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## *What determines financial knowledge among college students?*

Amira Annabi
M. Jimena Gonzàlez R.
Fabian Müller

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# What Determines Financial Knowledge among College Students?

**Amira Annabi**[1](*corresponding author*)

Assistant Professor of Finance
Department of Economics and Finance,
School of Business, Manhattan College
4513 Manhattan College Parkway, Riverdale, NY 10471
Tel: (718) 862-7320; Email: amira.annabi@manhattan.edu

**M. Jimena González R.**[1]

Assistant Professor of Economics
Department of Economics and Finance,
School of Business, Manhattan College
4513 Manhattan College Parkway, Riverdale, NY 10471
Tel: (718) 862-7510; Email: jimena.gonzalez@manhattan.edu

**Fabian Müller**[1]

Graduate Research Assistant
School of Business, Manhattan College
4513 Manhattan College Parkway, Riverdale, NY 10471
Tel: (806) 206-3930; Email: fmueller01@manhattan.edu

[1]All authors contributed equally to this paper.

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**What Determines Financial Knowledge among College Students?**

# ABSTRACT

The rapidly growing literature on financial literacy finds an alarming low level of financial knowledge among young adults. During their college years, students are likely to face expenditure, savings, credit card, and student loan decisions for the first time on their own. At the same time, they are investing in their human capital, which will allow them to be become better decision-makers. As students enter the workforce, their lack of financial literacy could prevent them from making adequate financial decisions, such as buying a house or preparing for retirement. Hence, our objective is to assess financial knowledge at this early stage of their adulthood. More specifically, we empirically identify the key determinants that increase financial knowledge among undergraduate college students while controlling for confounding variables that could affect it. Using data from a survey given at a private college in the Northeast, we identify a number of key determinants that influence financial knowledge including but not limited to first-generation status and having a student loan or a credit card. Based on our analysis, we recommend the implementation of school-wide personal finance classes for non-business students. We suggest offering personal finance workshops especially targeting minorities, women, first-generation students, and students who have a student loan.

**Keywords:** college students, first-generation, financial knowledge, personal finance, financial literacy

**JEL Code:** A22, I23, I24

The last decade has seen a dramatic growth in the student loan market, whose size has almost doubled since mid-2009 to over $1.3 trillion today, according to data collected among U.S. households by the Federal Reserve of New York. More recently, delinquency rates among college graduates have also been on the rise, reaching double-digit levels even as the broader economy continues its expansion (Lee 2013). These increases have prompted a great deal of attention both from academic researchers and regulators. In a recent report sponsored by the TIAA-CREF Institute, Scheresberg, Lusardi and Yakoboski (2014) show that college-educated millennials have a low level of financial knowledge and tend to struggle with their personal finances. The goal of this paper is to empirically investigate the determinants of financial knowledge among undergraduate students. Recognizing these determinants is of paramount importance both at individual and aggregate levels. From an individual standpoint, young adults face financial decisions such as renting an apartment or purchasing a car or a house. These decisions are typically highly dependent on their credit quality. As college students enter the workforce, they will face retirement, savings, and investment decisions. Consequently, it is critical for young adults to acquire adequate financial knowledge to make optimal personal financial decisions. From a policy perspective, a persistently high-delinquency rate among college graduates combined with a lack of financial knowledge could constrain the ability of young households to make sound financial decisions.

With this motivation in mind, we investigate determinants of financial knowledge by surveying undergraduate students from a private regional college located in the Northeast. The survey contains a variety of questions that provide information on financial knowledge, demographic, socioeconomic, and college-related characteristics. Using a logistic regression for each financial knowledge question, we estimate the marginal effects of each covariate on the probability that a student will answer correctly. We contribute to the existing literature on financial literacy among college students by using a rigorous methodology to estimate the way various demographic, socio-economic, and college-related characteristics determine financial knowledge among college students.

To be more specific, we assess financial knowledge through nine previously established questions about the following concepts: liquidity, interest rates, the relation between risk and return, diversification, numeracy, compound interest, the relation between interest rate, inflation, and purchasing power, time value of money, and money illusion. While the literature on college students has connected being a first-generation college student, being a business student, and having a job to financial knowledge using aggregate statistics, we carefully estimate the influence of these variables through marginal effects. Our models also confirm that variables such as GPA, age, gender, race, having a credit card, having a student loan, and having work experience influence the likelihood that a student is financially knowledgeable. Based on our results, we recommend the implementation of school-wide personal finance classes targeting non-business majors, minorities, women, first-generation students, and students who have student loans.

The paper is organized as follows. First, we summarize the existing literature. Second, we describe our data collection process and present summary statistics. Third, we describe our methodology and analyze our results. Then, we provide a discussion and offer a policy recommendation. Lastly, a conclusion ends our paper.

## LITERATURE REVIEW AND BACKGROUND

This paper is closely related to the rapidly growing literature on financial literacy. A recent study shows that from 2002 to 2015, the number of publications per year increased by a factor of 18 while the number of citations per year increased by a factor of 271 (Stolper and Walter, 2017). Studies have divided financial literacy into three distinct dimensions: financial knowledge, skills, and behaviors or attitudes (e.g. Remund, 2010). In this paper, we only explore the financial knowledge component. Financial knowledge has been investigated among different populations ranging from high school students to senior adults on the verge of retirement.

