Financial Software Use and Retirement Savings

Qianwen Bi,[a] Michael Finke,[b] and Sandra J. Huston[c]

Financial software offers an appealing substitute for an investment in complex financial knowledge to help individuals make better financial decisions. Little is known, however, about which consumers use financial software and whether the use of financial software results in improved financial outcomes. Using data from the 2008 National Longitudinal Survey of Youth 1979 cohort (NLSY79), we find that respondents with greater human capital and financial resources are more likely to use financial software. The use of a financial software program to calculate retirement needs is a stronger independent predictor of accumulated retirement wealth than calculating retirement needs without a computer aid and is surpassed only by cognitive ability as an independent predictor of retirement savings. Results suggest that financial software is used primarily by those that have greater endowed and attained human capital and may be a complement to (rather than a substitute for) financial literacy.

Keywords: financial software, computer program, retirement preparation, retirement savings

Workers face increasingly complex financial decisions when choosing financial products and services to fund retirement savings (Parrish & Servon, 2006). This complexity presents consumers, who often possess low financial knowledge and limited numeracy skills, with the prospect of investing in ever greater financial knowledge to align financial decisions with saving preferences (Mandell & Klein, 2009; Willis, 2008). Computer programs, including online calculators and planning software, can help consumers make better financial decisions by performing complex calculations that are beyond the capabilities of most workers. These planning tools can significantly increase an individuals' retirement well-being by improving their ability to recognize trade-offs and calculate optimal savings strategies.

Little is known about which consumers use a computer program to help make complex retirement planning decisions. If computational complexity is a barrier to retirement planning, the availability of a tool, which simplifies the process, may be particularly attractive to consumers who are less likely to have a professional financial adviser. If, however, more knowledgeable consumers seek out computer aids to reduce the time or psychic costs of planning for retirement, the benefits of financial software may accrue primarily to those with greater financial knowledge and access to other planning resources. Little is also known about how the use of financial planning software is related to the amount saved within a retirement account or whether financial planning software may be even more effective when combined with other financial planning aids.

Over the past 20 years, there has been a significant shift from defined benefit plans to defined contribution plans and personal savings vehicles (Ibbotson, Milevsky, Chen, & Zhu, 2007). This shift increases individual responsibility for funding retirement income from savings. The average American household appears to be saving too little to replace preretirement consumption after retirement (Dugas, 2002). This undersaving is recognized by the 73% of retirees who wish they had saved more (Hurd & Zissimopoulos, 2003) and the minority of American household heads who feel confident about retirement saving adequacy (Lusardi & Mitchell, 2011). In the aftermath of the Great Recession, individuals are not only cutting back their spending and borrowing but also seeking to improve their financial literacy (O'Neill & Xiao, 2012) and to spend time educating themselves about financial planning (if younger) or seeking the services of a financial advisor (if older; Zick, Mayer, & Kara, 2012).

[a]*Assistant Professor, Finance and Economic Department, Woodbury Business School, Utah Valley University, MS 280, 800 West University Parkway Orem, Utah 84058. E-mail: Rachel.Bi@uvu.edu*
[b]*Dean and Chief Academic Officer, The American College, 270 S. Bryn Mawr Ave., Bryn Mawr, PA 19010. E-mail: Michael.Finke@TheAmericanCollege.edu*
[c]*Associate Professor and Director, Personal Finance Program, Texas Tech University, Department of Personal Financial Planning, Box 41210, Lubbock, TX 79409. E-mail: Sandra.Huston@ttu.edu*

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Even though households are willing to save more, most workers have no idea how much they need to save for retirement (Goda, Manchester, & Sojourner, 2014). This is not surprising because most households have difficulty calculating the growth of assets over time (Stango & Zinman, 2009), and few are aware of the amount of money needed to create an annuitized income at retirement (Brown, Kapteyn, Luttmer, & Mitchell, 2011). Consumers can use technology to bridge gaps in knowledge and mathematical skills. Early adopters of technology, however, appear to be those whose decision-making capability is greater than the average consumer. Consistent with the theory of diffusion of innovation, Lee and Lee (2000) find that more educated, more affluent, and younger consumers are the first to adopt electronic banking technology. Younger investors also intend to adopt online trading more (Li, Lee, & Cude, 2002). The primary benefit of using electronic financial technologies appears to be reduced search costs, leading to higher adoption rates among those with either high time costs or increased familiarity with technology (Anguelov, Hilgert, & Hogarth, 2004). Bartel and Sicherman (1998) find that more educated individuals may need to exert less effort to respond to technological change if their general skills allow them to learn the new technology more efficiently.

This study adds to the existing literature on computer-aided retirement planning by investigating (a) which consumers will use the technology and (b) whether those who use the technology save more for retirement. Results provide important insight into the effectiveness of computer aids as a retirement planning tool and into the limitations of complex technology as a means of increasing savings rates among less educated consumers.

Literature Review, Conceptual Framework, and Hypotheses

User Characteristics and Use of Computer Programs

Life cycle theory plays an important role in optimal retirement saving calculation (Hanna, Fan, & Chang, 1995). According to the standard life cycle model, individuals try to smooth consumption across periods (Modigliani & Brumberg, 1954). Lusardi, Michaud, and Mitchell (2013) first build an illustrative two-period model to reveal the relationship between wealth and income. They assume that the individual only receives income y in the first period, w denotes the wealth in the second period, R denotes the return factor on saving $\frac{w}{R}$, π denotes the monetary cost of raising R, β denotes the discount factor. Therefore, the maximizing utility function is as follows:

$$\max_{w,R} u\left(y - \pi R - \frac{w}{R}\right) + \beta u(w)$$

Assuming a power utility function is $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$, the optimal wealth equation is obtained from first order conditions as follows:

$$w^{\frac{1}{2\sigma}-1}(y - 2\sqrt{\pi w}) = \left(\frac{\sqrt{\pi}}{\beta}\right)^{\frac{1}{\sigma}}$$

Lusardi et al. (2013) conclude that the intuition behind this equation is the complementary relationship between an individual's need to save and his or her willingness to invest in raising R. In other words, the larger gap between the first- and second-year consumption, the bigger need for the individual to save, and the greater his or her willingness is to invest in raising R.

According to Lusardi et al. (2013), there are two types of technologies one can use in raising R. The first is basic technology like using checking and saving accounts, which yields a certain low-return $\bar{R}$. The second is sophisticated technology, which yields a stochastic high-return r. We assume that a computer software program can serve as this technology. The stochastic return is dependent on how much overall financial intelligence can be enhanced at the end of t. The stochastic return function is as follows:

$$\tilde{R}(f_{t+1}) = \bar{R} + r(f_{t+1}) + \sigma_{\varepsilon}\varepsilon_{t+1}$$

where σ_{ε} is the standard deviation of returns on the sophisticated technology and ε_{t+1} is the error term.

