted streamlined participants reversed their initial reduction in stock market exposure post-reform, so that by the end of 2013 their market beta was actually significantly larger than before the streamlining. Also both streamlined groups reversed their initial reduction in tilt toward value stocks ($\Delta\beta(\text{HmL})$ in Table 9A) and ended 2013 with significantly larger value stock exposure, relative to the non-streamlined group. It is also worth noting that the reduction in idiosyncratic risk for both streamlined groups reported for the shorter interval remains significant over the longer interval, although the change was smaller. Thus the initial effects of the reform remained largely intact by the end of 2013.

To summarize the results in this section, the streamlining of the DC plan described here had a statistically significant and economically important impact on the characteristics and risk attributes of savers' accounts. Specifically, within-fund turnover in participants' retirement portfolios (a significant cause of largely unseen transaction costs) and expense ratios were significantly reduced; and many dimensions of systematic/non-diversifiable risk, as well as idiosyncratic/diversifiable risk, were also significantly curtailed. As such, our results complement and extend previous studies suggesting that plan simplification enhances retirement saving (e.g., Beshears et al. 2013), though previous work has focused only on participation and contributions, but not on asset allocation outcomes as here.

6. Conclusions

This study has examined the salutary effects of streamlining the DC fund menu by deleting some funds and tiering options in an easier-to-understand format. While recent studies have evaluated how simplification can influence retirement plan participation and contributions, they have not examined how streamlining changes investment patterns. Our analysis examines how halving the fund menu while including a new brokerage account changed investment behavior at a large nonprofit institution. We find that participants who initially held at least one deleted fund were relatively older, more likely to be male, and earned higher incomes; they also held higher balances in riskier funds and lower balances in safer/balanced/target date funds. Interestingly, in response to the changed lineup, only 9% of these participants moved any money at all into the new brokerage window, taking only 0.4% of assets. Moreover, streamlined participants' new allocations included significantly fewer funds and had significantly lower exposure to non-market systematic risks; they also contained a lower allocation to stocks. Streamlined participants' new allocations also led to fund holdings with significantly lower expense ratios and within-fund turnover rates, which, based on reasonable assumptions, could lead to potential accumulated savings for these participants over a 20-year period of \$20.2M, or over \$9,400 per participant.

The changes we have discerned are important, particularly given regulators' growing interest in retirement plan fees and costs. As one example, recent US Department of Labor guidance to plan participants alerted members to the possibility that costs may rise as investment options become more numerous.¹⁵ Such costs, in turn, can reduce the size of the nest egg available

¹⁵ For instance, the US Department of Labor (US DOL) states on its website (http://www.dol.gov/ebsa/publications/401k_employee.html): "In recent years, there has been a dramatic increase in the number of investment options typically offered under 401(k) plans as well as the level and types of services provided to participants. These changes give today's employees who direct their 401(k) investments greater opportunity than ever before to affect their retirement savings. As a participant you may welcome the variety of investment options and the additional

for retirement. Additionally, employers in their plan fiduciary capacity are charged under pension law with managing retirement plans in the best interests of participants.¹⁶ Our work implies that plan sponsors would do well to recognize that the length and complexity of their plan menus matter. Accordingly, our results should be of substantial interest to those seeking to improve defined contribution retirement plan design, including employers, fund providers, consultants, and regulators.

services, but you may not be aware of their cost. As shown above, the cumulative effect of the fees and expenses on your retirement savings can be substantial.”

¹⁶ The US DOL points out that plan sponsors must “ensure that fees paid to service providers and other expenses of the plan are reasonable in light of the level and quality of services provided; and select investment options that are prudent and adequately diversified; disclose plan, investment, and fee information to participants to make informed decisions regarding their investment options under the plan; and monitor investment options and service providers once selected to see that they continue to be appropriate choices.”

(http://www.dol.gov/ebsa/publications/401k_employee.html)

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Table 1. Description of Fund Menu Post- (and Pre-) Streamlining

Tier 1 : 13 Target Date Funds

Tier 2 : 4 Funds (Money Market, U.S. Diversified Stocks, U.S. Bonds, Int'l Stocks)¹

Tier 3 : 32 Funds [Number of funds kept (Number of funds eliminated)]²

Bond Funds

	Short	Intermed	Long
Treasury	0 (2)	2 (1)	1 (1)
Corporate	1 (1)	1 (1)	2 (0)
Other Bonds (High Yield)	1 (0)		

Stock Funds

	Large	Mid-Cap	Small
Diversified	1 (3)	3 (0)	1 (0)
Value	3 (9)	1 (1)	1 (3)
Growth	4 (2)	1 (1)	2 (1)

Balanced Funds

2 (2)

International Stock Funds

1 (3) 2 (2) 1 (2)

Other (Alternative Assets, Sector Funds)

1 (4)

¹ Three Money Market funds were eliminated.

² Thirty-nine funds were eliminated.

Note: Post (pre) allocation computed as of end-December (June) 2012.

Source: Authors' calculations.

Table 2. Total Balances in Retained (and Deleted) Funds by Risk Category (as of end-June 2012; \$M)

<i>Tier 1</i>				
	Target date	101.0 (0)		
<i>Tier 2 (Index/Passive)</i>				
	Money Market	33.2 (4.8)		
	Bond Market	34.0 (0)		
	Stock Market	37.2 (0)		
	International stocks	14.0 (0)		
<i>Tier 3</i>				
Bonds		Short	Interm.	Long
	Treasury	0 (6.7)	26.7 (0)	7.5 (9.3)
	Corporate	10.6 (3.1)	9.2 (7.7)	15.3 (0)
	Other Bonds	15.2 (0)		
Stocks		Large-Cap	Mid-Cap	Small-Cap
	Diversified	81.7 (2.3)	42.0 (0)	12.2 (0)
	Value	89.8 (31.4)	9.2 (9.6)	5.2 (6.6)
	Growth	101.5 (20.7)	2.4 (1.9)	20.0 (1.4)
Balanced		64.2 (20.3)		
International		7.4 (13.6)	22.7 (0)	15.6 (7.7)
Other		12.7 (46.0)		

Source: Authors' calculations.

Table 3. Balances, Number of Participants, and Number of Funds Owned: Streamlined vs Non-Streamlined Participants (as of end-June 2012)

	Streamlined Group		Non-Streamlined Group		Overall	
	(N=2,238)		(N=2,371)		(N=4,609)	
Total Balance (\$Millions)	603.8		380.0		983.7	
# Participants	2,238		2,371		4,609	
# Funds	87		47		87	
<i>Contribution (\$, per part.)</i>	<i>Mean</i>	<i>Median</i>	<i>Mean</i>	<i>Median</i>	<i>Mean</i>	<i>Median</i>
To all funds	1,802	1,395	1,356	849	1,573	1,084
To Deleted funds	588	330				
To Nondeleted funds	1,214	833				

Source: Authors' calculations.

Table 4. Differences in Mean Characteristics: Streamlined vs Non-Streamlined Participants
(as of end-June 2012)

	Streamlined	Non-Streamlined	Difference (S-NS)	
Age				
18-30	0.02	0.08	-0.06	***
31-40	0.20	0.25	-0.05	***
41-50	0.33	0.29	0.04	***
51-60	0.32	0.28	0.04	***
> 60	0.13	0.11	0.03	***
Gender				
Male	0.55	0.45	0.10	***
Female	0.45	0.55	-0.10	***
Education				
less than graduate school	0.43	0.50	-0.07	***
at least graduate school	0.41	0.33	0.08	***
Household Income				
low	0.16	0.19	-0.04	***
med	0.35	0.37	-0.01	
high	0.46	0.39	0.07	***
Number of Funds	6.78	2.11	4.66	***

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The low income group is defined to have household income of $< \$50K$; the middle group $\$50-100K$, and the high income group $> \$100K$.

Source: Authors' calculations.

Table 5. Difference in Distribution of Mean Participant Asset Allocations: Streamlined vs Non-Streamlined Participants (as of end-June 2012)

<i>% of contribution in:</i>	Streamlined (N=2,238)	Nonstreamlined (N=2,371)	Difference
Stock Funds	0.45	0.28	0.18 ***
Sector Funds	0.07	0.00	0.07 ***
Other Funds	0.01	0.00	0.01 ***
TDF Funds	0.10	0.55	-0.46 ***
Other Balanced Funds	0.08	0.04	0.04 ***
International Funds	0.11	0.04	0.07 ***
Bond Funds	0.17	0.08	0.09 ***

Note: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Source: Authors' calculations.

Table 6. Difference in Mean Participant Asset Allocations: Post- minus Pre-Streamlining
(end-December 2012 vs end-June 2012)

	Plan-Defaulted & Streamlined (N=1,616)	Not-Plan-Defaulted & Streamlined (N=565)	Non-Streamlined (N=2295)
% of contribution in:			
Stock Funds	-0.188 ***	-0.043 ***	-0.004 **
Sector Funds	-0.064 ***	-0.098 ***	0.000
Other Funds	0.002 ***	0.019 ***	0.001 **
TDF Funds	0.353 ***	0.138 ***	0.002
Other Balanced Funds	-0.046 ***	-0.004	0.000
International Funds	-0.035 ***	-0.037 ***	-0.001
Bond Funds	-0.023 ***	0.004	0.001
Brokerage Account	0.001 *	0.020 ***	0.000

Note: * p<0.10, ** p<0.05, *** p<0.01

Source: Authors' calculations

**Table 7. Difference in Mean Participant Asset Allocation by Income:
Post-Streamlining minus Pre-Streamlining (end-Dec 2012 vs end-Jun 2012)**

	<i>Diff(High Income - Low Income)^a</i>		
	Plan_defaulted & Streamlined (N=1,616)	Non-plan-defaulted & Streamlined (N=565)	Non-Streamlined (N=2295)
<i>% of contribution in:</i>			
Stock Funds	0.0756 ***	-0.0221	0.0037
Sector Funds	0.0195 *	-0.0045	0.0000
Other Funds	-0.0001	-0.0037	0.0013 *
TDF Funds	-0.1008 ***	-0.0055	0.0007
Other Balanced Funds	0.0125	-0.0256	0.0004
International Funds	-0.0106 *	-0.0139	0.0020
Bond Funds	0.0040	0.0595 **	-0.0088 **
Brokerage Account	-0.0001	0.0157	0.0007

^a Significance levels: * p<0.10, ** p<0.05, *** p<0.01

Source: Authors' calculations

Table 8A. Changes in Fraction of Portfolio Invested in Stocks, Annual Turnover, Expense Ratios, and Number Funds Held (end-December 2012 minus end-June 2012 balances)

<i>Explanatory Variables</i>	<i>Mean</i>	$\Delta\%Stock$	$\Delta Turnover$	$\Delta ExpRatio$	$\Delta Nfunds$
Not-Plan-Defaulted-Streamlined	0.13	-0.0484 ***	-0.1146 ***	-0.0595 ***	-1.4653 ***
Plan-Defaulted-Streamlined	0.36	0.0127 ***	-0.1111 ***	-0.0308 ***	-1.3179 ***
Age	47.64	0.0005	0.0044 *	-0.0001	0.0218
Age**2	2383.79	0.0000	-0.0001 **	0.0000	-0.0001
Male	0.50	-0.0077 **	0.0013	-0.0020	-0.1262 **
Education gradschool	0.37	-0.0049	0.0101 *	-0.0018	-0.0323
HH income low	0.18	-0.0001	-0.0105	-0.0035	0.1173 *
HH income high	0.42	-0.0037	0.0052	0.0001	0.0547
Balance/100k	2.10	0.0015 **	-0.0006	-0.0002	-0.0172
N		4,476	4,447	4,476	4,476
R-squared		0.04	0.09	0.17	0.14
Diff ($\beta(Non-Plan-Def) - \beta(Plan-Def)$)		-0.0611 ***	-0.0034	-0.0287 ***	-0.1473
Mean of dep var		-0.007	-0.056	-0.021	-0.600

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Dependent variables as follows: $\Delta\%Stock$ is the % of the participant's portfolio of funds invested in common stocks; $\Delta Turnover$ measures participant changes in overall annual portfolio turnover (post-pre); $\Delta ExpRatio$ measures the change in annual participant expense ratios (post-pre) and $\Delta\#funds$ measures the change in the number of funds held (post-pre). Values computed for each participant using end-December 2012 minus end-June 2012 balances. Source: Authors' calculations.