The focus on high school students has increased after datasets from nationwide surveys such as the Jump$tart Survey (Mandell, 2008) and the National Longitudinal Survey of Youth (Lusardi et al., 2010) have become available. Other papers investigating high school students have used different data collection approaches, such as quasi-experimental design with a treatment and

control groups (Walstad et al., 2010) or a test development process involving extensive item writing and review (Walstad and Rebeck, 2017).

Switching to college students, Chen and Volpe (1998) develop a 52-question survey to measure financial literacy among college students. Their methodology has been adopted and extended in other papers to specific topics such as exploring gender differences in personal financial literacy (Chen and Volpe, 2002). The sample sizes of these studies vary greatly, ranging from small samples of 41 students (Rosacker et al., 2009) and 64 students (Seyedian and Yi, 2011) to large samples above 1000 students (Mandell, 2008; Rob 2011).

Adult populations, ranging from recent graduates to adults about to retire, have been extensively covered in the literature as well. For the 2004 Health and Retirement Study (HRS), Lusardi and Mitchell (2007b) build a model to investigate retirement planning and financial literacy among adults between the age of 51 and 56. They conclude that these adults are not financially prepared for retirement, which has sparked researchers' interest in the field (Lusardi and Mitchell, 2011; Robb 2011; Atkinson and Messy, 2012 and Knoll and Houts, 2012 among many others). In a pilot study, Atkinson and Messy (2012) examine financial literacy patterns among adult populations in countries including Germany, the U.K., South Africa, and Ireland. Their analysis shows general patterns of financial literacy around the world. However, their results are not confirmed by inferential statistics analysis.

In this paper, we focus on undergraduate students and aim at identifying the key factors that affect their financial knowledge. We survey students about concepts such as numeracy, compound interest and money illusion, among others. We use questions asked in previous studies in order to compare our results to existing findings (Chen and Volpe, 1998 & 2002; Mandell, 2008; Lusardi et al, 2010). However, we modified a number of questions. Using logistic regressions, we explore different covariates including but not limited to age, gender, race and school of study, which may influence financial knowledge.

Our paper extends the work of Chen and Volpe (1998, 2002) who find that older, female, and white students tend to be more financially literate. Their survey consists of 52 questions of which 36 are multiple choice questions that test college students about their personal financial knowledge. We only collect information on 11 financial knowledge questions, because we are concerned about respondent fatigue. The sample size of 924 respondents in their survey compares

to our sample size of 553 students. However, their survey is conducted on 14 college campuses including private and public colleges, main and branch campuses of large universities and small community colleges in California, Florida, Kentucky, Massachusetts, Ohio and Pennsylvania. Our respondents are from a single college with an undergraduate population of roughly 3500 students. To explore determinants of financial knowledge, Chen and Volpe (1998) build a financial literacy index defined as a mean score for each respondent. They run logistics regressions and define the dependent variable as a dichotomous variable that takes the value of one for a respondent with a financial literacy index above the median and zero otherwise. Their logistic regressions do not include any college fixed effects that would capture differences across campuses that are part of their sample. The lack of fixed effects might result in omitted variable bias. For example, a student from a small community college might be systematically different than a student who attends a large, private university. At the same time, each college or university offers unique aspects that must be controlled for. Another major shortcoming of their methodology is that the dependent variable in their logistic regressions is transformed from an index to a dichotomous variable. Logistic regressions are employed for outcome variables that take the value of 0 or 1. Converting an index to a dichotomous variable is problematic, because the model assumes that a respondent who is slightly above the median is equivalent to someone above the $90^{th}$ percentile. Thus, the analysis does not accurately capture the way each covariate affects the underlying outcome variable. Moreover, their definition can treat two respondents differently (e.g. one slightly below and the other slightly above the median), while they might not be different. In our paper, we avoid the described shortcoming by running a separate logistic regression for each financial knowledge question, which allows us to explore determinants of each financial knowledge concept. Chen and Volpe (1998, 2002) do not report any marginal effects limiting their interpretation of the logistic regression results. We address this issue by reporting marginal effects, which allows us to better capture the contribution of each covariate to the level of financial knowledge.

We also build our work on Lusardi, Mitchell, and Curto (2010), who use a sample of 7417 US teenagers with ages between 12 and 17 across a number of years. They study differences in mean regressions and find that male and white high school students are more likely to answer financial knowledge questions correctly. They confirm their results by looking at the marginal effect of associations with correct answers. Our paper extends their results to a population of college

students of ages between 18 and 25 by adopting a similar rigorous methodology.

The literature has documented differences in financial literacy between male and female students (Chen and Volpe, 1998; Chen and Volpe, 2002; Mandell, 2008; Lusardi, Mitchell and Curto, 2010; Seyedian and Yi, 2011). Combining datasets collected between 2009 and 2010 from the U.S., The Netherlands and Germany, Bucher-Koenen et al. (2016) find that both young and adult women display a low level of financial literacy. However, we note that more recent studies find mixed results on the importance of the gender factor. Using data from five Jump$tart surveys between 2000 and 2008, Mandell (2008) shows that there is little difference in financial literacy by gender. By contrast, they find that white students consistently outperform all others. Using the 2006 Jump$tart survey only, Eitel and Martin (2009) provide further confirmation of these results. It can be argued that main shortcomings of these papers are either very small sample sizes (Seyedian and Yi, 2011) or that they are not based on a statistical inference analysis (Mandell, 2008). We address both of these issues in our paper.