It is possible that people who have higher financial literacy are more likely to see a higher return from using sophisticated technology to help manage their finances. Let $\pi(i_t)$ denote the cost of enhancing financial intelligence, c_d denotes the purchase cost of obtaining the sophisticated technology, k_t denotes the decision dummy variable of whether an individual decides to engage the sophisticated technology. Then the asset at period $t + 1$ is as follows:

$$a_{t+1} = \tilde{R}_k[f_{t+1}]\left[a_t + y_t - c_t - \pi(i_t) - c_d k_t\right]$$

where $\tilde{R}_k(f_{t+1}) = (1 - k_t)\,\bar{R} + k_t\tilde{R}\,(f_t)$. If an individual decides to make an investment in purchasing sophisticated computer software, $k_t = 1$, then the stochastic return is the sum of the basic technology and the sophisticated technology. If an individual does not participate in sophisticated technology, $k_t = 0$, then the total return is only from the basic technology. The asset equation shows that the end of period asset accumulation is influenced by the overall return on technology investment. Scholz, Seshadri, and Khitatrakun (2006) define a strictly concave utility function in consumption as $n_t u\left(\frac{c_t}{n_t}\right)$, where n_t is an equivalence scale capturing known changes in demographics. Using Bellman equations, the value function of the decision on adopting technology for different education groups at each point of an individual's life is as follows:

$$\mathrm{V}_d(S_t) = \max_{c_t, i_t, k_t}\left[n_{e,t}u\left(\frac{c_t}{n_{e,t}}\right) + \beta\int_{\varepsilon}\int_{\varphi_y} V(S_{t+1})\,dF_e(\varphi_y)\,dF(\varepsilon)\right]$$

The function mentioned earlier indicates that the value of making an investment in sophisticated technology depends on the current demographic status and education level of the household plus the discounted future possible return from adopting the technology.

The utility function earlier tells us that there is an optimal amount of savings that maximizes an individual's lifetime utility. Without using a computer program, consumers could save too much or too little, causing a loss in lifetime utility. By using a computer program, consumers can get closer to the optimal savings amount, which means they could obtain a more realistic estimate of the level of savings that would maximize the expected lifetime utility. People who have more financial resources benefit more from making tax efficient financial decisions in tax-sheltered savings accounts. From the ending asset equation, we see that costs of using sophisticated technology include both time costs and money. A consumer needs time to input information into the software and to use the technology that increases his or her financial decision-making ability. Money costs are simply the dollar amount of purchasing the technology (if there is a cost), or the expenses of participating in a defined contribution plan that offers retirement technology. It is worth mentioning that although the time cost for higher earners might be higher, more educated people may be able to improve their financial decision-making ability more efficiently when using technology that requires financial knowledge to interpret outputs (Lusardi et al., 2013). Based on the discussion earlier, we propose the following:

H1: People who have more financial resources and more education are more likely to adopt sophisticated financial technology such as a computer program.

Computer-Aided Planning and Retirement Savings

There are three primary reasons why using computer software may have an impact on retirement savings. First, life cycle theory predicts that individuals make savings choices based on the total resources available to them over their lifespan. However, life cycle theory does not take persistent psychological biases and cognitive constraints into account.

For example, subjects asked to visualize a future behavior were more likely to subsequently engage in this behavior, suggesting that the process of imagining a positive future behavior increases the likelihood that it will occur (Libby, Shaeffer, Eibach, & Slemmer, 2007). Lacking belief or imagination, people may fail to envision the future consequences of decisions (Parfit, 1971; Schelling, 1984). Bartels and Rips (2010) find that perceived connectedness with future self affects choices on temporal discounting tasks. The interaction with a vivid version of one's future self encourages individuals to place a greater weight on retirement, leading to increased saving in both short- and long-term decision-making tasks (Hershfield et al., 2011). Estimating retirement needs through the use of a computer program forces a worker to visualize a retirement lifestyle, and this process of estimating the relation between saving today and the future version of oneself with insufficient money to live comfortably may motivate an individual to save more in the present.

Second, Banks and Oldfield (2007) find that respondents with higher numerical ability have greater retirement savings even when nonnumerical cognitive ability and education are controlled. Using computer programs may help households save for retirement by serving as a substitute for a lack of numerical ability or may enhance the effectiveness of retirement decisions among those with greater numerical skills. Stango and Zinman (2009) find that individual investors have a difficult time comparing dollar amounts across time periods, especially those that are female, non-White, or have relatively less formal education.

Third, researchers find that retirement saving decisions require substantial financial literacy (Lusardi & Mitchell, 2009, 2011). Financial literacy is a specific set of human capital, which allows an individual to understand and effectively apply personal finance-related information to increase expected lifetime utility from consumption (Huston, 2010). As a result, level of financial knowledge does influence a household's financial behavior (Robb & Woodyard, 2011). For instance, workplace financial education programs including online retirement planning assistance are found to improve employees' financial wellness and saving ratios (Prawitz & Cohart, 2014). Online financial education programs targeting special groups (e.g., chronically ill rural women) are also found to increase financial literacy (Haynes, Haynes, & Weinert, 2011).

Information and knowledge provided by computer software may help households save for retirement by enhancing their financial behaviors. Braunsten and Welch (2002) find that a workplace financial education program that provides web-based planning software led to improvements in financial behaviors including budgeting, managing debt, saving, insurance, and the creation of a will. There is also evidence that the use of computer software can improve the quality of decisions in various decision-making domains that involve complex trade-offs. For example, the use of a computer software program improves medical decision-making ability by providing patients with bar graphs that simplify probabilities and outcomes of therapeutic options (Ravdin et al., 2001).

In summary, using computer programs may help consumers estimate their optimal retirement saving level or allow them to see their future selves vividly through images, not only "photo images" but also "number images." Based on the effect of households' psychological, cognitive, numeracy, and financial literacy previously discussed, we propose the following hypothesis:

H2: People who use computer programs to plan for retirement are likely to have a higher level of retirement savings.

Method

Data

To examine the relation between computer software use when planning for retirement and retirement wealth, we use data from the 2008 National Longitudinal Survey of Youth, 1979 (NLSY79). The NLSY79 is a nationally representative sample of 12,686 individuals born between 1957 and 1964. The survey includes detailed information on education, retirement preparation, assets and income, and familial and demographic characteristics. At the time of the first interview, the sample was composed of respondents who were between 14 and 21 years old. The respondents were 43–52 years old at the time of the 2008 interviews. The original sample includes 6,111 young adults, 5,295 Hispanic or Latino, Black, and poor non-Hispanic or non-Black, and 1,280 military men and women.

The NLSY79 is well-suited for our research questions for several reasons. First, the data contain a set of five retirement preparation questions including the use of a computer program to help plan for retirement, which makes it possible for us to isolate the effect of using a computer program on retirement wealth. It also allows us to compare the effect of using other resources to using only a computer program. Second, respondents are well into the peak savings years of their life cycle. Third, the data also include detailed demographic information of respondents.

Because this study is focused on consumer computer program use, data were censored to those who answered a question from a retirement module added to the 2008 NLSY79 about whether they use a computer program to help plan for retirement. The 6,487 valid responses represent our sample for this study, or 84% of the total 7,757 surveys completed in the 2008 sample year.

