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FINANCIAL SERVICES REVIEW

Financial Services Review 30 (2022) v–vi

From the Editor

This issue contains **Volume 30 - Issue 2** of the *Financial Services Review* (*FSR*). Issue 2 is integral because it is the first to be published since the unexpected passing of our long-term Editor, Dr. Stuart Michelson. For our readers, who may not be aware, Dr. Michelson passed away unexpectedly in March of this year. On behalf of the President of the Academy of Financial Services and the entire executive team and board, we would like to express our sincere condolences to his family, friends, and colleagues. To honor Dr. Michelson, we will be naming an award after him at the Annual Conference of the Academy of Financial Services. During this transition, I will be taking over the FSR editorship's duties, having previously worked with Dr. Michelson as a guest editor. I would like to personally thank the board and Academy of Financial Services members for their support. I would also like to thank you, our authors, and readers for your patience.

As Interim Editor, I hope to build upon the great work that Dr. Michelson started, which includes broadening the scope of articles while still focusing on individual financial management and personal financial planning. Beyond that, we are exploring other avenues to increase the efficiency and timeliness of the Journal's publication processes.

The lead article "Why Are Women Less Motivated to Become Financially Literate?" is co-authored by Jaclyn J. Beierleina at East Carolina University, Kaleigh Launsby at Bank of American, and Haley Smith at Duke University Hospital. This article examines the motivations of women to become more financially literate. The authors find that women in their sample score lower on basic finance questions and report lower motivation to learn personal finance. They also find that women who expect to make decisions with a spouse report lower motivation than women who expect to make decisions alone.

Their findings show that women are less motivated to become financially literate due to confidence and shared financial responsibilities.

The second article explores credit and financial sophistication. "Financial literacy and its impact on the credit card debt puzzle" is authored by Laura Ricaldi at Utah Valley, Terrance K. Martin also at Utah Valley University, and Sandra Huston at Texas Tech University. Using the 2016 Survey of Consumer Finances and a series of multinomial regressions to investigate the credit card debt puzzle, the authors' results suggest that financially literate households are less likely to display irrational behavior. The authors break their sample into three subgroups in the analysis: convenience users, solvent revolvers, and insolvent revolvers.

The third article, "Your Mileage May Vary" is co-authored by Manoj Athavale, Stephen Avila, and Joseph Goebel at Ball State University. The paper centers around the topic of

retirement planning and retirement income management. The authors specifically define portfolio success to meet the parameters of their articles. Their results show that the likelihood of success is inversely related to withdrawal rate, retirement horizon, and portfolio risk increase and directly related to portfolio return, allocation aggressiveness, and early experience. In addition, they find that portfolio success is highly sensitive to withdrawal rates, highlighting that aggressive allocations may provide more dependable portfolio outcomes for retirees.

In the final article in this issue Jason Heller at Coastal Wealth, Benjamin Cummings at Utah Valley University, and Jason Martin at the American College of Financial Services coauthor the final article. In their paper "Distribution channel effects on advisor managed investment performance," the authors perform a series of analyses to determine whether advisors at Registered Investment Advisory (RIA) firms can produce higher net investment results compared to advisors employed at dually registered Independent Broker/Dealer (IBD) firms. The authors use a proprietary dataset from a large United States investment advisory platform. Using this dataset, they found that advisors at RIAs outperformed those at IBDs in higher-risk portfolios through Turnkey Asset Management Programs (TAMPs) and Unified Managed Accounts.

I want to thank everyone who makes the FSR production possible, including our authors, referees, and readers. Dr. Michelson often praised the outstanding work of our reviewers, and I wish to echo his sentiment. If you have a manuscript and looking for a publication outlet, please consider submitting it to the Financial Services Review. The Journal welcomes articles on the areas of personal financial planning. Like Dr. Michelson, I am committed to the goal of making Financial Services Review the best academic Journal in individual financial management and personal financial planning.

Yours Sincerely,
Terrance K. Martin Jr.
Interim Editor *Financial Services Review*

FINANCIAL SERVICES REVIEW

Financial Services Review 30 (2022) 89–105

Why are women less motivated to become financially literate?

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Abstract

Research suggests women know and care less about personal finance than men but offers no explanations. Women in our sample score lower on basic finance questions and report lower motivation to learn personal finance. Men and women report higher motivation when they say finance is "Very Important." However, women who expect to make decisions with a spouse report lower motivation than do women who expect to make decisions alone. Men's motivation does not vary with such expectations. Our results suggest women are less motivated to become financially literate when they lack confidence and when they expect to share financial responsibilities.

JEL classifications: D14; G530; A22

Keywords: Personal finance; Financial literacy

1. Introduction

Prior research indicates that women are less knowledgeable about and less interested in personal finance than men and less likely to invest in the stock market. Why? Do they think finance less important than men do? Do they feel less confident in their abilities to understand it? Are they more likely to expect that their parents or spouses will help them make financial decisions?

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The women in our sample score lower than the men on average on a series of questions designed to test basic financial knowledge. The women also report lower motivation levels on average. They do not rate it as less important, but they are less confident in their answers to our questions and in their ability to make future financial decisions. Statistically, the women and men in our sample have similar expectations regarding who will make their future financial decisions. About 30% of women and men chose the response "I will" and about 70% of women and men chose "My spouse and I will." No one chose either remaining response "My spouse will" or "My parents will." However, women who report that they expect to make financial decisions with a spouse also report lower motivation to learn personal finance than do women who expect to make financial decisions alone. Men's motivation levels do not appear to vary with their expectations regarding whether they will make decisions alone or with a spouse. If our sample results are representative of the larger female population, the high expectation among women that they will have a spouse with whom to make financial decisions coupled with the dampening effect that expectation appears to have on women's motivation to learn about finance could help explain why in study after study women tend to know less and care less about personal finance.

2. Literature review

Much empirical evidence exists that financial literacy is relatively low, particularly among women, and that low financial literacy reduces financial well-being (see, e.g., Lusardi & Mitchell, 2007; Mandell, 2006; The National Council on Economic Education, 2005; Tzu-Chin, Bartholomae, Fox, & Cravener, 2007; Van Rooij, Lusardi, & Alessie, 2011; Xiao, Serido, & Shim, 2010). Despite evidence that college students and college graduates are more knowledgeable than other high school graduates (Mandell & Klein, 2009), the average college student demonstrates relatively little financial knowledge, and the average female student is less knowledgeable than the average male student (Volpe, Chen, & Pavlicko, 1996). Chen and Volpe (1998) find that female college students and students who are not business majors, are in the lower class ranks, under age 30, and have little work experience have lower levels of financial knowledge, and that students who display less financial knowledge are more likely to assign little importance to financial matters and to make incorrect financial decisions. Chen and Volpe (2002) find that female college students are less knowledgeable than their male counterparts on personal finance topics, that they exhibit less enthusiasm, lower confidence, and less willingness to learn about personal finance topics than male students, and that they are less likely to rank personal finance, math, economics, and science courses as important. Mandell and Klein (2007) focus on the importance of one's motivation to be financially literate. Using data from the national Jump$tart survey of high school seniors, they find that students who believe financial difficulty results from poor decisions, that it is important to have enough money to pay bills, and that Social Security alone provides insufficient retirement income tend to earn higher scores on the financial literacy questions in the survey. Level of aspiration is another important determinant of financial literacy in their data. Students bound for a four-year college, a professional job, or a higher starting salary earned higher scores, on average, than students with lower aspirations.

Beierlein and Neverett (2013) find that female undergraduates are less likely than male undergraduates to take an elective personal finance course. Tang and Peter (2015) examine how young adults acquire financial knowledge and find that their financial education and experience and the financial experience of their parents are important factors. Tokar Asaad (2015) finds that financial confidence is also an important component of literacy. Harrington and Smith (2017) find that students are more interested in financial education when they perceive a higher return from financial education and when they are financially independent.

In summary, the literature tells us that financial education and experience, the financial experience of one's parents, confidence, interest, motivation, and educational and professional aspirations are important determinants of financial literacy and that, compared with men, women tend to be less knowledgeable, less confident, and less motivated to learn personal finance. Yet, extant literature offers little insight into why women may be less motivated to become financially literate. This is the question we explore in our research.

Expectancy theory of motivation, notably Vroom's (1964) model of motivational force, indicates that motivation is determined by expectancy, instrumentality, and valence. Expectancy is the belief that an action will result in an outcome. Instrumentality is the belief that the outcome will lead to an appropriate reward, and also perhaps that the outcome is necessary to earn the reward. Finally, valence is the importance placed on the reward. Thus, in our context, one's motivation to learn personal finance depends on how much one believes that one's efforts to learn will improve understanding of personal finance, how much one expects to rely on one's own knowledge to make good financial decisions, and how important one believes it is to make good financial decisions. As we are specifically interested in women's motivation, we take note of Claudia Goldin's (2006) address to the American Economic Association, "The Quiet Revolution that Transformed Women's Employment, Education, and Family." In it, she explains that as women's estimates of the time they would spend in the labor force increased, their investments in education and interest in more professional majors also increased. Therefore, it seems reasonable to expect that when a woman believes that she will be responsible for making financial decisions, she will be more motivated to become financially literate.

The literature reviewed above suggests several hypotheses to be tested:

1. The women in our sample are less knowledgeable about personal finance, less confident in their abilities related to finance, and less motivated to learn it than the men.

2. Motivation to learn personal finance is positively related to one's confidence (expectancy), whether one expects to be responsible for financial decision-making (instrumentality), and the importance one assigns to personal finance decisions (valence).

3. Women are less motivated to learn personal finance because they are less confident, they think it is less important, or they expect to have less responsibility for making financial decisions.

3. Methodology and data

The link to an online Qualtrics survey approved by the University's Institutional Review Board was emailed to undergraduate students at East Carolina University (ECU). Additionally, the link was posted on social media pages open only to students, and flyers were hung around

campus. Emails and other advertising for the survey noted that respondents would be entered in a drawing for gift cards to increase interest. The survey is composed of 64 questions. Students could exit the survey at any time. We analyze only completed surveys.

The entire survey and answer choices are in the Appendix. The first 11 survey questions address demographics, including verifying that the respondent was an undergraduate at East Carolina and asking for age, gender, class (e.g., freshman), race, employment status, parents' income range, and whether either parent works in the financial services industry. The next seven questions address students' awareness of the personal finance course offered at ECU, whether they had taken it or any other finance or economics courses or attended any related seminars and if so, where, and whether they planned to take the personal finance course or attend a related seminar. There are also four follow-up questions that appeared only for those who responded that they had taken the course. These address why they took the course, how it affected their opinions, whether they expected to use what they learned in the future, and the grade earned. For those who responded that they had not taken it, one follow-up question asks why not, and another asks if they plan to take it. The next question asks, "How important do you think personal finance is?" and then a free response follow-up question depending on the answer that asks "Why do you find personal finance (un)important?" The next question asks, "How motivated are you to learn about personal finance?" Then, there are 16 questions that ask how strongly the following had influenced the respondent's knowledge of personal finance and their financial decisions: parents, other relatives, instructors, peers, media, online resources, own experiences, and religion. The next question asks respondents to indicate where they might go for advice in the future when they had questions regarding personal finance. Then, a series of eight questions asks whether they had heard of or currently had the following financial products: a credit card, renters' insurance, a retirement account, and other types of investment accounts. The next question asks if they planned to invest in the stock market, and why or why not. The next seven questions are financial test questions adapted from the OECD/International Network on Financial Education pilot study (Atkinson & Messy, 2012).[1] These questions cover division of money, time value of money, inflation, interest (two questions), risk and return, and diversification. They do not require a calculator to complete and are either multiple choice or true/false. For the multiple-choice questions involving simple math, the choice "I don't know" is an option in addition to three numerical options. The next two questions asked how confident they were in their answers to the financial literacy questions and in their ability to make financial decisions in the future. The final question asked, "In the future, who do you expect to make your financial decisions?" Some of the questions described above were of interest to us beyond our hypotheses regarding women's motivation to become financially literate. The questions relevant to our hypotheses include several of the demographic questions, the financial test questions, the confidence, motivation, and importance questions, and the question regarding who would make their future financial decisions. The distributed survey collected 194 responses from undergraduate students at ECU. Of these, 176 participants finished the survey. This is approximately 0.8% of the University's undergraduate population. Descriptive statistics are in Table 1. Age ranges from 18 to 23 and averages 19.49 years. The majority (70%) of the respondents were female. Twenty-five percent of the students identified themselves as freshmen, 24% as sophomores, 31% as juniors, and 20% as seniors. A large number of respondents (53%) indicated they were Honors College students, who may have been more likely to attend to the email

Table 1 Descriptive statistics

Variables	*N*	Mean	Median	Standard deviation	Min.	Max.	
Panel A: Means and medians							
Age	176	19.49	19.50	1.19	18	23	
Total correct	176	5.70	6.00	1.15	2	7	
Allied health	176	0.05	0.00	0.21	0	1	
Business	176	0.15	0.00	0.36	0	1	
Education	176	0.03	0.00	0.17	0	1	
Engineering	176	0.07	0.00	0.26	0	1	
Fine arts	176	0.06	0.00	0.23	0	1	
Health	176	0.19	0.00	0.39	0	1	
Nursing	176	0.18	0.00	0.38	0	1	
Arts and sciences	176	0.27	0.00	0.45	0	1	
Male	176	0.30	0.00	0.46	0	1	
White	176	0.81	1.00	0.40	0	1	
African American	176	0.07	0.00	0.26	0	1	
Hispanic	176	0.03	0.00	0.18	0	1	
Asian	176	0.04	0.00	0.20	0	1	
Other race	176	0.05	0.00	0.21	0	1	
Work during school year	176	0.56	1.00	0.50	0	1	
Parents in finance	176	0.22	0.00	0.42	0	1	
Importance of finance	176	0.79	1.00	0.41	0	1	
Finance education	176	0.80	1.00	0.40	0	1	
Honors college	176	0.53	1.00	0.50	0	1	
Panel B: Frequencies (%)	0	1	2	3	4	5	
Class	176		25.00	23.86	31.25	19.89	
Parents' income	176	14.77	6.25	9.66	18.75	25.57	25.00
Motivation	176	17.61	48.30	34.09			

Note. Descriptive statistics for the full sample of 176 undergraduate students who responded to a survey invitation and completed the survey. Indicator variables are coded 1 if respondent selected that attribute, 0 otherwise. Means and frequencies for the indicator variables represent the percentage of respondents who selected that attribute. Importance of finance is coded 0 if respondents selected "Important" and 1 if "Very Important." No other choices were selected. Finance education is coded 1 if respondents indicated any prior instruction in finance or economics, 0 otherwise. Class rank is coded 1 for freshman, 2 for sophomores, 3 for juniors, and 4 for seniors. Parents' income is coded 0 if respondent chose "Unsure," 1 if <$30,000, 2 if $30,000-$59,000, 3 if $60,000-$89,000, 4 if $90,000-$119,000, and 5 if >$120,000. Motivation is coded 0 if respondent chose "Neither motivated nor unmotivated," 1 if "Somewhat motivated," and 2 if "Very motivated." No other choices were selected.

because the survey was distributed by Honors College students for their thesis research. As shown in Table 2, compared with the University, our sample contains a higher proportion of females, Asians, Hispanics, and Business majors, and a lower proportion of African Americans. Compared with 2019 U.S. population estimates, our sample contains a higher proportion of females and Whites, and a lower proportion of African Americans, Asians, and Hispanics.

4. Analysis and results

To address our first hypothesis, we consider whether the patterns found so often in previous research persist in our sample. Do our female respondents exhibit less financial literacy,

Table 2 Comparison to university demographic data

Variables	University data	Our sample	U.S. population
Female	61%	70%	51%
African American	14%	7%	13%
Asian	3%	4%	6%
Hispanic	2%	3%	19%
White	80%	79%	60%
Business	9%	14%	N/A

Note. Comparison of University demographic data to that of full sample of respondents who finished the survey. Shows percentages of students/respondents who selected that attribute on enrollment materials/in the survey. U.S. demographic estimates dated July 1, 2019 are available at https://www.census.gov/quickfacts/fact/table/US/PST045219.

confidence, and interest in personal finance than the men do? Using *t*-tests, we compare the women's and men's scores on our financial literacy test questions and their reported levels of motivation to learn about personal finance. Each respondent's score is number of correct answers, which could range from 0 to 7. The respondent's motivation level is coded as 0 for "Neither motivated or discouraged," 1 for "Slightly motivated," and 2 for "Very motivated." None of the survey respondents chose either of the remaining two choices for this question: "Slightly discouraged" or "Strongly discouraged." Results in Table 3, Panel A suggest that our female respondents are less knowledgeable about and less motivated to learn personal finance. On average, the women score about half a point lower than the men on our seven finance questions, scored at one point each. This difference is significant at less than 1%. Women were less likely to correctly answer questions about the time value of money, interest, saving, diversification, and risk and return, but equally likely to correctly answer questions about division of money and the definition of inflation. When asked, "How motivated are you to learn about personal finance?", a higher percentage of women than men said, "Neither motivated or discouraged" or "Slightly motivated," and a higher percentage of men than women said, "Very motivated." Women's mean motivation values are 26% lower than men's, on average, and this difference is significant at less than 1%.

In Panel B of Table 3, we examine why women might be less motivated to learn finance. We ask how confident they are in their test answers and in their abilities to make future financial decisions, who they expect to make their financial decisions in the future, and how important finance is. Using a Likert scale from 1 to 5 to indicate confidence levels from *not at all confident* to *very confident*, respondents rated their confidence in their answers on our finance questions and their confidence in their abilities to make financial decisions in the future. In both cases, women reported significantly lower confidence levels than men. When we asked, "In the future, who do you expect to make your financial decisions?" more than 60% of male and female respondents said, "My spouse and I together" and the remainder said, "I will." No one chose the other options, "My parents," or "My spouse." A slightly but insignificantly higher percentage of women than men said, "My spouse and I" while the reverse is true of "I will." More than 70% of respondents said personal finance is "Very Important" and the remaining respondents said, "Important." No one chose the other options, "Neither important or unimportant," "Unimportant," or "Very Unimportant." We assigned a

Table 3 Differences in means by reported gender

	0 = female 1 = male	*N*	Mean	Standard deviation	t	Sig. (two-tailed)	Mean difference F-M	Standard error difference
Panel A: Are women less knowledgeable and motivated?								
Total correct	0	124	5.54	1.199	−3.161	0.002	−0.537	0.170
	1	52	6.08	0.947				
Inflation	0	124	0.42	0.495	−1.921	0.056	−0.158	0.082
	1	52	0.58	0.499				
Interest	0	124	0.97	0.177	−2.025	0.045	−0.032	0.016
	1	52	1.00	0.000				
Saving	0	124	0.89	0.318	−2.722	0.007	−0.094	0.034
	1	52	0.98	0.139				
Diversification	0	124	0.67	0.472	−1.987	0.049	−0.138	0.070
	1	52	0.81	0.398				
Risk and return	0	124	0.77	0.420	−4.044	0.000	−0.187	0.046
	1	52	0.96	0.194				
Division of money	0	124	0.95	0.215	0.254	0.800	0.009	0.037
	1	52	0.94	0.235				
Inflation definition	0	124	0.87	0.337	1.077	0.283	0.063	0.059
	1	52	0.81	0.398				
Motivation	0	124	1.06	0.678	−3.247	0.001	−0.367	0.113
	1	52	1.42	0.696				

(continued on next page)

Table 3 (Continued)

	0 = female 1 = male	*N*	Mean	Standard deviation	t	Sig. (two-tailed)	Mean difference F-M	Standard error difference
Panel B: Why are women less knowledgeable and motivated?								
Importance	0	124	0.77	0.425	−1.187	0.237	−0.080	0.067
	1	52	0.85	0.364				
Confident answers	0	124	3.34	0.892	−5.563	0.000	−0.738	0.133
	1	52	4.08	0.763				
Confident decisions	0	124	3.52	0.821	−4.170	0.000	−0.514	0.123
	1	52	4.04	0.713				
Decisions with spouse	0	124	0.69	0.463	0.513	0.608	0.040	0.077
	1	52	0.65	0.480				
Decisions myself	0	124	0.31	0.463	−0.266	0.791	−0.020	0.077
	1	52	0.33	0.474				
Questions parents	0	124	0.90	0.297	1.754	0.081	0.096	0.054
	1	52	0.81	0.398				
Questions books	0	124	0.10	0.297	−2.313	0.024	−0.153	0.066
	1	52	0.25	0.437				
Stock market too risky	0	124	0.19	0.397	5.433	0.000	0.194	0.036
	1	52	0.00	0.000				

Note. Independent sample *t*-tests reported. The sample is 176 undergraduate students who responded to a survey invitation and completed the survey.

value of 1 to Very Important and 0 to Important. Women's mean importance value was slightly but not significantly below the men's mean.