Since previous studies on first-generation status have relied on either a statistical comparison (Mandell, 2008) or on a sample of female college students (Eitel and Martin, 2009), we contribute to the literature by estimating the marginal effect of first-generation status for a sample of both female and male college students. In this way, we can study the interaction of first-generation status and gender in a more rigorous way.

We contribute to the literature in two ways. First, we employ and improve existing financial knowledge questions that allow us to compare our results to other studies. Second, using a rigorous methodology similar to Lusardi, Mitchell and Curto (2010) and estimating marginal effects, we identify determinants of financial knowledge among college students and estimate their influence on increasing the likelihood that a student is more knowledgeable.

## DATA COLLECTION

Our study utilizes a comprehensive online questionnaire tailored to cover major areas of personal financial knowledge among college students. We employ identical or similar questions that have been used in previous studies. The survey includes nine financial knowledge questions about interest rates, liquidity, risk and return, diversification, time value of money, and money illusion.

Other questions collect information on demographic, socio-economic, and college-related characteristics. The final question gives students the opportunity to participate in a raffle with the chance of winning one of ten $25 Amazon gift cards. Description of the consent to participate form can be found in Appendix A.

As part of the design process, a pilot study was conducted among graduate students at the college. Ten students completed the survey and were asked to provide feedback related to readability, difficulty, integrity of answer choices, order of questions (flow) and whether any part of the survey was objectionable or intimidating. Following the pilot study, improvements were made to several financial literacy questions. The question about credit cards from Chen and Volpe (1998) was altered to reflect current price levels. Out of the five basic financial literacy questions from Lusardi and Mitchell (2007b) and Lusardi, Mitchell and Curto (2010), two questions were changed. The time value of money question was changed, because confusion about the phrasing was expressed. Feedback pointed to the lack of information about inflation and interest rate that are necessary to answer the question. We contribute to the literature by improving this question. Table 1 shows the financial literacy questions and footnotes explain any changes that were made to the original questions.

[Insert Table 1 about here]

The survey was distributed at a private regional college in the Northeast and advertised through the college's announcement website and via email to a total of 3,517 undergraduate students using *Qualtrics*. The students received one initial invitation to the survey followed by four reminders in the intervals of three, four, two, and one day(s). The students were allowed to skip any question. Overall, there were 835 respondents to the survey representing a response rate of 23.74 percent. The sample size becomes 562 after removing observations from students who skipped at least one financial knowledge question or who did not fall within our targeted age group. Moreover, after removing observations with incomplete responses for the rest of the questions utilized in the analysis, our sample size becomes 553. Our sample size is within the range reported in the literature exploring financial knowledge among college students, which range between 41 students (Rosacker et al., 2009) and large samples above 1000 students (Mandell, 2008; Rob, 2011).

## SUMMARY STATISTICS

We collect information on several demographic, socio-economic, and school-related characteristics, which are summarized in Table 2.

[Insert Table 2 about here]

The college has six schools: School of Science, School of Engineering, School of Arts, School of Education, School of Business, and School of Continuing and Professional Studies. We focus on undergraduate students and do not have respondents from the latter school, because it offers accelerated, cohort-based programs for adult learners. We find that around 26, 12, 30, 20, and 12 percent of respondents are from the Schools of Business, Education and Health[1], Engineering, Liberal Arts, and Science, respectively. These percentages are comparable to the distribution of the undergraduate student population at the college, which is 25, 13, 33, 20, and 10 percent at each school, respectively.

The dichotomous variables derived from the survey are defined and summarized in Table 3.

[Insert Table 3 about here]

Roughly 41 percent of our sample is male and 58 percent is female. The college has around 55 percent of male undergraduate students and around 45 percent of female undergraduate students. Thus, our sample has a female overrepresentation and a male underrepresentation. In terms of race or ethnicity, our sample is composed of around 67 percent white respondents and 18 percent Latino or Hispanic respondents. Both are similar to the school's demographics of 31 percent minority and 20 percent Hispanic. Around 31 percent of participants are first-generation college students, which is very close to the college's actual 33 percent

## METHODOLOGY

[1] For simplicity, we will from now refer to the School of Education and Health as the School of Education.

We utilize a logistic regression model for each financial literacy question that has a correct answer. For each, the outcome variable is defined as:

$$y = \begin{cases} 1 & if\ correct\ answer \\ 0 & if\ incorrect\ answer \end{cases}$$

For binary response models, researchers focus on the response probability:

$$P(y = 1|\boldsymbol{x}) = G(\boldsymbol{x\beta})$$

Where $\boldsymbol{x}$ = (1, $x_1, x_2, \ldots, x_K$) and includes *K* covariates that affect the outcome variable $y$ and $\boldsymbol{\beta}$ is *K*+1 x 1. $\boldsymbol{G}$ maps $\boldsymbol{x\beta}$ into the response probability (Wooldridge 2010). For the *logit model*,

$$G(z) = \frac{e^z}{1 + e^z}$$

(Wooldridge 2010).

## RESULTS

Using most of the covariates described in Table 3, we run a logistic[2] model for each financial knowledge question described in Table 1. For any covariate that has a range, the midpoint from the range is taken as the value for the observation. Since marginal effects are commonly used for analysis of the results,[3] we report them in the remaining of this section. Marginal effects are calculated as the average partial effect among all observations for continuous covariates and as a discrete change, from 0 to 1, for dichotomous variables, which are summarized in Table 4[4].