Data Analyses

To answer the research questions, we conduct two regression models in this study. The model to identify computer program users when planning for retirement is Equation 1:

$$\textit{computer program use} = f\,(\textit{cognitive ability, demographic characteristics, other factors}) \quad (1)$$

The dependent variable for this model is a dummy variable indicating whether the individual has reported using a computer program to help plan for retirement. Variable proportions and means are reported in Table 1. Cognitive ability (IQ) was represented by Armed Forces Qualification Test (AFQT) percentile score. We standardized the AFQT with a mean of 100 and standard deviation of 15 to make it comparable to an IQ score. Demographic characteristics include

TABLE 1. Measurements of All Variables

Variables	Measurement	*n*
Calculated retirement income needs	1 if the respondent calculated retirement income needed, 0 otherwise	1,582
Computer program use	1 if the respondent used computer program to help plan for retirement, 0 otherwise	832
Financial planner use	1 if the respondent consulted a financial planner, 0 otherwise	1,118
Attend meetings	1 if the respondent attended meetings on retirement planning, 0 otherwise	1,011
None	1 if the respondent did not use computer program to help plan for retirement, did not consult a financial planner, did not attend meetings on retirement planning, did not calculate retirement income needed, 0 otherwise	4,042
Calculated retirement income needs only	1 if the respondent calculated retirement income needed but not used computer program or consulted a financial planner or attended meetings on retirement planning, 0 otherwise	499
Computer program use and calculated retirement income needs	1 if the respondent used computer program to help plan for retirement and calculated retirement income needed but not consulted a financial planner or attended meetings on retirement planning, 0 otherwise	183
Computer program use and not calculated retirement income needs	1 if the respondent used computer program to help plan for retirement but not calculated retirement income needed or consulted a financial planner or attended meetings on retirement planning, 0 otherwise	122
Financial planner use and calculated retirement income needs	1 if the respondent consulted a financial planner and calculated retirement income needed but not used computer program to help plan for retirement or attended meetings on retirement planning, 0 otherwise	226
Financial planner use and not calculated retirement income needs	1 if the respondent consulted a financial planner but not calculated retirement income needed or used computer program to help plan for retirement or attended meetings on retirement planning, 0 otherwise	233
Attend meetings and calculated retirement income needs	1 if the respondent attended meetings on retirement planning and calculated retirement income needed but not used computer program to help plan for retirement or consulted a financial planner, 0 otherwise	111
Attend meetings and not calculated retirement income needs	1 if the respondent attended meetings on retirement planning but not calculated retirement income needed or used computer program to help plan for retirement or consulted a financial planner, 0 otherwise	277
All aids and calculated retirement income needs	1 if the respondent used computer program to help plan for retirement, consulted a financial planner, attended meetings on retirement planning, and calculated retirement income needed, 0 otherwise	195
All aids and not calculated retirement income needs	1 if the respondent used computer program to help plan for retirement, consulted a financial planner, attended meetings on retirement planning but not calculated retirement income needed, 0 otherwise	26
Computer program use, financial planner use, and calculated retirement income needs	1 if the respondent used computer program to help plan for retirement, consulted a financial planner, and calculated retirement income needed but not attend meetings on retirement planning, 0 otherwise	128
Computer program use, financial planner use, and not calculated retirement income needs	1 if the respondent used computer program to help plan for retirement, consulted a financial but not attend meetings on retirement planning planner or calculated retirement income needed, 0 otherwise	43
Computer program use, attend meetings, and calculated retirement income needs	1 if the respondent used computer program to help plan for retirement, attended meetings on retirement planning, and calculated retirement income needed but not consulted a financial planner, 0 otherwise	83

(Continued)

TABLE 1. Measurements of All Variables *(Continued)*

Variables	Measurement	*n*
Computer program use, attend meetings, and not calculated retirement income needs	1 if the respondent used computer program to help plan for retirement, attended meetings on retirement planning but not consulted a financial planner or calculated retirement income needed, 0 otherwise	52
Financial planner use, attend meetings, and calculated retirement income needs	1 if the respondent consulted a financial planner, attended meetings on retirement planning, and calculated retirement income needed but not used computer program to help plan for retirement, 0 otherwise	157
Financial planner use, attend meetings, and not calculated retirement income needs	1 if the respondent consulted a financial planner, attended meetings on retirement planning but not used computer program to help plan for retirement or calculated retirement income needed, 0 otherwise	110

Variables	Measurement	Frequency/ Mean
Age (years)		
43–47	1 if the respondent's age is from 43–47, 0 otherwise	63.2%
48–52	1 if the respondent's age is from 48–52, 0 otherwise	36.8%
Gender		
Male	1 if the respondent is male, 0 female.	49.2%
Female	1 if the respondent is female, 0 male.	50.8%
Cognitive ability (IQ)	Armed Forces Qualification Test (AFQT) percentile score	
0–20 percentile	1 if percentile score is between 78 and 89, 0 otherwise	20.0%
21–40 percentile	1 if percentile score is between 90 and 99, 0 otherwise	20.0%
41–60 percentile	1 if percentile score is between 100 and 109,0 otherwise	20.0%
61–80 percentile	1 if percentile score is between 110 and 119 otherwise	20.0%
81–100 percentile	1 if percentile score is between 120 and 130, 0 otherwise	20.0%
Race		
Hispanic	1 if Hispanic, 0 otherwise	19.7%
Black	1 if Black, 0 otherwise	29.9%
Other races	1 if non-Hispanic and non-Black, 0 otherwise	50.4%
Education		
Less than high school	1 if respondent's highest degree is none, 0 otherwise	13.1%
High school	1 if respondent's highest degree is high school diploma, 0 otherwise	52.8%
Some college	1 if respondent highest degree is associate/junior college or other specify ones, 0 otherwise	12.2%
College	1 if respondent highest degree is BA/BS, 0 otherwise	14.4%
Graduate school	1 if respondent highest degree is MA, MBA, MS, MSW, PhD, MD, LLD, or DDS, 0 otherwise	6.5%
Marital status		
Never married	1 if respondent is never married, 0 otherwise	16.8%
Married	1 if respondent is married, 0 otherwise	55.5%
Separated	1 if respondent is separated, 0 otherwise	5.6%
Divorced	1 if respondent is divorced, 0 otherwise	20.2%
Widowed	1 if respondent is widowed, 0 otherwise	1.8%

(Continued)

TABLE 1. Measurements of All Variables *(Continued)*

Variables	Measurement	Frequency/ Mean
Income	Annual total family income	$73,800
0–20 percentile	1 if family income is between $1 and $20,615, 0 otherwise	20.0%
21–40 percentile	1 if family income is between $20,616 and $43,200, 0 otherwise	20.0%
41–60 percentile	1 if family income is between $43,201 and $70,000, 0 otherwise	20.0%
61–80 percentile	1 if family income is between $70,001 and $108,747, 0 otherwise	20.0%
81–100 percentile	1 if family income is between $108,748 and $454,737, 0 otherwise	20.0%
Net worth	Family net worth in 2008	$272,179
0–20 percentile	1 if net worth is between $1 and $3,000, 0 otherwise	20.0%
21–40 percentile	1 if net worth is between $3,001 and $48,000, 0 otherwise	20.0%
41–60 percentile	1 if net worth is between $48,001 and $149,557,0 otherwise	20.0%
61–80 percentile	1 if net worth is between $149,558 and $367,000, 0 otherwise	20.0%
81–100 percentile	1 if net worth is between $367,001 and $3,448,187, 0 otherwise	20.0%
Retirement wealth	Sum of family employer-sponsored retirement wealth and other tax-advantaged retirement wealth	$85,083
Homeownership	1 if family owns the residence, 0 otherwise	65.1%
Children	Number of bio/stepped/adopted children in family	1.1
Health status	1 if the respondent's job and income are limited by his/her health status, 0 otherwise	11.8%
Bankruptcy	1 if the respondent's ever declared bankruptcy, 0 otherwise	16.8%
Risk tolerance		
Conservative	1 if put less than 45% personal retirement account money into stocks, 0 otherwise	34.2%
Moderate	1 if put more or equal to 45% but less than 70% personal retirement account money into stocks, 0 otherwise	15.1%
Aggressive	1 if put more or equal to 70% personal retirement account money into stocks, 0 otherwise	15.4%

Note. BA = bachelor of arts; BS = bachelor of science; MA = master of arts; MBA = master of business administration; MS = master of science; MSW = master of social work; PhD = doctor of philosophy; MD = doctor of medicine; LLD = legum doctor; DDS = doctor of dental surgery.

age, gender, race, education, income, net worth, and marital status. We use logistic regression predict the likelihood of an individual's decision to use a computer program when planning for retirement.

