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Investment literacy, overconfidence and cryptocurrency investment

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Abstract

Cryptocurrency has been increasingly popular with investors. Using the 2018 National Financial Capability Study Investor survey, we examined the association between investment literacy and cryptocurrency investment—about 13% of investors invested in cryptocurrency directly or indirectly. Results from regression analyses show that objective investment literacy was negatively while subjective literacy was positively associated with holding cryptocurrency. Overconfident investors were more likely to invest in cryptocurrency, and results were robust across three overconfidence measures. This study has implications for investment advice, financial education, and research.

JEL classification: G5; G11; G53

Keywords: Investment literacy; Financial knowledge; Overconfidence; Investment; Cryptocurrency

1. Introduction

Cryptocurrency has become increasingly popular since 2008, since the invention of Bitcoin by Satoshi Nakamoto (Nakamoto, 2008). Although Bitcoin still dominates the cryptocurrency market, nearly 8,600 cryptocurrencies are currently trading around the world with a combined market capitalization of US$1.48 trillion as of March 2, 2020 (Coin Market

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Cap, 2020). The total value of holdings in cryptocurrencies is still small relative to holdings of gold and financial investments but is being increasingly studied as a component of portfolios of wealthy investors (Zhao, 2021). One indicator of the growing importance of cryptocurrencies is concern about the impact on the environment of the production of cryptocurrencies (Sorkin, 2021).

Although investment in cryptocurrency has been rapidly growing, there are not many studies on factors related to people investing in cryptocurrency. One of the major reasons is the limited availability of appropriate survey data and questionnaires. The 2018 National Financial Capability Study Investor Survey (thereafter, 2018 NFCS Investor Survey) released by FINRA Investor Education Foundation collects a series of questions about cryptocurrency investment. This allows us a unique opportunity to identify factors associated with investing in cryptocurrency by US investors. Given limited knowledge about investing in cryptocurrencies and the extreme volatility as an investment, what type of investor holds cryptocurrency investments?

The purpose of this study is to investigate the association between investment literacy and cryptocurrency investment. We tested investment literacy in three ways: (1) objective literacy, (2) subjective literacy, and (3) overconfidence in investment literacy. To check the robustness of our results, we used three different indicators of overconfidence in investment literacy, measured by divergence between objective and subjective literacy. In addition to the analysis on the association between investment literacy and investing in cryptocurrency, we examined various socioeconomic factors related to investing in cryptocurrency. This study contributes to the existing literature in two ways. While there has been increasing attention to cryptocurrency investment, our study is one of first attempts to explore the association between investment literacy overconfidence and investing in cryptocurrency of US investors. Further, we used an index of correct answers to investment knowledge questions, which captures one's investment literacy more comprehensively than commonly used measures of financial literacy (Lusardi & Mitchell, 2014). The major findings of this study provide important insights for investment advisors, financial educators, and researchers.

2. Literature review and theoretical consideration

2.1. Previous studies on cryptocurrency investments

While cryptocurrency is labeled "currency," the actual adoption of cryptocurrency as a payment method is still a topic of discussion. Cryptocurrency has advantages such as confidentiality, reliability of information transmission, and flexible transactions, but drawbacks such as significant volatility, lack of organized platforms, and the difficulty of projection hinder it from being integrated to the global financial market (Tasca et al., 2018; Titov et al., 2021).

Cryptocurrency has also gained a tremendous amount of attention as an investment vehicle. Chuen et al. (2017) argued that due to low correlation between cryptocurrencies and traditional assets as well as the higher daily expected return of the former option, investing in

cryptocurrencies could help one diversify their portfolio risks. When examined as a form of financial asset, cryptocurrency presented quite similar dynamics to stock investments (Liang et al., 2019).

Previous studies have documented several factors related to cryptocurrency investments. Socio-demographic factors such as age, gender, and education were correlated to cryptocurrency investment (Ante et al., 2022; Hasso et al., 2019; Henry et al., 2018). Since cryptocurrency is based on a cutting-edge technological innovation, many studies have also used the Technology Acceptance Model as a theoretical background for cryptocurrency investment. Studies confirmed that the new technology's perceived usefulness and ease of use as well as the risk associated with it affect one's intention to utilize cryptocurrency (Arias-Oliva et al., 2019; Bharadwaj & Deka, 2021).

One phenomenon that might be related to the growth of cryptocurrency investment is the bandwagon effect, or herding behavior (Avital et al., 2016; Bouri et al., 2019; da Gama Silva et al., 2019). Herding behavior combined with the subsequent high volatility could pose significant risks on the financial stability of the cryptocurrency investors. Thus, it calls for a cautious approach to cryptocurrency investment and emphasizes the importance of understanding whether investors selected cryptocurrency as an investment vehicle are capable of understanding complex dynamic and the potential consequences of their choices.

2.2. Financial literacy and investment decisions

Unlike what traditional economists have assumed and approached, many studies present evidence that investors are functioning under bounded rationality (de Bondt et al., 2008). The theory of bounded rationality (Simon, 2000) posits that individuals have limited ability to assess given information and make optimal decisions. This is mainly due to the complexity of environments, limited mental capacity, and limited resources (Ibrahim, 2009). Financial literacy is a measure of individuals' ability to understand situations and make optimal financial decisions based on their assessments (Seay et al., 2017). Therefore, those with higher financial literacy would behave in a more appropriate manner, and financial mistakes would be more common among the financially illiterate people. Enhancing financial literacy could help reduce the probability of a major systematic financial crisis due to bounded rationality (Siriopoulos, 2021). Grounded within the theory of bounded rationality, previous studies have documented the positive link between financial literacy and various financial outcomes including stock ownership (Kimball & Shumway, 2006; van Rooij et al. 2011), diversification (Goetzmann & Kumar, 2008; Guiso & Jappelli, 2008; Shin et al., 2020), wealth accumulation and planning for retirement (Lusardi & Mitchell, 2007).

Cryptocurrency investment is one of the complex financial decisions which would require one's understanding of the concept and characteristics of cryptocurrency and relatively unique procedures of investment, but there have been few studies conducted on the link between cryptocurrency and financial literacy (Arias-Oliva et al., 2019; Zhao & Zhang, 2021). Financial literacy has been conceptualized as objective and subjective measures, where objective financial literacy indicates one's actual understanding of financial concepts while subjective financial literacy refers to one's perceived understanding of the matter

(Kim et al., 2020; Robb et al., 2015). Objective financial literacy has been found negatively related to cryptocurrency use or acceptance (Zhao & Zhang, 2021) while subjective financial literacy has been found positively related to (Gupta et al., 2020) or did not have a statistically significant relation to cryptocurrency utilization (Arias-Oliva et al., 2019). Based on the findings from previous studies, we constructed the following two research hypotheses on the association between investment literacy and cryptocurrency investment.

Hypothesis 1: Objective investment literacy is negatively associated with investing in cryptocurrency.

Hypothesis 2: Subjective investment literacy is positively associated with investing in cryptocurrency.

We focused on the link between overconfidence in investment literacy and cryptocurrency investments, to provide new insights into factors related to holding cryptocurrency as an investment. Investors may be influenced by herd behavior instead of making investment decisions based on the value of cryptocurrencies; therefore, it is useful to investigate the cryptocurrency investment from the perspective of bounded rationality, and we extended it to the aspect of overconfidence in this study.

Overconfidence bias has been described as (1) overprecision or (2) miscalibration, indicating a systematic overweighting of the accuracy of one's own literacy (e.g., Robb et al. 2015; Xia et al., 2014). Researchers have examined the relationship between overconfidence and irrational behaviors such as excessive trading, excessive risk taking (Abreu & Mendes, 2012; Barber & Odean, 2000), under diversification (Chu et al. 2017; Shin et al., 2020; Xia et al., 2014) and high-cost borrowing (Robb et al., 2015). Some studies have raised concerns about the divergence between objective and subjective financial knowledge (e.g., Kim et al., 2020; Robb et al., 2015). False confidence in one's ability to understand complex investment concepts would lead to suboptimal financial decisions.