[Insert Table 4 about here]

[2] We also run probit models, which provide very similar results. Probit regression results are available upon request.

[3] Results from the logistic regressions are available upon request.

[4] While Table 4 provides a concise summary, standard errors and p-values associated with each marginal effect are available upon request.

## Liquidity

Around 60 percent of students correctly select money in a checking account as the most liquid asset. However, approximately 9 percent choose a house, which shows a deficit of knowledge about the basic concept of asset liquidity (see Table 1). These results are alarming, especially when compared to the findings of Chen and Volpe (1998), who ask the same question to 924 students from 14 college campuses. They find that around 73 percent answer this question correctly. Finding a decrease in the percentage of students who answer correctly is concerning given the different dates of the studies. A study published in 1998 shows a higher percentage than a study conducted in 2017. To study determinants that increase the likelihood of understanding liquidity, we estimate the marginal effects of each covariate, which are summarized in Table 4. We find that students are 17 percent more likely to understand the concept of liquidity if they have worked for pay during college. Students from the Schools of Science, Engineering, Arts, and Education are 24, 24, 34, and 30 percent less likely to understand liquidity compared to a student from the School of Business, respectively. A student with a higher GPA is more likely to understand liquidity, which is intuitive as that student tends to perform better in class.

## Risk and Return

Roughly 67 percent of students think the statement is true. While around 15 percent select *False*, approximately 17 percent are aware that they do not know the correct answer. Again, compared to the results shown by Atkinson and Messy (2012), our college students are on average less financially knowledgeable. For instance, 77 and 79 percent answer this question correctly in the UK and Germany, respectively. The connection between risk and return is better understood by male students, but we need to consider several interaction terms. Conditional on not being white, not being first-generation, and not having a credit card, a male student is around 19 percent more likely to answer this question correctly than a female student or a respondent who selected other[5] as gender. Focusing on the subset of white students who are not first-generation and who do not have a credit card, a male student is roughly 16 percent more likely to understand this concept than

[5] Any analysis of the male dummy variable is relative to both females and those who selected other as their gender. However, for simplicity, we will make comparisons relative to females from now to save space.

a female student. None of the marginal effects of the male interaction terms are larger than the marginal effect of male itself. Students who know their parents' income are around 9 percent more likely to understand the connection between risk and return. We conjecture that parents who share their personal income with their children are probably more likely to mentor their children on personal finance. Once again, we observe that students from the School of Business are more likely to answer this personal finance question correctly relative to students from the other schools. Notice that a student from the School of Education is almost 40 percent less likely to answer correctly relative to a student from the School of Business. As previously observed, GPA has a positive and statistically significant marginal effect. Thus far, being a business student and having a higher GPA increase the likelihood of being more knowledgeable in both personal finance questions.

## Diversification

Roughly 52 percent of respondents understand the concept of diversification. Approximately 22 percent consider the statement to be false and around 26 percent state that they do not know the answer. Our results are in line with Atkinson and Messy's (2012) findings for advanced countries. They find that 55 and 60 percent of adult participants answer correctly in the UK and in Germany, respectively. Relative to the previous questions, students appear to struggle with this financial concept, and this trend seems to be the same across different countries. Older students are slightly more likely to understand diversification, but the magnitude of the marginal effect is small (see Table 4). This finding is intuitive as older students are likely to be more experienced and are further into their education. Conditional on not being white, not being first-generation, and not having a credit card, a male student is 24 percent more likely to understand diversification than a female student. Focusing on the male interaction terms, the interaction between male and first-generation only has a negative marginal effect, but its size is smaller than the marginal effect of male itself. Examining race, a white female student is around 12 percent more likely to understand diversification relative to a non-white female student. In contrast, a white male student is only roughly 8 percent more likely to answer correctly than a non-white male student. In other words, race differences are smaller within males than within females. As with risk and return, knowing parents' income increases the likelihood to answer the question about diversification correctly by

11 percentage points. Regarding schools, business students are more likely to understand diversification relative to education, art, or science students. Notice that the School of Engineering's marginal effect is negative, but not statistically significant. The size of the school coefficients is smaller relative to previous findings.

## Numeracy

About 82 percent of respondents answer the numeracy question correctly and show an understanding of how interest is calculated (see Table 1). These results compare to Lusardi, Mitchell and Curto's (2010) findings, where 79.3 percent of high school students answer the question correctly. We find that older students are more likely than younger students to understand the concept of interest accumulation, but the size of the marginal effect is comparatively small (see Table 4). Older students are more experienced, further into their studies and more advanced in their academic development. This could explain why they are more likely to understand this financial knowledge concept. In addition, a white male student is roughly 15 percent more likely to understand interest accumulation than a non-white male student. Similarly, a white female student is roughly 12 percent more likely to understand this numeracy concept than a non-white female student. In this case, race differences are not very large across genders. These findings are different in comparison with the results from the diversification question. Furthermore, a first-generation male student is around 17 percent less likely to understand interest accumulation than a male student who is not first-generation. In contrast, a first-generation female student is only approximately 10 percent less likely to understand numeracy than a female student who is not first generation, showing that the negative effect of first-generation is stronger among male students. A possible explanation for the negative marginal effect in both cases could be that parents with a college education might be more likely to discuss personal finance with their children. Therefore, these children experience a greater exposure to financial decisions. Switching our focus to first-generation students only, we observe a very small gender effect. Students from the Schools of Arts and Education are less likely to answer this interest accumulation question correctly relative to students from the School of Business. As seen in previous regressions, the marginal effect of GPA is positive and statistically significant. Moreover, female students who have at least one credit card are around 7 percent more likely to understand this concept than female students who do not have

a credit card. Exposure to credit cards appears to have a positive impact on knowledge about interest accumulation among females. In contrast, male students who have a credit card are around 7 percent less likely to answer this question correctly. Hence, exposure to credit cards has the opposite effect for male students relative to female students.