Additional questions we asked to explore other possible differences between men and women included where they would turn when they had questions about personal finance, whether they were currently invested in or planned to invest in the stock market, and why or why not.[2] These questions are motivated by Van Rooij et al. (2011) and Cheng, Lin, and Liu (2011). Van Rooij et al find that those with low basic financial literacy are less likely to invest in the stock market and to use newspapers, financial magazines, guides, and books, financial information on the Internet, and professional financial advisers and more likely to rely on informal sources of information like family and friends than those with higher literacy. They also find that women score lower on their literacy measure and are less likely to be invested in the stock market but do not otherwise report findings by gender. Similarly, Cheng et al. find that women are more likely to choose a mortgage lender based on family and friends' recommendations, while men are more likely to search for lenders offering the lowest rates, with the result that women pay significantly higher mortgage rates, on average, after controlling for other interest rate determinants.

In our sample, more than 80% of men and women said they would go to their parents when they had questions about personal finance. Women were slightly more likely than men to choose this response, but this difference is only significant at 10%. In contrast, men were significantly more likely than women to say they would look in books when they had questions, but only 25% of men and 10% of women chose this option. When asked about current or future investments in the stock market, 20% of women said no because it is too risky, while none of the men chose that response. This difference is significant at 1%. Additional results showing no significant differences were excluded from the table for brevity. About 50% of men and women said they would look online when they have financial questions, 50% said they would consult a financial advisor, 30% said they would ask friends, and 20% said other relatives. No more than 20% of men and women said they were currently invested in stock market, and only about 50% of men and women said they planned to invest in the stock market.

Overall, our univariate results are consistent with prior literature and our first hypothesis. With respect to personal finance, the women in our sample appear to be less knowledgeable, less motivated to learn, less confident, and more risk averse, on average, than the men. They may be more likely to turn to parents when they have questions and less likely to turn to books than men are. Yet, like the majority of men in our sample, the majority of women think finance is very important and expect to make financial decisions with their spouses. Does their lower confidence and greater tendency to rely on others when making financial decisions help explain why they are less motivated to learn about personal finance? We turn to multivariate analysis to examine this question, focusing first on our second hypothesis to examine the determinants of motivation.

We use OLS regression and ordinal regression with the respondents' chosen level of motivation to learn personal finance as the dependent variable.[3] For measures of confidence (expectancy), we use each respondent's rankings of how confident he or she feels about the answers to the financial knowledge questions and how confident he or she feels about having to make financial decisions in the future. Both rankings are on a 1 to 5 scale to indicate "*Not*

at all confident" to "*Very confident*," respectively. For an indicator of whether one expects to be responsible for financial decision-making (instrumentality), we use each respondent's answer to the question, "In the future, who do you expect to make your financial decisions?" Because all respondents answered either "My spouse and I together" or "I will," we set Decisions with spouse to 1 for the former and 0 for the latter answer. For importance, we use an indicator set to 0 if the respondent selected Important or to 1 if Very Important when asked to rate the importance of personal finance. The other answer choices: Neither important nor unimportant, Unimportant, or Very Unimportant were not selected by any of the respondents. We also include demographic variables that may affect one's interest in finance. We include age and whether the respondent works during the school year because older students and those who work may see finance as more relevant to their lives than do younger students or those that do not work. We include parents' income because it may impact how students have experienced financial behaviors such as budgeting, borrowing, and investing. We include a dummy coded 1 if the respondent reported at least one parent who works in a finance-related field as an additional indicator of the student's exposure to finance or as an indication that the student has a close relationship with someone well-qualified to offer financial advice. Finally, we include gender set to 1 if the respondent self-identified as male, 0 as female to capture any remaining gender-related traits that could be affecting motivation. The results in Table 4 are consistent with Hypothesis 2. The respondent's confidence in his or her answers and how highly the respondent rates the importance of finance are significantly and positively associated with increased motivation to learn, while expecting to make decisions with a spouse significantly decreases motivation to learn. Motivation is also weakly associated with age. Gender is not significantly associated with motivation after controlling for other possible determinants, suggesting that the average differences between men and women that affect motivation to learn about personal finance are captured in the other independent variables. Though confidence in one's answers is a significant determinant of motivation, confidence in one's ability to make future financial decisions is not. To examine whether the first measure of confidence is masking the influence of the second, we repeated the regression without the confidence in one's answers variable. Both the coefficient and the *t*-statistic of the second confidence measure increased, but the *p*-value was still above 10% and the adjusted *R*-square of the regression fell slightly. In contrast, when we ran the regression with confidence in one's answers and without confidence in one's ability to make future decisions, the coefficient and t-statistic of the variable and the adjusted *R*-square of the regression all increased. Perhaps confidence in one's answers is a better measure of expectancy because it does not require respondents to speculate on their future abilities. Alternatively, confidence in one's future decisions may have a weaker relationship with motivation because it reflects both expectancy and the likelihood of sharing the responsibility for decision-making with a spouse, which tend to have opposite effects on motivation.

Two potentially important questions we failed to ask in our survey are what income level respondents expected to earn in the future and whether they expected to be financially dependent on a spouse or anyone else. High (low) expected income and independence may simultaneously increase (decrease) motivation to learn finance and decrease (increase) one's

Table 4 Factors associated with motivation

	B	Standard error	*t*	Sig.
Panel A: OLS				
(Constant)	−1.250	0.835	−1.497	0.136
Gender	0.174	0.110	1.573	0.118
Age	0.074	0.041	1.822	0.070
Work	−0.029	0.095	−0.307	0.759
Parents' income	0.016	0.027	0.583	0.560
Parents in finance	−0.116	0.115	−1.009	0.315
Importance	0.612	0.114	5.368	0.000
Confident answers	0.138	0.059	2.320	0.022
Confident decisions	0.032	0.063	0.502	0.616
Decisions with spouse	−0.254	0.102	−2.498	0.013
Adjusted R^2	0.263			
F (Sig.)	7.922 (0.000)			
Panel B: Ordinal regression	Estimate	Standard error	Wald	Sig.
Gender = 0	−0.526	0.370	2.025	0.155
Age	0.283	0.138	4.221	0.040
Work = 0	0.061	0.317	0.038	0.846
Parents' income	0.066	0.092	0.509	0.475
Parents in finance = 0	0.298	0.387	0.591	0.442
Importance	1.976	0.410	23.201	0.000
Confident answers	0.470	0.200	5.521	0.019
Confident decisions	0.181	0.212	0.732	0.392
Decisions with spouse = 0	0.775	0.345	5.058	0.025
Cox and Snell	0.295			
χ^2 (Sig.)	61.411 (0.000)			

Note. Reports results of OLS and Ordinal regression with Motivation as the dependent variable. Motivation is coded 0 if respondent chose "Neither motivated nor unmotivated," 1 if "Somewhat motivated," and 2 if "Very motivated." No other choices were selected. Gender is 1 if the respondent self-identified as male, 0 as female. Work is coded 1 if respondent works part- or full-time during the school year, 0 otherwise. Parents' income is coded 0 if respondent chose "Unsure," 1 if <$30,000, 2 if $30,000-$59,000, 3 if $60,000-$89,000, 4 if $90,000-$119,000, and 5 if >$120,000. Parents in finance is coded 1 if respondent reports at least one parent who works in a finance-related field. Importance of finance is coded 0 if respondent selected "Important" and 1 if "Very Important." No other choices were selected. Confident answers is the respondent's ranking of how confident he or she felt when answering the financial knowledge questions from 1 to indicate "Not at all confident" to 5 to indicate "Very confident." Confident decisions is the respondent's ranking of how confident he or she feels about having to make financial decisions in the future on the same 1 to 5 scale. Decisions with spouse is coded 1 if respondent expected to make future financial decisions with a spouse, 0 if respondent expected to make future financial decisions alone. OLS coefficient estimates for binary variables estimate the impact on the dependent variable, Motivation, when the response is coded 1. Ordinal regression coefficient estimates for binary variables estimate the impact on the dependent variable, Motivation, when the response is coded 0.

intention to make decisions with someone else. We cannot rule out this alternative explanation of the negative association we find between motivation and decisions with spouse.

To investigate whether the likely determinants of motivation affect women and men differently and test our third hypothesis, we split our sample into female and male subsamples and run the motivation regressions, excluding the gender independent variable, on each subsample. The results in Table 5 indicate that, among our female respondents, motivation to

Table 5 Factors associated with motivation by reported gender

	Female				Male			
	B	Standard error	*t*	Sig.	*B*	Standard error	*t*	Sig.
Panel A: OLS								
(Constant)	−1.047	1.044	−1.003	0.318	−1.413	1.385	−1.020	0.313
Age	0.079	0.050	1.587	0.115	0.045	0.068	0.669	0.507
Work	−0.109	0.115	−0.948	0.345	0.261	0.168	1.550	0.128
Parents' income	0.025	0.032	0.783	0.435	−0.037	0.051	−0.726	0.472
Parents in finance	−0.319	0.148	−2.159	0.033	0.201	0.173	1.159	0.253
Importance	0.473	0.130	3.629	0.000	1.063	0.231	4.610	0.000
Confident answers	0.125	0.066	1.895	0.061	0.098	0.143	0.689	0.495
Confident decisions	0.024	0.071	0.343	0.733	0.157	0.147	1.065	0.293
Decisions with spouse	−0.369	0.124	−2.969	0.004	−0.096	0.170	−0.564	0.576
Adjusted R^2	0.208				0.359			
F	5.030				4.570			
Significance	0.000				0.000			
Panel B: Ordinal Regression	Estimate	Standard error	Wald	Sig.	Estimate	Standard error	Wald	Sig.
Age	0.315	0.169	3.493	0.062	0.191	0.288	0.440	0.507
Work = 0	0.388	0.386	1.008	0.315	−1.403	0.740	3.595	0.058
Parents' income	0.090	0.109	0.692	0.405	−0.201	0.232	0.753	0.385
Parents in finance = 0	1.128	0.504	5.004	0.025	−1.405	0.826	2.889	0.089
Importance	1.536	0.457	11.316	0.001	4.289	1.199	12.801	0.000
Confident answers	0.426	0.223	3.657	0.056	0.443	0.616	0.518	0.472
Confident decisions	0.139	0.237	0.343	0.558	0.721	0.656	1.209	0.272
Decisions with spouse = 0	1.221	0.426	8.210	0.004	0.181	0.719	0.063	0.802
Cox and Snell	0.255				0.445			
χ^2	36.549				30.583			
Significance	0.000				0.000			

Note. Reports results of OLS and Ordinal regression with Motivation as the dependent variable and sample split by reported gender. Motivation is coded 0 if respondent chose "Neither motivated nor unmotivated," 1 if "Somewhat motivated," and 2 if "Very motivated." No other choices were selected. Work is coded 1 if respondent works part- or full-time during the school year, 0 otherwise. Parents' income is coded 0 if respondent chose "Unsure", 1 if <$30,000, 2 if $30,000-$59,000, 3 if $60,000-$89,000, 4 if $90,000-$119,000, and 5 if >$120,000. Parents in finance is coded 1 if respondent reports at least one parent who works in a finance-related field. Importance of finance is coded 0 if respondent selected "Important" and 1 if "Very Important." No other choices were selected. Confident answers is the respondent's ranking of how confident he or she felt when answering the financial knowledge questions from 1 to indicate "Not at all confident" to 5 to indicate "Very confident." Confident decisions is the respondent's ranking of how confident he or she feels about having to make financial decisions in the future on the same 1 to 5 scale. Decisions with spouse is coded 1 if respondent expected to make future financial decisions with a spouse, 0 if respondent expected to make future financial decisions alone. OLS coefficient estimates for binary variables estimate the impact on the dependent variable, Motivation, when the response is coded 1. Ordinal regression coefficient estimates for binary variables estimate the impact on the dependent variable, Motivation, when the response is coded 0.

learn finance increases weakly with age and confidence and significantly with how highly they rate the importance of finance. It decreases significantly when female respondents have at least one parent who works in a finance-related field and when they expect to make financial decisions with a spouse. In stark contrast, the only significant determinant of our male

respondents' motivation to learn finance is how highly they rate the importance of finance. Together, the results shown in Tables 3 and 5 are partially consistent with hypothesis three. The *t*-tests indicated that the only significant difference between men and women among the hypothesized determinants of motivation is in confidence. Women were less confident in their test answers and in their abilities to make future financial decisions than men were. But women did not rate personal finance as less important. Women were not more likely than men to say they would make decisions with their spouse; however, only among the women did the expectation that they would make decisions with their spouse decrease their motivation to learn personal finance. Thus, our results suggest that women tend to be less motivated to learn personal finance because they tend to be less confident. Their motivation also decreases when they expect to rely on a spouse or a parent to help them make their decisions.

5. Conclusion

Study after study indicates that women, with and without college educations, from high schoolers to retirees, are less financially literate, less interested in personal finance, and less confident in their financial knowledge and decision-making abilities than are men of similar education and age. Other studies show that these relative weaknesses in knowledge and interest have negative impacts on women's financial well-being, particularly with respect to how much retirement savings they accumulate and how much they pay for loans.

Our results are consistent with our hypotheses derived from expectancy theory of motivation and related literature. The women in our sample of undergraduate students appear to be less knowledgeable, less interested, less confident, and more risk averse, on average, than the men. Motivation to learn personal finance increases with confidence and how highly one rates the importance of finance. The majority of both men and women in our sample rated personal finance as Very Important and said that they expect to make future financial decisions with their spouse. None of the respondents indicated that they expected their parents or spouse to make decisions for them. Nevertheless, the women appear to be less motivated to learn about personal finance when they have at least one parent who works in a finance-related field or when they expect to make financial decisions with a spouse. This suggests that today's young women still expect to rely on parents or spouses when managing household finances. We know of no other recent evidence that this rather old-fashioned notion persists.

The principal limitation to our study is our low response rate and subsequently small sample size, particularly with respect to the number of male participants. Women and Whites are over-represented compared with the general population, and our survey participants are all college students aged 18-23. Another important limitation is the potential for measurement error that comes with self-reported data. We rely on our respondents to rate how confident and motivated they are and how important personal finance is. One respondent's definition of confidence, motivation, or importance may vary from others. Similarly, how one determines the magnitudes of these attributes can also vary. Notably, if the women in

our sample tend to define these attributes differently than men do, or if they are less likely to describe themselves or their beliefs using extreme modifiers, such as Very Confident or Very Motivated, this general tendency could explain some of our results in Tables 3 and 4. A third limitation is that two key questions rely on respondents' future expectations. We ask them to rate their "Confidence in their abilities to make financial decisions in the future," and "In the future, who do you expect to make your financial decisions?" Finally, we must acknowledge that our respondents are unmarried, financially dependent, college students with no children. Their motivation to learn finance could vary greatly from that of others with children, spouses, financial independence, and varying levels of income and education. For example, having children may increase one's motivation to take personal responsibility for financial decisions regardless of gender, marital status, age, or income. Similarly, data in Tables 4 and 5 indicate that parents' income does not affect reported motivation to learn personal finance, but one's own income could affect motivation and reliance on a spouse.

Nevertheless, every study must start somewhere, and college is the place where many people start to experience independence and financial responsibility. It may also be the easiest time of one's life to learn about personal finance, since education and preparing for the future is a key theme of college life. Furthermore, our results are consistent with prior literature and with the expectancy theory of motivation. Thus, we believe our key results that one's motivation to learn personal finance varies with how important one rates personal finance and that women tend to be less motivated to become financially literate when they are less confident in their financial knowledge and when they expect to make financial decisions with their spouse will generalize to larger, more representative samples and across education and income levels and ages. Further exploration to confirm and expand on our results is warranted.

Notes

1. Atkinson and Messy (2012) had eight financial knowledge questions. We chose not to include their compound interest question because they awarded a point for the correct answer only if another question on interest calculation was answered correctly. We also changed three open-ended questions requiring simple math to multiple choice because we felt students would be more likely to answer if choices were provided.
2. The question was, "When you have questions regarding personal finance in the future, where do you think that you will go to for advice? (Choose all that apply)."
3. As the motivation rating is an ordinal variable, ordinal regression is likely to be a more appropriate regression technique than OLS. See Norusis (2012).

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Appendix

Appendix: Survey

The following survey questions were administered electronically via Qualtrics. Open-ended questions are indicated by *Open* following the question. Otherwise, answer choices are italicized following the question.

1. What is your Pirate (school) ID? *Open*
2. Are you an undergraduate student at East Carolina University? *Yes, No*
3. What college or school do you fall into? *Engineering and Technology, Arts and Sciences, Nursing, Business, Health and Human Performance, Allied Health Sciences, Education, Fine Arts and Communication, Other*
4. What is your age? *Open*
5. What is your class rank? *Freshman, Sophomore, Junior, Senior*

6. What is your gender? *Male, Female, Other*
7. What is your race? *Asian, White/Caucasian, African American, Hispanic, Pacific Islander, Other*
8. What is your employment status? *I do not work, I work part time, I work full time*.
9. What is your/your parents total household income? *Not sure, less than $30,000, $30,000 to $59,999, $60,000 to $89,999, $90,000 to $119,999, $120,000 or more.*
10. Do either of your parents work in the financial services industry? *No; Not anymore, but one or both used to; Yes, one of my parents; Yes, both of my parents*.
11. Is English your primary language? *Yes, No*
12. Do you know about the personal finance course (FINA 1904) offered at ECU? *Yes, No*
13. Have you taken the personal finance course (FINA 1904) at ECU? *Yes, No*
14. If answer to Q13 is yes, why did you choose to take the course? *I thought it would be valuable to my future, I heard good reviews about the professor(s), I needed an elective course, I heard the class was easy.*
15. If answer to Q13 is yes, after taking the course do you feel that personal finance is more important or less important than before you took the course? *Less important, Neither more nor less important, Slightly more important, More important*
16. If answer to Q13 is yes, what grade did you receive in the course? *A, B, C, D, F*
17. If answer to Q13 is yes, how valuable do you feel what you learned will be in the future? *Not at all valuable, somewhat invaluable, neither valuable nor invaluable, somewhat valuable, very valuable*
18. If answer to Q13 is no, why did you choose not to take this course? *I did not think it would be worthwhile, I did not have any room in my schedule, I heard the class was hard, Other.*
19. If answer to Q13 is no, do you plan to take the personal finance course (FINA 1904) at ECU? *Yes, No*
20. Have you ever attended a personal finance seminar/informational session? *Yes, No*
21. Where have you ever studied personal finance? *I have never studied personal finance, High school personal finance class, College level personal finance class, Other*.
22. Do you plan to attend a personal finance seminar/informational session? *Yes, No*
23. Have you ever taken a finance course besides personal finance? *Yes, in high school; Yes, in college; No*
24. Have you ever taken an economics course? *Yes, in high school; Yes, in college; No*
25. How important do you think personal finance is? *Very unimportant, Unimportant, Neither unimportant nor important, Important, Very important.*
26. If answer to Q24 is Very Unimportant or Unimportant, why do you find personal finance unimportant? *Open*
27. If answer to Q24 is Very Important or Important, why do you find personal finance important? *Open*
28. How motivated are you to learn about personal finance? *Very discouraged, slightly discouraged, neither motivated nor discouraged, slightly motivated, very motivated.*
29. How strongly have your parents influenced your knowledge of personal finance? *1- Not at all, 2, 3, 4, 5 - A great deal*.
30. How strongly have other relatives (besides your parents) influenced your knowledge of personal finance? *1- Not at all, 2, 3, 4, 5 - A great deal*.
31. How strongly have instructors influenced your knowledge of personal finance? *1- Not at all, 2, 3, 4, 5 - A great deal.*
32. How strongly have your peers influenced your knowledge of personal finance? *1- Not at all, 2, 3, 4, 5 - A great deal*.
33. How strongly has the media influenced your knowledge of personal finance? *1- Not at all, 2, 3, 4, 5 - A great deal*.
34. How strongly have online resources influenced your knowledge of personal finance? *1- Not at all, 2, 3, 4, 5 - A great deal*.
35. How strongly have your own experiences influenced your knowledge of personal finance? *1- Not at all, 2, 3, 4, 5 - A great deal*.
36. How strongly has your religion influenced your knowledge of personal finance? *1- Not at all, 2, 3, 4, 5 - A great deal*.
37. How strongly have your parents influenced your financial decisions? *1- Not at all, 2, 3, 4, 5 - A great deal.*
38. How strongly have your other relatives (besides your parents) influenced your financial decisions? *1- Not at all, 2, 3, 4, 5 - A great deal*.