Equation 2 models total retirement wealth as a function of the use of a computer program, controlling for other factors:

Retirement wealth = f (computer program use, demographic characteristics, other factors) (2)

The dependent variable for this model is retirement wealth accumulated by respondents in the NLSY79. It is calculated as the sum of three variables: total imputed value of respondents' employer-sponsored retirement plan today (e.g., 401(k) and 403(b) plans), total value of respondents' spouse/partner employer-sponsored retirement plan today (e.g., 401(k) and 403(b) plans), and the total imputed amount in tax advantaged accounts (e.g., individual retirement accounts [IRAs] and Keoghs). We acknowledge that other resources, such as home equity and Social Security, may be used as a source of retirement income, but they do not represent the purposeful retirement saving that we intend to measure in this analysis. Respondents with missing values are omitted from the analysis. We conduct a log transformation on the total retirement wealth numerical variable

because the dependent variable is skewed. Observations with 0 total retirement wealth are coded as 1 before the log transformation so they remain 0 after the log transformation. According to the theoretical framework and past literature, demographic characteristics (e.g., age, gender, and race) and other factors (e.g., education, income, net worth, marital status, homeownership, number of children, health status, risk tolerance, and bankruptcy) that affect total retirement wealth accumulated are included as independent variables (see Table 1 for measurements). The computer program use variable is also included as our variable of interest in this model. Because the dependent variable has a substantial portion of extreme values, we use heteroscedasticity consistent ordinary least square regression to isolate the effect of using computer programs on retirement wealth (Hayes & Cai, 2007; White, 1980).

To find out whether using a computer program is a complement or substitute to other financial resources, we create 16 mutually exclusive and collectively exhaustive subgroups based on the possible combinations of information sources used for retirement. These include the use of a computer program whether the respondent calculated retirement income needs, attended meetings on retirement planning, and consulted a financial planner (see Table 1 for measurements).

Results

Detailed variable measurement and overall descriptive results for the whole sample are presented in Table 1. Among 6,487 valid responses, 832 respondents indicated that they used a computer program when planning for retirement, 1,582 respondents report that they calculated retirement income needs, 1,118 respondents consulted a financial planner, and 1,011 indicated that they attended meetings on retirement planning. There are 183 respondents who used a computer program to help plan for retirement and calculated retirement income needs without attending meetings on retirement or consulted a financial planner; 128 respondents used computer program to help plan for retirement, consulted a financial planner, and calculated retirement income needs but never attend meetings on retirement; 83 respondents used computer program to help plan for retirement, attended meetings on retirement, and calculated retirement income needs but never consulted a financial planner; 195 respondents used all of the three aids and calculated retirement income needs.

Overall, the average age of respondents is 47 years, and 49% are male. Approximately 20% of the respondents are Hispanic, 30% are Black, and 50% are non-Hispanic, Whites, and a small number of respondents of other races. Most respondents are married and have at least a high school education. On average, the annual family income is $73,800, net worth is $272,179, and accumulated retirement wealth is $85,083. More than half of the respondents own their residence and have, on average, one child. Twelve percent reported that their job or income has been limited by health status. Seventeen percent reported filing bankruptcy. Regarding risk tolerance, 34% of the respondents are conservative, 15% are moderate, and 15% are aggressive.

Descriptive statistics comparing demographic characteristic means among respondents who use various different retirement information sources to those who do not use a retirement aid are presented in Table 2. Among the respondents that have not used any of the three financial resources and have not calculated retirement income needs (n = 4,042), average income is $55,821, average net worth is $160,863, and average retirement wealth accumulated is $43,538. Respondents that only used a computer program to help plan for retirement and have calculated retirement income needs (n = 122) have a higher average income of $112,489, average net worth of $442,842, and average retirement wealth accumulation of $192,054. Interestingly, among the respondents that used a computer program, consulted a financial planner, and calculated retirement income needs (n = 128), average income is $161,362, average net worth is $803,918, and average retirement wealth accumulated is $284,755. Moreover, among the respondents that used a computer program, attended meetings on retirement planning, and calculated retirement income needs (n = 83), average income is $121,229, average net worth is $609,584, and average retirement wealth accumulated is $344,764. Respondents who used all three aids and calculated retirement income needs (n = 195), average income as $139,024, average net worth is $740,727, and average retirement wealth accumulated as $269,412. Respondents that did not use a computer program to plan for retirement generally have lower income, net worth, and retirement wealth.

Descriptive statistics that illustrates the percentage within retirement preparation by respondent groups are shown in Table 3. In general, higher human capital and socioeconomic status are associated with the use of retirement planning aids.

TABLE 2. Descriptive Statistics: Means of Respondent Sociodemographic Characteristics Categorized by Retirement Planning Aids

Variables	None (Reference)	Calculated Retirement Income Needs Only	Computer Program Use and Calculated Retirement Income Needs	Computer Program Use Only	Financial Planner Use and Calculated Retirement Income Needs	Financial Planner Use Only	Attend Meetings and Calculated Retirement Income Needs	Attend Meetings Only
Age (years)	46.63	46.81*	46.85	46.46	46.79	46.42	46.79	46.32**
Children	0.99	1.02	1.30***	1.30***	1.13**	1.35***	1.03	1.10
Income	$55,821	$75,363***	$112,489***	$105,005***	$119,262***	$99,911***	$78,768***	$77,294***
Net worth	$160,863	$276,533***	$442,842***	$358,678***	$618,534***	$494,114***	$275,480***	$269,558***
Retirement wealth	$43,538	$110,388***	$192,054***	$173,058***	$172,089***	$95,090***	$87,338***	$89,769***

Variables	None (Reference)	All Aids and Calculated Retirement Income Needs	All Aids and Not Calculated Retirement Income Needs	Computer Program Use and Financial Planner Use and Calculated Retirement Income Needs	Computer Program Use and Financial Planner Use and Not Calculated Retirement Income Needs	Computer Program Use and Attend Meetings and Calculated Retirement Income Needs	Computer Program Use and Attend Meetings and Not Calculated Retirement Income Needs	Financial Planner Use and Attend Meetings and Calculated Retirement Income Needs	Financial Planner Use and Attend Meetings and Not Calculated Retirement Income Needs
Age	46.63	46.52	46.92	47.07**	46.28	46.60	46.73	46.96*	46.56
Children	0.99	1.36***	1.31	1.48***	1.28*	1.23*	1.40***	1.15*	1.36***
Income	$55,821	$139,024***	$86,199***	$161,362***	$140,660***	$121,229***	$101,045***	$117,865***	$107,740***
Net worth	$160,863	$740,727***	$429,423***	$803,918***	$749,331***	$609,584***	$316,294***	$591,110***	$380,783***
Retirement wealth	$43,538	$269,412***	$76,424	$284,755***	$94,841**	$344,764***	$90,020**	$169,795***	$127,306***

*$p < .10$. **$p < .05$. ***$p < .01$.