## Compound Interest

In contrast to the simple interest accumulation question presented before, fewer students answer this question about compound interest correctly. The number of correct responses decreases by around 30 percentage points. Only about 52 percent of students understand the concept of compound interest. Roughly 30 percent of respondents answer that they would have *exactly $200* after 5 years of interest accumulation. This indicates that they do not understand how compound interest works. The percentage of correct responses is lower than the 83.5 percent of correct answers observed by Lusardi and Mitchell (2007b) in their survey of adults. Nonetheless, adults might be more financially knowledge because they have more experience making financial decisions. While the dummy variable for male is positive and statistically significant in other regressions, the interaction between male and first-generation dummy is negative and statistically significant for this financial literacy question (see Table 4). Among male students, a first-generation student is around 6 percent less likely to understand compound interest accumulation than a student who is not first-generation. Essentially, first-generation status has a negative effect among male students. Switching our focus to first-generation students only, a male student is 19 percent less likely to understand this concept relative to a female student. Therefore, being male has a negative effect among first-generation students, which was also observed for the numeracy question. These negative effect poses a noticeable contrast to studies that show male as a positive determinant of financial literacy. Knowing parents' income increases the likelihood to answer the question about compound interest correctly. As suggested previously, the greater exposure to finance-related topics through conversations with their parents might positively contribute to the students' financial knowledge. A student from the School of Education is roughly 13 percent less likely to understand compound interest accumulation than a student from the School of Business. GPA also has a positive and statistically significant marginal effect. A higher GPA increases the likelihood that a student knows how compound interest works. Surprisingly, a student who has

taken out at least one student loan is around 12 percent less likely to understand compound interest accumulation than a student without a loan. Students without any student loan might come from wealthier families, who might have investments and who might take the time to discuss personal finance and compound interest accumulation with their children. However, students who take out student loans should be aware of compound interest accumulation, because they will eventually have to pay back the loan and its compounded interest. Thus, it is very concerning that these students are less likely to answer correctly. More efforts should be channeled to increase financial knowledge among these students. This is of even greater importance given the growing amount of student loans and the alarming level of credit card delinquency rates. Compound interest is the single most important debt feature and should be understood by all students who take out a loan. We also observe that a student who knows his or her credit score is more likely to understand compound interest accumulation.

### Interest Rate, Inflation and Purchasing Power

We find that 53 percent of respondents answer this question correctly. This compares to 88.4 percent of correct responses of a college educated adult sample observed by Lusardi and Mitchell (2007b), and 54 percent of correct responses of high school students (Lusardi, Mitchell and Curto 2010). Roughly 27 percent of the students surveyed state that they do not know how to answer this question. This indicates a lack of understanding of the concept of purchasing power. Job experience has a positive and statistically significant marginal effect on answering the purchasing power question correctly (see Table 4). A student who has worked for pay during college is more likely to understand the relation between interest rate, inflation and the resulting purchasing power than a student who has not worked for pay. The amount of hours worked has a negative and statistically significant coefficient, but its magnitude is closer to zero. Students from the Schools of Art or Education are less likely to answer correctly than students from the School of Business. This difference between schools supports previous findings regarding school of study.

### Time Value of Money

Around 63 percent of students choose the correct answer, which implies that they understand the concept of time value of money. These students comprehend that their inheritance accumulates

interest, which eventually makes them richer. Around 16 percent of students admit that they do not know the answer. Asking the same question to a sample of college educated adults, Lusardi and Mitchell (2007b) find that 71.7 percent answer this question correctly. Older students, presumably with more experience and further into their education, are around 3 percent more likely to answer the time value of money question correctly than younger students (see Table 4). A white male student is around 17 percent more likely to answer correctly than a non-white male student. Focusing on white students who are not first-generation and who do not have a credit card, a male student is around 18 percent more likely to understand time value of money than a female student. Differently, looking at the subset of first-generation white students without a credit card, a male student is only approximately 6 percent more likely to answer this question correctly than a female student. Once we focus on first-generation students, the positive effect of being male decreases. Knowing parents' income has a positive and statistically significant marginal effect. This agrees with findings from previous questions. A student who has worked for pay during college is around 15 percent more likely to answer correctly than a student who has not worked for pay while in college. As encountered earlier, students from the School of Business are more likely to answer correctly than students from the Schools of Arts or Education.