39. How strongly have your instructors influenced your financial decisions? *1- Not at all, 2, 3, 4, 5 - A great deal*.
40. How strongly have your peers influenced your financial decisions? *1- Not at all, 2, 3, 4, 5 - A great deal.*
41. How strongly have online resources influenced your financial decisions? *1- Not at all, 2, 3, 4, 5 - A great deal*.
42. How strongly has the media influenced your financial decisions? *1- Not at all, 2, 3, 4, 5 - A great deal.*
43. How strongly have your own experiences influenced your financial decisions? *1- Not at all, 2, 3, 4, 5 - A great deal*.
44. How strongly has your religion influenced your financial decisions? *1- Not at all, 2, 3, 4, 5 - A great deal.*
45. When you have questions in regard to personal finance in the future, where do you think that you will go to for advice? (Choose all that apply). *Friends, Parents, Other Relatives, Online, Books, Financial Advisor.*
46. For the following financial products, please indicate if you have heard of the product - Credit Card. *Yes, No*
47. For the following financial products, please indicate if you have heard of the product - Renters Insurance. *Yes, No*
48. For the following financial products, please indicate if you have heard of the - Retirement Account. *Yes, No*
49. For the following financial products, please indicate if you have heard of the product - Investment Account (529 College Savings Plan, Trust, etc.) . *Yes, No*
50. For the following financial products, please indicate if hold this type of account - Credit Card. *Yes, No*
51. For the following financial products, please indicate if you hold this type of account - Renters Insurance. *Yes, No*
52. For the following financial products, please indicate if you hold this type of account - Retirement Account. *Yes, No*
53. For the following financial products, please indicate if you hold this type of account - Investment Account (529 College Savings Plan, Trust, etc.) . *Yes, No*
54. Do you plan to invest in the stock market? Why or why not? *Yes, I plan to invest in the stock market in the future; Yes, I a.m. currently invested in the stock market; No, the stock market is too risky; No, I will not make enough money to invest; Other.*
55. Imagine that five brothers are given a gift of $1,000. If the brothers have to share the money equally how much does each one get? *100, 200, 250, I don't know*.
56. Now imagine that the brothers have to wait for one year to get their share of the $1,000 and inflation stays at 3%. In one year's time will they be able to buy: *Less than they could buy today, The same amount as they could buy today, More than they could buy today, I don't know.*
57. You lend $25 to a friend one evening and he gives you $25 back the next day. How much interest has he paid on this loan? *100%, 50%, 0%, I don't know*.
58. Suppose you put $100 into a no fee savings account with a guaranteed interest rate of 2% per year. You don't make any further payments into this account, and you don't withdraw any money. How much would be in the account at the end of the first year once the interest payment is made? *98, 100, 102, I don't know*.
59. High inflation means that the cost of living is increasing rapidly. *True, False*.
60. It is usually possible to reduce the risk of investing in the stock market by buying stocks in many different companies. *True, False*.
61. An investment with a high return is likely to be low risk. *True, False*.
62. How confident are you in your answers to the above financial literacy questions? *1 - Not Confident At All, 2, 3, 4, 5 - Extremely Confident.*
63. How confident are you in your ability to make financial decisions in your future? *1 - Not Confident At All, 2, 3, 4, 5 - Extremely Confident.*
64. In the future, who do you expect to make your financial decisions? *Yourself, You and Your Spouse Together, Your Parents, Other*

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Financial literacy and its impact on the credit card debt puzzle

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Abstract

The credit card debt puzzle is not well understood. Households exhibit inefficient behavior when they have sufficient liquid assets to pay off their credit card balance, but do not. Based multinomial regression analyses of the 2016 Survey of Consumer Finances, the study discovered that households that display this behavior are more likely to have lower financial literacy than convenience users. The findings suggest financially literate households are less likely to display irrational behavior regarding the credit card debt puzzle.

JEL classifications: G530; J24; G510

Keywords: Behavioral life-cycle; Credit card debt puzzle; Financial literacy; 2016 survey of consumer finances

1. Introduction

Household credit card use is widespread. Comparing all debt across households, credit card debt is the debt type most extensively used by households (Bricker et al., 2017). Over 70% of U.S. households have a credit card (Bucks, Kennickell, Mach, & Moore, 2009). There are two main groups of credit card users: those users who pay off their balance at the end of each month, commonly called convenience users, and those who carry a balance from month to month. These households that carry a balance from month to month are known as revolving credit card users (Kim & DeVaney, 2001). According to the 2016

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Survey of Consumer Finances, 44% of families carry a balance on their credit cards. Since 2013, the median and mean balance both decreased by 3% balance (Bricker et al., 2017).

Within the revolving credit card users, there is a group of users, solvent revolvers, who have enough liquid assets to pay the balance of their credit cards but choose not to pay it off. Bi (2005) finds that 58% of revolving credit card users have liquid assets (liquid assets include monetary assets including checking, saving, and money market accounts and call accounts) totaling more than their credit card balance. Credit cards typically charge high interest rates on a revolving balance and liquid accounts (like checking and money market accounts) accrue low (if any) after-tax interest. Based on the interest rates, it is inefficient for a household to maintain a revolving balance. Previous studies that have investigated this irrational behavior call this the credit card debt puzzle or the co-holding puzzle (Bertaut, Haliassos, & Reiter, 2009; Gathergood & Weber, 2014; Haliassos & Reiter, 2005; Laibson, Repetto, & Tobacman, 2001).

Many studies research the credit card debt puzzle; however, few combine human capital theory and behavioral life cycle theory. The purpose of this paper is to study the effect of financial literacy on credit card debt treatment. It is hypothesized that households that have higher financial literacy will be less likely to display this puzzling behavior.

2. Literature review

Literature suggests a planner or doer framework is often a way to explain irrational behavior. The behavioral life cycle theory puts forward that a household is composed of two dueling selves, the planner and the doer. The planner is the forward-thinking, rational self while the doer is myopic and focused on current consumption (Shefrin & Thaler, 1988). The household makes decisions to satisfy both the planner and doer and may display conflicting and inefficient behaviors, such as the credit card debt puzzle. Several studies attempted to explain the credit card debt puzzle, or solvent revolving credit card use, with several distinct factors such as financial human capital, precautionary savings motives, and self-control. Gross and Souleles (2002) find that revolving high credit card balances while simultaneously holding liquid assets stem from behavioral explanations, not lack of liquidity.

2.1. Human Capital

The planner/doer model suggests the planner will reduce consumption in the current period by exerting a level of willpower. Because willpower is costly, the planner will resort to other techniques to reduce the consumption of the doer. Some of these techniques include mental accounting and rule-setting (Shefrin & Thaler, 1988). In the planner/doer model, the level of human capital can impact financial decisions. Becker (1964) describes human capital as an individual's stock of knowledge, health, skills, or values. It is a function of goods, services, time, and the individual's current stock of human capital. Human capital is often improved through learning, maturity, and experiences. In the realm of finance, individuals can improve their human capital by taking financial courses to improve their ability to understand and

make effective financial decisions. Individuals can also improve their financial human capital through experiences like using credit cards or taking out a home mortgage. Households with an elevated level of financial knowledge and experience are considered financially literate or financially sophisticated; these households can make more effective financial decisions than households with a lower level of financial literacy or financial sophistication.

Financial literacy gives the household the potential to improve their ability to make better financial decisions. The households with a higher level of financial sophistication tend to be aware of the consequences of their decisions. Bertaut et al. (2009) suggests that financially sophisticated households would be convenience users of credit cards as well as benefit from floating and other advantages of credit cards.

Although, some financially sophisticated households display characteristics that are not sophisticated. For example, Haliassos and Reiter (2005) find that in the shopper/accountant model, the shopper is not fully financially sophisticated. The accountant/shopper model is like the planner/doer model.

2.2. Mental accounting and precautionary savings motives

To control the doer, the planner creates mental accounts to reduce the temptation to spend from them. Households divide assets, expenditures, and income into distinct categories or mental accounts. An economist would state that these accounts are substitutable, but they are not (Thaler, 1999). The household views the mental accounts, either assets or expenses, as different things, and marginal propensity to consume from these accounts are different. For example, households save money in an emergency fund account to prepare for an uncertain event. The household uses framing to earmark these accounts for difference purposes. Households that save in liquid accounts for emergencies or unexpected events do not believe the assets are substitutable for other assets or expenses.

When households use mental accounting for expenses, especially with credit cards, they decouple the payment from the consumption. Once the bill is received, the purchase is mixed with other purchases. Thaler (1999) states that it is hard for the consumer to attribute the balance to any purchase: therefore, the consumer carries a balance from month to month. Because households have mental accounts, they will not view accounts used for savings as available to pay off credit card balances since these accounts are not substitutable.

Uncertainty and precautionary savings motives play a role in mental accounting. Telyukova and Wright (2008) propose that households stay solvent revolvers to maintain sufficient liquid assets for uncertain future events. Bi and Hanna (2006), Druedahl and Jørgensen (2018), and Gorbachev and Luengo-Prado (2019) find that households will display the credit card debt puzzle when precautionary savings motives are present.

2.3. Self-control

Although the planner creates mental accounts to control the doer, the individual must exhibit self-control. An individual displays self-control issues by either postponing action (e.g., procrastination) or by consuming immediately (e.g., no willpower to wait). Households that display self-control issues either consume all their resources without saving

or paying debt or putting off making critical decisions. One study shows that in an accountant/shopper household, the accountant would choose not to pay off the credit card balance to impose control over the shopper (Bertaut et al., 2009). By reducing the available limit on the credit card, the shopper is unable to consume more. Gathergood and Weber (2014) show that the likelihood of displaying the credit card debt puzzle, or co-holding, increases with self-assessed impulsiveness.

Other studies have identified other behavioral factors that affect solvent revolving credit card use. Credit attitude and bankruptcy history are often considered when households exhibit credit card debt puzzle. First, Chien and DeVaney (2001) find that a positive credit attitude was related to a higher credit card balance. Rutherford and DeVaney (2009) find that those households that had a positive attitude toward credit are less likely to be convenience users.

3. Theory and conceptual framework

Other studies evaluate how the credit card debt puzzle, and the relevant behavioral factors are related, however few focus on the intersection of financial knowledge and behavior. This study uses a combination of the behavioral life-cycle hypothesis and human capital theory to focus on how behavioral factors and human capital influence the likelihood of being a solvent credit card revolver.

Like the life-cycle hypothesis, the behavioral life-cycle hypothesis (Shefrin & Thaler, 1988) puts forward that to maximize utility, a household will shift resources in periods where the marginal utility of consumption is low to periods where the marginal utility of consumption is high. A good example of this is when households save during the working years for consumption during retirement years. Unlike the traditional life-cycle hypothesis, the behavioral life-cycle hypothesis posits that households have a dual preference framework where they are both planners (long-term) and doers (short-term). The planner preference is when households make rational decisions regarding when to shift resources to maximize utility. The planner focuses on long-term decisions to maximize utility. The doer preference, or short-term preference, is when households succumb to temptation to consume in the current period. The three behavioral factors, self-control, mental accounting, and framing are what make the behavioral life-cycle hypothesis different from other life-cycle models.

Self-control refers to the household's temptation to make immediate consumption decisions, rather than saving for future consumption. For the doer, immediate consumption is always a tempting alternative to future consumption. There is discomfort for the doer associated with postponing current consumption; therefore, the planner will enforce saving devices and rules of thumb to deal with self-control issues for various situations. These are types of external rules that households use to plan for future consumption. Households also use internal rules, like refusing to borrow for current consumption, to maintain self-control.

Mental accounting refers to placing wealth into different non-substitutable accounts. The typical breakdown of mental accounts is current income, current assets, and future income (Shefrin & Thaler, 1988). Households use mental accounting to restrict the doer from bringing future resources into the current period. The way a household frames the different mental accounts determines the temptation to spend from each account. Each account has a different

level of temptation associated with spending from it. The marginal propensity to consume from the current income account is much higher than the marginal propensity to consume from the future income account. Temptation plays an important role in the household's decision to spend or save.

By carrying a credit card balance, the doer is bringing consumption into the current period. The households that are solvent (i.e., households who have enough liquid assets to pay off their balance but do not) are not displaying the planner behavior but are displaying the doer behavior. In contrast, convenience users are keeping future resources in future periods by paying off the balance while still benefiting from the advantages of using a credit card.

In addition to the behavioral life-cycle hypothesis, human capital theory also plays a part in solvent revolving credit card use. Human capital is an individual's knowledge, health, skills, or values and is often described as a function of goods, services, time, and the individual's current stock of human capital. A household's level of human capital impacts its ability to make efficient financial decisions. Households with a higher level of financial human capital (i.e., financial sophistication) have the potential to improve the ability to make effective and efficient financial decisions.

4. Hypotheses

Based on the theoretical framework, the concepts developed for this paper include human capital, mental accounting/precautionary savings motives, self-control factors, and other lifecycle control factors. The concepts serve as control factors to explain why households display puzzling behavior that is inefficient. The hypotheses are as follows:

H01: Higher levels of financial literacy will reduce the likelihood of revolving credit card debt even when financially solvent.

H02: Mental accounting behaviors will increase the likelihood of revolving credit card debt even when financially solvent.

H03: Self-control issues will increase the likelihood of revolving credit card debt even when financially solvent.

5. Method

5.1. Data and sample

The data used were from the 2016 Survey of Consumer Finances (SCF), a triennial survey, which is sponsored by the Federal Reserve Board and collected by the National Organization for Research at the University of Chicago (Board of Governors of the Federal Reserve System, 1998-2013). The SCF collects detailed information on the finances of U.S. households. The 2016 SCF included 6,248 households in the public data set. The 2016 SCF contains five implicates to deal with missing data. The total number of observations with all

five implicates is 31,240 observations. For this study, we only used the first implicate and because this study only analyzes those households that have a credit card, the final sample is limited to 4,725 observations. We created an additional subsample (N-2360) by censoring the data to only solvent revolvers and convenience users to assess credit use decisions among the most financially literate respondents (answered all financial literacy questions correctly).

5.2. Dependent variables

The dependent variable is constructed by categorizing credit card users into one of three categories. First, solvent revolvers are credit card users have liquid assets greater than or equal to the balance still owed on their main credit card after the last payment was made to the account. The total liquid assets are derived from the Federal Reserve Board definition in the net worth code. From this definition, liquid assets include money market accounts, checking accounts, savings accounts, call accounts, and prepaid cards. Next, insolvent revolvers are credit card users have liquid assets less than the balance still owed on their main credit card after the last payment is made to the account. Last, convenience credit card users do not have an outstanding balance on their main credit card. To answer our research questions, we create an unranked three level categorical variable of credit card user, and dichotomous variables to for each credit card user type.

5.3. Independent variables by concept

Based on the behavioral life-cycle hypothesis and human capital theory, four concepts were identified: human capital/financial literacy, mental accounting/precautionary savings motives, self-control factors, and other lifecycle control factors. Independent variables operationalized these concepts.

The human capital concept explains the household's potential to make effective decisions. Households that do not have a strong base in financial human capital (i.e., financially literate) tend to make suboptimal financial decisions (Bertaut et al., 2009). Because the purpose of this study is to evaluate the impact of financial literacy on solvent revolvers, human capital is the focus of the study. The human capital concept was measured by two independent variables: financial literacy and education. Financial literacy represents a type of human capital specific to personal finance while education represents a general type of human capital. The variables that make up this concept moderate the financial decisions made by the households to not pay off their credit card balance even when the household has the financial liquidity to do so.

Our primary independent variable is this concept is financial literacy. Respondents who participated in the 2016 SCF were asked three financial literacy questions. The questions stated in the survey include:

1. Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?

2. Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account?

3. Buying a single company's stock usually provides a safer return than a stock mutual fund.

In prior studies, researchers like Lusardi and Scheresberg (2013) use these same questions to construct their proxy for financial literacy. If a respondent answered all the above questions correctly, they are classified as financially literate and coded 1. If the respondent did not answer all questions correctly then they are coded 0. The second variable included in the human capital concept is the level of education for the head of household. The level of education was categorized as noncollege degree (including less than high school, high school degree, and some college) and college degree.

The mental accounting concept relates to how the planner controls the doer's consumption by using various mental accounts. Past literature shows that households maintain solvent revolving due to mental accounting and the framing of the different accounts. With the behavioral life-cycle hypothesis, households do not view mental accounts as substitutable. Households do not tend to use emergency savings accounts to pay off credit card balances if they are not in an emergency situation. The variables that make up this concept represent why the household will maintain liquid assets more than their credit card balance and maintain their status as a solvent revolver.

Mental accounting is measured by six independent variables. The first variable, having an emergency fund. If the household indicated they have savings for a subjective emergency fund, they are coded as 1 and 0 otherwise. The second variable, saving for unemployment, is constructed by combining two variables: if the household stated they had a savings motive for unemployment and if they expect their future income will decrease in comparison with prices in the next year. The variable is coded as 1 if the household had a motive to save for unemployment and 0 otherwise. The third variable, saving for illness, was constructed by combining two variables: if the household stated they had a savings motive for in case of illness or future medical expenses and if they have a poor health status. The variable is coded as 1 if the household had a motive to save for illness and 0 otherwise. The fourth variable is the household's ability to borrow $3,000 from friends or relatives in an emergency. The variable is coded as 1 if the household was able to borrow and 0 if the household was not able to borrow from friends or relatives. The fifth variable is if either the head of household or the spouse is self-employed. The variable is coded as 1 if self-employed and 0 if not self-employed. The last variable is the proxies whether a household owns liquid accounts. If a household report owning a liquid account such as a checking account, we code that as a 1 or 0 otherwise.

The self-control concept is included since households have limited time to make financial decisions. Households display self-control issues regarding financial decision making. Self-control plays a role in the household's susceptibility to give in to temptation to spend/consume during the current period. The self-control concept is comprised of past payment history, bankruptcy history, credit attitude, likelihood to increase spending with increased asset value, and unwillingness to decrease spending with a decrease in asset value. The first variable is the past payment history of all loans, mortgages and credit cards made during the past year. The variable is coded as 1 for those households who made payments on schedule or had no payments and 0 for those who were behind or missed payments. Past literature shows that a household maintains solvent revolving due to credit attitude and bankruptcy history. The household's credit attitude is measured by their feelings about using credit. The

variable is coded as positive if the household feels credit is a good idea, ambivalent if the household feels credit is good in some ways and bad in others, and negative if the household feels credit, is a bad idea. The ambivalent credit attitude group is the reference group for the regression analyses. Last, bankruptcy history is coded 1 if the household has ever filed for bankruptcy, or 0 if they have never filed for bankruptcy.

As a further proxy for the self-control concept, include two variables that represent spending and consumption when faced with positive or negative changes in income or financial assets. The variables, likelihood to increase spending if assets increase and unwillingness to reduce spending if assets decrease, are operationalized as dichotomous variables and coded as 1 if they report doing the action and 0 if otherwise.

The lifecycle factors concept is included since households make decisions based on being in various stages of the lifecycle. The variables that make up this concept represent why the household will maintain liquid assets more than their credit card balance and maintain their status as a solvent revolver.

The concept is measured using age, race, gender, marital status, income, and net worth. First, age is coded categorically as under 35, between 35 and 55, and over 55. Race is separated into four categories, Black, White, Hispanic, and Other. Next, gender and marital status are included in the analysis. Gender is coded as male or female and male is the reference category for the regression analyses. Marital status is coded as married or not married. The married category is the reference group. Next, household income is a continuous variable. Income is logged to see the magnitude and its effect in each of the regressions. Last, net worth is a continuous variable. Household net worth is logged to see the magnitude and its effect in each of the regressions.

5.4. Empirical models

To answer the research questions, we use a combination of multinomial logistic regressions (MLR) and binary logistic regressions (BLR). MLR is used due to the structure of the dependent variable. Recall, the dependent variable is constructed by categorizing credit card users into one of three *unranked* categories: convenience users, solvent, and insolvent revolvers. We present four MLR models, specification A–D. In Specification A, we regress the human capital concept on the dependent variable. In Specification B, we include mental accounting to the previous model. We then add the self-control and estimate Specification C. In the final MLR model, we include life cycle factors to all previous three concepts. The final model uses a restricted sample that includes only convenience users and solvent revolvers who are financially literate; therefore, a BLR is used. The model seeks to explain why households remain solvent revolvers when they have the financial resources and financial sophistication to be convenience users.

5.5. Analysis of data

Descriptive statistics were conducted to look at the characteristics of households. To generalize the findings back to the U.S. population, the descriptive statistics are weighted using a weight variable provided by the Federal Reserve (Lindamood, Hanna, & Bi, 2007). Since

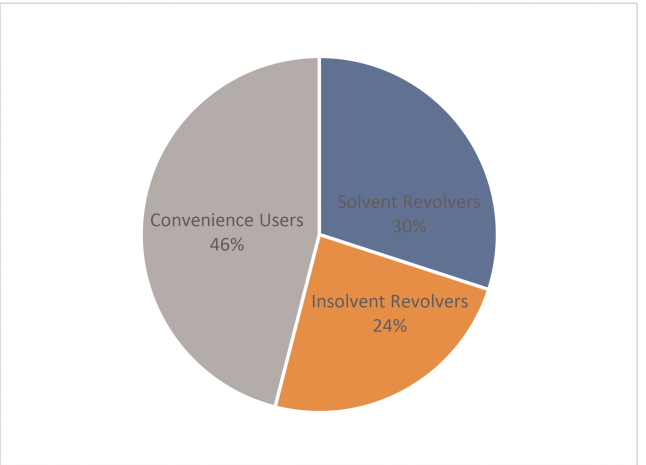

Fig. 1. Shows distribution of sample by type of credit card user type.

the dependent variables are unranked and categorical multinomial and binary logistic regressions are used to estimate the likelihood of the dependent variables occurring given the set of independent variables. The regression analyses are not weighted (Lindamood et al., 2007).

6. Results

6.1. Descriptive statistics

Since the descriptive statistics are weighted, the reported percentages, means, and standard errors represent all U.S. households. Fig. 1 shows the distribution of credit user groups in the full sample. Convenience users account for 46% of the sample, while insolvent and solvent revolvers make up 30% and 24%, respectively. Fig. 2 presents a pie chart that shows the distribution of the sample by the number of financial literacy questions that were answered correctly. From the pie chart only 50% of the respondents in our sample were able to answer all three questions correctly. For our research, we consider respondents that answered all questions correctly as financially literate. Fig. 3 separates the credit user group by financially literate or not financially literate. Financially literate respondents are more likely to be convenience users and less likely to be solvent revolvers. See Table 1A for frequency distributions and Table 1B for mean and median of the full sample and by type of credit ser for other independent variables included in our models.