In this study, we propose the following research hypothesis on the association between investment literacy overconfidence and cryptocurrency investment.

Hypothesis 3: Overconfidence in investment literacy is positively associated with investing in cryptocurrency.

3. Method

3.1. Dataset and analytic sample

This study utilized data from the 2018 National Financial Capability Study (NFCS) and the follow-up 2018 Investor Survey, which includes a subset of respondents who had indicated ownership of nonretirement investments. The 2018 NFCS state-by-state data collected approximately 500 observations per state plus the District of Columbia, which leads to the total sample of 27,091 adults in the United States, with approximately 500 observations per state plus the District of Columbia. The 2018 NFCS Investor Survey includes a sample drawn from individuals who indicated owning nonretirement investments. To explore the associations between investment literacy and investing in cryptocurrency, the analytic

sample started with the 2,003 individuals who completed both the 2018 NFCS and the 2018 NFCS Investor Survey. The final sample includes 1,819 investors, excluding missing responses.

3.2. Dependent variables

The 2018 NFCS Investor Survey includes questions on cryptocurrency. The dependent variable is a binary indicator whether the respondent has invested in cryptocurrency, based on the following question, "Have you invested in cryptocurrencies, either directly or through a fund that invests in cryptocurrencies?"

3.3. Investment literacy and overconfidence

The 2018 NFCS Survey includes questions designed to measure investment literacy covering various investment-related topics and concepts. We created an objective investment literacy index, measured as each respondent's number of correct answers to 10 questions and ranged from 0 to 10. The topics of investment literacy cover stock, bond, bankruptcy, investment risk, investment return, municipal bond, stock margin, selling short, investment indicator, and index fund. The subjective assessment of investment knowledge was measured by the following question: "On a scale from 1 to 7, where 1 means very low and 7 means very high, how would you assess your overall knowledge about investing?"

Following the approach of Kim et al. (2020), we tested three measures of investment literacy overconfidence: (1) overconfidence defined as having higher than the sample median for subjective literacy, but lower than the sample median for objective literacy; (2) a continuous measure of divergence between objective and subjective financial literacy; and (3) the residual from a least squares regression of objective literacy on subjective literacy.

3.4. Control variables

In addition to investment literacy variables, we included age, gender (male, female), marital status (married, single, separated/divorced/widow(er)), having a dependent child, race/ethnicity (White, Black, Hispanic, Asian/others), employment status (full-time employee, self-employed, part-time employee, homemaker, student, disabled, unemployed, retired), education (high school diploma or lower, some college, associate degree, bachelor degree, postbachelor degree), household income, investment assets in nonretirement account, and region (state of residence) as control variables.

3.5. Empirical specification

We used logistic regression models to investigate the effects of various factors associated with an investment in cryptocurrency, especially for the role of investment literacy and its overconfidence measured by divergence between objective and subjective literacy. Both descriptive and multivariate results were weighted using the sampling weight provided by NFCS Investor survey. Empirical models are expressed as follows;

$$Pr(C)_{\mathrm{i}} = \log\left[\frac{Pr(C)_{\mathrm{i}}}{\left(1 - Pr(C)_{\mathrm{i}}\right.}\right] = \beta_0 + \beta_1 IL_{\mathrm{i}} + \beta_2 X_{\mathrm{i}} + \varepsilon_{\mathrm{i}}$$

Where, $Pr(C)_{\mathrm{i}}$ is the probability of investing in cryptocurrency; β_0 is an intercept; *IL* denotes the level of investment literacy including objective, subjective investment literacy (baseline model) and three overconfidence induce. The control variables and state of residence are denoted as X_i.

4. Results

4.1. Descriptive results

As shown in Table 1, about 13% of investors invested in cryptocurrency directly or indirectly. Based on the proportion of all households with nonretirement investments, we can infer that less than 4% of all households held cryptocurrency. We also tested the mean differences in investment literacy of cryptocurrency investors and noninvestors. Respondents owning cryptocurrency investments had lower objective investment literacy scores and higher subjective literacy than noncryptocurrency investors. In addition, the level of overconfidence in investment literacy was higher for cryptocurrency owners than nonowners across three overconfidence indexes. Socio-demographic characteristics of the analytic sample are presented in Appendix.

4.2. Multivariate results

Results of logistic regressions on cryptocurrency investment are reported in Table 2. In Model A (baseline), objective investment literacy was negatively, but subjective literacy was positively associated with investing in cryptocurrency. In particular, a one unit increase in objective literacy decreased the odds of investing in cryptocurrency by 10.5%; while a one

Table 1 Descriptive results of selected variables, 2018 NFCS investor survey

Variables	All investors	Investing in cryptocurrency	Not investing in cryptocurrency
Dependent variable			
Investing in cryptocurrency	12.90%	—	—
Investment literacy			
Objective literacy (0–10), mean (median)	4.77 (5.00)	3.96 (4.00)***	4.89 (5.00)
Subjective literacy (1-7), mean (median)	4.79 (5.00)	5.55 (6.00)***	4.68 (5.00)
Overconfidence in investment literacy			
Index 1 (high subjective/low objective literacy)	28.28%	58.7%***	23.9%
Index 2 (numerical difference), mean (median)	0.02 (0.00)	1.58 (3.00)***	−0.21 (0.00)
Index 3 (residual measure), mean (median)	0.00 (0.18)	0.86 (1.04)***	−0.13 (0.04)

Notes. Weighted results. *t* test or χ^2 are conducted for a group comparison.
Significance level: *$p < .05$, **$p < .01$, ***$p < .001$.

Table 2 Logistic regressions on cryptocurrency investment, 2018 NFCS investor survey

Variables	(A) Baseline model		(B) Overconfidence index 1 (high subjective, low objective)		(C) Overconfidence index 2[a] (discrepancy)		(D) Overconfidence index 3[b] (residual)	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Investment literacy variables								
Objective literacy	−0.1114*	0.0472	—	—	—	—	—	—
Subjective literacy	0.591***	0.0812	—	—	—	—	—	—
Overconfidence in literacy	—	—	1.1224***	0.1982	0.2369***	0.042	0.5979***	0.0807
Age	−0.0911***	0.0102	−0.0918***	0.0102	−0.0883***	0.0102	−0.0916***	0.0102
Male	0.3868	0.1993	0.3664	0.1935	0.4975*	0.1936	0.3707	0.1979
Marital status (ref: married)								
Single	−0.6844**	0.2527	−0.7624**	0.2482	−0.7387**	0.2471	−0.6898**	0.2525
Separated/divorce/widow	−0.4592	0.3486	−0.3481	0.3417	−0.3626	0.3421	−0.4816	0.3471
Presence of dependent child (ref: No)	0.3519	0.2171	0.3508	0.2101	0.3539	0.209	0.3627	0.2167
Race/ethnicity (ref: White)								
Black	−0.0273	0.2836	0.0427	0.2742	0.0855	0.2717	−0.0161	0.2835
Hispanic	−0.3788	0.3455	−0.3791	0.3361	−0.3352	0.3322	−0.3541	0.3432
Asian/others	0.6099	0.3157	0.4587	0.307	0.6575*	0.3076	0.5968	0.3151
Education (ref: high school diploma or lower)								
Some college	0.5082	0.2905	0.5127	0.2813	0.5093	0.2806	0.5034	0.2906
Associate degree	0.5331	0.3511	0.5062	0.3379	0.5036	0.3401	0.5421	0.351
Bachelor degree	0.0957	0.293	0.1677	0.2841	0.1943	0.2856	0.0743	0.291
Post-bachelor degree	0.3322	0.3586	0.3387	0.3489	0.3803	0.3511	0.3102	0.3568
Employment status (ref: full-time employee)								
Self-employed	−0.0064	0.3032	0.0069	0.3006	0.0266	0.2983	−0.0173	0.3026
Part-time worker	0.3111	0.3401	0.0993	0.3310	0.0934	0.3283	0.3029	0.3404
Homemaker	−1.4017*	0.6234	−1.4617*	0.5991	−1.5898**	0.5957	−1.4035*	0.6248
Student	−0.8581	0.4550	−0.9147*	0.4399	−0.9344*	0.4470	−0.8545	0.4546
Disabled	0.5048	0.8070	0.1875	0.7839	−0.0005	0.8031	0.5273	0.8043
Unemployed	−1.2446	0.7342	−1.1226	0.7172	−1.0897	0.7084	−1.2383	0.7332
Retired	−0.1402	0.4550	−0.2263	0.4526	−0.2926	0.4540	−0.1411	0.4543
Income (ref: less than $35,000)								
$35,000–$49,999	−0.6865	0.3676	−0.6697	0.3629	−0.7638*	0.3579	−0.6860	0.3677
$50,000–$74,999	−0.3442	0.2932	−0.4094	0.2856	−0.4894	0.2845	−0.3483	0.2932
$75,000–$99,999	−0.5859	0.3369	−0.5728	0.3292	−0.7192*	0.3246	−0.5917	0.3371

