ADDING UP THE BENEFITS: EDUCATION, NUMERACY AND FINANCIAL LITERACY

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Abstract

Based on data obtained from the Survey of Financial Competences conducted by the Banco de España, this study examines the relationship between education and financial literacy across the Spanish population, with an emphasis on numeracy skills. Financial literacy is assessed through a set of indicators derived from various combinations of the survey questions, allowing for a comprehensive analysis of individuals' financial awareness across different topics. The findings indicate that, on average, higher levels of formal education are related to higher financial literacy and that graduates in science and economics outperform graduates from other disciplines. The study highlights the importance of strengthening numeracy skills to support improvements in financial literacy.

Resumen

Este estudio se basa en los datos obtenidos de la Encuesta de Competencias Financieras elaborada por el Banco de España y en él se examina la relación entre el nivel educativo y las competencias financieras en la población española, haciendo hincapié en las competencias matemáticas. Las competencias financieras se evalúan mediante un conjunto de indicadores calculados a partir de diversas combinaciones de preguntas de la encuesta, lo que permite un análisis exhaustivo de los conocimientos financieros que tienen las personas sobre distintos temas. Los resultados indican que, en promedio, los niveles más altos de educación formal se asocian a mejores competencias financieras, y los graduados en Ciencias y en Economía superan a los de otras materias. El estudio subraya la importancia de reforzar las competencias matemáticas para favorecer la mejora de las competencias financieras.

Palabras clave: competencias financieras, educación financiera, educación universitaria, campo de estudio, destrezas matemáticas.

Códigos JEL: G53, I21.

Contents

1 Introduction

Over the past decades, numerous public and private organisations have adopted initiatives aimed at enhancing individuals' financial literacy and supporting informed financial decision-making. Many countries around the world have implemented national financial education strategies, underscoring the value that public authorities and international organisations, such as the Organisation for Economic Cooperation and Development (OECD), place on equipping citizens with fundamental financial skills. Through these initiatives educational resources are provided to the population to promote sound financial decision-making and effective interaction with the financial system (OECD, 2015; OECD, 2022). In the European Union, various national and supranational bodies also commit resources to initiatives designed to improve the financial skills of the population (European Banking Authority, 2023; European Securities and Markets Authority, 2022).

The literature on the effectiveness of financial education initiatives reveals mixed results, depending on the type of programme analysed, the outcomes evaluated regarding improved financial knowledge or financial behaviour, the data available and the analytical methods employed (see, for example, Hathaway and Khatiwada, 2008; Willis, 2009; Fernandes, Lynch and Netemeyer, 2014; Cole, Paulson and Shastry, 2016; Kaiser and Menkhoff, 2020 and Kaiser, Lusardi, Menkhoff and Urban, 2022). There is no guarantee that a financial education programme will be successful or that participants will retain the knowledge acquired over the long term. As more public and private resources are allocated to financial education on a global scale, examining the determinants of their effectiveness and tailoring educational initiatives for maximum benefit become all the more crucial.

The most comprehensive definitions of financial literacy, such as the one currently employed by the OECD, underscore the complexity of this domain: financial literacy is "a combination of financial awareness, knowledge, skills, attitudes and behaviours necessary to make sound financial decisions and ultimately achieve financial well-being" (OECD, 2023a, p.13). Developing a sufficient understanding of financial topics to make sound financial decisions requires, at a minimum, a foundational grasp of the structure and functioning of financial markets and products, knowledge of current regulations governing rights and obligations in financial contracts and familiarity with specific concepts such as the time value of money or financial risks, to name justt a few.[1]

Financial literacy is aided by specific economic and financial training and other cognitive aspects, such as reading and numerical ability (OECD, 2023b). Understanding written materials related to transactions or contracts, performing basic arithmetic (including calculations with percentages and index numbers), understanding basic probability concepts and interpreting charts and diagrams are all essential skills. Numerical ability plays a

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[1] For a systematic review of the definitions of financial literacy and use of synonyms in the literature (such as financial capability or financial knowledge), see Huston (2010); Goyal and Kumar (2021) or Zaimovic, Torlakovic, Arnaut-Berilo, Zaimovic, Dedovic and Meskovic (2023). In this paper we use financial literacy and financial knowledge interchangeably. Although some definitions of financial literacy are broader, financial knowledge is a critical part of this construct.

particularly relevant role in financial literacy (Sunderaraman, Baker, Chapman and Cosentino, 2022). Applying numeracy skills to financial contexts is not always straightforward. However, those who are comfortable with maths will probably find it less challenging to work out the return on an investment, interpret a rate of growth or determine the impact of inflation on savings. These types of calculations pose significant challenges for many people around the world (Lusardi, 2012).

Over time, various studies have highlighted the importance of numeracy skills in understanding concepts used in financial contexts. For instance, Skagerlund, Lind, Strömbäck, Tinghög and Västfjäll (2018) argue that numeracy is a critical factor in predicting financial literacy, with emotional attitudes toward numbers (what they call "math anxiety") also serving as a predictor of financial literacy. This suggests that targeting numeracy skills could contribute to improving financial literacy. These authors point out that a "substantial portion of the construct of 'financial literacy' may in fact be explained by numeracy, whereby numeracy may provide the computational engine behind financial decision making based on conceptual knowledge of finance". The OECD also highlights this link both in the case of adults (OECD, 2023a) and high school students participating in the PISA assessments (OECD, 2024a).