6.2. Regression

Table 2 provides multinomial logistic regression results for four specifications of our empirical model. Recall that the dependent variable is credit card user type with three levels: solvent revolver, insolvent revolver, and convenience user. Convenience user is the base

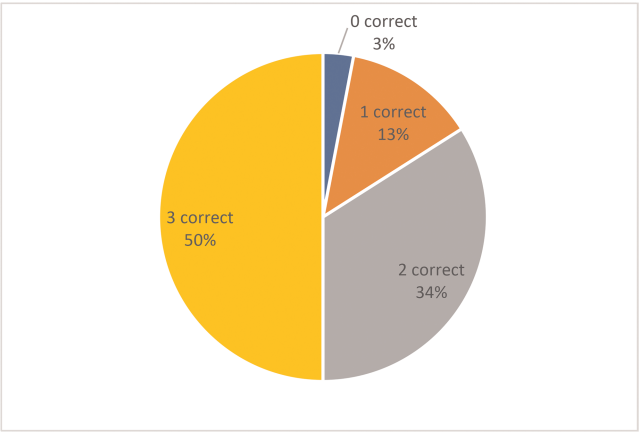

Fig. 2. Presents a pie chart that shows the distribution of the sample by the number of financial literacy questions that were correct.

reference for the MLR models discussed. All four concepts provide some value in explaining an individual's approach to credit card use. From Specification A, we see the impact of only human capital on the estimation of the likelihood of choosing between the three types of credit card use. In comparison to convenience users, financially literate individuals 46% less likely to be solvent revolvers and 54% less likely to be in insolvent revolvers. Similarly, college graduates with at least a bachelor's degree are 58% less likely to be either solvent or insolvent revolvers. In Specification B, we consider mental accounting factors in our estimation. Financially literate individuals remain less likely than not financial literate individuals to be solvent and insolvent revolvers of credit card debt, 42% and 39%, respectively. Turning to mental accounting factors, we see statistical significance from five of our six factors. Respondents with an emergency fund, are 45% less likely to be a solvent revolver and 80% less likely to be an insolvent revolver when compared with a convenience use. We observe a similar trend among the self-employed respondents as they are 32% less likely to be a solvent revolver and 52% less likely to be an insolvent revolver relative to convenience users who are not self-employed. Mixed results are observed for those who own liquid accounts, can borrow, and save for unemployment. For example, among respondents with

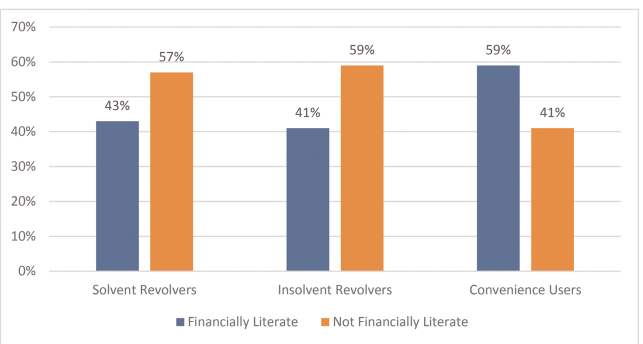

Fig. 3. Separates the credit user group by financially literate or not financially literate.

Table 1A Frequencies of independent variables (full sample and by credit user group)

	Full sample (%)	Insolvent revolver	Solvent revolver	Convenience user
		Human capital		
Financially literate	50.00	42.00	43.00	59.00
College degree	43.00	30.39	35.23	54.43
		Mental accounting/precautionary savings motives		
Have emergency fund	58.40	30.73	59.25	72.36
Saving for unemployment	3.42	3.45	3.99	3.04
Saving for illness	5.62	4.80	6.08	5.74
Ability to borrow from friends/relatives	27.97	40.18	26.43	22.58
Self employed	14.71	11.66	15.54	15.76
Have liquid accounts	63.02	46.70	70.48	66.67
		Self-control		
Payment history				
On time/no payment	89.25	79.04	87.02	96.07
Behind	10.75	20.96	12.98	3.93
Credit attitude				
Positive	27.35	27.79	30.38	25.2
Ambivalent	44.38	45.74	43.19	44.45
Negative	28.24	26.48	26.43	30.35
Bankruptcy history	12.29	22.07	15.44	5.08
Spending attitude				
Likely increase	21.76	26	21.57	19.67
Unwilling to reduce	28.58	25.67	26.02	31.81
		Lifecycle factors		
Age				
Under 35	18.47	18.45	23.12	15.21
35 to 55	36.59	45.53	40.95	29.02
Over 55	44.93	35.62	35.92	55.77
Gender				
Male	76.15	69.73	75.12	80.20
Female	23.85	30.27	24.88	19.80
Married	53.99	48.1	50.91	59.12
Race				
White	76.51	70.55	69.25	84.43
Black	11.93	16.02	18.05	5.74
Hispanic	9.19	14.59	10.80	5.28
Other	4.51	2.09	4.82	5.59

Note. Statistics derived from weighted analysis of one implicate. *Source:* 2016 Survey of Consumer Finances.

the ability to borrow, we estimate a 66% increase in the likelihood of being an insolvent revolver but no statistical difference in being a solvent revolver when compared with convenience user who could not borrow from a relative. As another example, liquidity plays an interesting role on the impact of credit card user type. Owning a liquid account result in a 50% increase in the likelihood of being a solvent revolver, but a 36% decrease in the likelihood of being an insolvent revolver relative to convenience users that did not own liquid accounts.

Table 1B Mean and median statistics of independent variables (full sample and by credit user group)

	Full sample	Insolvent revolver	Solvent revolver	Convenience user
		Mean		
Net worth	$912,469.96	$157,114.26	$413,347.22	$1,638,477.82
Log net worth	12.19	11.2428	11.7480	12.8805
Household income	$123,934.20	$65,830.40	$100,734.04	$169,748.06
Log HH income	11.11	10.8058	11.1073	11.2755
		Median		
Net worth	$ 180,180.00	$60,500.00	$126,600.00	$396,700.00
Log net worth	12.32	11.42	11.99	12.96
Household income	$67,000.00	$51,000.00	$68,000.00	$76,000.00
Log HH income	11.11	10.84	11.13	11.24

Note. Statistics derived from weighted analysis of one implicate. *Source:* 2016 Survey of Consumer Finances.

Specification C highlights the impact of human capital, mental accounting, and self-control concepts. Variables in the two previous concepts maintained their statistical significance with similar effect as in Specification B. Being behind on payments and a record of bankruptcy all increase the likelihood of being both a solvent and insolvent revolver when compared with convenience users with opposite characteristics. Respondents with delinquent accounts are more likely to be 230% and 344% more likely to be solvent revolvers and insolvent revolvers respectively in comparison to respondents reporting no delinquencies. Respondents that reported bankruptcy were 203% more likely to be a solvent revolver and 284% more likely to be an insolvent revolver compared with respondents who never filed for bankruptcy. Households whose assets reduced in value and refused to decrease their spending were 21% and 22% less likely to be a solvent or insolvent revolvers when compared with convenience users whose assets did not decrease.

In final MLR model estimation, we include all four concepts to estimate the impact on the dependent variables. By adding lifestyle factor variables, we observe notable changes in the effect of being financially literate, could borrow, being self-employed, and who were unwilling to reduce spending even after asset values declined. As an illustration, we comment on the impact of being financially literate. Households who were able to answer all the financial questions correctly were now only 18% less likely to be a solvent revolver compared with convenience users who were not financially literate. Moreover, there was no statistically significant difference in being an insolvent revolver compared with convenience users who were not financially literate. Of the lifestyle factors included in our analysis, we observe the following results. In comparison to respondents 34 years and younger, older respondents, 55 and over, are 59%% more likely to be solvent and 78% more likely to be insolvent revolvers when being a convenience user is an option. Women are more likely than men to be insolvent revolvers than convenience users. Specifically, the results show that compared with male convenience users, women are 63% more likely to be insolvent revolvers. Comparing unmarried households to married households who report being convenience users, unmarried respondents are 45% less likely to be insolvent revolvers. Income's impact on the credit card user type appears only marginally statistically significant for revolving insolvent debt. A one percentage increase in income decreases the likelihood of being a solvent revolver when

Table 2 Result of multinomial logistic regression results on credit user type (convenience user is the base group)

Variable	User type	A	*p*	B	*p*	C	*p*	D	*p*
Intercept	SR	1.09		1.24	**	0.95		34.74	***
Intercept	IR	0.92		2.16	***	1.58	***	955.85	***
		Human capital							
Financially literate	SR	0.54	***	0.58	***	0.60	***	0.82	**
Financially literate	IR	0.46	***	0.61	***	0.64	***	0.94	
College degree	SR	0.38	***	0.42	***	0.46	***	0.64	***
College degree	IR	0.30	***	0.42	***	0.46	***	0.77	**
		Mental accounting/precautionary savings motives							
Have emergency fund	SR			0.55	***	0.62	***	0.81	**
Have emergency fund	IR			0.20	***	0.24	***	0.34	***
Saving for unemployment	SR			1.57	**	1.42		0.84	
Saving for unemployment	IR			1.63	*	1.40		0.78	
Saving for illness	SR			0.93		0.97		1.07	
Saving for illness	IR			0.80		0.87		0.80	
Ability to borrow	SR			1.09		1.06		0.88	
Ability to borrow	IR			1.66	***	1.59	***	1.16	
Self employed	SR			0.68	***	0.67	***	1.32	**
Self employed	IR			0.48	***	0.47	***	1.11	
Have liquid accounts	SR			1.50	***	1.50	***	1.42	***
Have liquid accounts	IR			0.64	***	0.64	***	0.58	***
		Self-control							
Behind on payments	SR					3.30	***	2.19	***
Behind on payments	IR					4.44	***	2.97	***
Positive attitude toward credit	SR					1.23	**	1.18	*
Positive attitude toward credit	IR					1.01		1.08	
Negative attitude toward credit	SR					0.88		0.87	
Negative attitude toward credit	IR					0.77	**	0.75	**
Bankruptcy history	SR					3.03	***	2.19	***
Bankruptcy history	IR					3.84	***	2.70	***
Likely to increase spending	SR					0.99		1.04	
Likely to increase spending	IR					1.11		1.18	
Unwilling to reduce spending	SR					0.76	**	0.87	
Unwilling to reduce spending	IR					0.75	**	0.79	**
		Lifecycle factors							
Age 35–55	SR							1.77	***
Age 35–55	IR							2.61	***
Age 55+	SR							1.13	
Age 55+	IR							1.30	
Female	SR							1.08	
Female	IR							1.65	**
Not married	SR							0.87	
Not married	IR							0.50	***
Black	SR							2.48	***
Black	IR							1.54	**
Hispanic	SR							1.52	**
Hispanic	IR							1.45	**
Other race	SR							0.96	
Other race	IR							0.34	***
Log income	SR							1.08	
Log income	IR							0.88	*
Log net worth	SR							0.66	***
Log net worth	IR							0.62	***

Note. SR = Solvent Revolver. IR = Insolvent Revolver.

Table 3 Binary logistic results on the likelihood of being a solvent revolver

Variable	Odds ratio	*p*
Intercept	23.83	***
Human capital		
College degree	0.51	***
Mental accounting/precautionary savings motives		
Have emergency fund	0.69	**
Saving for unemployment	1.01	
Saving for illness	0.93	
Ability to borrow	0.84	
Self employed	1.15	
Have liquid accounts	1.35	**
Self-control		
Behind on payments	2.14	**
Positive attitude toward credit	1.22	
Negative attitude toward credit	0.82	
Bankruptcy history	3.67	***
Likely to increase spending	1.21	
Unwilling to reduce spending	0.85	
Lifecycle factors		
Age		
Age 35–55	1.17	
Age 55+	0.58	**
Female	1.06	
Not married	0.83	
Race		
Black	4.09	***
Hispanic	1.72	**
Other	0.83	
Log income	0.82	***
Log net worth	0.90	***

compared with a convenience user by 12%. Net worth's impact is more pronounced, as a one percentage increase in net worth estimates a 34% decrease in the likelihood of being a solvent revolver and a 38% decrease in the likelihood of being an insolvent revolver relative to convenience use of credit cards.

In Table 3, we present binary logistic regression results on the likelihood of being a solvent revolver compared with a convenience user. We use a restricted sample of solvent revolvers and convenience users who are financially literate. The analysis allows us to better understand the factors that affect the decision to revolve debt since solvent revolvers have the knowledge and financial ability to be convenience users. Compared with noncollege graduates, college graduates are 49% less likely to be solvent revolvers. Results show a similar pattern related to having an emergency fund as these households are 31% less likely to be solvent revolvers than households that do not have an emergency fund. Older respondents (55 and older) are 42% less likely than respondents 34 and younger to be solvent revolvers. Contrastingly, having liquid accounts, behind on payments, bankruptcy, and race all increased the likelihood of being solvent revolvers. Bankruptcy filings result in 267%

increase in the likelihood of be a solvent revolver. Black and Hispanic households are 309% and 72% more likely to be solvent revolvers, respectively, compared with white households. Income and net worth are also statistically significant at reducing the likelihood of being a solvent revolver. A one percentage increase in income, decreases the likelihood of being a solvent revolver by 18%. Similarly, a positive one percentage point change in net worth decreases the likelihood of being a solvent revolver by 10%.

7. Discussion

The research investigates the effect of financial literacy and other behavioral factors on credit card debt puzzle. There is a limited pool of empirical literature on the credit card debit puzzle. To be more specific, this study aims to evaluate solvent revolving credit card users and their financial literacy compared with insolvent revolvers and convenience users of credit cards. Based on the behavioral life-cycle hypothesis and human capital theory, the results provide an extension of the current literature.

Human capital plays a role in the decision to display the credit card debt puzzle. Hypothesis 1 suggests solvent revolvers will have a lower level of financial literacy than convenience users. Regarding specific financial human capital, solvent credit card revolvers have a lower level of financial literacy than convenience users. However, solvent revolvers should be more financially literate than insolvent revolving users. The findings of this paper support previous literature that solvent revolvers are not necessarily more financially literate than insolvent revolvers but moderating factors such as having a college degree play an important role (Bertaut et al., 2009; Haliassos & Reiter, 2005). Unsurprisingly, insolvent and solvent credit card users are less likely to have college degrees compared with convenience users; as a result, households should seek as much financial knowledge as possible or invest in assistance from a financial planner or counselor when making critical financial decisions.

Several factors in the mental accounting concept seem to have an impact on households' credit card debt use. Hypothesis 2 suggests that solvent revolvers would be more likely to display mental accounting and have higher precautionary savings motives than convenience users. Households that report having an emergency fund are less likely to revolve credit card debt. This finding is inconsistent with previous research that households that display the credit card debt puzzle are more likely to have a precautionary savings motive (Bi & Hanna, 2006; Telyukova & Wright, 2008, Gorbachev & Luengo-Prado, 2019). Self-employed households are less likely to be revolvers in general and less likely to be solvent revolvers. This finding suggests that households that are self-employed use credit cards for convenience purposes. The impact of family and friends was presented in the results. The ability to borrow increased the likelihood to be an insolvent revolver in the MLR models that included human capital, mental accounting, and self-control but not in the full model that includes lifecycle factors that differentiation from convenience users goes away. The ability to borrow allows households who may otherwise be solvent revolvers to be more like convenience users across all models. Last, having liquid accounts provides us with mixed results but highlights a notable difference between the credit card user groups. Households who report

having accounts such as checking and savings which are not earmarked for emergencies are more likely to be solvent revolvers. This finding suggests that households that save liquid assets in different accounts will choose not to pay off their credit card balance with those earmarked funds. Those who use mental accounting will have more liquid accounts compared with convenience users who have the self-control not to spend from fewer accounts.

The self-control factors contribute to the further understanding of the credit card debt puzzle. The variables making up this concept provide positive and negative insights in the likelihood of being a revolver of credit card debt and convenience use. In Hypothesis 3, we put forward that self-control will increase the likelihood of revolving credit card debt. Revolvers would be less likely to pay their bills on time, have a positive attitude toward credit, and have filed for bankruptcy in the past. First, when compared with those who are on time with their loan payments, the households that are behind are more likely to be solvent revolvers and even more so to an insolvent revolver. Next, attitude toward debt provides a surprising result. We reject our hypothesis that a positive attitude toward debt would be a characteristic of solvent revolvers. However, we see evidence that a negative attitude toward credit card debt does affect the decision to be an insolvent revolver. Households that have a history of bankruptcy are more likely to have revolving debt.

In regard to the lifecycle factors, solvent revolvers are more likely to be younger and have a lower household wealth. First, when compared with households under age 35, those households with individuals between 35 and 55 are more likely to be solvent revolvers than a convenience user. Among the most financially literate households, we see a differing effect in the over 55 as they are less likely to be solvent resolvers compared with 35 and younger. Gender plays a role as married females are more likely to be insolvent revolvers of credit card debt. Last, income appears only to be a statistically significant factor among the most financial literate of the sample. In this subgroup, a positive increase can decrease the likelihood of revolving credit card debt by 18%. On the other hand, wealth is a consistent factor in reducing the likelihood of revolving credit card debt.

8. Implications

Financial planners and financial counselors have a fiduciary duty to their clients. When providing financial planning to clients, financial professionals should help and educate households on the behavioral factors that impact the client's financial goals. A change in behavior is necessary, especially since revolving credit card users believe it is okay to spend now and pay later. Since self-control factors have such an impact on solvent revolving tendencies, financial planners and counselors should help clients identify debt management issues as well as increase their awareness of the importance of making payments on time. The client would benefit from a change in behavior to maximize utility and avoid making inefficient decisions.

To facilitate the education process for solvent households, there are two steps. One, financial planners and financial counselors must teach the client about behavioral biases that exist when making financial decisions. Two, financial planners and counselors should educate clients about the inefficiency associated with solvent revolving.

The first step is to educate the client about behavioral biases. Since behavioral biases affect most individuals, it is important to know about them to diminish some of the unfavorable effects. Financial planners and counselors can help the consumer develop strategies to control inefficient behavior and implement appropriate behavior. First, the consumer can set up automatic payments toward their credit card balance. This would reduce the credit card balance while decreasing the likelihood of consumers missing or being behind on their payments. A recent study by Middlewood, Chin, Johnson, and Knoll (2018) suggest that clients who automate savings decisions typically have financial skill, but still need focused help from their advisor to set up the automated rules. Next, the planner, counselor, or educator should help the client set realistic goals for paying off the debt and help the client understand their motives for saving. Last, the planner could suggest reallocating high interest rate debt to a lower interest rate debt tool (Greenberg & Hershfield, 2019). The idea of shifting debt to lower interest rate tools is shared by another article on myopia, financial literacy, and the choice between debit and credit (Ricaldi & Huston, 2019). The authors suggest that households that consistently revolve a credit card balance should switch to debit cards. Once the household is accustomed to budgeting techniques and self-control, they should switch to using a credit card as a convenience tool to take advantage of the rewards.

The next step in helping solvent revolvers understand their inefficient behavior is to educate them as to why the behavior is inefficient. Education about interest rates, savings accounts, and the tradeoff between holding a balance on a credit card and paying off the balance using savings is essential. Following these steps can allow financial planners to help clients build wealth instead of exhibiting inefficient behaviors.

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Your mileage may vary

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Abstract

The traditional model of retirement planning centers around the accumulation of a portfolio during the earning years followed by a drawdown from this portfolio after retirement. This drawdown is intended to support a desired retirement lifestyle, and central to a successful retirement is the sustainability of the retirement portfolio over the expected planning horizon. We define portfolio success to mean the ability of the retirement portfolio to sustain a desired retirement lifestyle over the desired planning horizon, and use simulations and logistic regressions to evaluate the impact of asset allocation, the profile of portfolio returns, the withdrawal rate, and the length of the planning horizon on portfolio success. Our analysis shows that the likelihood of success is inversely related to withdrawal rate, retirement horizon, and portfolio risk increase, and directly related to portfolio return, allocation aggressiveness, and early experience. The analysis also indicates that portfolio success is highly sensitive to withdrawal rates, with conservative allocations exhibiting greater variation in portfolio outcomes and aggressive allocations providing more dependable portfolio outcomes for retirees who desire higher withdrawal rates.

JEL classifications: G51; G53

Keywords: Retirement planning; Portfolio success; Retirement income; Withdrawal rate; Sequence risk

1. Introduction

In the process of building wealth and trying to ensure a financially secure retirement, individuals typically go through two distinct phases: an accumulation phase over the course of their career, and a postretirement drawdown or withdrawal phase. These withdrawals from

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the accumulated retirement portfolio are intended to sustain the desired lifestyle over the retired lifetime. Traditionally, retirees typically relied on Social Security, pension benefits, and personal savings to sustain their retirement lifestyle. Social security benefits in the United States are designed to only partially replace earnings that workers lose when they retire, and average only about 40% of total retirement income (Biggs & Springstead, 2008). Further, employer-sponsored defined-benefit pension plans have been declining over the years, and are being replaced by defined-contribution pension plans. The prospective retiree has to rely on social security retirement income and their retirement portfolio comprised of the defined-contribution plan balance and personal savings.