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Table 2 (Continued)

Variables	(A) Baseline model		(B) Overconfidence index 1 (high subjective, low objective)		(C) Overconfidence index 2[a] (discrepancy)		(D) Overconfidence index 3[b] (residual)	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
$100,000–$149,999	−0.4307	0.3497	−0.5912	0.3446	−0.6147	0.3416	−0.4473	0.3488
$150,000 or more	−1.2693**	0.4884	−1.3458**	0.4859	−1.4306**	0.4859	−1.2716**	0.4877
Investment assets (ref: less than $5,000)								
$5,000–$24,999	−0.7178*	0.3154	−0.7805*	0.3069	−0.6929*	0.3054	−0.7142*	0.3155
$25,000–$49,999	−0.1918	0.3417	−0.1907	0.3371	−0.0930	0.3297	−0.1954	0.3425
$50,000–$99,999	−0.5003	0.3251	−0.3135	0.3161	−0.2106	0.3127	−0.5069	0.3250
$100,000–$249,999	−0.5751	0.3630	−0.2897	0.3536	−0.2698	0.3536	−0.5835	0.3624
$250,000–$499,999	0.0967	0.3769	0.3084	0.3677	0.3825	0.3683	0.0946	0.3760
$500,000–$999,999	−1.3453*	0.6497	−1.0019	0.6322	−0.9790	0.6355	−1.3809*	0.6488
$1,000,000 or more	−0.0822	0.4941	0.4369	0.4658	0.5109	0.4698	−0.1349	0.4877
Constant	−1.7652*	0.8008	0.317	0.6705	0.4317	0.6672	0.5821	0.6816
Regional fixed effect (State of residence)	Yes		Yes		Yes		Yes	
Model fit								
Concordance rate	89.0%		87.5%		87.7%		89.0%	

Notes. Weighted results.

[a]Discrepancy between subjective and objective financial literacy.

[b]We regress subjective financial literacy on the objective literacy and take the residual as an overconfidence measure.

Significance level: *$p < .05$, **$p < .01$, ***$p < .001$.

unit increase in subjective literacy increased the odds by 80.6%. In Models B, C, and D, we found strong positive associations between overconfidence (as specified three different ways) and cryptocurrency investment. Investors with overconfidence in investment literacy (Model B, index 1) had 3.1 times the odds of investing in cryptocurrency as investors who were not overconfident. Additionally, a one unit increase in overconfidence index 2 (Model C) increased the odds of investing in cryptocurrency by 26.7%, and a one unit increase in overconfidence index 3 (Model D) increased the odds of investing in cryptocurrency by 81.8%.

Among control variables, age was negatively associated with the likelihood of investing in cryptocurrency. Single investors were less likely to invest in cryptocurrency than married couples. Homemakers and students had lower likelihood of investing in cryptocurrency than full-time employee. Investors with the lowest amount of income were more likely to invest in cryptocurrency than those with the highest income ($150,000 or more). Investors with the lowest amount of investment assets (less than $5,000) were more likely to invest in cryptocurrency than those with the investment assets of $5,000–$24,999.

5. Discussion and implications

While investment in cryptocurrency has been rapidly growing, the academic research on cryptocurrency investors is still understudied. To fill this gap, this study investigated the associations between investment literacy and cryptocurrency investment of US investors. One of the notable findings is that objective investment literacy is negatively while subjective literacy and overconfidence are positively associated with the likelihood of investing in cryptocurrency. Further, we found various socioeconomic characteristics related to cryptocurrency investment.

In line with previous research on risky assets and stock investment, we confirmed a salient effect of investment literacy on cryptocurrency investment. Given the high volatility and anomalies in the cryptocurrency market, and the short history of the market, such investments do not seem prudent, so our finding that overconfident individuals are more likely to hold them is not surprising. However, given the trend of increasing and considerable trading volume in a market, our finding provides some implications for financial practitioners and educators. Many studies have documented low level of financial literacy (e.g., Atkinson & Messy 2012; Lusardi & Mitchell 2017) and significant divergence between objective and subjective financial literacy (e.g., Kim et al., 2020; Robb et al., 2015). Use of financial advice or delegation of financial decisions could be possible alternatives to accompany improving one's investment literacy and assessing their financial literacy level realistically. Our study did not test this issue empirically, but the use of financial advice could be a complementary and supplementary source of financial and investment literacy of investors.

This study has some limitations to be noted. First, given the cross-sectional design of the NFCS Investor Survey, this study did not address any causal inferences between investment literacy and investing in cryptocurrency. Ideally, analyses that use longitudinal dataset or experimental study are needed to address the causal inference. Second, the timeframe of cryptocurrency investment is not specified in the NFCS survey, for example, "Have you invested . . ." Also, the survey question does not ask specific type of cryptocurrency available in a marketplace. Despite these limitations, this study provides a source of understanding the divergence in investment literacy and its association with cryptocurrency investment.

Appendix

Sample characteristics

Variables	Percentage
Age, mean (SD)	50.8 (17.6)
Gender	
Male	56.7
Female	43.3
Marital status (ref: married)	
Married	58.4
Single	25.4
Separated/divorce/widow	16.2
Presence of dependent child	31.3
Race/ethnicity	
White	76.9
Black	8.3
Hispanic	6.9
Asian/others	7.9
Education	
High school diploma or lower	20.4
Some college	24.1
Associate degree	10.8
Bachelor degree	26.6
Post-bachelor degree	18.1
Employment status	
Full-time employee	42.9
Self-employed	9.0
Part-time employee	7.7
Homemaker	3.8
Student	2.5
Disabled	1.3
Unemployed	1.9
Retired	30.9
Income	
Less than $35,000	15.6
$35,000–$49,999	12.3
$50,000–$74,999	23.9
$75,000–$99,999	18.9
$100,000–$149,999	18.3
$150,000 or more	11.0
Investment assets	
Less than $5,000	12.4
$5,000–$24,999	15.1
$25,000–$49,999	10.8
$50,000–$99,999	14.9
$100,000–$249,999	17.0
$250,000–$499,999	14.2
$500,000–$999,999	8.3
$1,000,000 or more	7.3

Note. Weighted results.