Table 8B. Changes in Fraction of Portfolio Invested in Stocks, Annual Turnover, Expense Ratios, and Number of Funds Held (end-December 2013 minus end-June 2012 balances)

<i>Explanatory Variables</i>	<i>Mean</i>	$\Delta\%Stock$	$\Delta Turnover$	$\Delta ExpRatio$	$\Delta Nfunds$
Not-Plan-Defaulted-Streamlined	0.13	-0.0072	-0.1060 ***	-0.0478 ***	-1.4941 ***
Plan-Defaulted-Streamlined	0.36	0.0253 ***	-0.1010 ***	-0.0171 ***	-1.2826 ***
Age	47.66	-0.0015	-0.0008	-0.0078 ***	0.0132
Age**2	2384.89	0.0000	0.0000	0.0001 ***	0.0000
Male	0.50	-0.0156 ***	0.0007	-0.0058 **	-0.1153 *
Education gradschool	0.37	-0.0085 *	0.0195 ***	0.0027	0.0074
HH income low	0.18	-0.0046	0.0001	-0.0069 *	0.0817
HH income high	0.42	-0.0062	0.0124	-0.0045	0.0891
Balance/100k	2.11	0.0029 ***	-0.0067 ***	-0.0056 ***	-0.0238 *
N		4,434	4,406	4,434	4,434
R-squared		0.02	0.09	0.13	0.10
Diff ($\beta(Non-Plan-Def) - \beta(Plan-Def)$)		-0.0325 ***	-0.0050	-0.0307 ***	-0.2115
Mean of dep var		0.007	-0.113	-0.076	-0.487

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Dependent variables as follows: $\Delta\%Stock$ is the % of the participant's portfolio of funds invested in common stocks; $\Delta Turnover$ measures participant changes in overall annual portfolio turnover (post-pre); $\Delta ExpRatio$ measures the change in annual participant expense ratios (post-pre) and $\Delta\#funds$ measures the change in the number of funds held (post-pre). Values computed for each participant using end-December 2013 minus end-June 2012 balances. Source: Authors' calculations.

Table 9A. Change in Participant Portfolio Systematic and Idiosyncratic Risk Exposures (end-Dec 2012 minus end-Jun 2012 balances)

		$\Delta\beta(\text{Mkt})$	$\Delta\beta(\text{SmB})$	$\Delta\beta(\text{HmL})$	$\Delta\beta(\text{WmL})$	$\Delta\beta(\text{Term})$	$\Delta\beta(\text{Def})$	$\Delta(\text{RMSE})$
<i>Explanatory Variables</i>	<i>Mean</i>							
Not-Plan-Defaulted-Streamlined	0.13	-0.1320 ***	0.0082 **	-0.0096 ***	-0.0188 ***	-0.0087 **	-0.0313 ***	-0.0048 ***
Plan-Defaulted-Streamlined	0.36	0.0189 ***	-0.0072 ***	-0.0211 ***	-0.0156 ***	-0.0044 ***	-0.0162 ***	-0.0030 ***
Age	47.64	0.0004	-0.0001	0.0012 **	0.0001	0.0001	0.0010 *	0.0000
Age**2	2383.79	0.0000	0.0000	0.0000 **	0.0000	0.0000	0.0000	0.0000
Male	0.50	-0.0120 ***	0.0001	-0.0007	-0.0022 ***	0.0017	-0.0040 ***	-0.0006 ***
Education gradschool	0.37	-0.0089 *	-0.0009	0.0025 *	0.0000	0.0006	0.0003	-0.0002
HH income low	0.18	-0.0078	-0.0004	0.0022	0.0015	0.0014	0.0022	0.0002
HH income high	0.42	-0.0002	0.0009	0.0026	0.0012	-0.0002	0.0016	0.0002
Balance/100k	2.10	0.0001	0.0008 ***	0.0000	0.0006 ***	-0.0008 ***	-0.0005	0.0000
N		4,476	4,476	4,476	4,476	4,476	4,476	4,476
R-squared		0.100	0.012	0.050	0.089	0.009	0.052	0.142
Diff ($\beta(\text{Non-Plan-Def}) - \beta(\text{Plan-Def})$)		-0.1509 ***	0.0153 ***	0.0115 ***	-0.0032	-0.0043	-0.0152 ***	-0.0018 ***
Mean of dep var		-0.0145	-0.0017	-0.0075	-0.0079	-0.0016	-0.0081	-0.0017

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Post-Pre dependent variables measured as follows: $\Delta\beta(\text{Mkt})$ measures changes in participants' exposure to market risk; $\Delta\beta(\text{SmB})$ measures changes in participants' exposure to the difference in performance of small relative to big stocks; $\Delta\beta(\text{HmL})$ measures changes in participants' exposure to the difference in performance of value stocks to growth stocks; ; $\Delta\beta(\text{Term})$ refers to changes in participants' exposure to the difference in returns on a market portfolio of long-term corporate bonds and the one-month Treasury bill rate measured at the end of the previous month; and $\Delta\beta(\text{Def})$ measures changes in participants' exposure to the difference between the monthly long-term government bond return and the one-month Treasury bill rate; and ΔRMSE is the standard deviation of the residuals from the 6-factor model in section 5.2. Values are computed for each participant using end-December 2012 minus end-June 2012 balances. Source: Authors' calculations; see variable descriptions in text.

Table 9B. Change in Participant Portfolio Systematic and Idiosyncratic Risk Exposures (end-Dec 2013 minus end-Jun 2012 balances)

		$\Delta\beta(\text{Mkt})$	$\Delta\beta(\text{SmB})$	$\Delta\beta(\text{HmL})$	$\Delta\beta(\text{WmL})$	$\Delta\beta(\text{Term})$	$\Delta\beta(\text{Def})$	$\Delta(\text{RMSE})$
<i>Explanatory Variables</i>	<i>Mean</i>							
Not-Plan-Defaulted-Streamlined	0.13	0.0512 ***	0.0057 **	0.0051 *	-0.0002	-0.0174 ***	-0.0136 ***	-0.0007 ***
Plan-Defaulted-Streamlined	0.36	0.0372 ***	0.0029 **	0.0041 ***	-0.0007 *	-0.0028 *	-0.0051 ***	-0.0004 ***
Age	47.66	-0.0257 ***	0.0006	0.0014 ***	-0.0003 **	-0.0002	-0.0001	-0.0002 ***
Age**2	2384.89	0.0002 ***	0.0000	0.0000 ***	0.0000 ***	0.0000	0.0000	0.0000 ***
Male	0.50	-0.0224 **	0.0004	0.0013	-0.0001	0.0015	-0.0009	-0.0003 ***
Education gradschool	0.37	0.0137	0.0009	-0.0011	-0.0005	0.0016	0.0013	0.0001
HH income low	0.18	-0.0044	-0.0009	0.0016	-0.0008 *	0.0023	0.0045 ***	0.0001
HH income high	0.42	-0.0310 ***	0.0025	0.0001	0.0000	0.0008	-0.0003	-0.0001
Balance/100k	2.11	-0.0161 ***	0.0004	0.0002	0.0003 ***	-0.0010 **	-0.0006 **	-0.0001 ***
N		4,433	4,433	4,433	4,433	4,433	4,433	4,433
R-squared		0.063	0.008	0.006	0.029	0.028	0.026	0.041
Diff ($\beta(\text{Non-Plan-Def}) - \beta(\text{Plan-Def})$)		0.0141	0.0027	0.0010	0.0006	-0.0146 ***	-0.0085 ***	-0.0003 *
Mean of dep var		-0.1897	0.0128	0.0095	0.0017	-0.0171	-0.0130	-0.0016

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Post-Pre dependent variables measured as follows: $\Delta\beta(\text{Mkt})$ measures changes in participants' exposure to market risk; $\Delta\beta(\text{SmB})$ measures changes in participants' exposure to the difference in performance of small relative to big stocks; $\Delta\beta(\text{HmL})$ measures changes in participants' exposure to the difference in performance of value stocks to growth stocks; $\Delta\beta(\text{Term})$ refers to changes in participants' exposure to the difference in returns on a market portfolio of long-term corporate bonds and the one-month Treasury bill rate measured at the end of the previous month; $\Delta\beta(\text{Def})$ measures changes in participants' exposure to the difference between the monthly long-term government bond return and the one-month Treasury bill rate; and ΔRMSE is the standard deviation of the residuals from the 6-factor model in section 5.2. Values are computed for each participant using end-December 2013 minus end-June 2012 balances. Source: Authors' calculations; see variable descriptions in text.

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Cognitive Constraints on Valuing Annuities

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Abstract

This paper documents consumers' difficulty valuing life annuities. Using a purpose-built experiment in the American Life Panel, we show that the prices at which people are willing to buy annuities are substantially below the prices at which they are willing to sell them. We also find that buy values are *negatively* correlated with sell values and that the sell-buy valuation spread is negatively correlated with cognition. This spread is larger for those with less education, weaker numerical abilities, and lower levels of financial literacy. Our evidence contributes to the emerging literature on heterogeneity in financial decision-making abilities, particularly regarding retirement payouts.

Key Words: pension, annuity, retirement income, Social Security, financial literacy, cognition

JEL Codes: D14, D91, G11, H55

Cognitive Constraints on Valuing Annuities

1. Introduction

It is difficult for the average person contemplating retirement to determine how to draw down his wealth. While formal economic models typically feature consumers willing to, and fully capable of, engaging in complex intertemporal optimization in the face of multiple sources of uncertainty, this approach is often adopted because of its analytical tractability rather than due to its realism as a portrayal of actual consumer behavior. Moreover, individuals can differ with regard to how they solve the complex problem of selecting wealth decumulation and consumption strategies to maximize lifetime utility. Economists have begun to document such differences in individual decision-making abilities. A key implication of this research is that there can be a gap between people's actual decisions and the decisions that a normative model would prescribe (c.f., Choi, Kariv, Müller, and Silverman 2014). The size of such gaps may vary across individuals and across decision contexts (Campbell 2006; Guiso and Sodini 2013). The gap could reflect people's inability to costlessly optimize, but, as suggested by Calvet, Campbell, and Sodini (2007) in the context of understanding household portfolio allocations, it could also arise when households take their limited abilities into account and effectively optimize subject to constraints on their cognitive abilities or knowledge.

The present paper explores this idea in the important context of retirement income security, focusing on how cognitive abilities influence the valuations that individuals place on an annuitized income stream. We focus on whether people are internally consistent in their annuity valuations across a variety of different

elicitation methods. Specifically, we present individuals with scenarios in which they are offered an opportunity to decrease their annuity holdings for a lump sum (what we call annuity “selling”), as well as scenarios in which the same individuals are offered an opportunity to exchange a lump sum for additional annuitized wealth (called annuity “buying”). Our central hypothesis is that people differ in their ability to meaningfully value a stream of life annuity income relative to a lump sum, and that this ability is associated with measures of cognitive ability including education, financial literacy, and numeracy.

We study the lump-sum versus annuity choice, rather than other financial or economic decisions, for four reasons. First, the annuitization decision is important in its own right as an academic research topic. Indeed, there is a vast academic literature dating back a half-century on the role that annuities should and do play in people’s portfolios in later life.¹ Second, as we discuss below, it is also an important retirement policy concern in many developed nations. Third, the annuitization decision is a natural place to look for variation in consumers’ decision-making abilities. Valuing an annuity versus a lump sum is cognitively challenging because it requires that one wrestle with multiple sources of uncertainty (e.g., mortality, returns, inflation), and it also requires that one make a near-term choice with far-distant consequences, which are characteristics known to render decision-making difficult (Beshears, Choi, Laibson, and Madrian 2008). Fourth, because individuals are typically faced with annuitization decisions only once or twice in their lifetimes, these are not transactions that people learn about through repeated market interaction (Bernheim 2002). In such

¹ Two useful reviews include Benartzi, Previtro, and Thaler (2011) and Poterba, Venti, and Wise (2011).

settings, behavior is known to be less likely to follow the predictions of costless optimization (Kling, Phaneuf, and Zhao 2012), which can drive a wedge between true versus revealed preferences (Beshears, Choi, Laibson, and Madrian 2008).

We provide six pieces of evidence consistent with the hypothesis that individuals have difficulty valuing annuities, and that the degree of difficulty is correlated with cognitive abilities. First, we show that a non-trivial fraction of the population has implied annuity values that are difficult to reconcile with costless optimization under any plausible set of parameters. Second, we uncover a large divergence between the price at which individuals are willing to buy versus sell an annuity, a result that cannot be explained by liquidity constraints or endowment effects. Third, and even more striking, we find that people's buy and sell valuations are negatively correlated. In other words, those who demand higher sell prices are also more likely to offer very low buy prices. Fourth, we show that the size of the sell-buy valuation discrepancy is strongly negatively correlated with cognitive ability as measured by education, financial literacy, and numeracy. This is consistent with less cognitively capable individuals having much greater difficulty valuing a stream of annuity payments. Fifth, we use additional experimental variation to show that the elicited valuations are sensitive to anchoring effects. Finally, we argue that it is difficult to explain observed cross-sectional variation in the measured annuity valuation amounts with theoretically attractive measures. In other words, the pattern of significant marginal valuation predictors is more consistent with individuals using relatively simple heuristics, rather than engaging in costless optimization to value the trade-offs.

Our evidence is drawn from a randomized experiment we conducted in the American Life Panel (ALP), where we present respondents with hypothetical scenarios involving choices with different lump sum amounts and levels of the

Social Security annuity. By varying whether the questions elicited a compensating variation (CV) or an equivalent variation (EV) value, whether the individual was buying or selling the annuity, the size of the increments or decrement of the Social Security annuity, and the order of the questions, we directly examine the internal consistency of subjective valuations placed by respondents on their Social Security annuities. We collected a number of additional variables to control for potentially confounding factors such as heterogeneity in liquidity constraints and beliefs about political risk.

Like most economists, we usually find evidence based on actual choices in natural settings more compelling than evidence based on hypothetical choices. We acknowledge important drawbacks of using hypothetical choices, such as the possibility that lower stakes could lead respondents to exert less effort and seek out fewer resources to assist them with their decisions. However, although these considerations may make hypothetical choice behavior noisy, it would be surprising if they led to systematic patterns in hypothetical choice behavior that would be completely absent in actual choices.