The cash flow characteristics of each source of retirement income is different. Social security retirement income is similar to a defined-benefit plan with fixed inflation-indexed payments over the life of the retiree with some survivor benefits and no potential for a bequest. The traditional defined-contribution plan requires the retiree to take minimum distributions (RMD) that fluctuate every year based on the actual plan balance and the relevant life expectancy factor for that year. A retiree who lives longer than expected may face a substantially depleted plan balance and reduced cash flow towards the later retirement years, while a retiree who dies earlier than expected may leave a large bequest. Elective withdrawals can be made from Roth defined-contribution plans and from personal savings, and any balance remaining in either is available for a bequest. These elective withdrawals serve to supplement retirement income available from other sources. An additional consideration affecting retirement cash flows is the different tax implications of each of these sources.

An important financial issue that most prospective retirees contend with, and has been extensively examined by financial planners and in the financial planning literature is: "How much can I spend each year from the retirement portfolio without completely depleting the retirement portfolio?" The most common response to this question is the "4% rule" which in its most general form, suggests that a retiree with a diversified portfolio could make inflation-adjusted annual withdrawals equal to 4% of the initial portfolio balance with a low chance of depleting the retirement portfolio over a 30-year retirement horizon. While it is popularly termed a rule, both financial planners and the academic literature understand that it is a guideline, a starting point for discussion, and that the safe withdrawal rate (SWR) should be modified based on individual circumstances.

This discussion suggests that the ability of the retirement portfolio to successfully sustain the desired lifestyle would depend on various factors such as asset allocation, portfolio return characteristics, the desired retirement horizon, and of course the desired withdrawal rate. While the literature suggests that retirees remain flexible to individual circumstances, there is very little guidance about the manner in which these factors impact portfolio success. All retirees do not make the same retirement portfolio choices and consequently may face very different retirement outcomes. We create plausible retirement scenarios and simulate variations in these factors to determine portfolio success or failure. We then use logistic regression to measure the impact that these factors have had in determining portfolio success.

Unlike previous studies, we define portfolio outcome as a binary variable and use logistic analysis to highlight the likelihood of portfolio success as a function of five retirement planning horizons, three asset allocation strategies, and five fixed real withdrawal rates to arrive

at 75 plausible unique retirement scenarios. For each scenario, we use four distinct monthly return generating distributions and run 100 simulations to arrive at 30,000 portfolio outcomes and use these in a logistic regression to examine the determinants of portfolio success or failure. We show that the probability of portfolio success is inversely related to withdrawal rate, retirement horizon, and portfolio risk, and directly related to portfolio return, allocation aggressiveness, and the returns experience in the five years immediately after retirement.

This paper is important because it applies an interesting methodology to a large number of retirement scenarios and portfolio outcomes to enable a retiree better understand how their unique set of circumstances and choices impact retirement success. The rest of this article is organized as follows: We begin by reviewing some of the relevant literature to provide the necessary context for the current research. We then present the empirical design of our research, data definitions, sample statistics, and the results of our regression analysis. Finally, we present our conclusions, practical implications, and suggestions for future research.

2. Background and literature review

The traditional view of retirement is that in the early years people earn, save and invest (the "accumulation" stage) to subsequently retire and withdraw from their retirement portfolio to finance consumption over their retirement horizon (the "decumulation" or "asset distribution" stage). In the decumulation stage, individuals balance the competing goals of maintaining consumption in retirement without prematurely depleting their retirement portfolio.

One of the early solutions to the problem of creating retirement cash inflows was the state retirement pension program created in 1889 by Chancellor Bismark of Germany that provided a pension starting at age 70 when life expectancy was merely an additional two years. However, with improved working conditions and increased life expectancy, the amount of time spent in retirement today is now both longer and also a larger proportion of total life expectancy. Retirement income is now needed for a few decades rather than a few years.

The reduction in the number of defined-benefit plans and an increase in defined-contribution plans, transfers risk from the employer to the retirement saver. Employees are now responsible for the saving decision, the asset allocation decision, and the asset withdrawal decision, while simultaneously accepting the real danger of premature retirement portfolio depletion ("portfolio failure").

The determination of a sustainable withdrawal rate that would reduce the probability of portfolio failure has been addressed in a number of prior studies generally using the overlapping periods methodology or simulation methodology. A historical analysis of the overlapping retirement experiences of individuals retiring between 1926 and 1980 led to the early consensus that a retiree with a diversified portfolio could make inflation-adjusted annual withdrawals equal to 4% of the initial portfolio balance with a low chance of depleting the retirement portfolio over a 30-year retirement horizon. This 4% rule refers to the popular withdrawal rate that originated from studies like Bierwirth (1994), Bengen (1994), and Cooley, Hubbard, and Walz (1998) that were meant to dispel the notion that higher

withdrawal rates that matched the historic average real returns on a diversified portfolio (between 5% to 6%) were sustainable over the retirement horizon.

Saving for retirement is challenging, and most employees have little training upon which to draw in making the relevant decisions (Benartzi & Thaler, 2007, p.102). Similarly, most retirees lack the skills required to manage their retirement portfolio successfully, highlighting the need for practical and easily understood solutions to generating sustainable retirement income (or, alternately, the need for an experienced and reputable financial advisor). Merton (2014, p.1408) states that requiring people to save for retirement is reasonable, but expecting them to acquire the expertise necessary to make investment and withdrawal decisions is not reasonable. Further, cognitive functions may decline in retirement (Bonsang, Adam, & Perelman, 2012) and while the portfolio decisions of older investors may reflect greater knowledge about investing, their investment skill does deteriorate with age due to the adverse effects of cognitive aging (Korniotis & Kumar, 2011).

This is where retirees may find the 4% rule to be useful, and it is certainly a reasonable and intuitive starting point in the retirement planning process. Indeed, Cooley, Hubbard, and Walz (1998, p.16) argue that individual experiences may vary due to personal behavioral traits, circumstances, and goals, and that no single rate appears appropriate for every investor. Moreover, the finding of a 4% SWR itself has been subject to various challenges. Pfau (2010) contends that the early consensus may be an artifact of the data used in the analysis for a couple of reasons. First, the use of rolling 30-year periods emphasizes data from the middle of the period and hence introduces temporal bias in these analyses. Second, from an international perspective, a 4% real withdrawal rate would have been "safe" in only four of 17 developed countries. These results are consistent with Dimson, Marsh and Staunton (2004) who explained that the United States has had higher real returns and lower market volatility during the 1900 to 2002 period when compared with many other countries. These results are also consistent with Estrada (2018, p. 62) who examined the retirement experience across 21 countries and 115 years using 11 asset allocations. Using equally weighted returns to a balanced portfolio across all countries in the sample, they find that a retiree with a 30-year retirement horizon would face a 50% probability of failure with a 4.8% withdrawal rate and could only withdraw 2.6% if a 5% probability of failure was desired. Further, the maximum withdrawal rate varied substantially, leading them to conclude that individuals who retired in some countries or at certain points in time had vastly different standards of living than those who retired in other countries or at other points in time.

The success of any retirement portfolio certainly depends on the expected return assumptions used in the analysis. Pye (2000) showed that 4% withdrawals from an equity portfolio with 8% real return and 18% standard deviation could be sustained for 35 years with an 81% chance of success, but a higher 4.5% withdrawal rate could be achieved by allocating 60% of the portfolio to Treasury Inflation Protected Securities (TIPS) assuming a certain 3.7% real return. Finke, Pfau, and Blanchett (2013) used simulations to review the safe withdrawal rate in the current low-yield environment to conclude that a 30-year retirement portfolio would have a failure rate of 18% if yields revert to their historic mean in 5 years. Similarly, Blanchett, Finke, and Pfau (2014) test the sustainable withdrawal rate in a low bond-yield environment and use a drift model of bond yields to show that a 4% initial withdrawal rate has just a 50% probability of success over a 30-year retirement horizon.

Thus, there is some evidence that the demonstrated success of the 4% rule is partly an anomaly of historic U.S. market returns and assumptions of expected returns. The implication from these studies is that the historical asset returns used in the overlapping periods model are not suitable for forward-looking forecasts on which retirement withdrawal strategies should be based. Further, asset returns experienced in the last decade appear to have disrupted the conventional thinking about the safe withdrawal rate, and Athavale and Goebel (2011) reinforced the notion that the 4% rule constitutes a probabilistic model and past success does not guarantee future success.

In addition to returns, there is some evidence that the standard deviation of returns and the sequence of returns may impact the success of a retirement portfolio. Blanchett and Blanchett (2008) investigate the relative importance of portfolio return and standard deviation on portfolio success using the standard 4% withdrawal rate over a 30-year period. They find that a 1% reduction in returns is likely to result in an increase in the probability of failure that is approximately four times greater than a 1% increase in portfolio standard deviation, leading them to conclude that portfolio returns have greater impact on the probability of portfolio success compared with standard deviation. Clare, Seaton, Smith, and Thomas (2017, 2021) suggest that the sequence of returns matters in both the accumulation and decumulation stages, and show that a portfolio-timing strategy using the cyclically adjusted price-to earnings (CAPE) ratio can help investors mitigate sequence risk and achieve higher withdrawal rates.

In addition to the overlapping periods model and the simulations model, researchers have explored the use of other sophisticated models to design withdrawal strategies. For example, Milevsky and Robinson (2005) use investment risk and return, mortality estimates, and spending rates in a stochastic present value framework to investigate the relationship between withdrawal rates and the probability of portfolio failure. They find that 4% withdrawals by a 65-year old retiree invested in a balanced portfolio has a 9% chance of portfolio failure, and a 3.24% withdrawal rate has a 5% chance of portfolio failure, leading them to conclude that payout ratios should be lower than generally recommended. Scott, Sharpe, and Watson (2009) suggest a strategy that includes buying and selling 30-year European call options on the market portfolio over the planning horizon to replicate the traditional 4% withdrawals, but acknowledge that many practical issues remain to be addressed before this utility maximizing methodology can be incorporated in retirement planning.

Recent studies have focused on dynamic rule-based multi-asset allocation and liquidation strategies, and switching from fixed withdrawals to variable withdrawals to improve the probability of portfolio success. A case study of the retirement experience of a 1973 retiree invested in a balanced multi-asset portfolio led Guyton (2004) to conclude that systematic decision rules and some restriction on subsequent inflation adjustments could allow for a 5.8% initial withdrawal rate.

Other examples of dynamic withdrawal strategies include adjusting the withdrawal rate based on portfolio performance and remaining life expectancy to improve retirement portfolio success and average lifetime withdrawal rates (Stout & Mitchell, 2006); using a multi-asset portfolio with periodic adjustments to the asset mix and a “bonds first” withdrawal strategy that mitigates the higher volatility in equity returns (Liu, Chang, De Jong, &

Robinson, 2009); and calculating the probability of portfolio failure each year and changing the withdrawal rate based on decision rules (Blanchett & Frank, 2009).

The importance of analyzing portfolio success rates in determining withdrawal rates has previously been emphasized by Cooley, Hubbard, and Walz (2011). They assert that changes should be made to withdrawal rates in response to unexpected changes in financial market conditions, and use the overlapping periods methodology to present portfolio success rate tables for various combinations of withdrawal rates, portfolio compositions, and payout periods.

Dynamic adjustment strategies have been shown to be relevant in both the accumulation stage (Estrada, 2019) and in the drawdown stage (Estrada, 2020) of the retirement portfolio. Specifically, Estrada (2020) shows that dynamic strategies outperform a static strategy of sticking to the plan, and periodic adjustments to the withdrawal rate is superior to adjusting portfolio asset allocations. Similarly, Robinson and Tahani (2010) treat portfolio return, longevity, and consumption as stochastic variables and use an analytical model to conclude that changing consumption to match changes in wealth could reduce the risk of portfolio failure.

These dynamic withdrawal strategies do have intuitive appeal. It is logical to calibrate asset allocations and withdrawals to changing circumstances and economic realities. An unresolved question is whether retirees would have the discipline to follow decision rules and would have the flexibility to reduce consumption. These strategies are still in the early stages of their development and we need a better understanding of the manner in which relevant variables impact portfolio success (DeJong & Robinson, 2017). Retirees may become better equipped to make these changes if they understand the implications of economic circumstances and their actions on the probability of portfolio success. Our current research, therefore, is an effort to better understand the determinants of retirement portfolio success.

3. Hypothesis development and empirical design

Each individual entering retirement has to decide about the asset allocation for their retirement portfolio, the expected retirement horizon, and the desired withdrawal rate from their retirement portfolio. In making these decisions, the retiree faces the tradeoff between maximizing consumption during retirement while minimizing the probability of prematurely exhausting the retirement portfolio.

In this context it is important to understand the composition of the retirement portfolio. As previously described, the retirement portfolio may comprise some proportion of the traditional defined-contribution plan balance, the Roth defined-contribution plan balance, and personal savings. Each of these is taxed differently; consequently, a million dollars in a traditional retirement account is not equivalent to a million dollars in personal savings which, in turn, is not equivalent to a million dollars in a Roth retirement account. Generally, withdrawals from the traditional plan balance are taxable as ordinary income; the capital gains arising from assets liquidated from personal savings prior to withdrawal are taxable at a reduced capital-gains rate; and withdrawals from Roth plan balances are not taxable. Therefore, all references to a retirement portfolio should be on a tax-equivalent basis, and for the purpose of this

research, to avoid the differential effect of taxes on retirement withdrawals, we implicitly assume that the retirement portfolio referenced here has been aggregated on an after-tax basis.

It is also necessary to differentiate between the terms withdraw and consume. While the purpose of withdrawals is to finance a desired level of consumption, RMD rules may result in a withdrawal different from that necessary to finance that level of consumption. In the event RMD rules require a withdrawal greater than that needed for a desired lifestyle, we implicitly assume that the prudent retiree would reinvest the excess so as to reduce the risk of premature portfolio depletion.

Prior research has documented that the probability of portfolio success is impacted by withdrawal rates, asset allocation, retirement horizon, and measures of actual portfolio performance, including return, standard deviation of returns, and the sequence of returns. The retiree makes decisions about the withdrawal rate, the planning horizon, and the asset allocation for the retirement portfolio. However, the retirement portfolio will be affected by economic circumstances and chance, factors which are outside the retiree's control, but which will nevertheless affect the actual return, standard deviation, and sequence of returns that the retirement portfolio may experience.

We define a retirement portfolio to be a success if the portfolio can sustain a specified level of withdrawal over the entire retirement horizon. Conversely, a portfolio that is fully consumed within the retirement horizon is a "failure." Retirees need to be cognizant of the factors that can lead to portfolio failure, and while some of these factors cannot be controlled, other factors (most commonly, the withdrawal rate) can be managed to mitigate the risk of portfolio failure.

While financial planners and prior academic research encourage retirees to remain flexible with their retirement expenditures, retirees may not be aware of the impact that these variables may have on the probability of a successful retirement and may therefore be ill-equipped to make these decisions or respond to circumstances. We seek to identify those factors that contribute to portfolio success, and measure the impact that each of these factors will have on the probability of portfolio success.

Portfolio success lies at the intersection of the planning horizon, asset allocation, and withdrawal strategy (Collins, Lam, & Stampfli, 2015, p.194), and the probability of portfolio failure (also called "ruin") is a useful risk metric that can help retirees understand the link between their withdrawal strategy, planning horizon, and the asset allocation of their retirement portfolios (Milevsky & Robinson, 2005, p. 99). We use portfolio success as the dependent variable in our analysis.

We model the retirement experience as a sequence of annual adjustments, with the initial retirement portfolio growing or shrinking according to the portfolio returns in the first year followed by a withdrawal at the end of the year to finance retirement expenditures. The remaining portfolio balance then grows or shrinks according to the portfolio returns in the second year followed by an inflation-indexed withdrawal, and this progression continues over the duration of the retirement.

The decisions that the retiree makes about asset allocation, the retirement horizon, and the desired withdrawal rate are used as inputs in our analysis. We assume that the retiree prefers fixed real withdrawal rates as they are easy to understand and provide the retiree with constant purchasing power. Annual portfolio returns and standard deviation are a function of

the selected asset allocation but reflect the uncertain external environment, and are determined by simulation. The simulated annual portfolio returns also determine if the retirement portfolio encounters an unfortunate sequence of negative returns during the early retirement years. The early sequence of negative returns may decimate the portfolio and significantly impair the portfolio's ability to grow and generate income, decreasing the probability of a successful retirement (Blanchett et al., 2014, p. 55).

Evaluation of retirement strategies involves the consideration of a large number of simulated or historical retirement periods and the subsequent estimation of their failure rate. The use of simulations in retirement planning has both proponents and opponents, and Sandidge (2020) explains that that simulations are ineffective because most people lack the numeric skills needed to assess probability. Collins, Lam, and Stampfli (2015) reviewed retirement income modeling strategies and state that the simulation methodology overcomes the limitation of relying on past returns as the basis of potential outcomes, thus allowing for a much greater range of potential outcomes. However, the inputs that drive these models need to be realistic. Cooley, Hubbard, and Walz (2003, p. 128) find that success rates differ when using Monte Carlo simulation methodology compared with the overlapping periods methodology, and recommend the use of simulation methodology for the longer payout periods which are important in retirement planning. We intend to simulate a large number of scenarios representing the wide spectrum of possible retirement experiences. We then follow the previously described sequence of annual adjustments over the retirement horizon to determine the outcome of each scenario, that is, whether each of the scenarios ends in portfolio success or portfolio failure. And finally, we will model the portfolio outcome (success or failure) using a logistic regression that generally takes the form:

$$Ln\left(\frac{p}{1-p}\right) = \alpha + \sum \beta_i X_i + \varepsilon$$

where p is the probability of portfolio success, and the left-hand term is the log-odds. The explanatory variables include the retiree choice variables (withdrawal rate, asset allocation, and retirement horizon) and the chance variables (return, risk, and the early returns experience). These variables are defined in Table 1.

The binary logistic regression is typically preferred when modeling a dichotomous outcome variable. We intend to use a logit model because the dependent variable is a binary categorical variable, equaling one when the portfolio successfully sustains the desired withdrawal rate over the entire retirement horizon, and zero when the outcome is portfolio failure. The logistic regression allows us to identify and analyze the impact of factors that influence portfolio success in a multivariate setting.

4. Data and method

At the start of the retirement period, individuals can make choices about the retirement planning horizon, asset allocation, and the withdrawal rate. Individuals retiring today are living longer than prior generations and spending longer periods of time in retirement. For the

Table 1 Variable names and descriptions

Name	Description
Withdrawal rate	A retiree determined withdrawal rate expressed as a percentage of the initial portfolio balance. Withdrawals from the portfolio at this rate, adjusted for inflation, are intended to finance a fixed level of real consumption over the retirement horizon. We have used five withdrawal rates in the analysis (2.50%, 3.25%, 4.00%, 4.75%, and 5.50%).
Allocation	A retiree determined portfolio allocation. We have used three allocations in the analysis (Conservative, Balanced, and Aggressive) that differ based on expected return and risk. This is treated as a categorical variable.
Horizon	Expected longevity of the retiree's portfolio. This is expected to match the retirement horizon and is determined by the retiree at retirement based on age at retirement, life expectancy, health, and lifestyle choices. We have used five horizons in the analysis (23, 26, 29, 32, and 35 years).
Return	The simple average annual real rate of return that would have been earned by the portfolio over the retirement horizon. Return is a chance variable and is a function of not only portfolio allocation but also selection, fees, and so forth. This variable introduces differences in outcomes between retirees and deviation from expected return in small samples. This information becomes known at the end of the planning horizon and cannot be used for midterm course correction. This variable is used in the analysis as an environmental control variable.
Risk	The standard deviation of the annual real rate of return, and like Return, is a chance variable. This information becomes known at the end of the planning horizon and cannot be used for midterm course correction. This variable is used in the analysis as an environmental control variable.
Early experience	The ratio of the actual portfolio balance at the end of the fifth year to the expected balance assuming certainty in returns. This is a chance variable that captures a sequence of unfavorable returns early during the retirement experience. While this variable is not determined by the retiree, it can nevertheless be useful in considering midterm corrections.

Note. This table describes the explanatory variables that are used in this analysis. Some of these variables are retiree choice variables (withdrawal rate, portfolio allocation, and planned retirement horizon) while others are chance variables (realized return, realized risk, and sequence risk proxied by the novel early experience variable).

average American, life expectancy for males, females, and married couples is 82, 85, and 89, respectively, and the probability that one member of a married couple will live to age 95 is 18% (Browning, 2016, p.51). The problem with determining the correct retirement horizon is that retirees do not know precisely when they will die. Further, while in theory a retirement portfolio is meant for consumption, in practice most retirees will feel comfortable under-consuming the retirement portfolio and planning for a long retirement rather than risking portfolio failure (longevity risk). Our analysis assumes that retirees will select one of five retirement planning horizons (23, 26, 29, 32, or 35 years) based on their health and lifestyle. Our analysis recognizes that each retirement situation is different and this uniqueness is captured through the intentional use of a wide range of values for the independent variables, allowing the analysis to apply to many retirement scenarios. For example, assuming life expectancy of 90 years, our choice of planning horizon is wide enough to cover both the traditional age 67 retiree and with a 23-year retirement horizon and the age 55 early retiree with a 35-year retirement horizon.