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FINANCIAL SERVICES REVIEW

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Assessing the relative need and demand for financial education programs: A case study of graduate students

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Abstract

We measure the relative need and demand for financial education programs among graduate students at a large university system. We find that self-assessed and measured financial literacy is significantly related to interest and demand for financial education. Individuals who self-report a high level of financial literacy but have low measured financial literacy are significantly less likely to be interested in financial education, while the opposite is true for financially literate individuals self-reporting a low level of financial literacy. Our study adds to research showing the importance of both believed and actual financial literacy measures and has implications for financial education programs.

JEL classifications: D14; G53

Keywords: Financial education; Financial literacy; Overconfidence

1. Introduction

Over the last several decades, there has been a substantial increase in the investment, health, and longevity risk burdens borne by individuals. This shift has increased focus on the importance of household financial literacy in managing these risks and enhancing financial well-being. As noted by Lusardi and Mitchell (2014), a lack of financial literacy can have long-term impacts on households' financial well-being. For example, not properly managing

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debt or planning for retirement can have substantial impacts on financial well-being over the lifecycle.

While recent research has documented the link between low financial literacy and financial fragility, many adults continue to have poor understanding of basic personal finance concepts.[1] However, effectively engaging individuals in improving their financial literacy has proven challenging. In this paper, we conduct a case study on the need and demand for financial education programming by graduate students in a large university system. Leveraging the differences between self-assessed and actual financial literacy levels, we find that students most in need of additional financial education are least likely to take advantage of programming.

Graduate students are good candidates to receive financial education programming. They are among the most receptive consumers of education, command commensurately higher lifetime earnings postgraduation, and may be more likely to have complex financial planning needs over the lifecycle. Many also have prior workforce experience, which may expose them to employer-sponsored benefits and retirement savings plans. However, this prior workforce participation may make graduate students more anxious about their financial security due to low earnings and savings and likely increased debt, during graduate studies. Providing financial education programming during this time can help students gain confidence in their long-term financial well-being.

Our interest in studying financial education programming is whether it is economically rational for individuals to invest in financial education, and relatedly, can financial education programs improve outcomes. Regarding the latter, evidence increasingly suggests that financial education affects outcomes across a variety of contexts.[2] With respect to financial education investment, Lusardi, Michaud, and Mitchell (2017) discuss that investment in financial literacy should be a function of the associated expected benefits. They find that low-education low-lifetime income groups might rationally choose *not* to invest in obtaining financial literacy skills because of their larger relative reliance on public social welfare programs. Because our target sample is of high education and higher-than-median expected lifetime income, they should rationally choose to invest in financial literacy education.

We measure self-assessed and tested financial literacy for graduate students in a large public university system. Similar to past studies, we find measurable weakness in the populations' understanding of basic personal finance concepts, despite most students expressing concern regarding their own personal finances. Regarding financial education engagement, we document two main findings. The first is that interest in financial education relates significantly to an individual's self-assessed level of financial knowledge relative to their actual measured financial literacy level. Individuals who estimate they have a high level of financial literacy but perform poorly on a financial literacy quiz are significantly less likely to be interested in financial education, while the opposite is true for financially literate students who self-report a low level of financial acumen. We also find that while receptivity to financial education programming increases significantly with financial literacy levels, overall engagement in financial education is low, despite nearly half of survey respondents signaling interest in programming. The students most likely to indicate interest in financial education are the ones with higher financial literacy and lower overconfidence in their financial literacy. Our work adds to the small body of existing research, namely Allgood and Walstad

(2016) and Anderson et al. (2017), that perceived financial literacy and actual financial literacy are dually important. Our results indicate that employers using financial education programming need to adopt innovative engagement strategies to improve the financial literacy and well-being of those employees who need it most.

2. Research design and methodology

Our educational protocol was developed using an early career workplace education offering from a large financial services organization.[3] We targeted the financial education offering to the entire pool of graduate students with the following research protocol. At the beginning of the academic year, and ahead of inviting the graduate student population to take our initial survey, we developed a series of prompts. These consisted of 5 × 7 inch postcards announcing the project with lighthearted financial literacy questions on a front side and the correct answer along with a description of what to expect next on the back.[4] We developed three distinct cards, with the goal that students might compare the particular card they received to others and discuss them. Regarding signals of validity, integrity, and quality of the effort, the cards prominently featured the collaborating university and were placed in orientation packets for incoming students by the university. The university also placed cards at each department's reception desk. A research assistant (RA) was assigned to attend graduate student council meetings and other graduate student group meetings of various types across the university system. In these student meetings, the RA was granted five-minute slots to discuss the project and the potential benefits of participation and left cards at each meeting.[5]

Two weeks after the cards were distributed initial invitations for the online survey were sent to all graduate students (17,819) in a large public university system. These invitations were designed to resonate with the information on the cards we had just distributed. The survey was designed to record information on students' individual and educational characteristics, financial aspirations, personal financial concerns, self-assessed financial acumen, and a financial literacy quiz.[6] Once the survey was completed, we provided quiz scores to students and offered them the correct answers to missed questions. We then asked whether a respondent was interested in taking part in a financial education seminar or webinar in the near future.

Our survey was open for one month between mid-September and mid-October, ahead of midterm examinations. Over this four-week period the student received an initial invitation and up to four reminders targeted to students who had not taken the survey nor opted out of email engagement. Initial and reminder response survey engagement rates are shown in Fig. 1.

Our email prompts to engage the survey were successful with approximately 60% of the survey sample engaged the survey following a reminder as seen with the spikes in the response rate, supporting Dechausay et al.'s (2015) result that reminders can improve engagement.

From the initial invite population, 2,487 students (14%) engaged the survey. To set up the second stage of our study we invited a matched, random subsample of our surveyed students to a financial education seminar or webinar, whichever they preferred. We randomly selected 1,632 students to match to invited and noninvited groups. Of the 1,632 students eligible for invitation, roughly two-thirds (1,101) were invited to participate.[7] Our invited

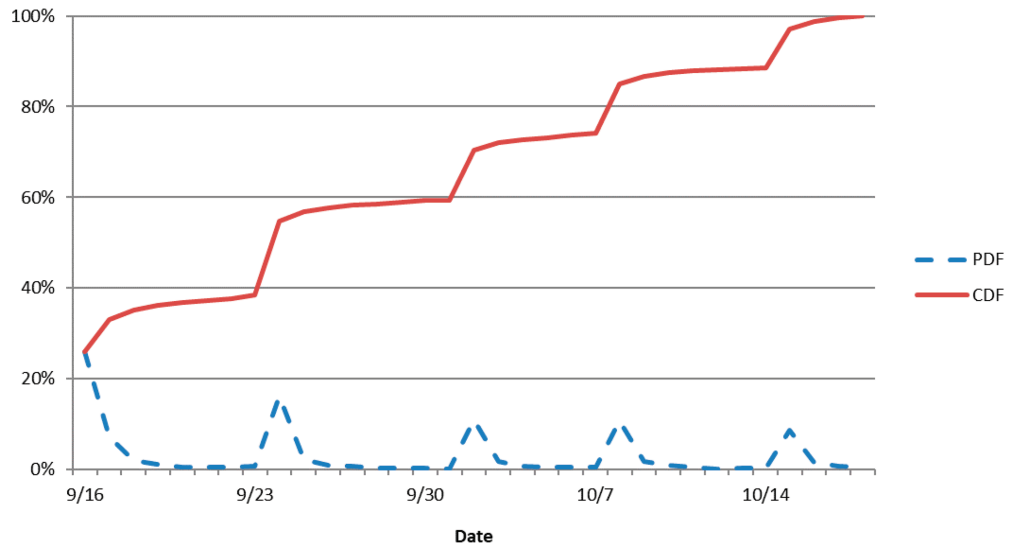

Fig. 1. Survey response rates.

student group was designed to be a balanced representation of participants across several dimensions: gender, degree of concern regarding financial matters, score on the financial literacy quiz, and whether or not the student was in a quantitative field.[8] Invitations were also balanced across those who did or did not initially indicate interest in the program. This allowed students to change their mind if they later decided they wanted to attend. The invitation email contained a link for those wishing to sign up and clicking the link brought the student to a standard web-based submission form. In the invitation to participate, we offered two mid-day and two early evening times for either a seminar or webinar at each campus in the university system. We also offered lunch or dinner to seminar participants; something our pilot run in the previous year had revealed as being important.