Counterbalancing these drawbacks are three important benefits of using a hypothetical choice setting. First, it allows us to observe an individual's annuitization choices for a wide range of annuity prices, from which we obtain individual-specific annuity valuations without having to rely on functional form assumptions. By contrast, in real-world settings, annuitization decisions are typically made at a single price (and if there is price variation, it is generally not exogenous). Second, in a hypothetical setting it is feasible to elicit both the price at which an individual is willing to buy and the price at which he is willing to sell the annuity. Such within-person variation turns out to be extremely valuable in exploring cognitive constraints on consumers' abilities to value annuities. Third,

the hypothetical setting allows us to elicit annuitization choices for a broadly representative sample of the U.S. population. As discussed in the literature overview below, actual annuitization decisions in natural settings are typically only observed for rather select populations.

In addition to advancing the academic understanding of consumer behavior in this area, our results also have considerable practical policy relevance. In March 2014, for example, the UK Chancellor announced the end of a requirement that savers annuitize a portion of their assets upon retirement (PricewaterhouseCoopers 2014), a significant policy change that led to an immediate and substantial decline in annuity sales (Gray 2014). In contrast, the U.S. has been moving in the direction of encouraging annuities in defined contribution plans (US DOL 2010), with some analysts going so far as to suggest that people be automatically annuitized upon retirement (Gale, Iwry, John, and Walker 2008; Steverman 2012). Numerous other countries are also debating these issues.² These discussions, in part, revolve around whether people can make optimal payout decisions using their accumulated retirement assets. Moreover, many countries are grappling with fiscally unsustainable pay-as-you-go public pension systems. The extent to which households are poorly equipped to value the annuities offered by their public pensions has implications for the political feasibility of reforms changing the benefit structure, particularly if retirees were to be offered a choice between a lump sum and future annuity payments. The same point applies to state and local public defined benefit plans (DB) in the U.S.,

² Similar debates about the role of lifetime income in retirement plans are occurring in Europe, including the Netherlands (Brown and Nijman 2012), Italy (Guazzarotti and Tommasino 2008), and elsewhere (Fornero and Luciano 2004).

which also face substantial underfunding problems (Novy-Marx and Rauh 2011). Indeed, some reformers have called for a reduction in DB annuities in exchange for lump-sum contributions to defined contribution (DC) accounts (e.g., Kilgour 2006).

In what follows, we first summarize key prior studies on the demand for annuities from both the neoclassical and the behavioral economics literatures. Next, we describe the American Life Panel (ALP) Internet survey, a broadly representative sample of the U.S. population, and we outline how we elicited lump-sum versus annuity preferences in this survey. We then present our key empirical results, followed by a number of robustness checks and further analyses for subgroups that vary according to financial capabilities. We conclude with a discussion of possible policy implications and future research questions.

2. Related Literature

2.1 Annuity Demand

There is a very large economics literature focused on modeling the optimal level of annuitization for life-cycle consumers under various assumptions.³ That literature began with Yaari's (1965) paper in which he noted

³ Rather than providing a comprehensive review here, we instead highlight those studies most germane to the research that follows. Readers interested in the broader literature on life annuities may consult Benartzi, Previtro, and Thaler (2011); Poterba, Venti, and Wise (2011); Brown (2008); Horneff, Maurer, Mitchell, and Dus (2008); and Mitchell, Poterba, Warshawsky, and Brown (1999). Note that we use the term "life annuity" because we are interested in products that guarantee income for life, as opposed to financial products such as

a set of conditions under which it would be optimal for an individual to annuitize all of his wealth.⁴ Extensions to the theory went on to show that full annuitization would be optimal under more general conditions,⁵ a puzzling prediction in light of very low annuitization rates in the real world (Mitchell, Piggott, and Takayama 2011). Extended life-cycle models have been constructed to measure consumer valuations of life annuities and to compute how optimal annuitization will vary with numerous other factors.⁶ Although these model extensions affect the level at

“equity indexed annuities” that are mainly used as tax-advantaged wealth accumulation devices (and hence they are rarely converted into life-contingent income).

⁴ The conditions include no bequest motives, time-separable utility, exponential discounting, and actuarially fair annuities (among others).

⁵ Davidoff, Brown, and Diamond (2005) showed that full annuitization is optimal under complete markets with no bequest motives. Peijnenburg, Nijman, and Werker (2010; forthcoming) found that if agents saved optimally out of annuity income, full annuitization can be optimal even in the presence of liquidity needs and precautionary motives. They further found that full annuitization is suboptimal only if agents risk substantial liquidity shocks early after annuitization and do not have liquid wealth to cover these expenses. This result was robust to the presence of significant loads.

⁶ Among the many factors modeled in research are pricing (Mitchell, Poterba, Warshawsky, and Brown 1999); pre-existing annuitization (Brown 2001; Dushi and Webb 2006); risk-sharing within families (Kotlikoff and Spivak 1981; Brown and Poterba 2000); uncertain health expenses (Turra and Mitchell 2008; Peijnenburg, Nijman, and Werker 2010, forthcoming); bequests (Brown 2001;

which individuals value annuities, most models still imply that individuals have an internally consistent valuation of an annuity versus a lump sum.

Our paper focuses on how an individual's annuity valuation varies depending on whether the transaction is structured as buying or selling the annuity. Unlike a "bid-ask spread" in financial markets, which is a wedge between the highest price a buyer is willing to pay for an asset and the lowest price for which a different seller is willing to sell it (e.g., due to counterparty risk), we document what amounts to a bid-ask spread *for the same individual*. There are two extensions of the standard model with costless optimization in which a within-individual bid-ask spread could arise: liquidity constraints and transaction costs. For liquidity-constrained individuals, the buying price is capped by their limited liquidity, but no such cap exists for their selling price. In our empirical work below, we show that liquidity constraints are not the primary explanation of our findings. Although there may be transaction costs that could lead to a spread in a market setting, these transaction costs are not relevant in our experimental setup.

Much of the annuity literature has focused on theory or simulation, largely owing to the small size of the voluntary life annuity market in most

Lockwood 2011); inflation (Brown, Mitchell, and Poterba 2001, 2002); the option value of learning about mortality (Milevsky and Young 2007); stochastic mortality processes (Reichling and Smetters 2015; Maurer, Mitchell, Rogalla, and Kartashov 2013); and broader portfolio issues including labor income and the types of assets on offer (Inkmann, Lopes, and Michaelides 2011; Koijen, Nijman, and Werker 2011; Chai, Horneff, Maurer, and Mitchell 2011; Horneff, Maurer, Mitchell, and Stamos 2009, 2010).

countries making empirical work difficult. The empirical literature that does exist often points to behavior suggestive of heterogeneity in decision-making abilities. For example, Brown (2001) used the 1992 wave of the U.S. Health and Retirement Study (HRS) to show that expected annuitization from DC plans was correlated with the annuity valuations predicted by a life-cycle model based on demographic characteristics, but only for persons with sufficiently long (1+ year) planning horizons. Hurd and Panis (2006) explored payouts from DB plans in the HRS and found that many people exhibited behavior consistent with *status quo* bias. Büttler and Teppa (2007) used Swiss administrative data to track choices made by employees in ten different pension plans and concluded that annuitization was higher in plans where an annuity was the default payout option. Chalmers and Reuter (2012) exploited exogenous variation in the price of annuities using Oregon public-sector workers; they (unexpectedly) found that worker demand for partial lump-sum payouts rose rather than fell as the value of the forgone life-annuity payments increased, leading them to conclude that the decisions were being made by unsophisticated individuals. Fitzpatrick (2015) examined a policy in which Illinois Public School employees could purchase additional annuitized pension benefits. Using the observed take up of this policy and how the take up varies with the annuity's price, she estimated that the average employee is willing to pay only 20% of the actuarial value of the annuity. Previtro (2014) showed that annuity demand was negatively correlated with the prior year's stock returns, consistent with consumers engaging in naïve trend-chasing. Shepard (2011) examined the implicit purchase of marginal annuities through the delay of claiming Social Security. Using perturbation arguments, he argued that standard explanations (such as lack of liquidity, risk of medical expenditure shocks, bequest motives, actuarially unfair pricing, and political risk)

cannot explain the puzzle of why so few people delay claiming. He concluded that understanding the annuity puzzle likely rests on a behavioral explanation.

Several experimental papers have also suggested that annuitization decisions are not well described by models of optimizing agents facing no cognitive constraints or decision-making costs. Agnew, Anderson, Gerlach, and Szykman (2008) showed that people can be steered toward or away from life annuities in an experimental setting, depending on whether the products were described using positive or negative frames. Brown, Kling, Mullainathan, and Wrobel (2008) used an internet survey to show that perceptions of annuity value relative to alternative financial products were heavily influenced by whether the products were described using “consumption” or “investment” frames. Beshears, Choi, Laibson, Madrian, and Zeldes (2014) also found evidence that framing affects annuity demand. Brown, Kapteyn, and Mitchell (2016) showed that Social Security claiming behavior (which is akin to making an annuitization decision) was influenced by framing changes. Accordingly, this small literature suggests that individuals behave at odds with models based on costless optimization.

The two studies closest to ours in spirit are Cappelletti, Guazzarotti, and Tommasino (2013) and Liebman and Luttmer (2014), although both were more limited in focus. The first of these used a 2008 survey of Italian households to investigate whether people would give up half their monthly pension income (assumed to be €1000) in exchange for an immediate lump sum of €60,000. The study reported that the better educated and more financially literate were more likely to annuitize. The second paper conducted a 2008 survey on the perceived labor supply incentives in Social Security, which included a question asking for the equivalent variation of a \$100/month increase in Social Security benefits. Because each of those papers used only a single elicitation method, neither

addressed the hypotheses we test here across elicitation measures based on within-person differences in valuation.

2.2. Variation in Decision-making Abilities

Lusardi and Mitchell (2014) provide a comprehensive review of the large and growing literature relating financial literacy to behavior, including the robust finding that many households lack basic financial knowledge. Indeed, many households make a range of financial mistakes when managing their financial affairs (e.g., Calvet, Campbell, and Sodini 2007, 2009; Agarwal, Driscoll, Gabaix, and Laibson 2009), and households making such mistakes often lack day-to-day financial skills (Hilgert, Hogarth, and Beverly 2003). Relatedly, findings by Agarwal, Chomsisengphet, and Zhang (2015) indicate that financial literacy plays an important part in mortgage default behavior. The literature has also established that financial literacy is correlated with the propensity to participate in financial markets (Kimball and Shumway 2006; Christelis, Jappelli, and Padula 2010; van Rooij, Lusardi, and Alessie 2011; Almenberg and Dreber 2015; and Arrondel, Debbich, and Savignac 2013), and in pensions (Fornero and Monticone 2011). Moreover, Lusardi and Mitchell (2007, 2011) demonstrated that more financially knowledgeable individuals are more likely to engage in retirement planning and accumulate retirement wealth.

A related literature has focused on the links between cognitive abilities and financial decision-making. Fang, Keane, and Silverman (2008) showed that cognitive functioning was a stronger predictor of Medigap purchase patterns than risk preferences. Agarwal and Mazumder (2013) reported that performance on cognitive tests helped explain the quality of financial decisions related to the use of credit. A subset of this literature has also focused more specifically on retirement preparedness among older individuals. For example, McArdle, Smith,

and Willis (2011) and Banks, O’Dea, and Oldfield (2010) found that people with greater cognitive ability had accumulated more retirement wealth.

Taken together, these and other studies suggest that people differ in their financial decision-making abilities, and these differences are important correlates of financial well-being later in life. Taking this literature a step further in establishing causality, Choi, Kariv, Müller, and Silverman (2014) conducted a large-scale experiment designed to directly test the extent to which individual decisions were consistent with the Generalized Axiom of Revealed Preference (GARP). They detected substantial heterogeneity and found that their measure of decision-making quality was higher among younger and better-educated individuals. Additionally, they showed that individuals having better decision-making skills accumulated more wealth. Behrman, Mitchell, Soo, and Bravo (2012) also reported that the more financially literate saved more in their pensions, controlling for the possible endogeneity of financial knowledge.

Our work below contributes to this literature in two ways. First, we focus on a decision important in its own right – annuitization – but we concentrate on an area where heterogeneity in decision-making quality has not yet been studied, namely Social Security annuities. Second, we explore an outcome novel to the study of decision-making ability by investigating a measure of low decision-making quality, namely the spread of individual responses across different approaches to eliciting stated valuations for life annuities. We show that this spread is strongly inversely related to various measures of cognition and financial literacy.

3. Methodology and Data

3.1 The Experimental Context

Rather than describing an unfamiliar hypothetical annuity product, our experiments use Social Security benefits as the context. This approach has several advantages. First, most workers understand that Social Security pays benefits to retirees that last for as long as they live (Greenwald, Kapteyn, Mitchell, and Schneider 2010), which means that respondents are likely to understand the nature of our “offer” to trade off annuities and lump sums. Second, our context provides a simple way to control for possible concerns about the private annuity market that might otherwise influence results, such as the lack of inflation protection (our question makes it clear that Social Security is adjusted for inflation), or concerns about counterparty risk of the insurer providing the annuity.⁷ Third, our setting is highly policy relevant. For example, past discussions of possible pension reforms around the world, as well as at the U.S. state and local levels, have included proposals to partially “buy out” benefits by issuing government bonds to workers in exchange for a reduction in their annuitized benefits. Several U.S. corporations have also recently offered to buy back defined benefit pension annuities from retirees in exchange for lump sums (c.f., Wayland 2012).