Our analysis also assumes that a retiree will select one of three asset allocation strategies (a conservative strategy with an emphasis on fixed-income investments, with expected real return of approximately 3.1% and standard deviation of 8%, a balanced strategy with expected real return of 5.1% and standard deviation of 12%, and an aggressive strategy with an emphasis on equity investments, with expected real return of 7.1% and standard deviation of 16%) based on their personal risk tolerance. These numbers reflect the approximate averages of the mean real return and standard deviation reported in prior research referenced in this paper. Finally, our analysis also assumes that a retiree will select one of five fixed real withdrawal rates (2.5%, 3.25%, 4%, 4.75%, and 5.5%) based on their consumption needs. The use of a range of annual withdrawal rates, retirement planning horizons, and stock allocations, is consistent with Cooley et al. (1998). These three decisions about Retirement Horizon, Asset Allocation, and Withdrawal Rate result in $5 \times 3 \times 5 = 75$ unique retirement scenarios.

The next step in the analysis is to consider likely outcomes for each of these scenarios. For example, does a 2.5% withdrawal rate from a conservative portfolio sustain the retirement portfolio over a 23-year retirement horizon? While we know that our conservative portfolio will average annual returns of approximately 3.1% and have a standard deviation of 8% over long periods of time, returns in any particular year can fluctuate away from the average with a wide range of uncertain values. The standard methodology in such cases draws random returns for each year of the retirement horizon from a theoretical distribution. We should test our hypothesis by drawing random annual returns for the first year, making 2.5% withdrawals, noting the portfolio balance at the end of the year, and if the portfolio has not been depleted, continuing this exercise for a total of 23 years.

Drawing random annual returns to the retirement portfolio requires us to impose a priori assumptions about the functional form of the distribution of expected returns, and a standard assumption is that returns are characterized by the normal distribution. This assumption, though convenient, was empirically challenged by Fama (1965) who found that the distribution of monthly stock returns belonged to a non-normal member of the stable class of distributions. Subsequently, Officer (1972) confirmed that the distribution of stock returns has fat-tails, and Gray and French (1990) confirmed that the distribution of stock index returns also

deviates from the normal distribution. The preponderance of empirical evidence finds that return distributions are not normally distributed (Kring, Rachev, Höchstötter, Fabozzi, & Bianchi, 2009, p. 272), and have rejected the normal distribution in favor of either a skewed distribution or a fat-tailed distribution (Levy & Duchin, 2004 p. 48). We relax the assumption that returns follow any single distribution and use four different continuous probability distributions (Beta, Kumaraswamy, Pert, and Triangular) from which to draw random annual returns. In the absence of theoretical arguments or empirical evidence to guide our selection of the appropriate distribution, we selected four continuous distributions which allowed negative returns, allowed us to specify bounds, and displayed skewness and fat tails. The parameters of the distributions were set to ensure consistency with the desired mean and standard deviation, and reasonable boundaries were established. Thus, each of the 75 previously mentioned scenarios were tested using four different returns distributions.

Continuing our prior example, we define a retirement portfolio to be a success if 2.5% withdrawals from a conservative portfolio could be sustained over a 23-year retirement horizon, when realized returns followed the Beta distribution. In such cases we assign Outcome = 1, and in cases where the retirement portfolio is prematurely depleted before the end of the retirement horizon, we assign Outcome = 0. This gives us a total of $75 \times 4 = 300$ retirement experiences, reflecting both the choices the retiree has made and the returns uncertainty that impacts portfolio outcomes.

Another returns uncertainty that we considered in the analysis is that portfolio outcomes may also be impacted by the sequence of returns obtained. A sequence of large negative returns early in the retirement period may hasten portfolio depletion. Sequence risk (or serial returns risk) refers to the risk of premature portfolio depletion caused by a combination of withdrawals and significant negative returns early in retirement. We proxy for sequence risk by constructing an Early Experience variable, defined as:

$$Early\ Experience = \frac{Observed\ Balance\ (5,\ 2.5\%,\ 3.1\%,\ 12\%)}{Expected\ Balance\ (5,\ 2.5\%,\ 3.1\%,\ 0\%)}$$

where, the numerator is the observed portfolio balance at the end of the fifth year after 2.5% withdrawals each year from a conservative portfolio earning 3.1% average real returns that follow the Beta distribution with a standard deviation of 12%, while the denominator is what the balance would be assuming certainty in portfolio returns. A better Early Experience implies a greater probability of portfolio success, and we would expect a positive relation between the Early Experience variable and the Outcome variable. The observed portfolio balance at the end of the fifth year and the value of the Early Experience variable at the end of the fifth year are presented in Table 2.

The process described above was repeated 100 times. Thus, the 300 retirement experiences simulated 100 times each gives us $300 \times 100 = 30{,}000$ portfolio outcomes. Another way of thinking about this is that the simulations are a way of testing the retirement scenarios to see the potential outcome of many possible trajectories and to gauge how vulnerable the scenarios are to portfolio failure. Our model is consistent with Pfau (2012) in that portfolio success is dependent on the interaction of withdrawal rates, capital market conditions, retirement durations, and asset allocation, and the Spitzer, Strieter, and Singh (2007)

Table 2 The early (returns) experience

Portfolio allocation	Withdrawal rate	Average portfolio balance	Early experience		
			Mean	Minimum	Maximum
Conservative	2.50%	1,033,998	100.20	47.78	170.27
	3.25%	994,054	100.20	46.39	172.39
	4.00%	954,110	100.21	44.89	174.71
	4.75%	914,166	100.21	43.26	177.23
	5.50%	874,222	100.22	41.47	179.97
Balanced	2.50%	1,145,076	100.10	38.63	206.12
	3.25%	1,103,597	100.10	37.27	208.77
	4.00%	1,062,118	100.11	35.80	211.64
	4.75%	1,020,638	100.12	34.21	214.73
	5.50%	979,159	100.13	32.48	218.10
Aggressive	2.50%	1,284,861	101.56	22.52	274.61
	3.25%	1,241,476	101.61	21.20	278.86
	4.00%	1,198,091	101.65	19.77	283.43
	4.75%	1,154,706	101.70	18.25	288.35
	5.50%	1,111,322	101.75	16.59	293.65

Note. This table presents information about the observed portfolio balance at the end of the fifth year and the value of the early experience variable. The early experience variable is a proxy for sequence risk which refers to the risk of premature portfolio depletion caused by a combination of fixed withdrawals and significant negative returns in the early years of retirement. There are 2,000 observations in each of the 15 combinations of portfolio allocation and withdrawal rate for a total of 30,000 observations.

assertion that a blanket four percentage withdrawal rule may be an oversimplification of a complex set of circumstances.

5. Descriptive statistics and empirical results

The frequency of success (Outcome = 1) or failure (Outcome = 0) among the 30,000 portfolio outcomes described in the previous section is presented in Table 3.

Portfolio success occurred 83.3% (24,989 of 30,000) of the time among the observed portfolio outcomes. The aggressive portfolio had an average success rate of 87.83% (8,783 of 10,000) while the conservative portfolio has a success rate of 76.34%. As expected, the portfolio with a 2.50% withdrawal rate had an average success rate of 99.13% (5,948 of 6,000) while the portfolio with a 5.50% withdrawal rate had a success rate of 59.08%. And finally, as expected, the portfolio with a 23-year planning horizon had an average success rate of 91.3% (5,478 of 6,000) while the portfolio with a 35-year horizon had a success rate of 75.73%.

We had previously indicated that the retiree decides about portfolio allocation (based on risk tolerance), withdrawal rate (based on consumption needs), and retirement horizon (based on expected life expectancy and lifestyle choice), and we can disaggregate the observed portfolio success rates using these variables. These disaggregated observed portfolio success rates are presented in Table 4.

Table 3 Frequency table of observed portfolio outcomes

		Failure	Success
By portfolio allocation	Conservative	2,366	7,634
	Balanced	1,428	8,572
	Aggressive	1,217	8,783
		5,011	24,989
By withdrawal rate	2.50%	52	5,948
	3.25%	253	5,747
	4.00%	731	5,269
	4.75%	1,520	4,480
	5.50%	2,455	3,545
		5,011	24,989
By retirement horizon	23 Years	522	5,478
	26 Years	750	5,250
	29 Years	1,004	4,996
	32 Years	1,279	4,721
	35 Years	1,456	4,544
		5,011	24,989

Note. $N = 30{,}000$ portfolio outcomes. This table presents the number of successes (or failures) among the 30,000 portfolio outcomes in our sample, aggregated by portfolio allocation, or withdrawal rate, or retirement horizon. These numbers suggest that conservative portfolios, higher withdrawal rates, and longer retirement planning horizons increase the chance of portfolio failure.

A few observations are notable. A withdrawal rate of 2.5% can largely be sustained irrespective of portfolio allocation and retirement horizon. However, higher withdrawal rates (5.5%) over longer retirement horizons (35 years) have a success rate of 65.5% with an

Table 4 Observed portfolio success rates

Portfolio allocation	Withdrawal rate	Retirement horizon				
		23 Years	26 Years	29 Years	32 Years	35 Years
Conservative	2.50%	100.00%	100.00%	99.50%	99.75%	99.00%
	3.25%	99.75%	98.75%	96.00%	95.75%	91.25%
	4.00%	96.00%	93.00%	83.25%	79.50%	71.00%
	4.75%	88.25%	76.75%	59.75%	50.25%	37.25%
	5.50%	66.50%	47.75%	38.75%	23.50%	17.25%
Balanced	2.50%	99.75%	99.50%	99.75%	98.50%	99.00%
	3.25%	99.25%	97.50%	96.00%	94.50%	93.25%
	4.00%	95.50%	92.75%	90.50%	84.50%	84.00%
	4.75%	86.50%	83.50%	83.00%	73.50%	68.25%
	5.50%	77.25%	70.75%	65.50%	56.75%	53.75%
Aggressive	2.50%	98.75%	99.00%	98.00%	98.50%	98.00%
	3.25%	96.50%	96.00%	94.75%	94.00%	93.50%
	4.00%	94.50%	92.50%	88.50%	84.50%	87.25%
	4.75%	89.25%	86.00%	82.25%	77.75%	77.75%
	5.50%	81.75%	78.75%	73.50%	69.00%	65.50%

Note. This table allows us to evaluate the simultaneous impact of portfolio allocation, withdrawal rate, and retirement horizon on portfolio success rates. Portfolio success occurs in 24,989 of the 30,000 portfolio outcomes.

aggressive portfolio allocation, but only 53.75% with a balanced portfolio allocation and 17.25% with a conservative portfolio allocation. A withdrawal rate of 4% over a 29-year horizon has a success rate of 90.50% with a balanced portfolio allocation, 88.50% with an aggressive portfolio allocation and 83.25% with a conservative portfolio allocation. And finally, a conservative portfolio exhibits wide variations in outcomes ranging from 100% to 17.25%, while an aggressive portfolio allocation exhibits variations ranging from 99.00% to 65.50%. These results confirm that aggressive portfolios improve the probability of portfolio success for higher withdrawal rates.

We next use regression analysis to analyze the impact of factors which influence portfolio success in a multivariate setting. Our variable of interest is portfolio success that is a binary dependent variable. In such cases, the ordinary least squares technique can be nonconforming and the estimates of the dependent variable can go out of bounds (0, 1). The logistic regression technique is well suited to examining the relation between portfolio success and the predictor variables as it keeps the predicted values of the dependent variable within expected bounds.

At the start of the retirement period, the retiree makes decisions about the withdrawal rate, the planning horizon, and the asset allocation for the retirement portfolio. The retirement portfolio will also be affected by actual returns, standard deviation, and sequence of returns that the retirement portfolio may experience. While these factors are outside the retiree's control and will nevertheless impact portfolio outcome, the retiree may be able to observe and act on any early unfavorable sequence of returns that the portfolio may experience. These then, are the explanatory variables used in the analysis.

The logistic function is used to estimate, as a function of unit changes in the independent variables, the probability that the event of interest will occur. Our logistic model provides a good fit for the data if we can demonstrate an improvement over the intercept-only model, and we check this using the Akaike Information Criterion and the Schwarz Criterion. We also note that the Cox and Snell R^2 is 46%, Nagelkerke's rescaled R^2 is 78%, and McFadden's pseudo R^2 is 69%. In addition, the maximum likelihood coefficient estimates are all individually significant at 1% using the Wald χ^2 test.

Direct interpretation of the logistic regression coefficients is difficult since coefficient estimates are in terms of log-odds. The estimated coefficients do not represent the marginal effects of the independent variables on the probability of portfolio success. Instead of the coefficients being the rate of change in the dependent variable as the independent variable changes, a coefficient derived from a logistic regression is interpreted as the rate of change in the log-odds as the independent variable changes. Exponentiating the coefficient gives us the odds ratio, which can range from 0 to infinity, and which allows for somewhat easier interpretation. The model coefficients and the odds ratio are presented in Table 5.

While the odds ratio is somewhat easier to interpret than the coefficients of the logistic regression, neither is as useful as the traditional marginal effect. Unlike a linear regression, the marginal effect is not constant across the entire range of values of the explanatory variable, and hence the marginal effect is calculated at each observation in the dataset, and then averaged. This average marginal effect indicates expected changes in the predicted probability of portfolio success as a function of a change in an explanatory variable while keeping

Table 5 Determinants of portfolio success

	Coefficient	Wald χ^2	Odds ratio	Marginal effect
Intercept	18.4342 (0.6080)	919.2899		
Withdrawal rate	−3.1056 (0.0552)	3161.9001	0.045	−0.1311
Allocation aggressive	2.7052 (0.7069)	14.6443	14.957	0.1142
Allocation conservative	−2.3530 (0.5821)	16.3402	0.095	−0.0993
Horizon	−0.3638 (0.00870)	1746.6138	0.695	−0.0154
Return × Allocation Conservative	1.5348 (0.0412)	1384.7595	4.641	0.0648
Return × Allocation Balanced	1.3722 (0.0358)	1466.0887	3.944	0.0579
Return × Allocation Aggressive	1.2288 (0.0320)	1477.4365	3.417	0.0519
Risk × Allocation Conservative	−2.648 (0.0424)	38.9240	0.767	−0.0112
Risk × Allocation Balanced	−0.3202 (0.0377)	72.1836	0.726	−0.0135
Risk × Allocation Aggressive	−0.4087 (0.0317)	166.5041	0.664	−0.0173
Early experience	0.0781 (0.00178)	1916.2730	1.081	0.0033
R^2	69%			

Note. $N = 30{,}000$. Standard errors are placed below the coefficient. All coefficients are significant at the 1% level. This table presents the results of the logistic regression analysis used to model the probability of portfolio success, where portfolio success is defined as the ability of a retirement portfolio to sustain a desired lifestyle over a desired retirement horizon.

other covariates constant. The average marginal effect for each explanatory variable is also presented in Table 5.

The marginal effect of the Withdrawal Rate variable indicates that the probability of portfolio success changes by −0.1311 for a 1-level change in the Withdrawal Rate. Similarly, the marginal effect of the Retirement Horizon variable indicates that the probability of portfolio success changes by −0.0154 for a 1-level change in the Retirement Horizon. Early Experience is a continuous variable and hence the marginal effect is defined as the partial derivative of the probability of portfolio success with respect to Early Experience. Similarly, higher levels of Return increase the probability of portfolio success while higher levels of Risk decrease the probability of portfolio success, and this is consistent across all allocations. Finally, an Aggressive Allocation changes the probability of portfolio success by 0.1142 compared with a Balanced Allocation, and a Conservative Allocation changes the probability of portfolio success by −0.0993 compared with a Balanced Allocation.

Table 6 Determinants of portfolio success (partitioned by portfolio allocation)

	Aggressive		Balanced		Conservative	
	Coefficient	Marginal effect	Coefficient	Marginal effect	Coefficient	Marginal effect
Intercept	14.62		16.12		24.98	
Withdrawal rate	−2.11	−0.0814	−2.84	−0.1137	−4.62	−0.1962
Horizon	−0.26	−0.0101	−0.32	−0.0126	−0.55	−0.0232
Early experience	0.06	0.0023	0.07	0.0030	0.11	0.0045
Return	0.93	0.0360	1.26	0.0506	2.18	0.0926
Risk	−0.31	−0.0120	−0.29	−0.0117	−0.38	−0.0163
R^2	66%		68%		75%	

Note. $N = 10{,}000$ for each of the three partitions. All coefficients are significant at the 1% level. This table presents the results of the logistic regressions (sample partitioned by portfolio allocation) analyzing the impact of the explanatory variables on the probability of portfolio success.

We also analyzed the determinants of portfolio success by partitioning the data based on Allocation. This facilitates validation of the full-sample results and also allows for easier interpretation of the results. The results of this analysis are presented in Table 6.

As before, retiree-determined variables (Withdrawal Rate and Retirement Horizon) are significant across all three values of Allocation, as are the chance variables (Early Experience, Return, and Risk). The negative sign on withdrawal rate indicates a lower probability of portfolio success at higher withdrawal rates. This effect is most pronounced for the conservative portfolio allocation—the probability of portfolio success changes by −0.1962 for a 1-level change in Withdrawal Rate. Retirees who select a conservative portfolio allocation will find that the probability of portfolio success is more sensitive to the determinants of portfolio success, as compared with selecting a conservative or aggressive allocation.

6. Concluding comments

This analysis has examined the impact of various retiree-determined and chance variables on the probability of portfolio success. The results of this analysis provide retirees with specific information about the impact their actions may have on the probability of portfolio success. While the chance variables, by definition cannot be controlled, retirees may be able to mitigate the risk of portfolio failure by using intermediate targets like Early Experience to determine the need for midterm corrections to the retirement plan.

The results of the analysis confirm that portfolio success is impacted by both retiree-determined variables (Allocation, Withdrawal Rate, and Planning Horizon) and chance variables (the profile of portfolio returns includes Return, Risk, and Early Experience). However, the relative impact of each of these variables differs. Withdrawal Rate is the most significant driver of portfolio success, and though relevant, Early Experience is not as significant. Retirees who select a conservative portfolio allocation will find that their portfolio success is much more sensitive to the explanatory variables, when compared with retirees who select other allocations. Conservative portfolio allocations also result in wide variations in portfolio success outcomes, while aggressive portfolio allocations result in relatively narrow variations

across different withdrawal rates. These results are consistent with the Ho, Milevsky, and Robinson (1994) assertion that equity should have a bigger role in retirement portfolios than is recommended by most financial planners. The actual return to a particular retiree may differ from that suggested by the portfolio allocation. Both Return and Risk are significant in the analysis suggesting that asset selection within a portfolio is important to mitigating any adverse effect that these variables would have on portfolio success. The Early Experience variable could serve as an early indicator of the need for midterm course corrections to the retirement plan with the withdrawal rate serving as the transmission mechanism for portfolio success.

Planning for success in sustaining a retirement portfolio would be incomplete without also discussing other issues which arise even in the event of portfolio success. In the event of portfolio success, by definition, there is a residual (unconsumed) portfolio balance. This reduced consumption over the retirement horizon is the prudent reality of dealing with an uncertain future in the absence of well-accepted instruments that can capture the value of a potential future surplus. Another issue is the possibility of the retiree living beyond the planned retirement horizon. While any unconsumed portfolio balance may serve to mitigate longevity risk, longevity insurance is also available in the form of a single-premium deferred inflation-indexed fixed life annuity, and this could allow real consumption at the same level as that experienced during the expected retirement years. And finally, many financial planners recommend that retirees maintain a cash bucket outside their invested portfolio as part of their overall strategy. This cash bucket is intended to meet unexpected consumption needs, reduce the need to liquidate portions of the invested portfolio during market downturns, and finance any mismatch in the timing of cash flows.

When it comes to retirement planning, the cost of failure is high. Nevertheless, most retirees lacking the knowledge and tools, engage in wishful thinking rather than structured planning. Retirement planning is complex and has inherently uncertain outcomes. This analysis is a simple and imperfect representation of the complex realities of retirement planning. Although the analyses are simplistic, the results provide guidance to the manner in which various retiree-determined and chance variables impact portfolio success. The research proposed in this study is a topic of active policy debate, and may serve as a baseline for additional research and sophisticated and dynamic models for generating lifetime income for retirees, pension funds, endowments, and managed payout mutual funds.

This research also has various limitations. The simulation methodology requires us to specify the unknown future distribution from which returns might obtain, and the expected parameters of that distribution. We have assumed that the retiree makes withdrawals at the end of every year, and have not considered monthly or quarterly withdrawals. We have also implicitly assumed that the retire may engage in additional retirement planning outside the invested portfolio (e.g., bequests, longevity insurance, and a cash bucket for liquidity) and that retirees desire a constant level of real consumption over the retirement horizon. And finally, our analysis examines portfolio success as a binary (success/failure) variable but does not consider the size of the bequest or the timing of the portfolio failure as measures of the extent of success or failure (Estrada and Kritzman, 2019).