**Money Illusion**

Around 81 percent of students answer the money illusion question correctly. Interestingly, our sample outperforms the population of adults surveyed by Lusardi and Mitchell (2011), who find that only 76.9 percent of college educated adults answer correctly. This question has one of the highest percentages of correct responses. As in other regressions, the interaction between white and male has a positive and statistically significant marginal effect (see Table 4). Among male students only, being white increases the probability to understand this concept by 15 percentage points. Focusing on white students who are not first-generation and who do not have a credit card, a male student is around 19 percent more likely to answer this money illusion question correctly than a female student. In contrast, looking at white first-generation students without a credit card, being male increases the likelihood to understand this concept by approximately 6 percentage points only. Once we focus on first-generation white students, we observe a smaller gender gap. As in other regressions, a student with a job during college is 9 percent more likely to understand

the concept of money illusion than a student who has not worked during college. We suggest that employment increases financial knowledge by providing exposure to the real world and by giving students the opportunity of managing their own finances. As in most regressions, business students are more likely to understand money illusion than education and art students. While the savings amount covariate has a statistically significant coefficient, the latter is basically zero. We further examine that a student who has at least one credit card is around 10 percent more likely to understand money illusion than a student without any credit card even after considering the interaction between male and credit card. Ownership of a credit card might expose students to personal finance decisions, which might increase financial knowledge.

## DISCUSSION AND POLICY RECOMMENDATIONS

Based on the eleven logistic regressions, we find common patterns and identify variables that most consistently influence the likelihood to answer financial knowledge questions correctly. Being from the School of Business positively affects the likelihood. While students from the Schools of Education and Arts generally perform worse, students from the Schools of Science and Engineering do so only in a few questions. While it makes sense that business students perform well in financial knowledge questions, we conclude that there is a need to expand financial literacy education to other schools. Some colleges and universities require a personal finance course, others offer voluntary workshops and training sessions. A debate about the effectiveness of this solution has been discussed in the literature. For instance, Mandell and Klein (2009) show that high school students who take a personal financial management course are no more financially literate than those who do not. Surveying 2357 young respondents, Carlin and Robinson (2012) find that financial training improved students financial knowledge.

Another determinant of financial knowledge is GPA. A student with a higher GPA is more likely to answer correctly the five questions related to liquidity, risk and return, credit card charges, financial numeracy, and compound interest. Older students are more likely to understand diversification, financial literacy numeracy, and the time value of money, but the size of the marginal effects are not very large. As mentioned before, older students are likely to have more

experience and are further into their education, increasing their likelihood of exposure to personal finance decisions and courses that might cover the topic. White, male, and their interaction increase the likelihood to answer correctly a number of questions. However, the interaction between male and first-generation decreases the likelihood that a student understands compound interest. First-generation students are also more likely to underperform in the numeracy and money illusion questions. We conjecture that first-generation students are less exposed to personal finance as they might be less likely to discuss financial literacy with their parents who did not attend college. Differently, it is plausible that students who have at least one parent with a college education have more exposure to personal finance and investment decisions. Given these results, we recommend promoting financial literacy workshops among female, minorities, and first-generation college students.

We also observe that students who know their parents' income are more likely to understand risk and return, diversification, compound interest, and time value of money. This finding illustrates the important influence parents have on their children's education. Parents who share information about their income are probably also sharing other personal finance information, contributing to their children's financial literacy. On the other hand, having a credit card or having a student loan also influence financial knowledge. Female students who have at least one credit card are more financially knowledgeable regarding numeracy and money illusion. In the case of male students, having a credit card has a positive effect in the money illusion question, but a negative effect in the numeracy question. A student who has any student loan is less likely to understand compound interest than a student without any loan. We conjecture that students who do not have to take a student loan to go to college are likely to come from wealthier families, who are likely to have investments and substantial experience with personal finance decisions. These families can pass along some of their financial knowledge, increasing the likelihood that the student answers correctly this compound interest question. However, students who take out loans should understand compound interest accumulation, as they will eventually have to pay back the loan and its compounded interest. Given this concerning result, we recommend offering student loan workshops that explain compound interest accumulation.

Lastly, a behavioral variable that positively determines financial literacy is whether a student has worked for pay during college. Having a job increases the likelihood that a student understands

liquidity, the relation between inflation and interest rate, time value of money, and money illusion. Having a job provides valuable experiences that translate to higher financial knowledge. We recommend the promotion of internships and work among college students.

## CONCLUSION

While we focus on the knowledge dimension, we contribute to the literature on financial literacy in several ways. First, we build our survey from previous studies, which allows us to improve questions in certain cases and to compare results. We measure financial knowledge through nine questions about the following concepts: liquidity, interest rates, the relation between risk and return, diversification, numeracy, compound interest, the relation between interest rate, inflation, and purchasing power, time value of money, and money illusion.

Second, we employ a rigorous methodology to investigate determinants of financial knowledge among college students. We estimate the way several demographic, socio-economic, and school-related characteristics influence the likelihood that a student is financially knowledgeable. While Lusardi, Mitchell and Curto (2010) employ a probit regression and its marginal effects, they mainly focused on high school students, who are then followed in life. For the studies primarily focused on college students, several derive their results from aggregate statistics, without controlling for potential confounding variables. Others force the conversion of a financial literacy index into a dichotomous variable, run a logistic regression, but fail to report marginal effects. In addition, some of these studies have very small sample sizes. We contribute to the literature on financial literacy among college students by carefully estimating the influence of each determinant using a logistic regression, its marginal effects, and by controlling for several confounding variables. We confirm that variables such as age, gender, race, and GPA are positively correlated with financial literacy among college students. While being a first-generation college student, being part of the School of Business, and knowing his or her parents' income have been correlated with financial literacy among college students using aggregate statistics, we are the first to carefully study the influence of these variables through marginal effects among college students.