3.2. Our Experiments in the American Life Panel

To test how people value their Social Security annuity streams, we fielded a survey between June and August of 2011 using the RAND American Life Panel, a panel of U.S. households that regularly take surveys over the Internet. RAND

⁷ Below we examine whether concerns about the fiscal sustainability of Social Security influences people’s valuation of the Social Security annuity. See Luttmer and Samwick (2015) for a detailed analysis of the effects of policy uncertainty on valuations of future Social Security benefits.

provided Internet access to household lacking such access.⁸ By not requiring Internet access at the recruiting stage, the ALP has an advantage over most other Internet panels when it comes to generating a representative sample.⁹ At the time of our survey, the American Life Panel included about 4,000 active panel members. The survey was conducted over two waves of the ALP. For the first wave, we selected 2,954 respondents age 18 or older, of whom 2,478 completed the survey for a response rate of 83.9%. Those who completed the first wave were invited to participate in a second survey at least two weeks later; of these, 2,355 respondents completed the second wave for a response rate of 95%. About 4% of participants indicated that they thought they would not be eligible to receive Social Security benefits (either on their own earnings records or on those of a current, late, or former spouse). We showed these respondents the level of Social Security benefits equal to the average received by people with their age/education/sex characteristics, and asked them to assume for the purposes of the survey that they would receive this level of benefits. Our full sample included 2,112 complete responses for both waves 1 and 2.¹⁰

⁸ Initially these households received a WebTV allowing them to access the Internet. Since 2008, households lacking Internet access have received a laptop and broadband Internet access.

⁹ A more detailed explanation of the ALP is provided in Online Appendix A. Our survey instrument is included in Online Appendix B.

¹⁰ Of the 2,355 respondents who completed the second wave, we dropped 69 observations from the pilot version of wave 2 (where the questionnaire was slightly different). We further dropped 168 observations where the survey instrument was incorrectly administered due to a technical glitch and we dropped

Table 1 compares our sample characteristics with those of the same age group in the Current Population Survey (CPS).¹¹ Our sample is, on average, five years older, more female, more non-Hispanic white, better educated, slightly better-paid, and has a somewhat smaller household size than the CPS; the regional distribution is close to that of the CPS. The fact that our sample is more highly educated means that, if anything, our respondents should be in a better position to provide meaningful responses to complex annuity valuation questions, compared to a national sample. Despite the differences between the ALP and the CPS, our ALP sample does include respondents from a wide variety of backgrounds, so in this sense, we think of the ALP as broadly representative of the U.S. population.

[Table 1 here]

3.2. Eliciting Lump-Sum versus Annuity Preferences

To elicit preferences regarding annuitization, respondents were posed several questions of the following sort:

In this question, we are going to ask you to make a choice between two money amounts. Please click on the option that you would prefer.

Suppose Social Security gave you a choice between:

(1) Receiving your expected Social Security benefit of $\$SSB$ per month.

or

(2) Receiving a Social Security benefit of $\$(SSB-X)$ per month and

6 observations with missing information on basic demographics (age, education, or marital status).

¹¹ Summary statistics of other key variables from our survey such as annuity valuations (discussed below) are provided in Online Appendix Table A.1.

receiving a one-time payment of $\$LS$ at age Z .

The variable SSB is an estimate of each respondent's estimated monthly Social Security benefit; the variable LS refers to the lump-sum amount; and Z is an age that depends on whether the respondent currently receives Social Security benefits. For those not currently receiving benefits, the trade-off was posed as a reduction in future monthly Social Security benefits in exchange for a lump sum to be received at that person's expected claiming age. For those currently receiving Social Security benefits, the questions were modified to compare a change in monthly benefits to the receipt of a lump sum in one year. In both cases, the receipt of the lump sum was to take place in the future in order to avoid having present bias possibly confound our results.

Before asking the annuity trade-off question, we explained that the question referred to real after-tax amounts (i.e., "you don't owe any tax on any of the amounts we will show you;" and "please think of any dollar amount mentioned in this survey in terms of what a dollar buys you today because Social Security will adjust future dollar amounts for inflation"). In the trade-off question, we told married respondents: "benefits paid to your spouse will stay the same for either choice." Thus, individuals were asked to value a single-life inflation-indexed annuity.

To probe the reliability of the valuations provided by respondents, we also varied the question in a systematic way along two dimensions. First, we elicited how large a lump sum would be required to induce an individual to accept a reduction of (i.e., to *sell*) a portion of his Social Security income; below we refer to this version of the question with the shorthand "sell." We also elicited how large a lump sum the individual would be willing to *pay* in order to increase his Social Security annuity (the "buy" condition).

Second, we varied our questions depending on whether we elicited a compensating variation (CV) – the annuity/lump-sum trade that would keep a respondent at his existing utility level – or an equivalent variation (EV) –the lump-sum amount that would be equivalent in utility terms to a given change in the monthly annuity amount. As we discuss in more detail below, an analysis of the CV versus EV distinction should allow us to distinguish our findings from a simple *status quo* bias or endowment effect because the *status quo* was not included in the EV choice set. All choices in the EV scenario either involved a change in Social Security benefits or the payment or receipt of a lump sum. Even though there is no *status quo* in the EV version, we continue to use “sell” to describe the version that includes the respondent receiving a lump sum as a choice and to use “buy” for the version that has the respondent paying a lump sum as a choice. We believe this description fits with the common notion of the meaning of buying and selling, but we acknowledge that this description implicitly assumes that selling and buying is perceived as relative to the choice where the respondent receives only Social Security income.

In total, we elicited four measures and designate them for discussion purposes as **CV-Sell** (as in the example above), **CV-Buy**, **EV-Sell**, and **EV-Buy**. The chart below describes these four scenarios. We define *SSB* as the monthly Social Security benefit the individual was currently receiving (if the individual was a current recipient), or was expected to receive in the future (if the individual was not a recipient); *X* is the increment (or decrement, if subtracted) to that monthly Social Security benefit. Finally, we set *LS* as the lump-sum amount offered in exchange for the change in monthly benefits. In essence, this paper is about how individuals trade off a monthly benefit of $\$X$ for a lump sum of $\$LS$.

Four Variants of the Annuity Valuation Tradeoff Question

	"Sell" Version		"Buy" Version	
	Choice A	Choice B	Choice A	Choice B
Compensating Variation (CV)	$[SSB-X] + LS$	$[SSB]$	$[SSB+X] - LS$	$[SSB]$
Equivalent Variation (EV)	$[SSB] + LS$	$[SSB+X]$	$[SSB] - LS$	$[SSB-X]$

Note: *SSB* stands for current/expected monthly Social Security benefits, *X* is the amount by which monthly Social Security benefits would change and *LS* is a one-time, lump-sum amount. Positive amounts are received by the individual while negative amounts indicate a payment by the individuals. Amounts between square brackets are paid monthly for as long as the individual lives, whereas *LS* is a one-time payment or receipt. The individual is asked to elect Choice A or Choice B.

The CV-Sell scenario presented respondents with a choice between their current (or expected) Social Security benefits (*SSB*) and an outcome in which their benefits are reduced by $\$X$ per month in exchange for receiving a lump sum of $\$LS$. The EV-Sell scenario provided a choice between receiving a higher monthly benefit ($SSB+X$) or receiving $\$SSB$ plus a lump sum of $\$LS$. Note that within the Sell scenario, one can obtain EV simply by adding $\$X$ to each side of the CV trade-off. Given that $X=\$100$ per month in the baseline versions, the change in benefits is modest relative to total monthly income for most individuals. We would therefore expect CV and EV to be comparable, barring strong endowment effects that might be present in the CV formulation but not in the EV formulation (where the *status quo* was not an option).

Switching to the Buy scenarios, the CV-Buy question provided a choice between *SSB* and a benefit increased by $\$X$ in exchange for paying $\$LS$ to Social Security. EV-Buy provided a choice between receiving a lower monthly benefit ($SSB-X$) and paying a lump sum to maintain the existing benefit. In these Buy scenarios, the respondent could obtain CV simply by adding $\$X$ to each of the EV scenarios. Again, no *status quo* option was available in the EV case.

In order to elicit the subjective valuation resulting from any given measure above, the survey used a "branching" approach. For example, we started

with a \$100 increment to the monthly annuity versus a \$20,000 lump sum. If the individual rejected the lump sum, then \$20,000 is the upper bound of the individual's valuation of the annuity. Conversely, if the lump sum was chosen, \$20,000 is a lower bound. Next, based on each individual's response, we either increased or decreased the amount of the lump-sum payment offered. Each subsequent response tightens the range of lump-sum values between the upper and lower bound. By going through four or five rounds of this branching process, we identify a narrow range of lump-sum values that contains each respondent's implied subjective valuation of the change in the annuity stream.

We chose one of our four approaches as a benchmark on which to do additional sensitivity tests along other dimensions. While there is no theoretical basis for suggesting that one treatment would be preferred to the other three, we selected the CV-Sell option as the benchmark condition because it is most relevant to policy discussions. For example, offering retirees an opportunity to sell their annuities for a lump sum is a transaction observed in recent years (e.g., GM has offered retirees lump sums in lieu of their life annuities). The Sell measure is also less likely than the Buy measure to be bounded by people's access to liquidity. Accordingly, all respondents were asked the CV-Sell question in one of the two waves, whereas the other three versions (CV-Buy, EV-Sell, and EV-Buy) were asked in a randomized order in the other wave. Placement of the CV-Sell question in the first or second wave was randomized across respondents. The two waves were administered approximately two weeks apart. Below, we test whether responses to CV-Sell differ across the first and second wave.

3.3. Other Sources of Experimental Variation

We also randomized along a number of other dimensions. The order of the options within a question was randomized to test whether respondents took

the survey seriously (as opposed to, say, always choosing option A). We also tested for anchoring effects in our benchmark question (CV-Sell) as well as whether responses varied with the magnitude of the change in the benefit, to provide an additional assessment of the role of cognitive limitations. Finally we asked a version of the questions designed to control for political risk, to ensure that our results were not driven by concern over the system's pending insolvency. Each of these factors is discussed in detail below, after we present our main results.

4. Evaluating Heterogeneity in Annuity Valuations

Figure 1 reports the cumulative distribution function (CDF) of the responses to the CV-Sell and CV-Buy questions, while Figure 2 provides a similar plot for EV-Sell and EV-Buy. Given our branching approach in eliciting valuations (described in Section II.C), the two Figures plot both the upper and lower bounds for each respondent's annuity valuation.¹² In Figure 1, the midpoint of the upper and lower bounds for the CV-Sell question indicates a valuation of \$13,750 for a \$100-per-month change in Social Security benefits. The CV-Buy question midpoint valuation is only \$3,000. In Figure 2, the comparable valuations are \$12,500 for EV-Sell and \$3,000 for EV-Buy. By comparison, the median *actuarial value* of this annuity for respondents in our sample is \$16,855 (computed using Social Security Trustees' Report intermediate assumptions of a

¹² The CV-Sell figure plots valuations only for individuals who saw the \$100 increment first (the other three annuity valuation questions are asked only for \$100 increments). Other respondents saw higher annuity amounts first which, as discussed below, led to an anchoring effect that increased their valuation.

3% interest rate and intermediate mortality).

Figures 1 and 2 here

Four patterns are evident in these two figures. First, median valuations are all substantially below the actuarial value of \$16,855. Second, substantial dispersion of valuations is generated by all four valuation approaches. Third, the distributions of EV and CV valuations appear similar, holding constant whether the Buy or Sell valuation was offered, although we will see below that the correlation is far from perfect. Fourth, there is a very large difference between the Sell and Buy valuations, regardless of whether this was elicited in a CV or an EV setting. After briefly discussing each of these issues, we will then delve more deeply by analyzing differences in valuations within and across individuals.

4.1. Median Valuations

When we simply pool responses to our four valuation questions – CV-Sell, CV-Buy, EV-Sell and EV-Buy – we find that 70% of the responses have an upper bound below the actuarially fair level and 64% of the responses have an upper bound at least \$5,000 below the actuarially fair level.¹³ This finding is interesting, given the ongoing discussion in the literature about the “annuity puzzle” which notes that life-cycle optimizers should recognize annuities’ high utility value, while real-world consumers avoid purchasing them. Nevertheless, there are several reasons for why people might value an annuity below its

¹³As in the figure, we limit the sample for the CV-Sell response to individuals who saw the \$100 increment first to avoid anchoring effects. If we double the weight on the remaining half of the CV-Sell responses (to compensate for the fact we dropped CV-Sell responses affected by anchoring), the percentages become 68% and 61%, respectively.

actuarially fair level, including bequest motives and a desire for liquidity. Indeed, the current paper does not attempt to explain the annuity puzzle; rather, our goal is to test whether people's valuations are internally consistent. The remainder of our results should be viewed in light of this important distinction.