There is no “one size fits all” single right answer when it comes to addressing the various tradeoffs and interactions associated with retirement planning, and outcomes will vary based

on retiree choices, economic circumstances, and chance. It is nevertheless important to understand them so that a realistic initial plan and consumption target can be established, and mid-term adjustments can be initiated if necessary. Just be aware that your mileage may vary.

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Distribution channel effects on advisor managed investment performance

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Abstract

This study focuses on the effects that business models have on advisor managed portfolio performance by attempting to determine if advisors at Registered Investment Advisory (RIA) firms produce higher net investment results compared with advisors employed at dually registered Independent Broker/Dealer (IBD) firms. Using data from one of the largest investment advisory platforms in the United States, we found qualified supporting evidence that advisors at RIAs outperformed advisors at IBDs in higher-risk portfolios through the use of Turnkey Asset Management Programs and Unified Managed Accounts.

JEL classification: G2

Keywords: Cognitive Load Theory; Registered Investment Advisor; Independent Broker/Dealer; Compensation puzzle; Investment performance

1. Introduction

The efficacy of financial advice often compares investment performance to benchmark portfolios. This study segments the financial advice market into two separate distribution channels—Registered Investment Advisors and Independent Broker-Dealers—to determine

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if membership in a particular channel has a significant predictive relationship with advisor managed portfolio performance.

Other than potential philosophical differences, the main difference that separates Registered Investment Advisory (RIA) and Independent Broker/Dealer (IBD) firms is the compensation structures employed. Traditionally, RIA firms derive their compensation from fee-only arrangements. In an assets-undermanagement model, the advisor charges a percentage of the client's portfolio on a quarterly or monthly basis. In typical assets-undermanagement programs, trading securities does not generate a commission for the advisor; the value in such actions lies in the potential of the replacing security outperforming the replaced security and thus increasing the account value, in turn generating a higher dollar amount earned by the advisor.

IBDs employ a dual registration model that allows for fee-for-advice models as well as commission-based compensation programs. The advisor retains the sole discretion as to which model or mixture of the two they utilize. The decision IBDs face about which compensation regime to pursue creates the potential for an advisor's attention to be diverted away from their central task of investment management. Due to this diversion, we seek to determine if the distribution channel affects advisor managed portfolio returns when comparing RIAs and IBDs.

The rest of the paper proceeds as follows: the literature review section provides a detailed background on the efficacy of financial advice, highlighting a gap in the literature regarding segmentation of advisor distribution channel membership. The theoretical framework relates Cognitive Load Theory to the task of investment management. The methods and data employed for the study are then explained, and the results are presented. A discussion of the results precedes the conclusion, which includes limitations and implications of the study as well as areas for future research.

1.1. Literature review

Numerous studies show that the majority of professional money managers do not consistently outperform passive benchmarks (Del Guercio, Reuter, & Tkac, 2010; Desai & Jain, 1995; Gil-Bazo & Ruiz-Verdú, 2009; Jensen, 1968; Malkiel, 1995). Gruber (1996), French (2008), and Reuter (2015) estimate that actively managed mutual funds underperform their benchmark indexes by an average of 64-67 basis points (bps) annually.

Other studies that show advisor recommended mutual funds underperform self-directed portfolios. Karabulut (2013) found that advised investors earned lower raw and risk-adjusted returns compared with self-directed investors even before deducting advisory fees and transactions costs. Bergstresser, Chalmers, and Tufano (2009) found that broker-sold funds had lower raw and risk-adjusted returns than direct-channel funds, even before distribution expenses were deducted. Del Guercio and Reuter (2014) found that broker-sold actively managed mutual funds underperformed both broker-sold index funds and direct channel actively managed mutual funds.

By studying the Oregon University System retirement plan, Chalmers and Reuter (2012) found that employees who retained the services of brokers earned significantly lower after-

fee returns and lower risk-adjusted returns compared with those employees who were defaulted into age-based target date funds. The average fee of 0.9% was the largest reason for the underperformance. Chalmers and Reuter (2012) did point out that employee accounts that were self-directed also underperformed the default target date funds, but to a lesser extent than broker advised accounts, echoing the sentiment in Bergstresser et al. (2009). Internationally, Hackethal, Haliassos, and Jappelli (2012) and Foerster, Linnainmaa, Melzer, and Previtero (2017) found similar results when studying German and Canadian investors and advisors' recommendations.

On the other hand, Kinniry, Jaconetti, DiJoseph, Zilbering, and Bennyhoff (2016) suggested that advisor-driven portfolios could outperform self-directed portfolios of clients, assuming the advisor did several tasks deemed to be too difficult, advanced, or time consuming for the novice investor. The study suggests that the so-called *Advisor Alpha* could be as high as 3.0% annually, the most valuable activity being behavioral financial coaching, which could contribute as much as 1.50% annually to a client's portfolio return.

Although Hackethal et al. (2012) found that the self-directed portfolios outperformed advised portfolios on average, advised accounts exhibited far greater diversification. Hackethal et al. (2012) suggests that a potential reason clients pay for advice lies in the convenience of outsourcing the task rather than to outperform other alternatives. Gennaioli, Shleifer, and Vishny (2015) put forth the concept of "Money Doctors" and posit that professional money managers instill confidence in the client by having a professional at the helm. This confidence reduces anxiety created by investing in risk-based assets and allows the client to invest more aggressively than they would on their own. Gennaioli et al. (2015) recognize that advisors' recommendations are costly, at times generic, and occasionally self-serving, which lead to consistent underperformance compared with passive benchmarks. While a client might earn negative market-adjusted returns after an advisor's fees, the excess return generated compared with a counterfactual portfolio with limited risk-based assets is another measure of the value of an advisor (Gennaioli et al., 2015). Warshcuer and Sciglimpaglia (2012) asked clients to rate the perceived value of financial planning services. Making sure the client is holding a sufficiently diversified portfolio and holding investments that meet each of the client's goals' time horizons and cash flow needs were viewed as more important than recommending investments that beat the market averages.

Although advisors in general are unable to consistently outperform passive benchmarks (and in some cases self-directed portfolios), little attention has been given to determine if the efficacy of financial advice improves across different advisor business models. We seek provide insight about the differences in advisor performance based on their distribution channel.

1.2. Theoretical framework

Cognitive Load Theory (CLT) describes the limits of mental effort used in working memory during problem-solving (Sweller, 1988). The amount of cognitive load levied on an individual engaged in a complex problem-solving exercise can be an explanatory factor in the individual's performance (Sweller, 1988). The heavier the cognitive load, the lower the expected level of performance.

Cognitive load is separated into three different types: intrinsic, extraneous, and germane. The first two forms of cognitive load are additive and together cannot exceed the capacity of working memory if the task is to be completed effectively (Paas, Renkl, & Sweller, 2003). Intrinsic cognitive load is the inherent level of difficulty associated with a particular task (Chandler & Sweller, 1991). It depends on the level of elemental interactivity in the problem-solving action (Paas et al., 2003). The more interrelated the elements of the task are, the higher the intrinsic cognitive load. High elemental interactivity imposes a heavy cognitive load because each element must be processed simultaneously. In contrast, problem-solving involving large numbers of unrelated elements would not impose as heavy a cognitive load because each element could be processed individually without reference to the other elements (Leppink, van Gog, Paas, & Sweller, 2015). Examples of intrinsic cognitive load for investment management include conducting due diligence and investment research and implementing portfolio decisions through trading, rebalancing, and ongoing monitoring.

Extraneous cognitive load, also known as ineffective cognitive load, is present when confounding variables are introduced into the problem-solving activity and interfere with its efficient completion (Paas et al., 2003). These variables or processes are related to the problem-solving activity but create unnecessary and inefficient additional steps to complete the problem, which hinder performance (Leppink et al., 2015). Due to the additive nature of the cognitive load architecture, the presence of extraneous cognitive load is particularly important when intrinsic cognitive load is high. Because cognitive load cannot exceed working memory capacity, when intrinsic cognitive load is high, there is less capacity for extraneous cognitive load (Paas et al., 2003). Examples of extraneous cognitive load that financial advisors may face include addressing client servicing tasks and related paperwork, developing and marketing the business, conducting administrative tasks, and engaging in professional development.

Germane cognitive load is used to explain any unused excess working memory capacity that can be refocused into activities that support intrinsic cognitive load (Sweller, Van Merrienboer, & Paas, 1998). The presence of germane cognitive load is desirable as it helps lessen the strain of intrinsic cognitive load and improves cognitive performance in problem-solving.

Since intrinsic cognitive load cannot be altered, in situations where the cognitive load level is high, reducing or eliminating extraneous cognitive load improves the overall cognitive process (Leppink et al., 2015; Sweller, 1988; Sweller et al., 1998). The split-attention effect provides an example of the toll extraneous cognitive load can have in explaining a limitation of human information processing (Chandler & Sweller, 1991). Extraneous cognitive load increases when a subject's focus is split between multiple elements in a cognitive process.

An additional deterrent to minimizing cognitive load is choice overload. As the choice set grows, the number of characteristics needing comparison increases and cognitive costs rise, potentially giving way to overload (Greenleaf & Lehmann, 1995; Shugan, 1980). When choices are consequential and/or involve numerous options, the decision-making process becomes more effortful, which can lead to cognitive overload (Botti & Iyengar, 2006; Huberman, Iyengar, & Jiang, 2004).

Cognitive load is also more likely to be exhausted when processing more complex tasks (Jacko & Ward, 1996). Campbell (1988) suggests that a complex task must minimally have either multiple paths, multiple outcomes, conflicting interdependence among paths, or uncertain probabilistic linkages. Using this definition, portfolio management can be defined as a complex task that requires considerable cognitive resources to perform and is more likely to exhaust cognitive load.

The effects on performance due to multitasking are also noteworthy. Gonzàlez and Mark (2005) discovered that task switching was equally created by external interruptions as well as internal self-interruptions, called *discretionary switching*. Discretionary switching is the type most associated with tasks that require multiple related, but separate subtasks, and is most closely related to our study. Like split-attention, discretionary task switching diverts cognitive resources from the primary task to a secondary or tertiary task, potentially before the completion of the primary task. Czerwinski, Horvitz, and Wilhite (2004) found that complex tasks were more difficult to resume once interrupted. Hodgetts and Jones (2006) found an inverse relationship between primary task difficulty and resumption times; the more difficult or complex the primary task, the slower the resumption time once it was interrupted. Gillie and Broadbent (1989) found that primary task accuracy after interruptions declined as task complexity increased. Jin and Dabbish (2009) identified seven categories of discretionary switching. Most relevant for this study is *inquiry*, which is switching to a secondary task to gain information that aides in completing the primary task.

Independent RIAs are typically fee-only planners whose compensation is derived either as a set fee (e.g., a flat or per hour charge for services), a percentage of the assets under management (AUM), or a combination of the two. Independent Broker/Dealers maintain a dual compensation model: (1) commission-based product placement and (2) a fee-based model similar to Independent RIAs. With investment management as the primary task, an advisor at an IBD must first complete a secondary task and determine (i.e., inquire and engage in discretionary switching) what amount of the client's investible net worth and/or discretionary income will be implemented through an asset-undermanagement compensation program and what amount will be implemented through a commission-based compensation program. Because advisors at IBDs have the additional process of determining a client's compensation program, this adds extraneous cognitive load to the investment management task for IBD advisors, what we call, the *Compensation Puzzle*. In addition, because commission-based compensation is not impacted by subsequent returns, when IBD advisors place client assets in commission-based products, they may have lower incentives than RIA advisors for their clients' portfolios to perform well in the future.

The Compensation Puzzle can be framed as a goal conflict between generating the highest return for clients and generating higher upfront compensation for an advisor. Campbell (1988) states that the presence of goal conflict increases task complexity. Thus, investment management is made more complex for IBD advisors due to the presence of the Compensation Puzzle. Because the relationship between task complexity and performance is negative, we expect RIAs to perform better than IBDs on the complex task of portfolio management. Further, because financial planning involves an ongoing relationship, an advisor could be required to revisit this Compensation Puzzle multiple times, switching from primary to secondary tasks in the process.

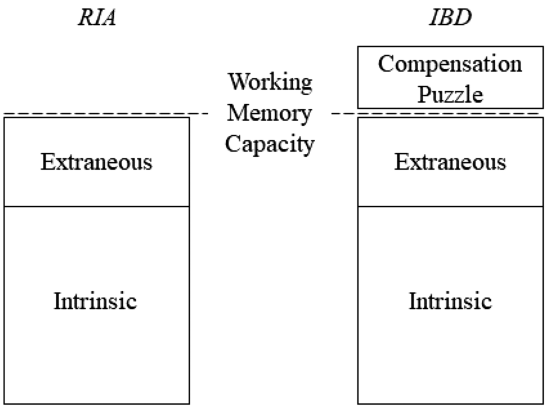

Fig. 1. Representation of the cognitive load and working memory capacity faced by advisors at RIA and IBD firms.

1.3. Hypothesis

The main hypothesis of this study states that due to the additional extraneous cognitive load levied against IBD advisors' working memory capacity due to the presence of the Compensation Puzzle, net investment performance of IBDs will be lower than that of Independent RIAs. As such, we propose the following null and alternative hypotheses:

H_0: RIAs will not have significantly different net returns than IBDs.

H_1: RIAs will have higher net returns compared with IBDs, regardless of portfolio management approach.

CLT serves as the main justification for the hypothesis that RIAs will outperform IBDs. The activity of investment portfolio creation and management is akin to a problem-solving exercise. Modern Portfolio Theory (MPT) states that portfolios are created such that expected return is maximized for a given level of risk. Each asset should be assessed based on its individual risk and return characteristics and how that asset contributes to the overall portfolio's risk and return, emphasizing the importance of the correlations between the assets within the portfolio (Markowitz, 1952). Due to the high levels of elemental interactivity when engaging in portfolio construction and management, the intrinsic cognitive load placed on an advisor is high, requiring significant working memory capacity. Because working memory capacity is limited, the potential addition of extraneous cognitive load from the Compensation Puzzle could lead to working memory capacity being exceeded and therefore, a reduced effectiveness in investment management. Fig. 1 provide a graphical representation of the Compensation Puzzle and how it relates to the cognitive load and working memory capacity of advisors at RIAs and IBDs.

2. Method

2.1. Data

Data were obtained through the generosity of a large, anonymous investment advisory platform. This platform provides a uniform tool that delivers advisor managed portfolios

(AMP), unified managed accounts (UMA), as well as turnkey asset management programs (TAMP). They serve Independent RIA firms, IBDs, Insurance Broker/Dealers, banks, and trust companies. For purposes of this study, banks and trust companies were excluded due to the nature of their product and service offerings. Banks and trust companies offer ancillary products and services that are outside the focus of investment management, and such offerings could influence the results. Insurance Broker/Dealers were combined with IBDs and referred to collectively as IBDs because their dual registration as fee-for-service and commission-based advisors are quite similar for the two distribution channels. All advisors at the RIA and IBD firms in this study receive fee-based compensation for the portfolios included in our analysis that they manage. In other words, IBDs advisors in this study have decided to place their clients' assets into fee-based models similar to those used by RIAs rather than to place them into commission-based products.

AMP are investment portfolios where the advisor maintains the responsibilities for the day-to-day investment management process, including formulating an investment strategy and asset allocation, conducing due diligence on the individual investments, implementing the strategy, and monitoring the portfolio and its component parts. AMP can contain only individual securities, mutual funds, and/or exchange-traded funds (ETFs). The AMP data contains 1,585 records for AMPs for the one-year time period, 1,151 records for the three-year time period, and 858 records for the five-year time period.

TAMP are investment portfolios where the day-to-day investment management process is completely handled by a third-party investment service provider. Benefits of a TAMP include outsourcing time-consuming activities such as investment research, portfolio allocation, and asset management tasks. A drawback of using TAMPs is that the originating advisor does not have direct control or input into the asset management process (Kenton, 2018). The TAMP contains the lowest amount of advisor responsibility for the investment management program of the three styles studied. The data contains 3,789 records for TAMPs for the one-year time period, 3,132 records for the three-year time period, and 2,434 records for the five-year time period.

Unified Managed Accounts (UMA) are investment portfolios that act as a hybrid between AMP and TAMP portfolios. Under a UMA program, an advisor has the responsibility to create a high-level asset allocation for a portfolio as well as to conduct the due diligence on the component parts of the portfolio. The advisor is not responsible for rebalancing the portfolio like they would be in an AMP; rather, these duties are handled by the investment platform. UMA portfolios do not contain individual securities. Instead, they contain mutual funds, ETFs, TAMPs, and Separately Managed Accounts (SMAs). While the advisor's overall responsibility is less in the UMA program compared with the AMP, there are still day-to-day investment management responsibilities. The data contains 1,484 records for UMAs for the one-year time period, 1,163 records for the three-year time period, and 857 records for the five-year time period.

Data were provided on a firm level rather than at the account or advisor level. For each variable, the average value for each firm was provided. For example, the one, three, and five-year average returns per firm were provided for RIAs and IBDs, for each of the three portfolio management approaches (i.e., AMP, UMA, and TAMP) and across the risk tolerance categories that the platform uniformly employs. Return data were provided for one,

three, and five-year average returns for the time period ending on July 31, 2019, which means that the five-year average return data spanned August 1, 2014, to July 31, 2019. Average account size, advisory fee, number of accounts, as well as number of advisors were provided as of July 31, 2019. Because the data are as of a single point in time, time series analysis was not possible.

Firm-level data were provided to protect the identities of the individual advisors, clients, and firms that utilize the investment advisory platform as customers. The data set contains a total of 694 Registered Investment Advisory firms and 723 Independent Broker/Dealer firms, although many of these firms have a combination of AMP, UMA, and TAMP portfolios.

2.2. Empirical model

The following OLS regression model is used to test the hypothesis, if the distribution channel has a significant relation with one, three, and five-year average performance across the different risk tolerance categories regardless of the portfolio management approach (i.e., AMP, UMA, or TAMP). The empirical model is run separately on subsamples of the data based on the portfolio management approach (AMP, UMA, and TAMP).

$$Avg\,1,3,or\,5-Year\,Return=\beta_0+\beta_1(RIA)+\beta_2(PortRisk)+\beta_3(RIA*PortRisk)$$
$$+\beta_4(AvgFee)+\beta_5In(AvgAcctSize)+\beta_6(NumAccounts)+\varepsilon \quad (1)$$

2.3. Dependent variables

The dependent variables are the one, three, and five-year average return ending July 31, 2019. These returns are generated net of the advisor fee. Accounts are included in each time frame if they have a long enough history. For example, a portfolio that has two years of return data will only be included in the analysis of one year of return data, whereas a portfolio with four years of return history will be included in the one- and three-year analyses.

2.4. Independent variables

The following independent variables included in the regression to determine if they impact the one, three, and five-year average rates of return of the portfolio.

2.4.1. RIA

This is a dichotomous variable that is positive for RIA firms and zero for IBD firms.

2.4.2. Portfolio risk

The investment advisory platform utilizes five distinct universal risk tolerance levels. Clients complete a questionnaire, which provides a risk tolerance rating. Once the client's risk tolerance rating is established, the platform will provide available TAMP portfolios that

meet the client's risk tolerance objective, account size, as well as the advisor's licensing. For advisors who choose to employ AMP or UMA strategies, the client risk tolerance rating provides a risk range that the advisor must adhere to when constructing the portfolio. The platform ranks each available component investment and assigns a composite risk value. As component investments are added to the portfolio, the composite risk score for the portfolio is created and must remain within the client's risk tolerance score to be considered compliant.

The five risk tolerance categories in descending order from most conservative to most aggressive are:

1. Capital Preservation
2. Conservative
3. Moderate
4. Growth
5. Aggressive Growth

We expect that risk tolerance (manifest as portfolio volatility) and average one, three, and five-year returns will have a positive relationship. As portfolio volatility increases across the five risk tolerance categories, total net return will also increase, due to the additional equity allocations and increased risk premium.

*2.4.3. RIA*portfolio risk*

This interaction variable provides a measure of the marginal impact of increased portfolio volatility among RIA firms.

2.5. Control variables

2.5.1. Average advisor fee

This variable represents the average advisor fee (expressed as a percentage) for each portfolio, which does not represent the total cost to the client. Advisor driven portfolios do not have manager fees that TAMPs (and UMAs) could have. Additionally, firms charge different program fees that split revenue with the advisory platform; these fees are not included in the average advisor fee but could influence what the advisor chooses to charge. Fees also tend to work on economies of scale; in other words, the larger the account, the lower the percentage fee charged. Lastly, these fees are not what the advisor actually earns. Each firm has a different compensation structure, and each advisor has a different payout, which could influence what the advisor chooses to charge. We expect the average advisor fee to have an inverse relation with each dependent variable. Average advisor fees range from 0.000046% to 2.293% for IBDs for the one-, three-, and five-year time periods. For RIAs, fees range from 0.0986% to 2.059% for the one-, three-, and five-year time periods.

2.5.2. Ln (average account size)

For all AMP, UMA, and TAMP accounts, the average client account size is reported per firm as of July 31, 2019. Average account size for RIA AMPs ranges from $26,343 to

$15,506,672. Average account size for IBD AMPs ranges from $26,090 to $41,286,141. Average account size for RIA UMAs ranges from $27,221 to $45,829,626. Average account size for IBD UMAs ranges from $26,259 to $4,504,614. Average account size for RIA TAMPs ranges from $25,073 to $13,600,157. Lastly, average account size for IBD TAMPs ranges from $25,137 to $6,875,348.