Based on our results, we recommend the implementation of school-wide personal finance classes for non-business students early on. We suggest offering personal finance workshops especially targeting minorities, women, first-generation students, and students who have a student loan. If

these policy recommendations are implemented, we would like to assess the effectiveness of personal finance classes and workshops.

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## APPENDIX A: Personal Finance Student Survey

### Consent to Participate

Welcome to this Personal Finance Survey. Your participation in this survey is completely voluntary. You may decline altogether, or leave blank any questions you do not wish to answer. Your responses will remain strictly confidential and anonymous; as individual responses cannot be identified. Data from this research will only be reported in aggregated levels.

You must be 18 years or older as well as an undergraduate student to participate in the survey and the raffle. If you agree to participate in this survey, please answer each question as best you can. It should take approximately 10 min to complete.

At the end of the survey, you will have the opportunity to enter a raffle to win 1 out of 10 $25 Amazon gift cards. Winners will be announced after Easter Break via email.

There are no known risks to participation in this survey beyond those encountered in everyday life and no anticipated direct benefits to your participation in this survey. However, your participation will allow you to take part in research that may contribute to overall knowledge in the area of financial literacy and personal finance. By clicking "Next" you give your consent to participate in this survey.

To begin the survey, please choose "Next", or you may exit your browser to leave this website. Choose "Next" to continue.

## TABLES

Table 1: Summary of Results for Financial Knowledge Questions (*N=562*)

Note: * indicates the right answer

| Financial Knowledge Concept | | Entire Sample | |
|---|---|---|---|
| | | **Frequency** | **%** |
| Liquidity | The most liquid asset is[6] | | |
| | a) A car | 50 | 8.90 |
| | b) A computer | 22 | 3.91 |
| | c) A house | 26 | 4.63 |
| | d) Money in a checking account* | 314 | 55.87 |
| | e) Money in a certificate of deposit | 21 | 3.74 |
| | f) Don't know | 129 | 22.95 |
| Risk and Return | An investment with high return is likely to be high risk[7] | | |
| | a) True* | 380 | 67.62 |
| | b) False | 86 | 15.30 |
| | c) Don't know | 96 | 17.08 |
| Diversification | It is usually possible to reduce the risk of investing in the stock market by buying a wide range of stocks[8] | | |
| | a) True* | 290 | 51.60 |
| | b) False | 124 | 22.06 |
| | c) Don't know | 148 | 26.34 |

[6] Source: Atkinson and Messy (2012). We added "usually" as an answer choice, omitted "refused", and altered answer choices from 2,3,4 to rarely, sometimes and often.

[7] Source: Chen and Volpe (1998). We altered the order of the answer choices.

[8] Source: Atkinson and Messy (2012). We omitted "…and shares" in the question.

| Financial Knowledge Concept | | Entire Sample | |
|---|---|---|---|
| | | **Frequency** | **Financial Knowledge Concept** |
| Compound interest | Suppose you had $100 in a savings account and the interest rate is 20% per year and you never withdraw money or interest payments. After 5 years, how much would you have on this account in total?[9] | | |
| | a) More than $200* | 293 | 52.14 |
| | b) Exactly $200 | 168 | 29.89 |
| | c) Less than $200 | 47 | 8.36 |
| | d) Don't know | 54 | 9.61 |
| Interest rate, inflation and purchasing power | 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?[10] | | |
| | a) More than today | 58 | 10.32 |
| | b) Exactly the same | 58 | 10.32 |
| | c) Less than today* | 296 | 52.67 |
| | d) Don't know | 150 | 26.69 |

[9] Source: Lusardi and Mitchell (2007b). We omit "refuse" as an answer.

[10] Source: Lusardi, Mitchell and Curto (2010). We omit "refuse" as an answer.

Table 2: Characteristics of the sample (*N=562*)

| | Entire Sample | |
|---|---|---|
| Demographic Variable | Frequency | % |
| School of: | | |
| a) Business | 145 | 25.8 |
| b) Education and Health | 65 | 12.28 |
| c) Engineering | 168 | 29.89 |
| d) Liberal Arts | 115 | 20.46 |
| e) Science | 65 | 11.57 |
| Race or ethnicity | | |
| a) American Indian or Alaskan | 3 | 0.53 |
| b) Asian or Pacific Islander | 32 | 5.69 |
| c) African American | 15 | 2.67 |
| d) Hispanic or Latino | 102 | 18.15 |
| e) White or Caucasian | 374 | 66.55 |
| f) Other | 17 | 3.03 |
| g) No answer | 19 | 3.38 |
| Age | 97 | 17.26 |
| a) 18 years old | 123 | 21.89 |
| b) 19 years old | 141 | 25.09 |
| c) 20 years old | 124 | 22.06 |
| d) 21 years old | 53 | 9.43 |
| e) 22 years old | 13 | 2.31 |
| f) 23 years old | 5 | 0.89 |
| g) 24 years old | 6 | 1.07 |
| h) 25 years old | | |
| GPA | | |
| a) < 1.5 | 1 | 0.18 |
| b) 1.5-1.99 | 3 | 0.53 |
| c) 2-2.49 | 13 | 2.31 |
| d) 2.5-2.99 | 91 | 16.19 |
| e) 3-3.49 | 201 | 35.77 |
| f) 3.5-3.749 | 133 | 23.67 |
| g) 3.75-4 | 120 | 21.35 |
| Average Work Hours per Week | | |
| a) None | 167 | 29.82 |
| b) 20 hours or less | 296 | 52.86 |
| c) Between 20 and 40 hours | 84 | 15.00 |
| d) 40 hours or more | 13 | 2.32 |
| Amount of savings and/or investments owned | | |
| a) None | 146 | 26.12 |
| b) Less than $1,000 | 110 | 19.68 |
| c) $1,000 to $2,499 | 99 | 17.71 |
| d) $2,500 to $4,999 | 62 | 11.09 |
| e) $5,000 to $9,999 | 66 | 11.81 |
| f) $10,000 or more | 76 | 13.59 |