3. Results

In this section we present results from our survey and financial education engagement protocol. We begin by examining the demographic, educational field, and financial literacy characteristics of students who engaged the survey. Section 3.2 examines how financial literacy (both self-assessed and actual) relate to interest in attending a financial education seminar. In Section 3.3, we use regression analyses to examine correlates of interest in financial education interest and engagement.

3.1. Survey sample characteristics

Table 1 presents characteristics of survey respondents. The average student who participated in the survey is nearly 30 years old and has almost 10 graduate course credits. Women (57%) were more likely to participate compared to men, approximately a quarter are

Table 1 Characteristics of targeted graduate student population

Student survey sample summary statistics						
	Mean/ proportion	Standard deviation	Obs		Proportion	Obs
Student characteristics				Degree type		
Age	29.5	7.5	2,487	Masters	0.50	2,487
Credits taken	9.8	5.1	2,487	Certificate	0.02	2,487
Married	0.37		2,306	Law	0.07	2,487
Female	0.57		2,487	Doctorate	0.27	2,487
International student	0.26		2,487	Medical	0.08	2,487
Research/teaching asst	0.24		2,487	Post-doc	0.01	2,487
Flagship campus	0.57		2,487	Other/non-degree	0.05	2,487
Prior work experience	0.68		2,288			
Education program type						
Liberal arts	0.20		2,487			
STEM	0.27		2,487			
Professional	0.38		2,487			
Business and economics	0.14		2,487			

international students, 57% of the graduate students attend the flagship campus, and nearly one in four graduate students work as research or teaching assistants. Half of the students in the sample are pursuing a Master's degree, over a quarter a doctorate, and other degree types represent less than 10% of the survey respondents. About two-thirds of survey participants have prior work experience.

We categorize a student's program or major into four mutually exclusive groups: Liberal Arts (e.g., liberal arts, humanities, language, music, and social sciences), STEM (e.g., science, engineering, medicine, mathematics, and technology), Professional (e.g., public health, public administration, education, nursing, law, and other (pre)professional programs), and Business (e.g., economics, finance, business, and accounting). Enrollment in a professional program represents the plurality of students surveyed (37%) followed by enrollment in STEM (27%), Liberal Arts (20%), and Business (14%) programs.

Table 2 displays financial education engagement numbers. Of the nearly 18,000 students we sent a survey, about 14% (2,487) responded. Of the representative 1,101 students to whom we sent invitations for a financial education session, 16% (176) accepted. Among the accepted group, 36% (64) attended a session with 44 opting for an in-person seminar and 20 for an online webinar. Acceptance rates for students who initially indicated interest (25%) were significantly higher than those who did not signal interest (8%). Program attendance rates for those initially indicating interest were also higher (39% vs. 29%) but the difference is not significant.

We next tabulate personal financial characteristics and engagement across program type and survey variables. Table 3 Panel A displays measurements of financial literacy, personal financial concerns, and education engagement for all surveyed students by program type. Financial Literacy Quiz Score is the average number of questions students answered correctly on our financial quiz (out of 12).[9] Financial IQ is the average of students self-assessed rating of how high their financial knowledge or IQ is, ranging from 1 (*very low*) to (7 *very high*). Relative FinIQ is an individual's relative financial knowledge calculated as the

Table 2 Financial education engagement results

Engagement	Number	Number invited	Proportion
Survey respondents	2,487	17,819	0.14
Eligible for invite	1,101	1,632	0.67
Interested in Fin Ed | eligible	511	1,101	0.46
Accepted | invited	176	1,101	0.16
Attended | accepted invite	64	176	0.36
Conditional on indicating interest			
Accepted invite	383	511	0.25
Attended | accepting invite	50	128	0.39

relative difference between performance on the financial literacy quiz and one's self-assessed financial IQ level and normalized on a scale of 0 to 1. Values below 0.5 represent overconfidence and values above 0.5 represent underconfidence. For example, a value of 0 indicates complete overconfidence in the self-assessment compared to their actual measured financial literacy knowledge and corresponds to a student answering 0 out of 12 financial literacy questions correctly and indicating a very high level (7) of Financial IQ on the self-assessment, whereas a value of 1 indicates complete underconfidence. A value of 0.5 indicates neither over- nor underconfidence.

Our personal finance concern metric is measured on an intensity scale from 1 (*no concern*) to 5 (*great concern*) across five areas (career goals, current finances, future finances, owning a home, and retirement), with a possible range from a low of 5 to a high of 25, which we normalized from 0 to 1. For engagement metrics, we list the percentage of students who responded to the survey, indicated that they were interested in financial education, accepting an invitation for an educational session, and attended a seminar or webinar (conditional on accepting an invitation).

Table 3 shows the average student got 65% of the financial literacy questions correct, with business students scoring significantly higher than any of the other program groups.[10] The mean self-reported financial IQ was 4.7 out of 7, again with business students indicating a significantly higher level of self-reported financial knowledge compared to nonbusiness

Table 3 Financial literacy, financial concern, and financial education engagement

Characteristic	Overall	Program type			
		Liberal arts	STEM	Business	Professional
Financial literacy and concern					
Financial literacy quiz score (0–12)	7.81	7.57	7.66	8.71	7.71
Financial IQ, self-assessed (1–7)	4.67	4.58	4.42	5.28	4.73
Relative FinIQ (0–1)	0.52	0.52	0.53	0.51	0.51
Personal finance concern (0–1)	0.72	0.73	0.70	0.71	0.73
Education engagement					
Responded to survey	14%	14%	14%	14%	14%
Interested in financial education	48	47	48	46	50
Accept invite | invited	16	17	15	13	17
Attend financial education conditional on accepting invite	36	51	27	42	33

Note. Means or percents reported.

Table 4 Other student characteristics, assets and debt

Characteristic	Overall	Program type			
		Liberal arts	STEM	Business	Professional
Banking, assets, insurance					
Checking account	90%	93%	88%	88%	90%
Savings account	74	78	71	72	75
Investment account	38	38	22	50	44
Life insurance	34	29	23	38	42
Student debt					
Only undergraduate	9	12	9	5	8
Only graduate	19	16	22	26	17
Both undergrad and grad	28	30	22	15	36
Any student debt	56	57	53	46	61
Other debt					
Credit card	31	34	23	26	37
Auto	20	16	15	23	24
Mortgage	20	20	11	24	25
Home ownership					
Home owner	22	21	12	27	28
Plan to purchase home	46	39	55	50	43

students (5.28 vs. 4.60 for nonbusiness students). The average student was slightly underconfident in their financial knowledge. There are limited differences in the relative measure by program type; however, STEM students display significantly greater underconfidence compared with the rest of the surveyed population. We find no significant differences by program for students who responded to the survey or for those who indicated interested in attending a financial education seminar or for acceptance rates. For seminar attendance, however, we find a significantly greater proportion of Liberal Arts students attended a seminar compared to students in other programs.