TABLE 3. Proportion Using Various Retirement Planning Aids Stratified by Respondent Sociodemographic Characteristics

	None (Reference)		Calculated Retirement Income Needs Only		Computer Program Use and Calculated Retirement Income Needs		Computer Program Use Only		Financial Planner Use and Calculated Retirement Income Needs		Financial Planner Use Only		Attend Meetings and Calculated Retirement Income Needs		Attend Meetings Only	
Variables	%	*n*	%	*n*	%	*n*	%	*n*	%	*N*	%	*n*	%	*n*	%	*N*
Race																
Hispanic	69.83	891	7.68	98	3.13	40	1.65	21	1.88	24	2.51	32	1.33	17	3.13	40
Black	66.68	1,293	7.68	149	1.60	31	1.39	27	2.17	42	2.58	50	2.06	40	5.42	105
Other races	56.78	1,858	7.70	252	3.42	112	2.26	74	4.89	160	4.61	151	1.65	54	4.03	132
Marital status																
Never married	72.46	792	7.69	84	1.28	14	0.27	3	2.65	29	2.84	31	1.28	14	3.93	43
Married	55.11	1,984	7.69	277	3.61	130	2.69	97	4.36	157	4.47	161	1.83	66	4.33	156
Separated	79.78	292	5.74	21	0.82	3	1.09	4	1.37	5	1.09	4	2.73	10	2.73	10
Divorced	68.09	894	8.07	106	2.44	32	1.37	18	2.51	33	2.67	35	1.45	19	4.95	65
Widowed	69.57	80	9.57	11	3.48	4	0.00	0	1.74	2	1.74	2	1.74	2	2.61	3
IQ																
0–20 percentile	82.26	1,025	7.14	89	0.88	11	1.28	16	1.04	13	1.12	14	0.72	9	1.93	24
21–40 percentile	72.73	907	8.82	110	0.88	11	1.36	17	1.92	24	2.65	33	1.60	20	3.53	44
41–60 percentile	61.51	767	7.54	94	2.65	33	1.44	18	3.29	41	3.69	46	2.09	26	5.45	68
61–80 percentile	52.69	657	7.30	91	4.17	52	2.25	28	5.37	67	5.29	66	2.65	33	6.01	75
81–100 percentile	40.69	507	6.98	87	5.78	72	3.37	42	6.02	75	5.54	69	1.69	21	4.49	56
Education																
Less than high school	85.95	728	6.26	53	1.18	10	0.47	4	0.59	5	0.94	8	0.83	7	1.30	11
High school	68.24	2,338	8.11	278	2.10	72	1.63	56	2.89	99	3.42	117	1.49	51	4.14	142
Some college	53.87	425	8.49	67	5.07	40	2.15	17	3.55	28	4.69	37	2.28	18	7.22	57
College	40.21	376	7.59	71	4.17	39	2.9	28	6.31	59	4.81	45	2.67	25	4.71	44
Graduate school	32.70	137	6.44	27	4.77	20	3.58	15	7.16	30	5.49	23	2.39	10	3.82	16
Homeowner	54.06	2,284	8.40	355	3.62	153	2.25	95	4.45	188	4.52	191	2.06	87	4.78	202
Health	76.23	680	8.18	73	1.12	10	0.45	4	1.57	14	1.91	17	1.57	14	2.47	22
Risk tolerance																
Conservative	63.62	1,411	7.84	174	2.71	60	1.71	38	2.84	63	3.74	83	1.71	38	4.15	92
Moderate	53.37	522	7.36	72	3.78	37	2.25	22	4.91	48	3.68	36	2.45	24	5.11	50
Aggressive	50.40	504	7.10	71	5.30	53	2.90	29	4.70	47	4.20	42	1.50	15	4.70	47

Variables	All Aids and Calculated Retirement Income Needs		All Aids and Not Calculated Retirement Income Needs		Computer Program Use and Financial Planner Use and Calculated Retirement Income Needs		Computer Program Use and Financial Planner Use and Not Calculated Retirement Income Needs		Computer Program Use and Attend Meetings and Calculated Retirement Income Needs		Computer Program Use and Attend Meetings and Not Calculated Retirement Income Needs		Financial Planner Use and Attend Meetings and Calculated Retirement Income Needs		Financial Planner Use and Attend Meetings and Not Calculated Retirement Income Needs	
	%	*n*	%	*n*	%	*n*	%	*n*	%	*N*	%	*n*	%	*n*	%	*N*
Race																
Hispanic	2.51	32	0.24	3	1.41	18	0.55	7	0.94	12	0.55	7	1.57	20	1.10	14
Black	2.58	50	0.31	6	1.55	30	0.31	6	0.93	18	1.03	20	2.06	40	1.65	32
Other races	3.45	113	0.52	17	2.44	80	0.92	30	1.62	53	0.76	25	2.96	97	1.96	64
Marital status																
Never married	1.10	12	0.46	5	0.82	9	0.46	5	0.73	8	0.82	9	2.01	22	1.19	13
Married	4.06	146	0.47	17	2.64	95	0.89	32	1.78	64	0.86	31	3.06	110	2.14	77
Separated	0.55	2	0.00	366	0.82	3	0.27	1	0.27	1	1.37	5	0.82	3	0.55	2
Divorced	2.36	31	0.30	4	1.45	19	0.30	4	0.76	10	0.53	7	1.68	22	1.07	14
Widowed	3.48	4	0.00	115	1.74	2	0.87	1	0.00	0	0.00	0	0.00	0	3.48	4
IQ																
0–20 percentile	1.04	13	0.24	3	0.4	5	0.16	2	0.16	2	0.32	4	0.72	9	0.56	7
21–40 percentile	1.20	15	0.16	2	1.44	18	0.40	5	0.16	2	0.64	8	1.04	13	1.44	18
41–60 percentile	2.97	37	0.24	3	1.20	15	0.56	7	0.80	10	1.12	14	3.21	40	2.25	28
61–80 percentile	3.93	49	0.24	3	1.60	20	0.80	10	2.00	25	0.72	9	2.89	36	2.09	26
81–100 percentile	5.94	74	1.12	14	5.30	66	1.52	19	3.37	42	1.04	13	4.74	59	2.41	30
Education																
Less than high school	0.35	3	0.12	1	0.24	2	0.35	3	0.12	1	0.00	0	0.71	6	0.59	5
High school	1.75	60	0.20	7	1.08	37	0.41	14	0.79	27	0.58	20	1.72	59	1.43	49
Some college	3.55	28	0.25	2	2.41	19	0.51	4	0.76	6	1.14	9	2.53	20	1.52	12
College	6.84	64	0.96	9	4.39	41	1.71	16	3.42	32	1.28	12	5.03	47	2.89	27
Graduate school	8.35	35	1.67	7	6.21	26	1.43	6	3.82	16	2.39	10	5.73	24	4.06	17
Homeowner	3.98	168	0.45	19	2.63	111	0.80	34	1.75	74	1.07	45	3.03	128	2.15	91
Health	1.35	12	0.34	3	1.12	10	0.34	3	0.45	4	0.56	5	1.35	12	1.01	9
Risk tolerance																
Conservative	2.34	52	0.36	8	1.58	35	0.59	13	0.99	22	1.08	24	2.71	60	2.03	45
Moderate	4.40	43	0.61	6	3.17	31	0.82	8	1.64	16	1.23	12	3.37	33	1.84	18
Aggressive	5.70	57	0.70	7	3.10	31	0.90	9	3.40	34	0.80	8	3.2	32	1.40	14

The percentage of those who use no retirement preparation tools nearly doubles from the highest IQ quintile (41%) to the lowest IQ quintile (82%) and increases monotonically with cognitive ability. Similarly, the percentage of those with less than a high school degree who have not used any aid to plan for retirement is more than twice that of those who have a college degree (86% vs. 40%). The percentage of those who have not used any tool to prepare for retirement is also higher among Blacks, Hispanics, those who are separated or never married, renters, and those with a conservative risk tolerance.