4.2. Valuation Dispersion

The cumulative distributions presented in Figures 1 and 2 reveal substantial heterogeneity in respondent valuations. For example, 5% of the sample reported upper-bound CV-Buy valuations of \$1,500 or less. Such low amounts are difficult to explain if the respondent can optimize costlessly since the \$100 monthly annuity payments would yield more than this in only 16 months. The exception would be if some individual were virtually certain that he would die in that time span, but these outliers persist even after we control for respondents' self-reported health status and expected survival probabilities. At the other extreme, 16% of the respondents gave lower-bound CV-Sell annuity values of \$60,000 or higher – nearly four times the actuarial value of the annuity. Moreover, more than 6% of the respondents in the CV-Sell approach said they would not accept a lump sum of less than \$200,000. This is unexpected, since even if someone earned only a 60 basis-point (0.60%) annual return on the \$200,000 lump sum, he could replace the \$100 per month he was giving up with this return and still keep the lump sum of \$200,000. As noted below, these findings are not explained by subjective life expectancy, concerns about political risk, or many other plausible explanations.¹⁴ In other words, many respondents

¹⁴ We control for political risk in two ways in this study. First, we asked individuals about their confidence that the Social Security system will be able to provide them with the level of future benefits they are supposed to get under

appear to have difficulty providing economically meaningful values for the Social Security annuity, at least in the tails of the CDF.¹⁵

4.3. Comparing CV and EV

current law. Including responses to this question as a control variable in various analyses does not substantially affect our findings. Second, we asked a version of our CV-Sell annuity valuation question in which we explicitly instructed individuals not to consider political risk by stating: “From now on, please assume that you are absolutely certain that Social Security will make payments as promised, and that there is no chance at all of any benefit changes in the future other than the trade-offs discussed in the question below.” Comparing the response to the no-political-risk question to the baseline CV-Sell question for those for whom the two questions were asked in different waves of the survey, we find that the response to the no-political-risk question is a statistically insignificant 10% *lower* than the response to the baseline CV-Sell question. Taken literally, this implies a negative risk premium, but we believe the more likely explanation is that our question may have had the unintended effect of making political risk more salient. Overall, our analysis suggests that the incorporation of political risk does not alter our main findings.

¹⁵ Individuals in the tails of the annuity valuation distributions tend to be worse off economically and score lower on indicators of cognition. We return to the relation between cognition and annuity valuations in Section III.F below. However, these differences are not dramatic and there is substantial overlap in the characteristics of those in the tails and those who are not. Online Appendix Table A.2 presents the mean characteristics of respondents in the tails of the annuity valuation distributions.

The EV-Sell options are obtained by adding \$100 to both of the options in the CV-Sell questions. Given the small magnitude of the shift (relative to mean estimated monthly benefits of \$1,395), we anticipated that a costlessly optimizing decision-maker would provide quite similar assessments across these two ways of eliciting value. Although the distributions of CV-Sell and EV-Sell look similar in Figures 1 and 2 (as do the distributions of CV-Buy and EV-Buy), individual responses are only moderately correlated. Table 2 reports the correlations across the four different measures.¹⁶ Column 1 shows that CV-Sell and EV-Sell are significantly positively correlated, but the correlation coefficient of +0.31 is far from one. Given that we asked the CV-Sell and the EV-Sell questions in survey waves separated by at least two weeks, it is unlikely that the correlation was driven by anchoring or memory effects that could arise if the questions had been asked within the same questionnaire. The correlation of +0.72 between CV-Buy and EV-Buy is substantially higher, but we cannot rule out that anchoring effects contributed to this higher correlation since CV-Buy and EV-Buy were asked in the same wave.

Table 2 here

4.4. Sell Prices Exceed Buy Prices

A key and very striking pattern emerging from Figures 1 and 2 is that the distributions of annuity valuations from the Buy solicitations are substantially below those of the Sell solicitations. Recall that the Sell question asked how much

¹⁶ To control for correlations induced by common experimental manipulations, we regress the log midpoint valuation on controls for the relevant manipulations and then correlate the residuals, which are reported in Table 2. Uncorrected correlations are similar and shown in Online Appendix Table A.3.

a person would have to be compensated to give up part of his Social Security annuity, whereas the Buy question asked how much he would be willing to pay to increase his Social Security annuity. In Figure 1, the median midpoint response drops from \$13,750 for CV-Sell to only \$3,000 for CV-Buy.

If we observed this result only in the CV case, one might argue that this could result from *status quo* bias (Samuelson and Zeckhauser 1988) or an endowment effect (Kahneman, Knetsch, and Thaler 1991). Yet Figure 2 shows that an almost identical shift occurs when we use the EV-Sell and EV-Buy responses, where the *status quo* is not an option because both the annuity and the lump sum are represented as deviations away from the initial endowment. Online Appendix C shows that a kinked utility function, such as is typically used to explain endowment or *status quo* effects, cannot simultaneously explain our findings for EV choices and CV choices.¹⁷

¹⁷ While our results cannot be explained by endowment or *status quo* effects if respondents take the Social Security benefit amount they report to us as the reference point, we cannot rule out that respondents may have had a “fuzzy” reference point that shifted based on the version of the question asked. In particular, if they shifted their reference point up by \$100 in the EV-Buy version (i.e., \$100 above their actual or expected Social Security benefits) and down by \$100 in the EV-Sell version (i.e., \$100 below their actual or expected Social Security benefits), then the EV answers could be explained by endowment or *status quo* effects. To explore this explanation, we compared sell and buy valuations of individuals who are least likely to have a fuzzy reference point, namely those who are currently receiving Social Security benefits and were able

To examine the possibility that answers might be driven by liquidity constraints, we asked respondents about their ability to come up with the money needed for the lump sum. The vast majority (91%) indicated that their choice was not due to liquidity constraints,¹⁸ and the clear divergence in valuations persists in the non-liquidity constrained sub-sample. Another possibility is that the difference between sell and buy prices arises because respondents had a differential understanding of these two questions. Although we have no way to empirically rule out this possibility, we note that we took great care to make the wording of the two questions as similar as possible and to balance the design in terms of when the questions were asked.

to report their benefit amount to us. The difference between EV-Sell and EV-Buy prices is as large for this group as for the rest of the sample.

¹⁸ Specifically, we asked whether each respondent could come up with \$5,000 “if you had to” and, separately, whether he could come up with the lump sum needed to purchase the higher annuity. The time frame for accessing the money was the same time frame as in the annuity valuation question, namely one year from now or the respondent’s expected claim date, whichever was later. About two-thirds of the respondents answered that they were certain they could come up with \$5,000, and over 90% responded that they could come up with the amount probably or certainly. About 82% of respondents indicated that they could come up with the lowest lump-sum amount that they declined to pay. Of the 18% that indicated they could not come up with this amount, half said that even if they had the money, they would decline to pay the lump sum. Thus, for 91% of the respondents, liquidity constraints were not the reason for the low reported annuity valuation in the CV-Buy trade-off question.

Rather than *status quo* bias, endowment effects, differential question understanding, or liquidity constraints, we conjecture that this wedge is the outcome of valuation difficulties on the part of respondents. This conjecture has two testable implications. First, individuals who have difficulty valuing annuities may seek to protect themselves by agreeing to an annuity transaction only if the annuity is priced very attractively, which would lead them to demand a high price to sell, but offer a low price to buy. We refer to this as a “reluctance to exchange,” which would imply that buy valuations will be negatively correlated with sell valuations if there is heterogeneity across people in their degree of reluctance. Second, it implies that the size of the wedge between buy and sell valuations will be decreasing with cognitive abilities.

4.5. Negative Buy-Sell Correlations

Although Figures 1 and 2 reveal large differences in the distributions of responses between Sell and Buy valuations, they do not indicate whether *within-person* responses to these alternative valuation measures are correlated. Hence we cannot yet conclude that the entire distribution is shifted to the left, or whether the same individuals change their positions in the distribution depending on whether they see a Sell or Buy question. This is addressed in Table 2, which reports a negative correlation between Buy and Sell valuations. Specifically, the correlation between CV-Sell and CV-Buy is -0.11, whereas the correlation between EV-Sell and EV-Buy is -0.15; both are highly statistically significant. These negative correlations suggest that individuals who place above-average values on a \$100/month annuity when asked to sell it tend to be willing to pay less than average to purchase a \$100/month benefit. The negative correlation also implies substantial movement within the distributions, rather than a uniform downward shift when we move from a Sell to a Buy elicitation method. This

pattern is consistent with individuals who have difficulty valuing annuities being reluctant to exchange annuities because they wish to ensure that they are not losers in a transaction they have difficulty evaluating.

4.6. The Role of Cognition and the Sell-Buy Spread

If the Sell-Buy differential is due to low-ability decision-makers being reluctant to engage in annuity transactions, then the size of this differential should be correlated with measures of cognition. To explore this, we construct a measure of the “Spread” that equals the absolute value of the difference between the log CV-Sell and the log CV-Buy valuation of a \$100 change in monthly Social Security benefits. The spread is defined as an absolute value because a discrepancy between Sell and Buy valuations in either direction is indicative of a lack of internal consistency. In practice, the spread is dominated by the 80% of the sample who place a higher value on CV-Sell than CV-Buy. Because the spread is measured as the difference in log points, this variable reflects the relative value of Sell and Buy valuations. The mean of the Spread variable is 2.58 and its median is 2.30, indicating that the median individual reports Sell and Buy valuations that differ by a factor of 10. In the large majority that places a higher value on the Sell than the Buy valuation, the mean and median of the Spread variable are 2.63 and 2.35 respectively. This implies that the median person in this sample demands a price to sell a \$100/month annuity 10.5 times higher than the price he is willing to pay to buy the same annuity.

Figure 3 shows the bivariate relation between the CV Sell-Buy Spread and various measures of cognition. Panel A groups respondents according to an index of financial literacy, measured as the sum of correct answers to the three questions devised for the Health and Retirement Study to rate respondents’

financial literacy levels.¹⁹ We find that that the Sell-Buy Spread falls sharply with measured increases in financial literacy. In Panel B, we make use of a number scoring test, where respondents are shown six incomplete sequences of numbers and are asked to complete each sequence (e.g.: 7, 8, ..., 10). Scores are assigned using a Rasch scoring algorithm (Linacre 1999). We find a sharp and monotonic decline in the Sell-Buy Spread across quintiles of this numeracy measure. In Panel C, we split the Spread measure by level of education and, once again, we find a sharply declining pattern. Panel D uses an overall cognition index, which is the first principal component of the three measures of cognition.²⁰ Given the fact that the weight on each of the three factors is roughly equal, it is not surprising that we also find a strong, monotonic, negative relation between the Sell-Buy Spread and our cognition index.²¹ Our conjecture that the Sell-Buy Spread stems from a

¹⁹ The three questions test for an understanding of inflation, compound interest, and risk diversification (for a complete listing of the questions see Online Appendix B).

²⁰ Although we use principal components analysis to construct the weights in the cognition index, the contributions of each of the three components turn out to be close to each other. We therefore obtain very similar results if we construct an index in which we give each of the three components equal weight.

²¹ Online Appendix Figure A.1 shows that findings of Figure 3 (monotonically declining spreads in each of the three measures of cognition as well as in the index) also hold when the Sell-Buy spread is based on EV valuations rather than CV valuations. Online Appendix Figure A.2 shows that we obtain declining spreads (but not always monotonically so) when we use the spread between CV and EV valuations (both using the Sell condition).

reluctance to exchange when individuals have difficulty valuing annuities has the testable implication that the Sell-Buy Spread falls with cognitive ability. The findings from Figure 3 support this testable implication.

Figure 3 here

We repeat this analysis in a regression framework in Table 3, along with controls for other factors. Column 1 regresses the Spread on age dummies and controls for experimental variations (to be discussed in the next section). The coefficient on age 65+ is positive and significant: on average, older individuals have a 0.44 log point larger absolute difference between their Sell and Buy valuations than the reference age category (age 34 or younger). The difference remains economically large and statistically significant if we compare them to the age 50-64 category. This finding is important for two reasons. First, it addresses the concern that our findings could be driven by younger individuals who might lack interest in decisions related to retirement or be less familiar with Social Security. Yet we find the opposite: younger individuals have a smaller Sell-Buy Spread than do older individuals. Second, the increase in the Spread with age fits with results of Agarwal, Driscoll, Gabaix, and Laibson (2009), who showed that cognitive functioning declines at older ages and may contribute to a decline in the quality of financial decision-making. As we will see below, this relation persists after adding direct controls for cognition. To the extent that the increase in the Spread with age is due to a decline in cognitive functioning, this implies that it is driven by dimensions of cognitive functioning not captured by our measures of cognition.²²

²² Our questions ask respondents to consider the choice between a change in Social Security and a lump sum paid/received at the Social Security claim age (or

Table 3 here

In column 2, we add our three direct measures of cognition. All three—financial literacy, education, and numeracy – are significantly negatively correlated with the Sell-Buy Spread. Each additional correct answer on the financial literacy questions reduces the spread by 0.49 log points. Moving up one education category reduces the spread by 0.19 log points. A one standard deviation increase in the score on the number series questions reduces the spread by 0.25 log points. In column 3, we combine these measures into our cognition index, and here again, we find a strongly significant relation. A one standard deviation increase in cognition corresponds to a 0.64 log point reduction in the Sell-Buy Spread. Column 4 adds additional controls for demographics and preferences including sex, marital status, race and ethnicity, family income, home ownership, self-reported health, having children, risk aversion, return expectations, and political risk, among others.²³ Even with this rich set of additional controls, the coefficient of -0.48 on the cognition index remains highly significant. The results of Table 3 are similar if we use the Sell-Buy Spread based on EV valuations rather than on CV valuations (see Online Appendix Table A.5).

one year from now for those already claiming). Hence, for younger respondents the consequences occur further in the future. As a result, it is possible that younger respondents think of the choice as less consequential and hence exhibit less reluctance to exchange. This is an alternative explanation for the age gradient in the Sell-Buy Spread.