Table 4 shows asset and debt characteristics of the surveyed students. We hypothesize that greater participation in financial services and the incidence of debt would be positively correlated to signaling interest in financial education. And having life insurance or an investment account may signal greater interest in financial planning over the life cycle. We include the incidence of students with a checking account, savings account, investment account, or a life insurance policy. Nine of 10 students surveyed have a checking account, with three in four having a savings account. The third row list the proportion of students with an investment account, which we define as having a brokerage account, an IRA, or an employer-sponsored retirement savings plan. This is owned by a minority of students (38%), but varies significantly by program type, ranging from 22% for STEM students to 50% for business students.

We posit debt should be positively correlated with financial education interest. Graduate students with student loan debt need to manage loan repayments in conjunction with other consumption, savings, and investment goals and in context of their postgraduate career outlook. Over half of the sample has some form of student loan debt, and this varies significantly by a student's major field. Professional students were significantly more likely to have any debt, both debt from graduate and undergraduate studies and from credit cards.

Credit card debt may demonstrate greater need for financial education since it relates to household balance sheets and not to human capital acquisition or indicates the reliance on high-cost credit card debt to finance education expenses.

Our final category is home ownership. About one in five already own a home and roughly 50% of students are planning to purchase one in the next 10 years, which varies significantly by a student's major field. We later control for this in our regression analysis because purchasing a home involves a substantial amount of financial planning, and we expect those planning to purchase a home to have greater interest in financial education.

3.2. Interest in financial education

In this section, we explore the relationship between self-assessed and measured financial literacy and graduate student initial interest in attending a financial education seminar. Nearly half (48%) of the students who participated in the survey indicated they were interested in financial education. In Table 5, we find differences for indicated interest across nearly all individual characteristics. While individuals who do not interact with financial institutions may gain marginally greater benefit from financial education, we find that those without checking and savings accounts, or life insurance are significantly less interested in financial education. However, on the liability side of household balance sheets, students with student loan debt or credit card debt were more likely to be interested in the educational offerings.

Table 5 Student characteristics by financial education interest

Survey characteristics	Interested	Not interested	Sig
Financial literacy and concern			
Financial literacy quiz score	8.31	7.19	***
Financial IQ (self-assessed)	4.59	4.82	***
Relative FinIQ	0.55	0.48	***
Personal finance concern	0.75	0.69	***
Banking, assets, insurance			
Checking account	98%	81%	***
Savings account	83	65	***
Investment account	42	34	***
Life insurance	37	31	***
Student debt			
Only undergraduate	11%	7%	***
Only graduate	21	18	*
Both undergrad and grad	32	24	***
Any student debt	64	48	***
Other debt			
Credit card	37%	26%	***
Auto loan	23	17	***
Mortgage	20	20	
Home ownership			
Own home	21%	23%	
Plan to own home	55	39	***

Note. Means or percents shown.

* and *** indicates differences are significant at the 10% and 1% levels, respectively.

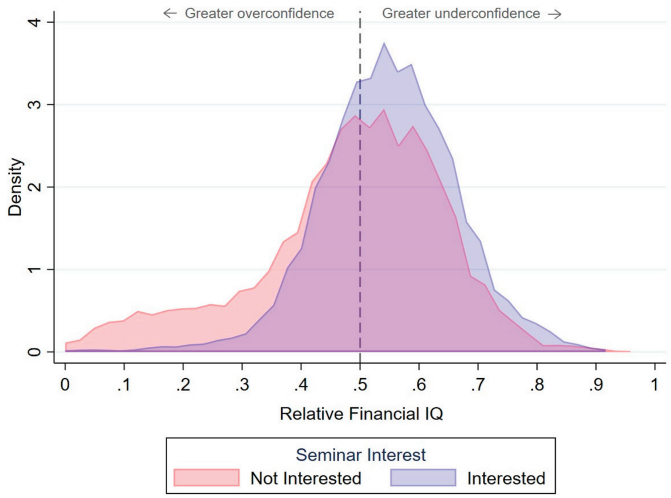

Fig. 2. Kernel density estimates of Relative FinIQ by indicated interest in financial education.

Graduate students signaling interest in financial education have significantly higher financial literacy, with interested students averaging about 1.2 more correct answers compared to non-interested students. Further, non-interested students are significantly more *overconfident* in their financial knowledge. This is also shown by the distribution of Relative FinIQ shown in Fig. 2, which displays kernel density estimates of Relative FinIQ by indicated interest in financial education. The two distributions are significantly different ($p < .01$), with non-interested students having a greater estimated density in the overconfidence range (values below 0.5). This result is economically meaningful as the mean difference of 0.07 in the relative measure between interested and non-interested students equates to 1.68 fewer questions answered correctly (out of 12) on our financial quiz for the relatively more overconfident student given a fixed self-assessed score. Alternatively, a 0.07 difference results in a 0.84 greater self-assessed score, given a fixed quiz score, for the relatively more overconfident student.

Overconfident students with low measured financial literacy would arguably benefit the most from financial education. Unfortunately, Table 6 and Fig. 3 indicates that these students were least interested in improving their financial knowledge. In Table 6, we examine the percentage of students interested in financial education by their self-assessed financial IQ rating and how well they did on the financial literacy quiz, grouping the latter into four categories. The data suggest there is a strong negative correlation between overconfidence and interest in financial education.[11] This finding is highlighted by Fig. 3, which displays a wireframe surface plot on the data points shown in Table 6. Financial literacy and self-assessed financial IQ are shown on the x and y axes, and the percentage of students who indicated they are interested in financial education is shown on the z (vertical) axis. Here the relationship is clear: students who have high financial literacy but self-assess a low level of financial IQ are the most interested in financial education (often over 70%). Comparatively, students with *low* financial literacy but self-assess a *high* level of financial IQ are less interested (generally less than 30% of the time).

Table 6 Financial education interest by measured and self-assessed financial literacy

	Percent interested in financial education					
Self-assessed	Percent of financial quiz questions correct					
Financial IQ	0–25%	26–50%	51–75%	76–100%	Mean	*N*
1 (very low)	50%	80%	50%	0%	55%	20
2	29%	65%	72%	82%	63%	80
3	26%	61%	68%	70%	62%	236
4	20%	49%	61%	58%	56%	646
5	22%	30%	64%	59%	57%	481
6	6%	30%	57%	55%	51%	484
7 (very high)	22%	0%	50%	45%	42%	153
Mean	20%	55%	62%	39%	48%	
N	221	257	974	1,035		2,100

To understand this relationship over all possible values, Fig. 4 displays predicted probabilities of financial education interest. The predicted probabilities are generated using a simple logit model estimating the likelihood that students indicated interest in financial education regressed on a student's FinIQ and Financial Literacy Quiz Score, treating the two exogenous variables as categorical variables.[12] The full profile of predicted probabilities is shown in Appendix Table A.1. Fig. 4 replicates and smooths the relationship shown in Fig. 3. Generally, the predicted probability that a student signals interest increases significantly in one's measured financial literacy but significantly decreases as a student's self-assessment increases. Students with a combination of *high* self-assessed financial IQ and *low* actual financial literacy are predicted to be the *least* likely to signal interest in financial education. For example, a student answering all questions correctly but self-assesses the lowest level of financial knowledge is predicted to signal interest with a probability above 60%, which decreases to 45% for a student self-assessing the highest level of financial knowledge. By contrast, a student answering no questions correctly on the financial literacy

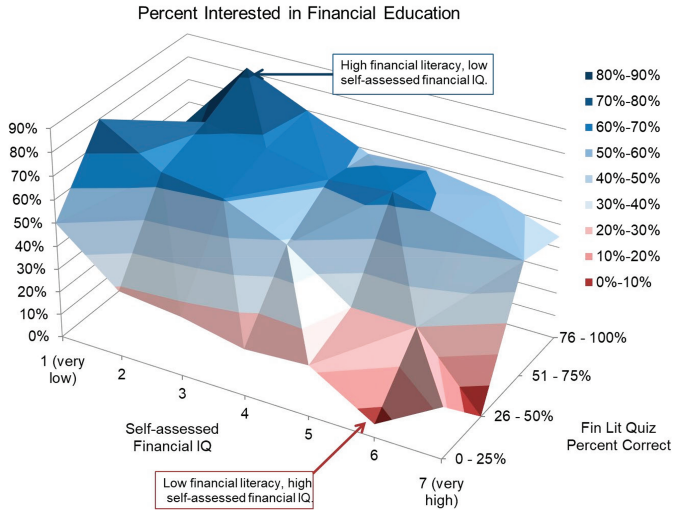

Fig. 3. Surface plot of financial education interest by measured and self-assessed financial literacy.