Among those who do use some tools to estimate retirement needs, the attendance of meetings appeared to be more popular among those with moderate levels of education and IQ. The use of a computer program and a financial planner (and combinations of both) was popular among those with higher cognitive ability and education.

In Table 4, the logistic regression shows potential effects of independent variables on the likelihood of using a computer program when planning for retirement. Male respondents are almost 70% more likely to use a computer program when planning for retirement. Higher IQ respondents are more likely to use a computer planning tool as are respondents in the top 40% IQ categories. Blacks and Hispanics are more likely to use computer software than other races after controlling for education and income. More educated respondents are more likely to use planning software. Never married respondents are less likely (33%) to use a computer program than married respondents. Higher income respondents are more likely to use a computer program when planning for retirement, as are respondents in the top 40% net worth categories.

The likelihood that a respondent will have calculated retirement income needs is reported in the first column of Table 5. To better understand how the use of planning aids may be combined to increase the likelihood of calculating retirement income needs, we sort respondents into groups by the use of planning aid to investigate the potential effect that the use of various retirement planning aids will have on the likelihood of calculating retirement needs among those who already use a planning aid. For example, among those who use a computer program, we estimate the potential impact a financial planner will have on the calculation of retirement needs.

Those who use a financial computer program are 473% more likely to have calculated retirement income needs, as compared to 325% among those who use a financial planner and 94% of those who attend meeting versus those who use no retirement planning aids. Among those who use a financial computer program, also using a financial planner increased the odds of calculating retirement needs by 152%, and attending meetings increased the likelihood by 193%. For all categories of respondents who used some aid to assist in retirement planning, combining aids strongly increased the likelihood of calculating retirement needs. Among control groups, those in higher income, wealth, and education groups were most likely to have calculated retirement needs. Black respondents were 93% more likely to calculate retirement needs than other races (primarily non-Hispanic whites) after controlling for other factors.

Results from a model estimating log retirement wealth are shown in Table 6. Using a computer program is positively and significantly associated with level of retirement savings. Retirement savings increases with income, wealth outside of retirement accounts (including housing), education, and risk tolerance. Homeownership and poor health decrease retirement savings. Married people have more retirement savings than others.

In Table 7, ordinary least square analysis results show that respondents who use a computer program to help plan for retirement along with other aids, such as consulting a financial planner or attending meetings on retirement planning, have higher retirement wealth accumulation than respondents who do nothing. Particularly, respondents who use a computer program, who attend meetings on retirement planning, and who have calculated retirement income needs have higher retirement wealth than respondents who do nothing. Respondents who use a computer program and calculate retirement income needs have greater retirement wealth accumulation.

In Table 8, heteroscedasticity consistent ordinary least square analysis (which allows the fitting of a model when the homoscedasticity assumption has been violated) on retirement wealth results show that respondents who only use a computer program to help plan for retirement and calculate retirement income needs have about $41,249 more in retirement savings than respondents who do nothing.

TABLE 4. Multivariate Logistic Analysis of Computer Program Use

	Computer Program Used		
Variable	**Coefficient**	***p* Value**	**Odds Ratio**
Intercept	−4.4221***	<.0001	
Age (43–47)			
48–52	0.0653	.4292	1.067
Gender (female)			
Male	0.5274***	<.0001	1.694
Cognitive ability (0–20 percentile)			
21–40 percentile	−0.1429	.4060	0.867
41–60 percentile	0.1982	.2150	1.219
61–80 percentile	0.4255***	.0079	1.530
81–100 percentile	0.7851***	<.0001	2.193
Race/ethnicity (other races)			
Hispanic	0.3323***	.0041	1.394
Black	0.5100***	<.0001	1.665
Education (high school)			
Less than high school	−0.5645**	.0138**	0.569
Some college	0.4327***	.0004***	1.541
College	0.5411***	<.0001	1.718
Graduate school	0.7435***	<.0001	2.103
Marital status (married)			
Never married	−0.3986***	.0097	0.671
Separated	−0.1570	.5470	0.855
Divorced	0.1270	.2980	1.135
Widowed	0.5497	.1179	1.733
Income (0–20 percentile)			
21–40 percentile	0.6763***	.0028	1.967
41–60 percentile	1.1429***	<.0001	3.136
61–80 percentile	1.1201***	<.0001	3.065
81–100 percentile	1.3336***	<.0001	3.795
Net worth (0–20 percentile)			
21–40 percentile	0.0892	.6455	1.093
41–60 percentile	0.2223	.2395	1.249
61–80 percentile	0.4711**	.0126	1.602
81–100 percentile	1.0937***	<.0001	2.985
	Chi-square	*df*	*p* Value
Likelihood ratio	782.25	24	<.0001***
−2 log likelihood	4,187.55		

*$p < .10$. **$p < .05$. ***$p < .01$.

TABLE 5. Likelihood of Calculating Retirement Needs and Retirement Planning Aids

	Calculated Retirement Income Needs	Computer Program Use	Financial Planner Use	Attended Meetings
Dependent Variable	**Odds Ratio**	**Odds Ratio**	**Odds Ratio**	**Odds Ratio**
Financial planner use	4.252***	2.524***	—	4.201***
Computer program use	5.725***	—	2.483***	2.901***
Attend meetings	1.937***	2.93***	4.199***	—
IQ (0–20 percentile)				
21–40 percentile	1.02	0.833	1.332*	1.134
41–60 percentile	1.056	1.015	1.547***	1.887***
61–80 percentile	1.181	1.306	1.626***	1.969***
81–100 percentile	1.193	1.908***	1.784***	1.643***
Age (43–47 years)				
48–52	1.05***	1.003	1.011	0.982
Gender (female)				
Male	0.964	1.766***	0.914	0.9
Race (other races)				
Hispanic	1.047	1.464***	0.794**	1.091
Black	1.132	1.452***	1.066	1.979***
Education (high school)				
Less than high school	0.848	0.616**	0.651**	0.633**
Some college	1.148	1.475***	1.063	1.323**
College	1.137	1.454***	1.28**	1.491***
Graduate school	1.029	1.706***	1.436***	1.642***
Marital status (married)				
Never married	1.19	0.64***	1.317**	1.035
Separated	1.048	0.906	0.695	1.082
Divorced	1.255**	1.126	1.128	1.084
Widowed	1.453	1.642	1.498	1.022
Income (0–20 percentile)				
21–40 percentile	1.129	1.777**	1.53**	1.853***
41–60 percentile	1.495***	2.626***	2.106***	2.322***
61–80 percentile	1.441**	2.599***	2.171***	2.34***
81–100 percentile	1.78***	3.015***	3.221***	1.813***
Net worth (0–20 percentile)				
21–40 percentile	1.244	1.027	1.136	1.528***
41–60 percentile	1.349**	1.2	1.231	1.456**
61–80 percentile	1.602***	1.352	2.063***	1.664***
81–100 percentile	1.96***	2.275***	2.766***	1.849***

*$p < .10$. **$p < .05$. ***$p < .01$.