²³ Definitions and summary statistics of control variables are given in Online Appendix Table A.1. The coefficients on the control variables can be found in Column 1 of Online Appendix Table A.4.

If we take the spread between CV-Sell and EV-Sell, which have similar values on average because they are both Sell measures, we continue to find significant negative effects of the cognition index on the spread, though the magnitude of the coefficient drops by half (see Online Appendix Table A.6). This indicates that individuals with higher values of the cognition index give more internally consistent answers even in settings where the “reluctance-to-exchange” motive should not be prominent.²⁴

Thus far, we have shown that many people have implied annuity values that are difficult to reconcile with costless optimizing behavior under any plausible set of parameters. We have also documented a large divergence between the price at which individuals are willing to buy an annuity and the price at which they are willing to sell an annuity, and we showed that this cannot be explained by liquidity constraints or endowment effects. Moreover, buy and sell valuations are negatively correlated, and the size of the sell-buy disparity is highly correlated with cognitive ability, as measured by education, financial literacy, and numeracy. The next section extends our analysis in several additional directions.

5. Robustness and Further Results

²⁴ In Online Appendix Figure A.3 and Table A.7, we show that the negative correlation between Sell and Buy valuations decreases in absolute value for those with higher levels of cognition. In addition, the positive correlation between CV and EV valuations tends to increase with cognition. Hence, cognition also has effects in the expected direction on our correlations. However, because correlations cannot be measured at the individual level (but only for subsamples), these results have less statistical precision.

5.1. Are the Responses Meaningful?

In view of the implausible values in the tails of the distributions, the negative correlation across Sell and Buy valuations, and the large Sell-Buy Spread, one might surmise that a subset of respondents may not have taken the survey seriously (or perhaps did not understand it). Nevertheless, we have already shown that there is information contained in the elicited valuations: respondents provide reasonably consistent responses to similarly constructed offers (e.g., CV-Sell and EV-Sell) despite being asked in different waves two weeks apart. Additionally, our survey contained two sources of variation designed to test whether responses were meaningful. First, we randomized the order of the scenarios to which people were exposed.²⁵ Second, we also randomized the order of the options *within* a question (i.e., whether the lump-sum amount was the first or the second option). If the order of the questions or the order of the options within the questions mattered, this would suggest that individuals had difficulty with the survey itself. We test for sensitivity to “asked in wave 1” and “lump-sum option shown first” in the sub-section below, when we also test for sensitivity to anchoring and starting values. As we shall see, our evidence is consistent with respondents reading and understanding the questions.

5.2. Sensitivity to Anchoring and Starting Values

We also incorporated two sources of experimental variation designed to further test for the consistency of valuations with costless optimization. First, we

²⁵ We first randomized at the individual level whether CV-Sell was asked in the first or second wave of our survey. Then CV-Buy, EV-Sell, and EV-Buy were asked in the other survey wave and their order was randomized at the individual level over each of the six possible orderings.

varied the starting values of the size of the lump sum, randomizing across \$10,000, \$20,000 and \$30,000; below, we refer to this as “log of starting value.” Second, in the CV-Sell case, we varied the order of size of the increment of the monthly benefit. Specifically, we presented the CV-Sell version multiple times to each respondent for $X=\$100$, $X=\$500$, $X=\$SSB$ (i.e., the entire amount of the respondent’s Social Security benefits), and for a random X that was a multiple of \$100 (less than $\min(\$SSB-100, 2000)$, and not equal to 100 or 500). We also randomized whether we asked CV-Sell with the X amounts arranged in increasing or decreasing order. We control for this randomization in the regressions (i.e., whether people were shown values from small-to-large or large-to-small). We refer to this in our tables as “asked after larger version.” These four randomizations (two used to test for meaningfulness of responses and two to test for consistency with costless optimization) were conducted independently.

5.3. Results of these Extensions

If individuals have difficulty valuing annuities, then we would expect to find that people would be sensitive to irrelevant cues such as starting values and whether questions were asked after a larger version. Conversely, the order of the scenarios or the options would not matter for valuation decisions as long as the respondent tried to answer the questions. Our findings on these points are provided in the first column of Table 4, where we regress the log midpoint of our baseline CV-Sell variable (using a \$100 variation in Social Security benefits) against the four variables capturing all sources of randomization.²⁶

²⁶ We do this analysis on the CV-Sell version because only the CV-Sell version asks for different increment sizes of the Social Security amount. This means that

Table 4 here

Several findings stand out. First, there is no evidence that respondents simply elected the first option shown (i.e., there is no effect of “Lump sum shown last”), giving some comfort that the respondents took care in answering the survey questions. Relatedly, it does not matter whether the question was asked in the first or second wave (i.e., “Asked in wave 1” has a small and insignificant coefficient estimate). Second, there is bias with respect to both of the other measures, as would be expected if individuals had difficulty valuing annuities. Specifically, the starting value has a statistically significant coefficient of 0.37. Because both the annuity valuation and the starting value are measured in logs, this means that increasing the first lump-sum amount shown by 10% raised respondents’ valuations by an average of 3.7%. Furthermore, when the CV-Sell question was shown after a CV-Sell question with a larger change in Social Security benefits (so the order was large-to-small), respondents reported a 0.7 log-point higher average valuation of the annuity than if the baseline CV-Sell question was seen first.

Next we re-run this regression on two respondent sub-samples: those in the top quintile of the cognition index (col. 2) and those in the bottom quintile (col. 3). We find the effect of the log of the starting value is insignificant for individuals with higher cognitive abilities, whereas it is substantially more important (the coefficient is 0.87) for those in the bottom quintile of cognition. This suggests that less cognitively capable people are more sensitive to anchoring effects. Interestingly, however, the effect of “asked after larger version” is

we can randomize the order in which the increment sizes are shown only for the CV-Sell version.

significant and similar in magnitude across the cognition quintiles. Moreover, the “asked after larger version” effect is extremely persistent across any cut of the data by measures of cognition. Whether the lump-sum option was shown as the first or second option or whether the question was asked in wave 1 or wave 2 continues to be insignificant for the top and bottom quintile.

In column 4, we return to the full sample and include interactions between the cognition index and each of the four survey manipulations. Results tell a similar story: people are sensitive to starting values and even more so if they have lower cognitive abilities. “Asked after larger version” is highly significant but not mitigated by cognition. “Asked in wave 1” and “lump-sum option shown last” continue to be statistically insignificant.

5.4. Explaining Annuity Valuations

A key reason that life annuities play such an important role in life-cycle economic models is that they provide a cost-effective way to smooth consumption by insuring against longevity risk. Although numerous authors have calculated the welfare gains associated with annuitization, there is conflicting evidence on the extent to which real-world individuals actually value the insurance. Brown (2001) showed that a utility-based measure of annuity valuation was correlated with a binary measure of intended annuitization of asset balances. Büttler and Teppa (2007) documented similar findings in the Swiss system. Nevertheless, such measures explain only a very small fraction of the variation in the annuitization decision. Brown, Kling, Mullainathan, and Wrobel (2008) suggested that the ubiquitous framing of retirement planning in terms of wealth accumulation has conditioned individuals to ignore the insurance aspects of annuities and view them through an investment lens, consistent with individuals resorting to simplified decision-making heuristics in the face of complexity

(Benartzi, Previtro, and Thaler 2011).

To further explore the determinants of annuity valuations, we regress annuity valuations against various determinants of annuity demand in our data. Column 1 of Table 5 regresses the average of CV-Sell and CV-Buy valuations against the actuarial value of the annuity offer presented (which varied by cohort, age at annuitization, and sex; it also assumed a real interest rate of 3%).²⁷ The actuarial value term has a coefficient of 1.02, suggesting that there is approximately a one-for-one correspondence between the annuity's actuarial value and individuals' subjective valuations of the annuity. Column 2 replaces the actuarial value with a theoretical utility-based measure. Following Brown (2001), this is derived from a parameterized life-cycle model with variation coming from age at annuitization, mortality differences by cohort and sex, marital status (which determines whether it is a single or joint optimization), risk aversion, current levels of non-annuitized wealth, current annuitized wealth, and interactions of these variables through the utility-maximizing model. We find that the coefficient on this theoretical, utility-based annuity value in column 2 is not significantly different from zero, though it is significantly different from one.²⁸ In columns 3 and 4, we repeat this analysis using even more control variables, and we obtain

²⁷ We use the CV versions because, unlike the EV versions, these were asked in different waves of the survey. We take the average of CV-Sell and CV-Buy because there is no a priori reason to consider one more credible than the other.

²⁸ In results not detailed here, when we include both the actuarial value and the utility-based measure, we continue to find that the coefficient on the actuarial value is approximately one and that the utility-based measure is insignificant.

very similar results.²⁹

Table 5 here

Overall, we view these results as casting some doubt on the notion that individuals take consumption-smoothing and insurance considerations into account when valuing annuities, although we acknowledge that the lack of predictive power of the theoretical utility-based measure could be related to possible misspecification of the underlying model. One possible interpretation of our findings in Table 5 is that individuals use a simple financial decision rule (e.g., “How long will it take me to break even?”) to obtain a first guess of the annuity value, and then they adjust this value to reflect their reluctance to trade an asset that they have trouble valuing. The adjustment would be upwards for CV-Sell and downwards for CV-Buy. Because these adjustments go in opposite directions, we obtain valuations that on average appear to be following a simple decision rule. We note that R-squared values are very low, at around 0.05 to 0.06. The low explanatory power is consistent with prior studies (e.g., Brown 2008),

²⁹ In Online Appendix Table A.8, we repeat the regressions in columns 1 and 3 of Table 5, but now we use each of our four separate valuation measures (CV-Sell, CV-Buy, EV-Sell and EV-Buy). In seven of the eight additional specifications, we cannot reject the hypothesis that the coefficient on the actuarial value is equal to one, but we can reject at the 10% level or better that it is equal to zero. In unreported results, we also find that the utility-based measure is not significant using these alternative dependent variables. Moreover, in Online Appendix Tables A.9 and A.10, we show that the results of Table 5 are robust to using either the CV-Sell or CV-Buy value (rather than their average) as the dependent variable.

which also found it difficult to account for observed variation in annuitization decisions.

Table 6 reports coefficient estimates on the actuarial value separately by cognition index quintile. Though the coefficients differ non-monotonically across the cognition quintiles, they are never significantly different from 1.³⁰ We do, however, find that the root MSE is monotonically declining with the level of cognition. Recalling that our dependent variable is in logs, these differences are economically meaningful. For example, the root mean squared distance from the regression line declines by 0.16 log-points when one moves from the bottom to the second cognition quintile, and by 0.60 log-points when one moves from the bottom to the top cognition quintile. In other words, decisions made by less cognitively capable individuals are substantially noisier than those made by the more cognitively able.

Table 6 here

5.5. Robustness to Outliers and to Age of the Sample

To verify that possible outliers have no important major effects on the results, we have replicated Figure 3 and Tables 2-6 using only annuity valuation measures winsorized at the 10th and 90th percentiles. Results are very similar (see Online Appendix Figure A.4 and Tables A.11-15). We also examined the

³⁰ We also ran a single regression in which the cognition index was interacted with the actuarial value (including the same controls as in Table 6, the direct effect of the cognition index and the direct effect of actuarial value). The interaction term has a coefficient estimate of -0.02 (s.e.: 0.146), which confirms that the effect of the actuarial value on the annuity valuation does not differ significantly by cognition.

possibility that our results might be driven by a lack of interest in our questions by younger respondents, who may not have given retirement planning much thought. Accordingly, we replicated Figure 3 and Tables 2-6 using only respondents age 50+, and our results for this sample are similar (see Online Appendix Figure A.5 and Tables A.16-20).

6. Discussion and Conclusions

The goal of this study has been to investigate what drives cross-sectional variation in individuals' abilities to value a stream of life annuity payments. We find that, on average, consumers tend to value annuities less when given the opportunity to buy more, but they value them more when given the opportunity to sell annuities in exchange for a lump sum. Because this finding holds even when no *status quo* option is available, this finding is not driven by standard *status quo* or endowment effects. Additionally, we show that liquidity constraints cannot explain this finding. Furthermore, there is considerable heterogeneity across individuals in the difference between the sell and buy valuations.