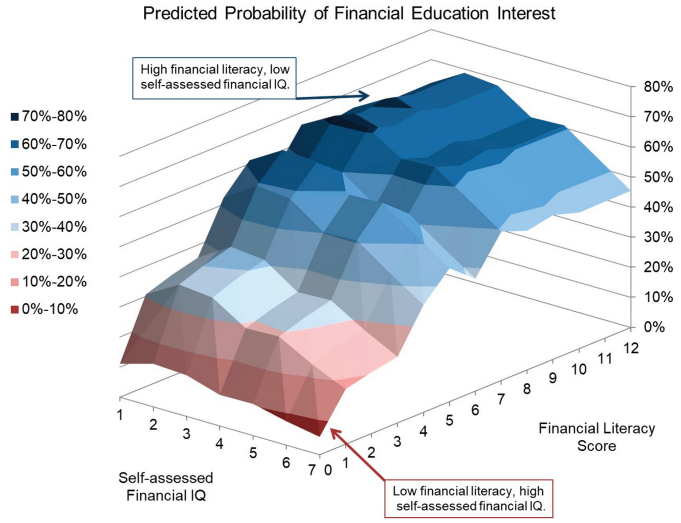

Fig. 4. Predicted probabilities of education interest by measured and self-assessed financial literacy.

quiz but is most confident in their financial knowledge, is predicted to signal interest with a likelihood of under 6%, increasing to only 11% for a student self-assessing the lowest level of financial knowledge. Program sponsors need to be innovative when thinking about how to engage the population of students who would most benefit from financial education.

3.3. Regression analysis of financial education interest and engagement

We begin our regression analysis with first considering who takes the survey. Table 7 uses ordinary Probit regression estimating whether a student engages in the survey or not using student and program characteristics, displaying marginal effects on the coefficients and standard errors in parenthesis. Because those who do not take the survey do not offer us data on their financial literacy, we only leverage the university system's administrative data. Women and student workers are significantly more likely to engage the survey. While there is no significant relationship for graduate students at the flagship campus, student workers at the flagship campus are significantly less likely to engage the survey, indicated by the interaction term in Model 2. These students may be more time constrained with their studies and work duties than their counterparts. We find no significant effect for international students. Students who have taken more graduate credits are significantly less likely to take the survey, but the marginal effect is small and has significant attenuation. There were no significant differences in a student's major subject area. When examining degree type, law students were significantly less likely and doctorate students only marginally less likely to engage in the survey, highlighting the possibility of time constraints for students in terminal degree programs.

Table 8 estimates the likelihood that a student indicates interest in financial education using ordinary Probit specifications showing marginal effects and standard errors in parenthesis. We display five specifications: Model 1 uses administrative data plus financial literacy characteristics, and Models 2 and 3 add asset and debt characteristics. Model 4 adds

Table 7 Regression estimates of survey engagement

	(1)		(2)		(3)		(4)	
	Mar. coeff.	Standard error	Mar. coeff.	Standard error	Mar. coeff.	Standard error	Mar. coeff.	Standard error
Student characteristics								
Woman	0.030***	(0.005)	0.030***	(0.005)	0.030***	(0.005)	0.030***	(0.005)
Age	−0.000	(0.000)	0.000	(0.000)	−0.000	(0.000)	0.000	(0.000)
Intl student	0.009	(0.006)	0.007	(0.006)	0.008	(0.006)	0.006	(0.006)
Main campus	0.002	(0.006)	0.009	(0.006)	0.007	(0.006)	0.008	(0.006)
Student teaching/research asst	0.037***	(0.007)	0.075***	(0.014)	0.077***	(0.014)	0.073***	(0.014)
Educ credits	−0.006***	(0.001)	−0.006***	(0.001)	−0.006***	(0.001)	−0.005***	(0.002)
ln(educ credits)	0.061***	(0.011)	0.061***	(0.011)	0.060***	(0.012)	0.056***	(0.012)
Main Campus * Student Asst			−0.050***	(0.016)	−0.049***	(0.016)	−0.046***	(0.016)
Program type (baseline = Liberal Arts)								
STEM					−0.002	(0.009)		
Professional					0.003	(0.008)		
Business					0.007	(0.010)		
Program type (baseline = Masters)								
Doctorate							−0.012*	(0.007)
Law							−0.033***	(0.009)
Other/non-degree							−0.000	(0.013)
Certificate							−0.027	(0.018)
Post-doc							−0.017	(0.032)
Medical							−0.016	(0.011)
Observations	17,750		17,750		17,750		17,750	

Note. Probit specifications with marginal coefficients reports and standard errors in parenthesis.
*, **, *** represents significance at the 10%, 5%, and 1% levels, respectively.

Table 8 Regression estimates of seminar interest

	(1)	(2)	(3)	(4)	(5)
Student and program characteristics					
Woman	0.023 (0.022)	0.021 (0.023)	0.021 (0.023)	0.019 (0.022)	0.001 (0.022)
Age	−0.004 (0.002)***	−0.004 (0.002)**	−0.003 (0.002)**	−0.001 (0.002)	−0.001 (0.002)
Int'l student	0.035 (0.027)	0.029 (0.028)	0.065 (0.031)**	0.059 (0.031)*	0.042 (0.031)
Main campus	0.008 (0.024)	0.003 (0.024)	0.009 (0.024)	0.005 (0.024)	0.004 (0.025)
Research/teaching asst	−0.001 (0.026)	−0.008 (0.026)	−0.010 (0.027)	−0.015 (0.027)	−0.017 (0.027)
Credits	−0.005 (0.002)**	−0.006 (0.003)**	−0.006 (0.003)**	−0.006 (0.003)**	−0.006 (0.003)**
STEM	0.044 (0.033)	0.043 (0.033)	0.047 (0.033)	0.038 (0.033)	0.035 (0.034)
Business	0.014 (0.038)	0.021 (0.039)	0.023 (0.039)	0.018 (0.039)	0.036 (0.039)
Professional	0.053 (0.029)*	0.056 (0.029)*	0.055 (0.029)*	0.051 (0.029)*	0.054 (0.029)*
Financial literacy characteristics					
Financial literacy	0.043 (0.004)***	0.043 (0.004)***	0.044 (0.004)***	0.044 (0.004)***	
Self-assessed financial IQ	−0.052 (0.008)***	−0.051 (0.009)***	−0.050 (0.009)***	−0.050 (0.009)***	
Relative FinIQ					0.853 (0.072)***
Personal finance concern	0.458 (0.055)***	0.461 (0.055)***	0.452 (0.055)***	0.431 (0.056)***	0.426 (0.056)***
Banking, assets, insurance					
Investment or retirement		−0.019 (0.026)	−0.015 (0.026)	−0.005 (0.027)	0.010 (0.026)
Savings account		0.025 (0.029)	0.028 (0.029)	0.028 (0.028)	0.036 (0.028)
Life insurance		−0.027 (0.025)	−0.031 (0.025)	−0.019 (0.025)	−0.018 (0.025)
Debt					
Student debt (undergrad only)			0.108 (0.038)***	0.101 (0.038)***	0.099 (0.038)***
Student debt (grad only)			0.027 (0.030)	0.019 (0.030)	0.016 (0.030)
Both undergrad and grad debt			0.060 (0.029)**	0.051 (0.029)*	0.043 (0.029)
Credit Card			−0.051 (0.063)	−0.059 (0.063)	−0.050 (0.063)
Auto			0.032 (0.027)	0.042 (0.027)	0.041 (0.027)
Home ownership					
Own home				−0.068 (0.037)*	−0.057 (0.037)
Plan to purchase home				0.053 (0.027)**	0.061 (0.027)**
Observations	2,098	2,098	2,098	2,098	2,098

Note. Probit with marginal effects shown.