TABLE 6. Ordinary Least Square Analysis of Computer Program Use on Logarithm Retirement Wealth

Variables	Coefficient	Standard Error	*t* Value	*p* Value
Intercept	1.9918***	1.1055	1.80	.0717
Computer program use	0.8185***	0.1630	5.02	<.0001
Age (43–47 years)				
48–52	−0.0124	0.0231	−0.54	.5907
Gender (female)				
Male	−0.7265***	0.1045	−6.95	<.0001
Race/ethnicity (other races)				
Hispanic	−0.6249***	0.1412	−4.43	<.0001
Black	−0.3283**	0.1290	−2.55	.0109
Education (high school)				
Less than high school	−0.7387***	0.1652	−4.47	<.0001
Some college	0.3372**	0.1637	2.06	.0395
College	0.7675***	0.1628	4.71	<.0001
Graduate school	0.5791**	0.2269	2.55	.0107
Marital status (married)				
Never married	−0.3254*	0.1751	−1.86	.0631
Separated	−0.5622**	0.2473	−2.27	.0230
Divorced	−0.6228***	0.1547	−4.02	<.0001
Widowed	−1.3502***	0.3996	−3.38	.0007
Income (0–20 percentile)				
21–40 percentile	1.3778***	0.1761	7.82	<.0001
41–60 percentile	2.3098***	0.1945	11.87	<.0001
61–80 percentile	2.9138***	0.2142	13.60	<.0001
81–100 percentile	3.3311***	0.2363	14.10	<.0001
Net worth (0–20 percentile)				
21–40 percentile	1.3404***	0.1714	7.82	<.0001
41–60 percentile	3.5101***	0.2002	17.53	<.0001
61–80 percentile	4.6090***	0.2162	21.31	<.0001
81–100 percentile	6.1781***	0.2358	26.19	<.0001
Homeownership	−0.4546***	0.1538	−2.96	.0031
Children	−0.0263	0.0480	−0.55	.5825
Health status	−0.3955**	0.1598	−2.47	.0134
Bankruptcy	0.0816	0.1414	0.58	.5638
Risk tolerance (conservative)				
Moderate	0.5844***	0.1479	3.95	<.0001
Aggressive	0.6253***	0.1479	4.23	.0006
R^2	0.4327			

*$p < .10$. **$p < .05$. ***$p < .01$.

TABLE 7. Ordinary Least Square Regression on Logarithm Retirement Wealth

Variable	Coefficient	Standard Error	*t* Value	*p* Value
Intercept	−0.1019	1.1786	−0.09	.9311
Retirement preparation (none)				
Calculated retirement income needs only	0.6246***	0.2037	3.07	.0022
Computer program use and calculated retirement income needs	2.0678***	0.3290	6.28	<.0001
Computer program use and calculated retirement income needs	1.3390***	0.3967	3.38	.0007
Financial planner use and calculated retirement income needs	1.8726***	0.2977	6.29	<.0001
Financial planner use and not calculated retirement income needs	1.4281**	0.2909	4.91	<.0001
Attend meetings and calculated retirement income needs	1.3986***	0.4120	3.39	.0007
Attend meetings and not calculated retirement income needs	1.5834***	0.2669	5.93	<.0001
All aids and calculated retirement income needs	1.7401***	0.3195	5.45	<.0001
All aids and not calculated retirement income needs	1.0651	0.8449	1.26	.2075
Computer program use, financial planner use, and calculated retirement income needs	2.4309***	0.3880	6.26	<.0001
Computer program use, financial planner use, and not calculated retirement income needs	1.4478**	0.6590	2.20	.0281
Computer program use, attend meetings, and calculated retirement income needs	2.8399***	0.4785	5.93	<.0001
Computer program use, attend meetings, not calculated retirement income needs	0.6795	0.6004	1.13	.2578
Financial planner use and attend meetings and calculated retirement income needs	1.8604***	0.3527	5.27	<.0001
Financial planner use, attend meetings, and not calculated retirement income needs	1.8100***	0.4152	4.36	<.0001
Age (43–47 years)				
48–52	−0.0025	0.0239	0.11	.9150
Gender (female)				
Male	−0.5741***	0.1081	−5.31	<.0001
Race (other races)				
Hispanic	−0.7425***	0.1464	−5.07	<.0001
Black	−0.6672***	0.1330	−5.01	<.0001
Education (high school)				
Less than high school	−0.9890***	0.1702	−5.81	<.0001
Some college	0.5390***	0.1697	3.18	.0015
College	1.2669***	0.1658	7.64	<.0001
Graduate school	1.2712***	0.2313	5.50	<.0001

(Continued)

TABLE 7. Ordinary Least Square Regression on Logarithm Retirement Wealth *(Continued)*

Variable	Coefficient	Standard Error	*t* Value	*p* Value
Marital status (married)				
Never married	−1.1356***	0.1745	−6.51	<.0001
Separated	−1.4232***	0.2508	−5.67	<.0001
Divorced	−1.4821***	0.1517	−9.77	<.0001
Widowed	−2.3236***	0.4103	−5.66	<.0001
Homeowner	0.4481***	0.1503	2.98	.0029
Health	−0.7359***	0.1614	−4.56	<.0001
Children	−0.0022	0.0498	−0.05	.9637
Bankruptcy	−0.3552**	0.1445	−2.46	.0140
Risk tolerance (conservative)				
Moderate	0.7132***	0.1533	4.65	<.0001
Aggressive	0.7033***	0.1534	4.58	<.0001
Log income	0.2391***	0.0289	8.26	<.0001
Log net worth	0.3469***	0.0160	21.65	<.0001

*$p < .10$. **$p < .05$. ***$p < .01$.

Respondents who use a computer program, consult a financial planner, and calculate retirement income needs have about $90,209 more in retirement savings than respondents who do nothing. Moreover, respondents who use a computer program, attend meetings on retirement planning, and calculate retirement income needs have about $102,338 more in retirement savings than respondents who do nothing. However, respondents who use all aids and calculate retirement income needs have about $87,603 more in retirement savings than respondents who do nothing. In general, respondents who use financial aids to help plan for retirement but do not calculate retirement income needs have less retirement saving than respondents who do nothing except for respondents who use computer program only.

Discussion

We find evidence that the use of a computer program is positively associated with retirement savings even after controlling for demographic characteristics and the use of other financial planning aids. Results from analyses that include various combinations of planning aids suggest that the use of financial software is a complement to the use of financial planner and attending retirement planning meetings.

Given the significant potential impact of the use of financial software on retirement savings, it is notable that men are more likely to use computer software. This is consistent with previous research findings that men are more financially confident and are more likely to be the primary financial decision maker (Croson & Gneezy, 2009). Higher income and wealthier consumers have more resources to use when investing, so they are more likely to purchase computer software to help them when planning for retirement. This is consistent with the theoretical model of decision-improving technologies. Interestingly, Black and Hispanic respondents are more likely to use computer software when we control for income, net worth, and education. This suggests that there may be cultural differences in preference for technology rather than using a financial planner. Compared to never-married households, married households may have a greater need to use a computer program because of the greater complexity of planning retirement for a multiperson household. Not surprisingly, head of households who have higher IQ and more education are more likely to use financial software. This is consistent with the model because investment in sophisticated technology is more cost-efficient for higher IQ and more educated households.