We conjecture that the discrepancy between sell and buy valuations arises because people are reluctant to enter into an annuity transaction if they have difficulty ascertaining its value. Such reluctance regarding difficult-to-value transactions will generally serve people well, because such transactions can come with a risk of being taken advantage of by a more sophisticated counterparty. One testable implication of our conjecture is that people who are less cognitively able and therefore have more difficulty valuing the annuity, will be more reluctant to trade, resulting in higher selling and lower buying prices. We show that the spread between sell and buy prices indeed falls with our index of cognition, which relies on measures of education, financial literacy, and numeracy. A second testable

implication is that heterogeneity in cognition will lead to a negative correlation between selling and buying prices. We indeed observe this negative correlation. A further indication that people have trouble valuing annuities comes from our finding that people are sensitive to framing and starting values and that the sensitivity to starting values decreases in the cognition index. Moreover, the cross-sectional variation in subjective annuity valuations is correlated with the relatively simple-to-calculate actuarial value, but not with a more cognitively challenging utility-based value. Finally, decisions made by less cognitively adept individuals are substantially noisier than those of the more cognitively able. Our conjectured mechanism – heterogeneity in cognitive abilities combined with a reluctance to exchange when one has trouble valuing an annuity – is consistent with all of our findings, and we have shown that many alternative explanations, such as transactions cost, endowment or *status quo* effects, or liquidity constraints, cannot explain all of our findings. Of course, we cannot rule out the existence of yet some other mechanism that might be consistent with the results.

Our findings raise questions about the extent to which consumers are able to make utility-maximizing choices when confronted with a decision about whether to buy longevity protection. While our results do not speak directly to why average annuity values are so low (and thus do not illuminate the “annuity puzzle”), they do indicate that one should not necessarily infer from low annuity demand that individuals’ experienced utility is maximized at low levels of annuitization. For example, the fact that so few people annuitize their defined contribution pension balances when given the opportunity to do so should not be interpreted as conclusive revealed preference evidence that they do not value longevity protection. Of course, even if an individual places similar values on an annuity when buying and selling, this does not imply that he correctly assesses

the value of the annuity to him; consistency in valuation across buying and selling is a necessary but not a sufficient condition for the correct valuation of annuities.

In addition to advancing our intellectual understanding, our results have considerable policy relevance. For example, in 2014 the UK eliminated its mandatory annuitization requirement, thus leaving the decision of whether or not to annuitize retirement account balances in the hands of individual retirees (Donaldson and Hutton 2014). By contrast, the Singaporean government now requires retirees to purchase life annuities sufficient to cover subsistence needs (Fong, Mitchell, and Koh 2011). U.S. policymakers have expressed interest in encouraging annuitization in 401(k) and other defined contribution plans. There is also an emerging debate in the U.S. about whether to encourage or discourage a particular form of “de-risking” of corporate defined benefit pension plans, where retirees are offered a lump sum in lieu of lifelong pension benefits. In these and other instances, our results suggest that many individuals face cognitive constraints in making appropriate judgments about annuitization. Accordingly, policymakers would do well to recognize the substantial heterogeneity in people’s capabilities to make important financial decisions that are in their best interest.

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Figure 1: Cumulative Distribution Functions of CV-Sell and CV-Buy Annuity Valuations

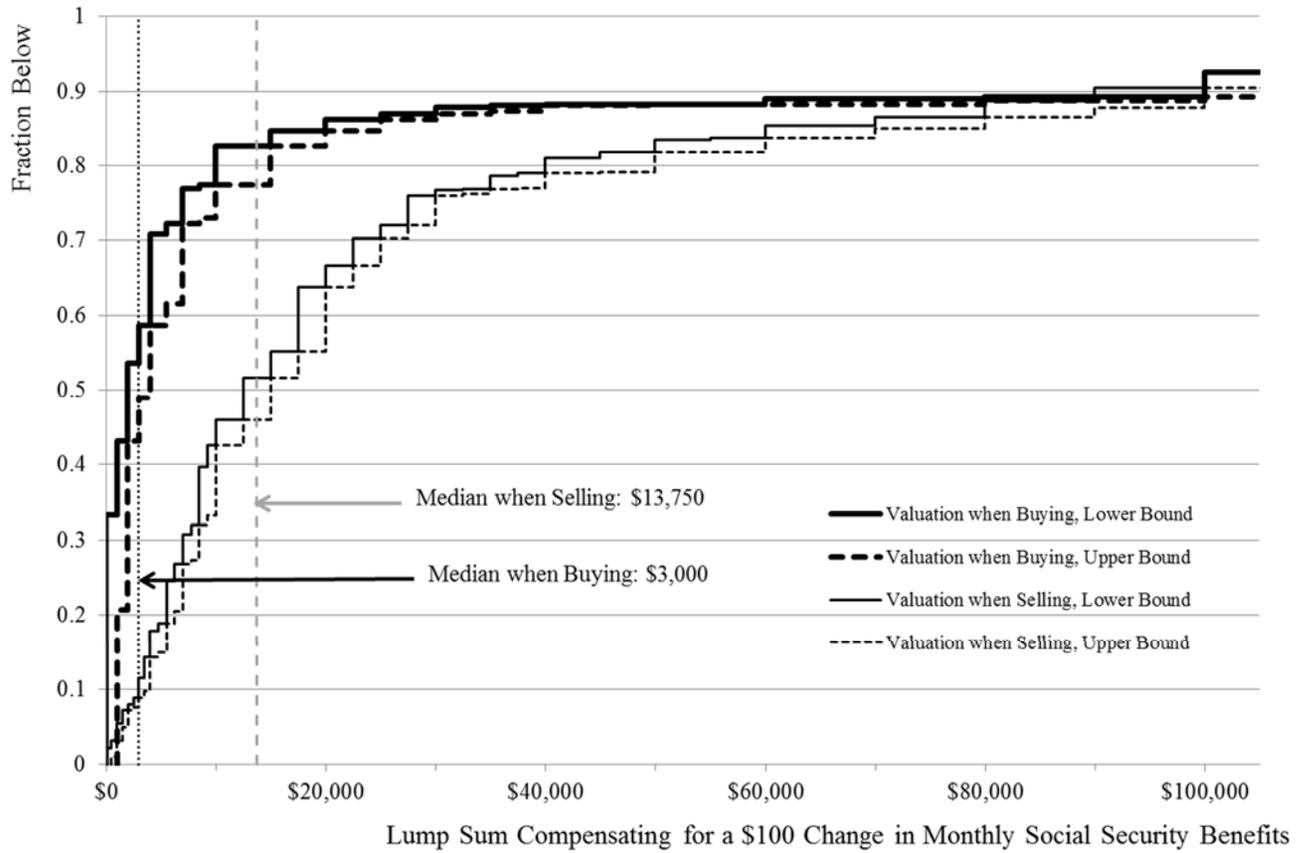


Figure 2: Cumulative Distribution Functions of EV-Sell and EV-Buy Annuity Valuations

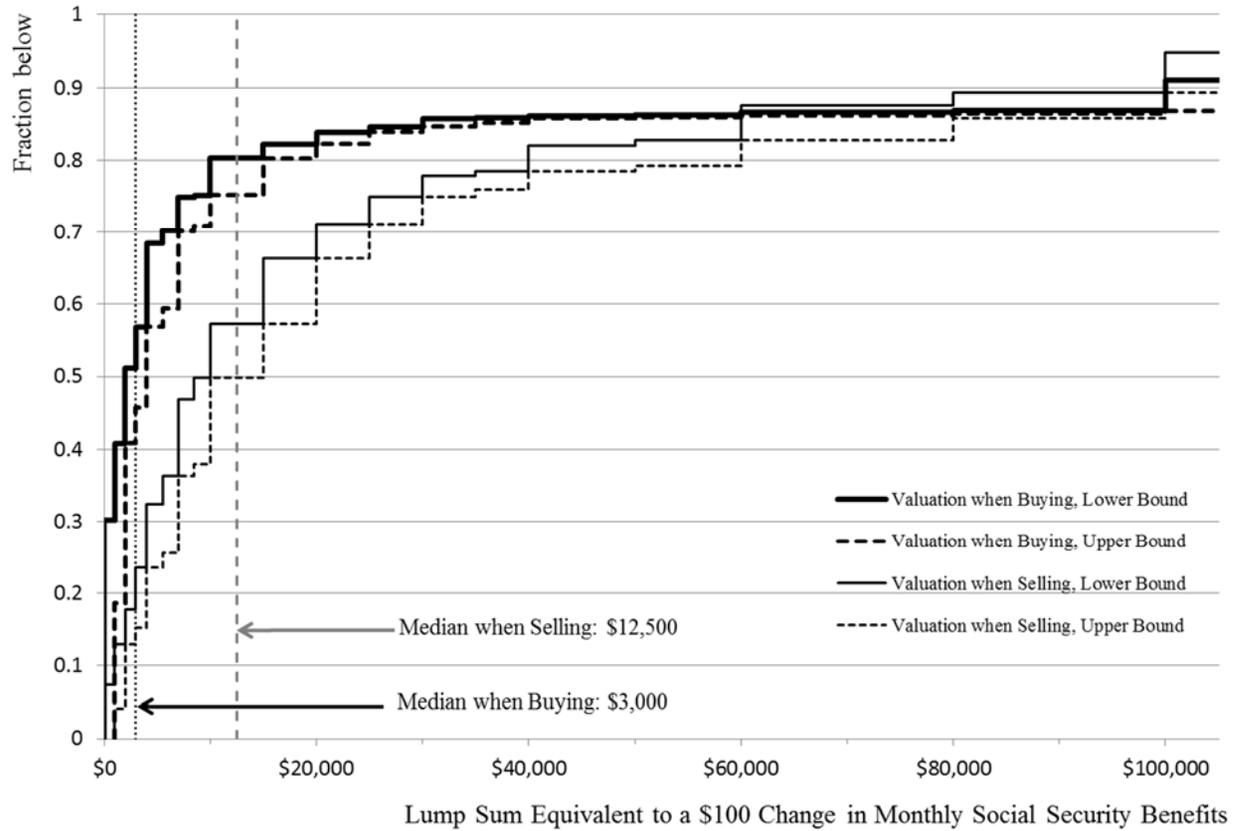
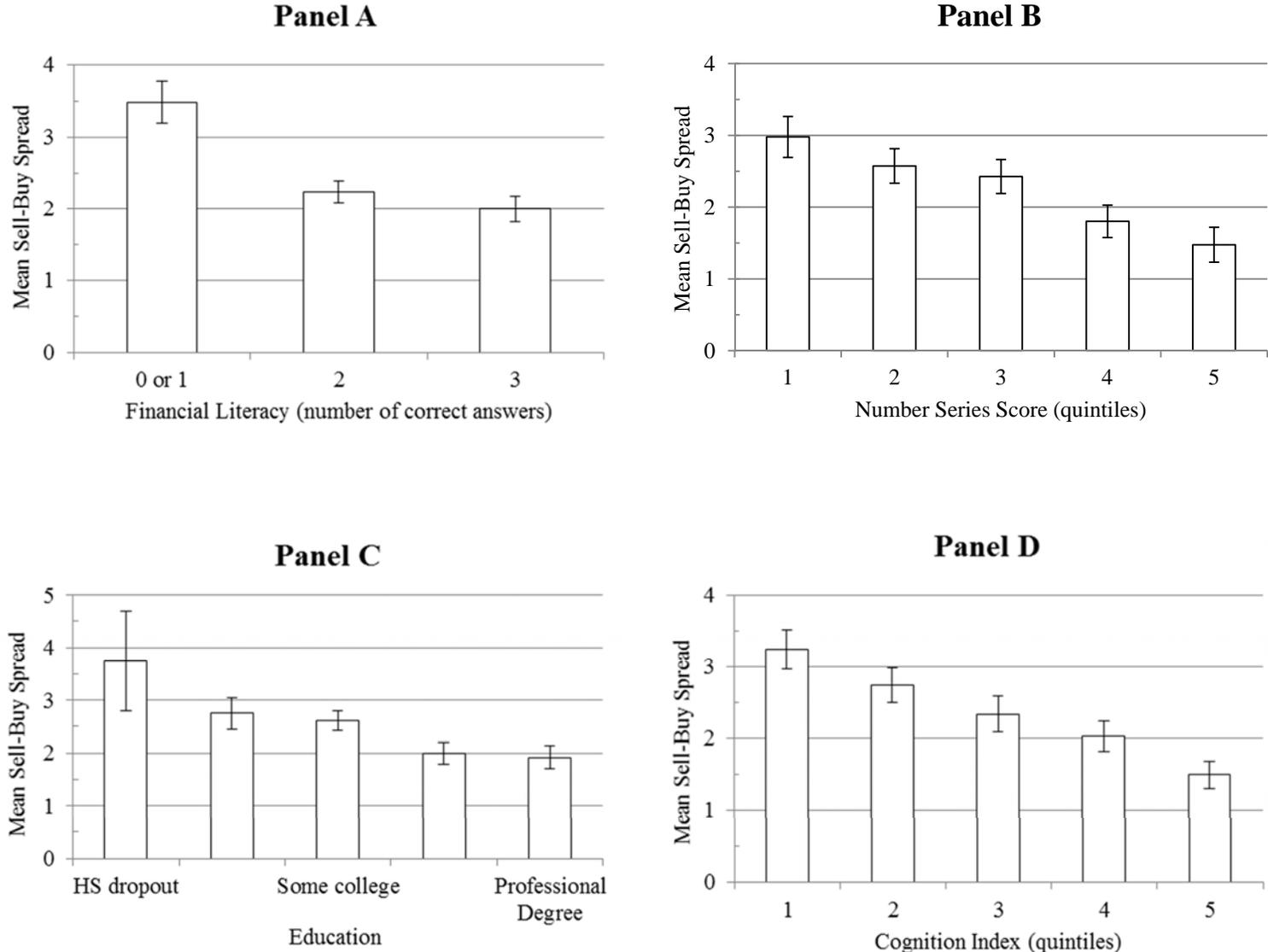


Figure 3: Sell-Buy Spread by Measures of Decision-Making Ability



Note: The whiskers represent 95% confidence intervals. The Sell-Buy Spread is measured as the absolute value of the difference between the log CV-Sell valuation and the log CV-Buy valuation of a \$100 change in monthly Social Security benefits. For the Financial Literacy measure, we grouped those with no correct answers with those with one correct answer because there are very few observations (4%) with no correct answers.