2.5.3. Number of accounts

This variable represents the total number of accounts for each RIA and IBD in each portfolio management approach. We expect the number of accounts and one, three, and five-year average returns to have an inverse relation with AMP and UMA performance. Incidentally, we also expect the number of accounts and average account size to be inversely correlated.

3. Results

A description of the samples for the one-year time period is included in Table 1. The average return for RIAs over one-year ranges from 3.6% for UMAs and 4.35% for AMPs, while the average return for IBDs ranges from 3.25% for TAMPs and 4.53% for AMPs. Average Portfolio Risk for RIAs and IBDs range from 3.2 to 3.5. Average account sizes by firm vary quite widely, from around $250,000 to over $800,000. The average fee charged is just under 1% across each of the models, and the number of advised accounts is considerably lower for RIAs than for IBDs.

To explore the relation between portfolio performance and business model (RIA vs. IBD), we start by performing *t*-tests on the average returns for each of the nine models (i.e., three reporting time periods for each of the three portfolio management approaches). The results are displayed in Table 2. Four of the nine models had a statistically significant difference in the mean return between RIAs and IBDs. In each of these instances, including all three TAMP models, the returns of the RIAs were higher.

Before analyzing the full empirical model described previously, we performed a series of simplified regression models, as indicated in Table 3. The initial model, Regression #1, is a simple regression consisting of investment performance as the dependent variable and the key variable of interest, RIA, as the only independent variable. Regression #2 adds Portfolio Risk as an independent variable. Regression #3 builds on the previous model by adding an interaction variable of RIA and Portfolio Risk. Finally, Regression #4 incorporates all the control variables, including the average advisor fee, the natural log of average account size, and the number of accounts. Each regression model was run separately on nine subsamples, one for each of the three portfolio management approaches (AMP, UMA, and TAMP) for each of the three time periods (one-, three-, and five-year).

Table 4 shows the results for Regression #1 for each of the portfolio management approaches in each of the three time periods. The main variable of interest (RIA) is positive and significant in four of the models (one-year UMA, and all three TAMP time periods), consistent with the results in Table 2. The other regressions do not have significant parameter estimates for RIAs.

Table 1 Descriptive statistics for the one-year sample, separated by portfolio management approach (AMP, UMA, and TAMP) and by distribution channel (RIA, IBD)

	AMP		UMA		TAMP	
	RIA	IBD	RIA	IBD	RIA	IBD
Average return	4.35%	4.53%	3.60%	3.31%	4.17%	3.25%
Portfolio risk	3.2	3.2	3.5	3.3	3.3	3.2
Average account size	$432,762	$377,176	$824,559	$437,266	$389,059	$250,693
Advisor fee	0.99%	0.97%	0.90%	0.94%	0.99%	0.93%
No. of advisor accounts	76	290	39	274	53	232
n	413	1,172	724	760	1,588	2,201

Table 2 Mean one-, three-, and five-year returns for RIAs and IBDs using AMPs, UMAs, and TAMPs

	One-year return	Three-year return	Five-year return
RIA AMP	4.347%	6.607%	3.690%
IBD AMP	4.527%	6.824%	3.825%
Difference	−0.180%	−0.217%	0.501%
RIA UMA	3.595%	6.211%	3.191%
IBD UMA	3.309%	6.344%	3.134%
Difference	0.286%*	−0.133%	0.057%
RIA TAMP	4.167%	6.272%	3.465%
IBD TAMP	3.247%	5.721%	2.964%
Difference	0.920%***	0.551%***	0.501%***

Note. Significant *t*-test results comparing the differences in the means are indicated with asterisks.
***$p < 0.001$, **$p < .01$, *$p < .05$.

Table 5 shows the results using Regression #2, which adds portfolio risk as an independent variable. Portfolio Risk is significant in all but one of the regressions. The parameter estimates for RIAs in each of the three TAMP time periods are positive and significant. The parameter estimate for RIAs in the one-year UMA time period is still positive but is no longer significant. Once we control for Portfolio Risk, the parameter estimate for RIAs in the three-year AMP and UMA models are now significant and negative.

Table 6 shows the results using Regression #3, which adds the interaction variable of RIA and Portfolio Risk as another independent variable. In all but two of these regressions (the one-year AMP and the five-year TAMP), the parameter estimate for RIA is now significant and negative. However, the parameter estimate for the interaction variable is also significant but positive in all but two of the regressions, suggesting the relationship between RIAs and investment returns includes a marginal effect dependent on the risk of the portfolio.

The results seen in Tables 5 and 6 suggest that the relative performance of RIAs may depend on the level of Portfolio Risk. To further explore this potential interaction, we perform t-tests on the returns of RIAs and IBDs after separating the sample by Risk Category. The results are included in Table 7. In the column for the Capital Preservation risk category, IBDs have a statistically significant higher mean return than RIAs for the three- and five-year TAMP time periods. At the opposite end of the risk spectrum, however, the column for the Aggressive Growth risk category shows statistically significant outperformance of RIAs

Table 3 Progression of the regression models, indicating the independent variables that are included in each regression

Independent variables	Regression #1	Regression #2	Regression #3	Regression #4
RIA	X	X	X	X
Portfolio risk		X	X	X
RIA*Portfolio risk			X	X
Average advisor fee				X
Ln (average account size)				X
Number of accounts				X

Table 4 Regression #1 results for each of the portfolio management approaches, where one-, three-, and five-year returns are the dependent variables

	One-year return	Three-year return	Five-year return
AMP			
Intercept	0.0453***	0.0682***	0.0383***
RIA	−0.0018	−0.0022	−0.0014
R^2	0.0005	0.0008	0.0007
N	1,585	1,151	858
UMA			
Intercept	0.0331***	0.0634***	0.0313***
RIA	0.0029*	−0.0013	0.0006
R^2	0.0028	0.0007	0.0003
N	1,484	1,163	857
TAMP			
Intercept	0.0325***	0.0572***	0.0296***
RIA	0.0092***	0.0055***	0.0050***
R^2	0.0233	0.0073	0.0132
N	3,789	3,132	2,434

***$p < 0.001$, **$p < .01$, *$p < .05$.

over IBDs by a considerable margin in five of the subsamples, including the five-year AMP time period, the one-year UMA time period, and all three TAMP time periods.

Table 8 shows Regression #4, which incorporates all the control variables in the empirical model. Not surprisingly, advisor fees in almost every regression are significant and

Table 5 Regressions #2 results for each of the portfolio management approaches, where one-, three-, and five-year returns are the dependent variables

	One-year return	Three-year return	Five-year return
AMP			
Intercept	0.0435***	0.0253***	0.0177***
RIA	−0.0018	−0.0037*	−0.0024
Portfolio risk	0.0006	0.0134***	0.0065***
R^2	0.001	0.31	0.17
N	1,585	1,151	858
UMA			
Intercept	0.0270***	0.0170***	0.0082***
RIA	0.0024	−0.0041***	−0.0010
Portfolio risk	0.0019***	0.0140***	0.0070***
R^2	0.010	0.45	0.26
N	1,484	1,163	857
TAMP			
Intercept	0.0347***	0.0017	0.0020*
RIA	0.0093***	0.0041***	0.0039***
Portfolio risk	−0.0007*	0.0171***	0.0086***
R^2	0.024	0.59	0.33
N	3,789	3,132	2,434

Note. Portfolio risk is included in each of the regressions as an independent variable.
***$p < 0.001$, **$p < .01$, *$p < .05$.

Table 6 Regressions #3 results for each of the portfolio management approaches, where one-, three-, and five-year returns are the dependent variables

	One-year return	Three-year return	Five-year return
AMP			
Intercept	0.0434***	0.0278***	0.0194***
RIA	−0.0016	−0.0166**	−0.0108*
Portfolio risk	0.0006	0.0126***	0.0060***
RIA*Portfolio risk	−0.0001	0.0039**	0.0026*
R^2	0.001	0.31	0.17
N	1,585	1,151	858
UMA			
Intercept	0.0325***	0.0185***	0.0109***
RIA	−0.0098*	−0.0075*	−0.0081**
Portfolio risk	0.0002	0.0135***	0.0062***
RIA*Portfolio risk	0.0036**	0.0010	0.0021*
R^2	0.017	0.46	0.26
N	1,484	1,163	857
TAMP			
Intercept	0.0414***	0.0063***	0.0051***
RIA	−0.0050*	−0.0058**	−0.0032
Portfolio risk	−0.0028***	0.0157***	0.0076***
RIA*Portfolio risk	0.0043***	0.0030***	0.0021***
R^2	0.035	0.59	0.34
N	3,789	3,132	2,434

Note. Portfolio risk and an interaction term combining RIA and portfolio risk are included in each of the regressions as independent variables.

***$p < 0.001$, **$p < .01$, *$p < .05$.

negatively associated with returns. The natural log of average account size was positive and highly significant in all nine regressions. The interaction variable between RIA and Portfolio Risk continues to be significant and positive in most of the regressions in Table 8.

For the regressions in Table 8 where both the RIA coefficient and the interaction variable coefficient are significant (the three- and five-year AMP time periods, the one-year UMA time period, and all three TAMP time periods), the combined effect of RIAs is positive only for the higher risk categories and not for the lower risk categories. (This combined effect is calculated by using RIA = 1 and Risk Category = 5 and multiplying by the corresponding parameter estimates.) In each of these instances, the Aggressive Growth risk categories shows that RIAs outperform IBDs. In the one-year UMA and all three TAMP time periods, RIAs outperform IBDs in the Growth risk category as well (where Risk Category = 4).

4. Discussion

Our hypothesis states that RIAs will outperform IBDs regardless of the portfolio management approach (AMP, UMA, or TAMP). This hypothesis was formulated based on the theoretical framework that RIAs expend less cognitive energy during the day-to-day activities of a practicing financial advisor due to the lack of the requirement to complete the

Table 7 Differences in mean returns for RIAs and IBDs by risk category

	Differences (RIA-IBD)	Risk category				
		#1 (capital preservation)	#2 (conservative)	#3 (moderate)	#4 (growth)	#5 (aggressive growth)
AMP						
	One-year return	−0.36%	−0.30%	0.45%	−0.59%	−0.07%
	Three-year return	−0.60%	−0.80%**	−0.76%*	−0.70%**	1.19%
	Five-year return	−0.43%	−0.61%	−0.42%	−0.55%	0.71%**
UMA						
	One-year return	−0.91%	0.18%	0.17%	−0.01%	1.00%**
	Three-year return	0.15%	−0.67%*	−0.76%***	−0.43%**	−0.07%
	Five-year return	−0.18%	−0.43%	−0.30%	−0.11%	0.36%
TAMP						
	One-year return	−0.14%	0.75%***	0.05%	0.58%**	1.81% ***
	Three-year return	−0.50%***	0.86%***	0.24%	−0.16%	1.17%***
	Five-year return	−0.33%*	0.47%*	0.15%	0.20%	0.76%**

Note. Significant *t*-test results comparing the differences in the means are indicated with asterisks.
***$p < 0.001$, **$p < .01$, *$p < .05$.

Table 8 Regressions #4 results for each of the portfolio management approaches, where one-, three-, and five-year returns are the dependent variables

	One-year return	Three-year return	Five-year return
AMP			
Intercept	0.0145	−0.0150	−0.0343**
RIA	0.0006	−0.0158**	−0.0115**
Portfolio risk	0.0009	0.0127***	0.0060***
RIA*Portfolio risk	−0.0007	0.0038**	0.0028*
Average advisor fee	−2.5417***	−1.5082***	−1.7469***
Ln (Average account size)	0.0043***	0.0046***	0.0057***
Number of accounts	0.0000001	0.0000004	0.0000005
R^2	0.041	0.35	0.28
N	1,585	1,151	858
UMA			
Intercept	−0.0381**	−0.0241**	−0.0388***
RIA	−0.0095*	−0.0072*	−0.0073*
Portfolio risk	−0.0002	0.0132***	0.0059***
RIA*Portfolio risk	0.0031**	0.0007	0.0014
Average advisor fee	−0.8754*	−0.5646	−0.6910*
Ln (Average account size)	0.0063***	0.0038***	0.0054***
Number of accounts	0.0000027***	0.0000032***	0.0000027**
R^2	0.074	0.48	0.34
N	1,484	1,163	857
TAMP			
Intercept	−0.0566***	−0.0478***	−0.0613***
RIA	−0.0076**	−0.0077***	−0.0056**
Portfolio risk	−0.0027***	0.0156***	0.0075***
RIA*Portfolio risk	0.0043***	0.0031***	0.0023***
Average advisor fee	−0.9896**	−0.6072**	−0.5024*
Ln (Average account size)	0.0089***	0.0050***	0.0059***
Number of accounts	0.0000002	0.0000004	0.0000005
R^2	0.109	0.62	0.40
N	3,789	3,132	2,434

Note. All the control variables are included as independent variables.
***$p < 0.001$, **$p < .01$, *$p < .05$.

Compensation Puzzle. The absence of this mental calculus, that IBDs must perform for every client, frees working memory capacity to potentially utilize in investment management.

Our analysis confirmed that risk is an important aspect to consider when evaluating the relative performance of RIAs and IBDs. Overall, RIAs may not outperform IBDs; however, when considering the risk category of the portfolio, our findings provide qualified support for our hypothesis that RIAs tend to outperform IBDs for portfolios in higher risk categories.

RIAs outperforming at higher risk categories can be explained through the theoretical framework and the equity risk premium, or the excess return above the risk-free rate provided to investors for taking on the additional risk of equity investments. Based on data from 1928 to 2018, the geometric average annual equity risk premium is 6.11% over 3-Month Treasury Bills and 4.66% over the 10-Year Treasury Bond (Damodaran, 2019). However, to achieve this equity risk premium one must also assume increased risk. Over the

same time period, from 1928 to 2018, the S&P 500 (including dividends) had a standard deviation of 19.58%, while the 3-Month Treasury Bill had a standard deviation of only 3.04%, and the 10-Year Treasury Bond had a standard deviation of 7.70%.

With a higher variance of returns and a higher expected average return, equities can be considered a more difficult asset class to effectively value than fixed income. When valuing a bond, the primary concern is whether the issuing company has enough capital to honor the interest and principal repayments. Although corporate profits are used to fund the capital requirements necessary to honor the covenants of a bond, the magnitude of corporate profits is not material in valuing a bond. Bonds held to maturity also receive a fixed return, making valuations rather straight-forward. Conversely, to properly value stocks, one must estimate future cash flows and discount those cash flows to the present. If a company does better than expected, equity shareholders could potentially be rewarded with increased dividends or improved share prices. Bond holders, however, are not entitled to any additional compensation beyond the bond covenants. Because equities are more difficult to value than fixed income instruments, they naturally require more cognitive load to analyze and evaluate. Because advisors at RIAs can devote more working memory capacity toward the task of investment management (due to fewer extraneous cognitive load detractors such as the Compensation Puzzle), our study provides evidence that advisors at RIAs who focus more on equity-heavy portfolios are able to outperform their IBD counterparts.

Implications from these findings apply to both clients and advisors. Clients with higher risk tolerance who wish to invest more in equities may be better served by employing advisors at RIAs rather than IBDs. Conversely, advisors may want to consider their competitive advantage as a financial professional. Advisors at IBDs, for example, may provide more benefit to clients with more conservative portfolios, while advisors at RIAs may have a competitive advantage on portfolios with more equity investments.

4.1. Limitations

We note that our study is not without limitations. For example, risk performance measures were not reported due to data limitations. While returns are key determinants of portfolio success, risk-adjusted returns would provide a more robust measurement of investment performance. In addition, individual account level data were not available, so firm level data were analyzed instead. Because firms served as our unit of analysis, we made no attempt to measure the experience level of the advisors at the firms. Experience could play a role in an advisor's ability to manage investments that could influence the affect created by the business model.

We also recognize that we have limited information about the advisors at the RIAs and IBDs in our study and their clients. For example, details about the attitudes, skills, preferences, and beliefs of the advisors of the firms in our study would have enhanced our analysis. Additional information about the clients of these firms would also have allowed for an analysis of potentially unobserved heterogeneity among client groups.

We also recognize that the performance windows that were analyzed were rather small and at a single point in time, July 31, 2019. As such, the results of this study are heavily

reliant on the capital market performance during the time periods preceding that date. In addition, the single point in time data limits the ability to analyze potential changes over time. For example, an account with a five-year track record could have seen its account size grow to the point where the advisor fee was decreased; however, the fee and size of the account were reported only as of the ending date, and changes in account sizes and fees were not observed.

Most importantly, we recognize that our results are correlational and do not indicate a direction of effect. Although our results provide evidence that advisors at RIAs may perform differently than advisors at IBDs because they have a different compensation motivation, it is also possible that each business model attracts different types of advisors. Due to data limitations, we are not able to disentangle these possible explanations.

4.2. Future research

Regulators continue to evaluate the role of advisor compensation in providing professional financial advice, as seen in the Department of Labor's Fiduciary Rule and the Security and Exchange Commission's Regulation Best Interest. In this discussion, one must also consider the role that business models play on portfolio performance. Future research in this area that can include demographic information about advisors (e.g., education, age, gender, years in the profession, advanced designations, and disciplinary actions) would provide a better understanding of the effects business models have on advisor managed portfolio performance. In addition, analyzing performance over longer time periods, such as seven or even ten years, would provide greater insight into the long-term effects of business models on investor returns.

4.3. Conclusion

Ample evidence both condemns professional financial advice (e.g., see Bergstresser et al., 2009; Del Guercio et al., 2010; Desai & Jain, 1995; French, 2008; Gil-Bazo & Ruiz-Verdú, 2009; Gruber, 1996; Jensen, 1968; Malkiel, 1995; Reuter, 2015), and praising it (Hackethal et al., 2012; Gennaioli et al., 2015; Kinniry et al., 2016; Warshcuer & Sciglimpaglia, 2012). However, the literature is scant regarding advantages or disadvantages provided to clients through the different business models available to advisors. This study sought to determine whether business models had an association with investment portfolio performance.

The theoretical framework suggests that advisors at RIAs can eliminate the extraneous cognitive load created by the Compensation Puzzle and would be able to potentially redirect freed working memory capacity toward the difficult task of investment management. By virtue of having more working memory capacity to apply to the intrinsic cognitive load of investment management, we hypothesize that RIAs could outperform IBDs regardless of the chosen portfolio management approach (AMP, UMA, or TAMP) and regardless of risk category. Our findings, however, provide qualified support of RIAs outperforming IBDs through UMA and TAMP portfolios at higher risk categories but not at lower risk categories.

While evidence is mixed regarding the efficacy of professional financial advice, this study provides qualified support for the hypothesis that business models have an association with

investment performance. Qualified support exists in favor of RIAs producing higher net investment results through AMP, UMA, and TAMP portfolios in higher risk categories when compared with IBDs.

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1. In Ricaldi, Martin, and Huston, the household that has enough money to pay off the credit card balance but chooses not to is called:
    a. A solvent revolving user
    b. A convenience user
    c. A revolving user
    d. An insolvent revolving user

2. In "Financial Literacy and its Impact on the Credit Card Debt Puzzle" by Ricaldi, Martin and Huston, to control the "doer" in a household, the "planner" will…
    a. Impose a spending limit on the credit card
    b. Pay off all credit card balances each month.
    c. The "planner" cannot control the "doer".
    d. Create mental accounts to reduce the temptation to spend.

3. When comparing convenience users to solvent revolvers with the highest financial literacy scores, the authors find that:
    a. Increases in income and net worth negatively impact the likelihood of being a solvent revolver.
    b. Income and net worth are not statistically significant in the likelihood of being a solvent revolver.
    c. Decreases in income and net worth negatively impact the likelihood of being a solvent revolver.
    d. Changes in income and net worth have different impacts on the likelihood of being a solvent revolver.

4. The Compensation Puzzle proposed by Heller, Cummings, and Martin describes
    a. the process RIAs undertake when determining how to charge clients
    b. the additional process IBDs face in determining a client's mix of products across different compensation programs
    c. the difficulty product manufacturers undergo when incorporating advisor compensation in new product offerings
    d. the differences in fee structures for IBDs compared to RIAs

5. Heller, Cummings, and Martin found that advisors at RIAs who focus more on _____ portfolios are able to outperform their IBD counterparts.
    a. fixed income
    b. equity-heavy
    c. balanced
    d. actively-managed

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There is a $100 submission fee payable to the Academy of Financial Services (AFS) for all submissions to FSR. Submission fees should be paid online at academy financial org. If none of the authors is a member of AFS, please complete an online membership application form, which can be downloaded at http://academyfinancial.org. When authors pay the $100 submission fee and are not currently members, they receive their first year of AFS membership at no charge. Submission of a paper will be held to imply that it contains original unpublished work and is not being considered for publication elsewhere. The Editor does not accept responsibility for damage or loss of papers submitted. Upon acceptance of an article, author(s) transfer copyright of the article to the Academy of Financial Services. This transfer will ensure the widest possible dissemination.

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(7) The abstract, consisting of no more than 100 words, should appear alone on page 2, titled, Abstract.

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Chapter in a book:

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Periodicals:

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