The most important finding in the ordinary least squares regression is that using computer software to plan for retirement is positively associated with households' retirement wealth accumulation after controlling for demographic

TABLE 8. Heteroscedasticity Consistent Ordinary Least Square Regression on Retirement Wealth

Variable	Parameter Estimate	*p* Value	Heteroscedasticity Consistent *p* Value
Intercept	−102,640**	.0772	.0231
Retirement preparation (none)			
Calculated retirement income needs only	32,225	.0018	.1267
Computer program use and calculated retirement income needs	41,249***	.0136	.0041
Computer program use and not calculated retirement income needs	16,124	.4220	.2217
Financial planner use and calculated retirement income needs	34,426**	.0235	.0279
Financial planner use and not calculated retirement income needs	−5,513	.7091	.6297
Attend meetings and calculated retirement income needs	16,334	.4337	.4787
Attend meetings and not calculated retirement income needs	6,658	.6228	.3400
All aids and calculated retirement income needs	76,603**	<.0001	.0278
All aids and not calculated retirement income needs	−23,954	.5753	.3811
Computer program use and financial planner use and calculated retirement income needs	90,209**	<.0001	.0138
Computer program use and financial planner use and not calculated retirement income needs	−51,379**	.1246	.0251
Computer program use and attend meetings and calculated retirement income needs	102,338***	<.0001	.0016
Computer program use and attend meetings and not calculated retirement income needs	5,700	.8512	.7982
Financial planner use and attend meetings and calculated retirement income needs	24,153	.1774	.1760
Financial planner use and attend meetings and not calculated retirement income needs	6,371	.7621	.6503
Age (43–47 years)			
48–52	2,836***	.0194	.0034
Gender (female)			
Male	−12,333**	.0245	.0297
Race (other races)			
Hispanic	−15,735***	.0338	.0024
Black	−11,125	.1014	.2042
Education (high school)			
Less than high school	46	.9957	.9854
Some college	−1,482	.8633	.7602
College	36,580***	<.0001	.0051
Graduate school	29,807	.0127	.1158

(Continued)

TABLE 8. Heteroscedasticity Consistent Ordinary Least Square Regression on Retirement Wealth *(Continued)*

Variable	Parameter Estimate	*p* Value	Heteroscedasticity Consistent *p* Value
Marital status (married)			
Never married	−19,055***	.0384	.0024
Separated	−15,513***	.2322	.0014
Divorced	−22,914***	.0048	.0001
Widowed	−35,744***	.0885	<.0001
Homeowner	−15,276***	.0585	<.0001
Health	−7,823**	.3508	.0245
Children	−1,208	.6315	.5224
Bankruptcy	−9,249***	.2130	.0006
Risk tolerance (conservative)			
Moderate	20,493**	.0083	.0243
Aggressive	18,874**	.0152	.0123
Income (0–20 percentile)			
21–40 percentile	−2,746	.7665	.2749
41–60 percentile	−12,994***	.2050	.0014
61–80 percentile	−1,068	.9246	.8567
81–100 percentile	55,082***	<.0001	<.0001
Net worth (0–20 percentile)			
21–40 percentile	684	.9394	.6606
41–60 percentile	12,349***	.2404	<.0001
61–80 percentile	30,832***	.0068	<.0001
81–100 percentile	190,191***	<.0001	<.0001

*$p < .10$. **$p < .05$. ***$p < .01$.

characteristics and other factors. In addition, using a computer program along with other financial aids, such as consulting a financial planner or attending meetings on retirement planning, has a larger effect on households' retirement wealth than doing nothing as long as these aids are used to calculate retirement needs. Interestingly, the use of a planner who does not calculate retirement income needs is associated with lower retirement saving, which is consistent with the use of a financial advisor who is compensated based on the sale of a product and does not provide comprehensive advice.

A limitation is that we do not know how sophisticated the computer software is, but we assume that it is complex enough to help improve financial decision making. The software packages can range from sophisticated simulations that simulate future risky asset returns to simple calculators that allow individuals to make calculations over time. It is also possible that a software program was used in the process of receiving additional advice by a financial planner. This variation in the quality and depth of computer-aided retirement advice will result in a greater variation in marginal impact on retirement saving.

We also do not know respondent's employee benefits. Those that work for a company that has a managed account provider may have access to sophisticated retirement planning software and, given employment in a prosperous business, may also receive relatively higher employer contributions to

their retirement accounts. Either way, the employee would still need to actively decide to use the software provided through these retirement platforms.

In the multivariate analysis controlling for financial resource availability and education, we find that using a computer program appears to complement other retirement saving aids such as consulting a financial planner or attending meetings on retirement planning. Respondents who use a computer program are more likely to have higher retirement savings than respondents who did not use a computer program. This suggests that the value provided by financial planning software is unique, for example, by providing an objective source of information or by allowing complex intertemporal comparisons.

Conclusion

Over the past few decades, the structure of the financial service sector has changed because of technological innovation. The availability of sophisticated financial planning–related computer software allows consumers to better estimate optimal life cycle retirement saving. This study investigates which consumers use retirement planning software and the relation between using a computer aid to plan for retirement and retirement wealth.

We find that those with greater expected financial benefit from improved retirement decision making, and those with greater endowed and attained human capital, are more likely to use financial software. The likelihood of using a computer program to plan for retirement increased sharply with cognitive ability, with those in the top quintile more than twice as likely to use financial software as those in the bottom quintile. Likewise, the use of retirement planning software is higher among those with more formal education. Those with a graduate degree were twice as likely to use a computer program to plan for retirement as respondents with a high school degree. The strongest predictors of computer-aided retirement planning, however, were financial resources. Those in the Top 3 quintiles of income were more than 200% more likely to use a computer aid, as were those in the top quintile of wealth (relative to the bottom quintile of each). These results indicate that using financial planning software is not substituting for a lack of financial knowledge but is serving to improve the decisions of more knowledgeable and wealthier households. Clearly, those who are most likely to use a computer aid to plan for retirement are those who are already more likely to have made more informed retirement decisions.

In a multivariate analysis controlling for financial resource availability, cognitive ability, and education, we find that the use of financial software is significantly associated with greater total retirement savings. When we separate the source of information used to prepare for retirement into groups that include various combinations of financial software and other categories, we find that using a computer program appears to enhance other retirement planning methods—particularly if the respondent has calculated retirement income needs. For example, those who both use a financial planner and financial software have more saved for retirement than those who use only a financial planner. This suggests that the benefits from using financial software, which may include estimating a pathway from savings behavior to retirement outcome, helps to motivate those who do and do not use additional resources to help plan for retirement. Financial software appears to enhance the benefit of other technologies that allow individuals to improve retirement saving decisions.

These results have important implications for information policy as well because those who are most likely to use information, for example, mandated income disclosure on defined contribution statements, will be those in higher socioeconomic status groups. If the workers most likely to use computer-aided financial advice are those who were more likely to make better savings decisions anyway, this could further increase the disparity in defined contribution savings in the United States between more and less educated and higher and lower income workers. Although technology can improve welfare for those who use it, computer-aided guidance may be less helpful at improving outcomes among workers who are in greatest need of advice. Interestingly, we also find that Black respondents were more likely to use computer aids and to estimate retirement income needs. This finding suggests that planning aids may help reduce retirement wealth disparities among Black workers, who have lower financial literacy scores on average (Lusardi & Mitchell, 2011).

Many employers implement a managed accounts program, which gives employees access to advanced retirement planning software. Our finding suggests that the use of this software by employees could significantly increase savings rates among those who were motivated to use the program.

To ensure that a range of employees benefits from the use of software, it may be helpful to encourage all employees to estimate retirement needs as a part of initial benefits planning. Our results suggest that the use of computer software provide an advantage over and above meeting with a financial counselor or planner. Financial counselors can help reluctant savers value the importance of retirement saving through the use of a software program that better allows them to envision how their savings decisions today will improve their financial well-being in the future. Future research that compares retirement savings outcomes among workers who work with an advisor, and who work with an advisor who uses financial planning software to estimate retirement savings needs, will provide further insight into the benefit of software as a complement to traditional counseling.

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