Table 1: Characteristics of the ALP Sample

	(1)	(2)	(3)
	ALP Sample Mean	CPS Mean	Difference ALP-CPS
Age	51.4	46.2	5.19***
Age: 18-34	0.16	0.31	-0.15***
Age: 35-49	0.25	0.27	-0.02
Age: 50-64	0.41	0.25	0.16***
Age: 65+	0.18	0.17	0.01
Female	0.58	0.51	0.07***
Married	0.60	0.54	0.07***
Race/Ethnicity			
Non-Hispanic White	0.80	0.68	0.12***
Non-Hispanic Black	0.08	0.12	-0.04***
Hispanic	0.09	0.14	-0.05***
Other Race/Ethnicity	0.03	0.07	-0.03***
Education			
High School Dropout	0.02	0.13	-0.11***
High School	0.16	0.30	-0.14***
Some College	0.37	0.28	0.09***
Bachelor's Degree	0.25	0.18	0.07***
Professional Degree	0.19	0.10	0.10***
Ln Family Income	10.89	10.77	0.13***
Family Income: Below 25k	0.18	0.24	-0.07***
Family Income: 25k-50k	0.27	0.24	0.04***
Family Income: 50k-75k	0.21	0.18	0.03***
Family Income: 75k-100k	0.13	0.12	0.01**
Family Income: Above 100k	0.21	0.23	-0.02*
Household size	2.68	3.00	-0.33***
Household size of one	0.22	0.14	0.08***
Household size of two	0.36	0.33	0.03***
Household size of three	0.15	0.19	-0.04***
Household size of four +	0.27	0.33	-0.06***
Region			
Northeast	0.17	0.18	-0.02*
Midwest	0.24	0.22	0.02**
South	0.35	0.37	-0.01
West	0.24	0.23	0.01
Observations	2,112	146,785	

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%. In both the ALP and the CPS the sample is restricted to those aged 18 and older. The ALP sample was collected between June and August of 2011. The CPS data are from March 2011 and use CPS person weights; the ALP data are unweighted.

Table 2: Correlations between Annuity Valuation Measures (All in Natural Logs)

Pairwise correlations	CV-Sell	EV-Sell	CV-Buy	EV-Buy
CV-Sell	1			
EV-Sell	0.31***	1		
CV-Buy	-0.11***	-0.17***	1	
EV-Buy	-0.11***	-0.15***	0.72***	1

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%. Each entry gives the pairwise correlation between the variable listed in the column and in the row. All four variables are a measures of the valuation that an individual places on \$100 change in monthly Social Security benefits. See the text for exact definitions. All measures are expressed in logs of the midpoint between the upper and lower bounds. To correct for correlations induced by common experimental manipulations (such as the starting value) across the four variables, we regress each variable on the relevant experimental manipulations and take the residual. The correlations between the resulting residuals are shown in the Table; uncorrected pairwise correlations are very similar and provided in Online Appendix Table A.3.

Table 3: Explaining the Sell-Buy Spread

Explanatory Variables	Dependent Variable: Absolute Value of Difference between Log CV-Sell and Log CV-Buy			
	(1)	(2)	(3)	(4)
Age 35 to 49	-0.10 (0.13)	0.08 (0.13)	0.09 (0.13)	0.22 (0.13)
Age 50 to 64	0.05 (0.12)	0.33*** (0.12)	0.34*** (0.12)	0.42*** (0.13)
Age 65 and older	0.44*** (0.14)	0.66*** (0.14)	0.68*** (0.14)	0.66*** (0.16)
Cognition index, standardized			-0.59*** (0.04)	-0.41*** (0.05)
Financial literacy index, 0-3 scale		-0.32*** (0.06)		
Education index, 1-5 scale		-0.24*** (0.04)		
Number series score, standardized		-0.31*** (0.05)		
Controls for demographics and preferences	No	No	No	Yes
Controls for experimental variation	Yes	Yes	Yes	Yes
Adjusted R ²	0.0279	0.1230	0.1233	0.1681
Number of observations	2065	2065	2065	2065
Mean of dependent variable	2.58	2.58	2.58	2.58
Standard deviation of dependent variable	1.85	1.85	1.85	1.85

Notes: Robust standard errors between parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%. Each column contains an OLS regression of the Sell-Buy Spread (absolute value of the difference between log CV-Sell and log CV-Buy) on the explanatory variables listed in the rows. CV-Sell is the lump-sum amount given to the individual that would exactly compensate the individual for a \$100 decrease in monthly Social Security benefits. CV-Buy is the lump-sum amount the individual is just willing to pay for a \$100 increase in monthly Social Security benefits. All regressions also include controls for missing values of explanatory variables and controls for experimental manipulations, namely: log of starting value, asked after larger version, asked in wave 1, lump-sum option shown last. The financial literacy index is equal to the number of correct answers to three financial literacy questions (mean: 2.12 s.d.: 0.80). The education index equals 1 for high school dropouts, 2 for high school graduates, 3 for some college, 4 for bachelor's degree, and 5 for professional degree (mean: 3.42 s.d.: 1.05). The number series score is a standardized measure of performance on a number of questions that involve completing number series. The cognition index is the first principal component of the financial literacy index, the education index, and the number series score. The coefficients on the demographic and preference variables of the regression in column 4 are shown in Online Appendix Table A.4 column 1.

Table 4: Effects of Randomizations and Interactions with the Cognition Index

Explanatory Variables	(1)	(2)	(3)	(4)
	Dependent Variable: Log CV-Sell			
	Entire sample	Top quintile of cognition index	Bottom quintile of cognition index	Entire sample
Log of starting value	0.37*** (0.07)	0.17 (0.13)	0.92*** (0.21)	0.39*** (0.07)
Asked after larger version	0.70*** (0.07)	0.70*** (0.12)	0.77*** (0.19)	0.69*** (0.07)
Asked in wave 1	0.04 (0.07)	0.01 (0.12)	0.38** (0.19)	0.05 (0.07)
Lump-sum option shown last	0.09 (0.07)	0.01 (0.12)	-0.03 (0.19)	0.08 (0.07)
Log of starting value × Cognition index				-0.20** (0.08)
Asked after larger version × Cognition index				-0.09 (0.07)
Asked in wave 1 × Cognition index				-0.03 (0.07)
Lump-sum option shown last × Cognition index				0.03 (0.07)
Cognition index				-0.17*** (0.04)
Adjusted R ²	0.0600	0.0832	0.0827	0.0737
N	2,090	385	412	2,090
Mean of dependent variable	10.02	9.82	10.27	10.02
Standard deviation of dependent variable	1.56	1.19	1.96	1.56

Notes: Robust standard errors in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%. Each column contains an OLS regression of the baseline CV-Sell measure on the explanatory variables listed in the rows. The baseline CV-Sell measure is the lump-sum amount given to the individual that would exactly compensate the individual for a \$100 decrease in monthly Social Security benefits. CV-Sell is expressed in logs of the midpoint between the upper and lower bounds. The starting value for the annuity valuation was randomized at \$10,000, \$20,000, or \$30,000. "Asked after larger version" equals one if the baseline CV-Sell measure was asked after a CV-Sell question in which Social Security benefits were varied by more than \$100. Whether this occurred was randomized. "Asked in wave 1" is a dummy variable that equals one if the CV-Sell question was asked in the first wave, and "Lump sum option shown last" is a dummy variable that equals one if the option involving the lump-sum amount was shown after the alternative option. Both dummy variables were randomized. The cognition index is the first principal component of the financial literacy index, the education index, and the number series score. All variables interacted with the cognition index are demeaned so that the coefficient on the cognition index can be interpreted as the effect of the cognition literacy index when the interaction variables are equal to their sample means.

Table 5: Explaining Annuity Valuations

Explanatory Variables	Dependent Variable: Mean of Log CV-Sell and Log CV-Buy			
	(1)	(2)	(3)	(4)
Log actuarial value	1.02*** (0.25)		0.84*** (0.26)	
Log theoretical utility-based annuity value		0.04 (0.04)		0.18 (0.13)
Age	-0.05*** (0.01)	-0.02 (0.01)	-0.04** (0.02)	-0.01 (0.01)
Age squared/100	0.06*** (0.02)	0.02 (0.01)	0.04*** (0.02)	0.01 (0.01)
Female	-0.08 (0.06)	0.01 (0.05)	-0.03 (0.06)	0.01 (0.06)
Married	0.05 (0.06)	0.04 (0.06)	0.08 (0.06)	0.13* (0.07)
Black	0.05 (0.12)	0.08 (0.12)	0.03 (0.12)	0.04 (0.12)
Hispanic	0.34*** (0.11)	0.36*** (0.11)	0.32*** (0.12)	0.32*** (0.12)
Other	-0.08 (0.13)	-0.08 (0.13)	-0.08 (0.12)	-0.09 (0.13)
Education index, 1-5 scale			-0.03 (0.03)	-0.03 (0.03)
Log family income			0.03 (0.04)	0.02 (0.04)
Owns an annuity			-0.07 (0.06)	-0.04 (0.06)
Owns home			-0.16* (0.08)	-0.16** (0.08)
Log financial wealth			0.01 (0.02)	-0.01 (0.03)
Self-reported health index, 1-5 scale			-0.03 (0.03)	-0.03 (0.03)
Ever had kids			-0.03 (0.06)	-0.04 (0.06)
Risk aversion (standardized)			0.02 (0.03)	0.02 (0.03)
Precaution (standardized)			-0.07** (0.03)	-0.07** (0.03)
Expects returns greater than 3% p.a.			0.10* (0.06)	0.10* (0.06)
Confident SS will pay promised benefits, 1-4 scale			0.12*** (0.03)	0.14*** (0.03)
Controls for experimental variation	Yes	Yes	Yes	Yes
Adjusted R ²	0.0543	0.0473	0.0649	0.0607
Number of observations	2065	2065	2065	2065
Mean of dependent variable	9.18	9.18	9.18	9.18
Standard deviation of dependent variable	1.22	1.22	1.22	1.22

Notes: Robust standard errors between parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%. Each column contains an OLS regression of annuity valuation (mean of log CV-Sell and log CV-Buy) on the explanatory variables listed in the rows. CV-Sell is the lump-sum amount given to the individual that would exactly compensate the individual for a \$100 decrease in monthly Social Security benefits. CV-Buy is the lump-sum amount the individual is just willing to pay for a \$100 increase in monthly Social Security benefits. All regressions also include controls for missing values of explanatory variables and controls for experimental variation, namely: log of starting value, asked after larger version, asked in wave 1, lump-sum option shown last. To calculate the theoretical utility-based annuity value, we solve the lifecycle dynamic programming problem for a household that matches the respondent on age, gender, marital status, spousal age (if married), start date of the annuity, financial wealth, existing annuity wealth, and coefficient of risk aversion, assuming a real discount rate of three percent per year. We solve this lifecycle dynamic programming problem twice: once for the CV-Sell equivalent wealth and once for the CV-Buy equivalent wealth. We take the log of both amounts and average them. The education index equals 1 for high school dropouts, 2 for high school graduates, 3 for some college, 4 for bachelor's degree, and 5 for professional degree. Summary statistics and sources for the explanatory variables are provided in Online Appendix Table A.1.

Table 6: Predictive Power of Actuarial Value by Quintile of the Cognition Index

	(1)	(2)	(3)	(4)	(5)
Dependent Variable: Mean of Log CV-Sell and Log CV-Buy	Coefficient on log actuarial value	p-value on coefficient=1	Root MSE	Adjusted R ²	N
Sample split by quintiles of the cognition index					
1. Bottom quintile	0.46 (0.77)	0.483	1.488	0.0922	404
2. Second quintile	0.76 (0.59)	0.686	1.246	0.0259	451
3. Third quintile	1.24** (0.49)	0.618	1.163	0.0204	392
4. Fourth quintile	0.77 (0.50)	0.650	1.034	0.0498	433
5. Fifth quintile	1.49*** (0.51)	0.340	0.889	0.0677	385

Notes: Robust standard errors in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%. Here we estimate specification 1 of Table 5 by subsample. Each row contains an OLS regression of the log annuity valuation (mean of CV-Sell and CV-Buy) on the log actuarial value and additional controls. Additional controls are those in specification 1 of Table 5. The cognition index is the first principal component of the financial literacy index, the education index, and the number series score.