Table 3: Summary of Dichotomous Variables (*N=562*)

| | | Percentage (%) | |
|---|---|---|---|
| **Covariate** | **Definition: = 1 if student** | **Yes = 1** | **No = 0** |
| male | is male | 40.93 | 59.07 |
| white | is white | 66.55 | 33.45 |
| latino | is latino or hispanic | 18.15 | 81.85 |
| white & male | is white and male | 27.94 | 72.06 |
| first.gen | is first generation | 29.36 | 70.64 |
| male & first.gen | is male & first generation | 11.57 | 88.43 |
| parents.income | is student knows parents' annual income | 82.38 | 17.62 |
| job | has worked for pay while being a full-time college student | 70.28 | 29.72 |
| science | is from the School of Science | 11.57 | 88.43 |
| engineering | is from the School of Engineering | 29.89 | 70.11 |
| arts | is from the School of Arts | 20.46 | 79.54 |
| education | is from the School of Education | 12.28 | 87.72 |
| business | is from the School of Business | 25.8 | 74.2 |
| savings | has any savings or investments | 74.02 | 25.98 |
| student.loan | has a student loan | 68.86 | 31.14 |
| credit.card | has a credit card | 52.85 | 46.44 |
| male & credit.card | is male and has a credit card | 21 | 78.29 |
| credit.score | knows his or her credit score or if the student knows that he or she doesn't have a credit score | 46.09 | 53.91 |

Table 4: Marginal Effects of Logistic Regressions (*N=553*)

| | Liquidity | Risk and Return | Numeracy | Compound Interest | Interest Rate & Inflation | Time Value of Money | Money Illusion |
|---|---|---|---|---|---|---|---|
| age | 0.0174 | 0.0022 | 0.0331** | 0.0192 | 0.0091 | 0.0332** | -0.0193 |
| male | 0.0138 | 0.1868** | 0.0774 | 0.1333 | 0.1039 | 0.0294 | 0.0541 |
| white | 0.0592 | 0.0286 | 0.0326 | 0.0431 | 0.0396 | 0.0169 | 0.0169 |
| white & male | 0.0834 | -0.0260 | 0.1216** | 0.0894 | 0.1437 | 0.1524** | 0.1347*** |
| first.gen | 0.0395 | -0.0107 | -0.1047** | 0.0018 | -0.0309 | -0.0414 | 0.0531 |
| male & first.gen | -0.1112 | -0.0251 | -0.0693 | -0.1926** | -0.0549 | -0.1193 | -0.1312 |
| parents.income | -0.0038 | 0.0851* | 0.0576 | 0.1041** | 0.0580 | 0.1129** | 0.0166 |
| job | 0.1707*** | -0.0792 | 0.0289 | 0.0796 | 0.1152** | 0.1545*** | 0.0970* |
| labor.hrs | -0.0009 | 0.0017 | -0.0001 | 0.0016 | -0.0057** | -0.0039 | 0.0009 |
| science | -0.2448*** | -0.1817** | 0.0061 | 0.0611 | 0.0735 | 0.0751 | -0.0019 |
| engineering | -0.2420*** | -0.2039*** | 0.0312 | 0.0623 | 0.0261 | 0.0237 | -0.0543 |
| arts | -0.3432*** | -0.2851*** | -0.1105** | -0.0934 | -0.1815*** | -0.1870*** | -0.1244** |
| education | -0.3004*** | -0.3994*** | -0.1352** | -0.1273* | -0.2244*** | -0.1635** | -0.2098*** |
| gpa | 0.1615*** | 0.0988** | 0.0838** | 0.1030** | 0.0719 | 0.0751 | 0.0496 |
| savings | -0.0246 | 0.0178 | 0.0228 | -0.0116 | 0.0418 | 0.0016 | 0.0611 |
| savings.amount | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000* |
| student.loan | -0.0603 | 0.0480 | -0.0153 | -0.1207*** | -0.0650 | -0.0133 | 0.0355 |
| credit.card | -0.0014 | 0.0582 | 0.0669* | -0.0226 | 0.0126 | -0.0272 | 0.0989** |
| male & credit.card | 0.1027 | 0.0236 | -0.1399 | -0.1101 | 0.0332 | 0.0591 | 0.0019 |
| credit.score | 0.0269 | 0.0318 | 0.0091 | 0.0989** | 0.0127 | 0.0394 | 0.0234 |