Standard errors shown in parenthesis. *, **, *** indicates significance at the 10%, 5%, or 1% level.

home ownership characteristics, and Model 5 uses the relative FinIQ measure on the full specification instead of quiz score and self-assessed financial IQ. Beginning with Model 1, younger students are significantly more likely to signal interest, but this is not robust in later specifications. Professional students are significantly more likely to signal interest; however, this is only significant at the 10% level when controlling for debt characteristics. We find no significant correlation for business students.[13]

In all specifications, financial literacy quiz scores and self-assessed Financial IQ have large significant effects on the likelihood to signal interest. These effects pull in the opposite directions, as discussed in Section 3.2., with predicted interest increasing in quiz score but decreasing in the self-assessed measure. An additional question answered correctly on the quiz score increases the estimated likelihood to indicate interest by 4%, while a one unit increase in the self-assessed measure decreases the likelihood by 5%. The personal finance degree of concern composite measure is significantly and positively related to indicating interest, following our hypothesis. In Model 5, we use Relative FinIQ as a regressor, instead of quiz score and the self-assess measure; and find estimated interest significantly increases (decreases) as under- confidence (overconfidence) increases.

Adding individual asset and banking in Model 2 has no significant impact. Model 3 includes student loan debt as a categorical variable (with no student loan debt as the baseline). Undergraduate student loan debt has a significant impact on the likelihood to be interested in financial education, compared to those without student loan debt. Although we do not find a (robust) significant effect for either graduate debt only or both debt from undergraduate and graduate school, the coefficient is positive—in the hypothesized direction. Debt management is likely to become a larger concern for graduate students in the accumulation phase of their lifecycle, especially since this group delays employment income, savings, and loan repayment before (re)entering the labor force, albeit at an expected relatively higher salary. Credit card debt was not a significant correlate. This may be of concern because some students may be using high-cost debt to finance part of their education and this group would benefit from financial education. When including home ownership characteristics in Model 4 we find those planning to purchase a home in the next ten years are significantly more likely to signal interest, following our hypothesis.

4. Discussion

This paper examined financial education interest among graduate students in a large public university system. We find a strong positive and significant correlation between underconfidence (overconfidence) in self-measured financial knowledge and (lack of) interest in financial education programming. This finding suggests the need for innovative engagement strategies to identify and provide programming to individuals who would benefit the most from improving their financial literacy.

The results speak to several components regarding the timing and delivery of financial education. The first is whether the timing is optimal for graduate students to engage in improving their financial literacy. Because many graduate students are close to (re)entering

the workforce, they may be focused on the near-term issues of graduating, finding a job, or moving. This can make them subject to present bias through the belief that they have scant time to devote additional resources to improving their long-term financial well-being. Innovative engagement strategies, such a providing lunch or tchotchkes, may nudge active participation in financial education. However, we find these nudges did not address to our main finding that those confident in their financial knowledge but have low financial literacy are significantly less interested in financial education.

How should these individuals be engaged in financial education? Mandatory financial education could be one response, and many states have begun to institute mandatory financial literacy programs in high school. Stoddard and Urban (2020), Urban, Schmeiser, Collins, and Brown (2018), and Collins (2013) find some benefits to mandatory education. However, there needs to be further research in this area as there remain many open questions, including whether the education benefits persist in later life, how such programs are implemented, what is included in the content, and when in the lifecycle are they delivered, among others. With most programs continuing to rely on voluntary education efforts, often offered by employer benefit programs, designers and implementers of financial education will need to consider how to attract individuals overconfident in their knowledge of personal finances.

Notes

1 For research on financial literacy see Yakoboski, Lusardi, and Hasler (2019), Clark, Lusardi, and Mitchell (2017), Lusardi and Mitchell (2014), Lusardi, Mitchell, and Curto (2014), Lusardi and Mitchell (2011), among others. For a broader discussion on financial literacy, financial education, and economic outcomes see Hastings, Madrian, and Skimmyhorn (2013).

2 Bernheim and Garrett (2003), Lusardi (2004), Maki (2004), and Bayer, Bernheim, and Scholz (2009) have studied employer-sponsored financial literacy programs and retirement preparedness. Other studies have found other positive benefits to financial education programs (i.e., Clark et al., 2006; Skimmyhorn et al., 2016; and Seligman and Bose 2012).

3 In the previous year, we piloted a similar survey and education to a small group of students. While the test group gave good feedback and generally positive reviews, we adjusted both our materials and engagement strategy to improve participation.

4 This postcard campaign is consistent with findings on the positive value of prompts from Dechausay, Anzelone, and Reardon (2015).

5 The RA had previously served as President of the Graduate Student Council and thus was a familiar and respected source of information across the body of groups we engaged.

6 Lusardi, Mitchell, and Curto (2014), Schmeiser and Seligman (2013), and Knoll and Houts (2012) have published work evaluating questions on measuring financial literacy using three independent methodologies. We take our financial literacy questions from this work, and consultation with financial counselors, and use a set of 12 questions from these studies.

7 A control group that was roughly one-third of eligible participants was not invited so as to be able to carry forward with other research questions.
8 We defined a student as being in a quantitative field if the student's program is in economics, business, engineering, statistics, mathematics, physics, chemistry, or computer science.
9 The financial literacy quiz covered questions on interest, inflation, and bond prices.
10 We control for degree type in our regression analysis.
11 Our relative measure cannot examine whether there are differences in student interest across the entire cross product of the financial literacy score and self-assessed financial IQ measure.
12 The overall model is significant ($p < .01$ with a χ^2 test). Moreover, the predicted probabilities for each combination of FinIQ and Quiz score (91 combinations) are all significant at the 5% level.
13 In separate regressions (not shown) we controlled for degree type and prior work experience; there were no significant differences.

Appendix

Table A1 Predicted probabilities of indicating interest in financial education by financial literacy and self-assessed financial IQ

Financial literacy quiz score	Self-assessed financial IQ						
	Very low 1	2	3	4	5	6	Very high 7
0 (0%)	11.1%	14.3%	13.7%	10.3%	10.5%	7.9%	5.9%
1	30.6	37.1	35.9	28.9	29.3	23.3	18.2
2	33.6	40.3	39.1	31.8	32.2	25.8	20.3
3	35.8	42.6	41.4	33.9	34.4	27.7	21.9
4	52.3	59.4	58.1	50.2	50.7	42.9	35.6
5	61.1	67.7	66.6	59.2	59.7	51.9	44.3
6 (50%)	54.1	61.2	60.0	52.1	52.6	44.8	37.3
7	65.9	72.1	71.1	64.1	64.5	57.1	49.4
8	63.0	69.4	68.3	61.1	61.5	53.9	46.2
9	64.5	70.8	69.8	62.7	63.1	55.6	47.9
10	62.0	68.6	67.5	60.1	60.6	52.9	45.2
11	62.2	68.7	67.6	60.2	60.7	53.0	45.4
12 (100%)	62.3	68.8	67.7	60.3	60.8	53.2	45.5

Note. Predicted probabilities from Logit model as described in Section 3.2, all are significant at the 5% level.

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