Some authors, such as Cole, Paulson and Kartini Shastry (2016), go even further and argue that financial literacy programmes do not significantly affect individuals' financial behaviours. Instead, they suggest that mathematics training is more effective and "leads to greater financial market participation, investment income, and better credit management, including fewer foreclosures". However, this is not the generally accepted view in the literature, as specific financial training is usually considered a must for improving financial literacy. In this respect, there is evidence that certain financial education programmes yield positive effects. For example, Tennyson and Nguyen (2005), Walstad, Rebeck and MacDonald (2010) and Asarta, Hill and Meszaros (2014) highlight improvements in the financial literacy of secondary school students who participate in these programmes. At the higher education level, Lyons (2004) shows that university students involved in financial education programmes are less likely to engage in risky credit behaviours. Brau, Holmes and Israelsen (2019) emphasise that the most significant impact occurs when experiential learning is integrated with concept formation. Similarly, Stella, Filotto and Cervellati (2020) find that individuals who participated in financial education programmes during school or university exhibit higher levels of financial literacy compared to their peers who did not. Lastly, Xiao and O'Neill (2016), using data from the US population, conclude that respondents with prior exposure to financial literacy courses perform better in financial decision-making.

Nonetheless, the link between numeracy and financial literacy merits further attention. Our paper examines the relationship between these two skills using data from the nationwide Survey of Financial Competences (SFC) conducted in Spain every five years by the Banco de España in collaboration with the National Statistics Institute (INE). Specifically, we analyse the extent to which financial knowledge is higher among individuals with more maths-intensive academic backgrounds, while controlling for other factors commonly

identified in the literature as having a significant association with financial knowledge. Our aim is to contribute to the discussion surrounding the relationship between numeracy skills and understanding financial concepts. It is reasonable to expect that individuals with a stronger background in mathematics exhibit a better understanding of certain financial issues, especially those that involve the more quantitative side of finance. Our findings support this hypothesis, highlighting the importance of strengthening numeracy skills to foster the development of financial skills.

2 The sociodemographic characteristics generally associated with financial skills

The literature on the determinants of financial literacy has expanded significantly since the 2008 financial crisis and commonly identifies several sociodemographic factors underlying an individual's financial literacy, which we will account for when analysing the link between numeracy and financial skills. In this section we summarise the most relevant of these variables and briefly explain how they are related to financial literacy.

These factors include gender, age, income, educational attainment, wealth and employment in finance-related fields (Chen and Volpe, 1998 and 2002; Lusardi and Mitchell, 2014 and 2023; Brau, Holmes and Israelsen, 2019; Goyal and Kumar, 2021). According to most studies, the individuals more likely to exhibit higher financial literacy compared to other social groups are male, middle-aged, university graduates, higher-income earners, wealthier and employed in finance-related jobs. Conversely, women, younger or retired individuals, those with only primary education and those with lower income and wealth are more likely to exhibit lower levels of financial literacy.

However, there is no generally accepted theory regarding the determinants of financial culture or financial competences. The observed disparities among different social groups may be attributed to socialisation or social learning processes, through interactions with peers or family members within specific social norms. These processes shape attitudes, intentions, behaviours and financial knowledge (Gutter, Garrison and Copur, 2010; Goyal and Kumar, 2021; Rehman and Mia, 2024). Some of them may be similar across time and cultures, while others might differ significantly depending on the country or specific social groups. There are currently relatively few studies that aim to explain individuals' financial literacy using existing behavioural theories (Goyal and Kumar, 2021). Since some of the factors commonly identified as linked to financial literacy are intertwined, it may also be challenging to isolate their effect.

For instance, in some societies, men may assume a larger role in financial decision-making than women or may become more aware of finance from an earlier age (Agnew and Cameron-Agnew, 2015; Aguiar-Díaz and Zagalaz-Jiménez, 2021), whereas in others no such division of financial decision-making may occur, and other factors might influence women's financial knowledge (Fonseca, Mullen, Zamarro and Zissimopoulos, 2012). In a recent publication, Hospido, Iriberri and Machelett (2024) show that gender gaps are significantly reduced when women are provided nudges to discourage them from choosing the "Don't know" option commonly included in surveys, which women select more often than men, potentially due to a lack of confidence in their knowledge. No gender differences in financial literacy have been detected among Spanish teenagers in the latest PISA financial literacy assessment (OECD, 2024b). This points towards different socialisation between the genders affecting adult women's confidence in their knowledge.

With respect to age, it is generally found that middle-aged individuals tend to possess more financial knowledge than younger individuals, possibly due to their broader experience

with financial products and financial decision-making. However, these skills may deteriorate to some extent during old age since cognitive levels tend to decrease (Jappelli and Padula, 2013; Lusardi, Michaud and Mitchell, 2017). At the same time, in some countries, certain generations may have benefitted from enhanced educational opportunities or incentives to learn about finances, or may have been exposed to situations that increased their awareness of certain economic and financial phenomena and related terminology (e.g. episodes of high inflation, real estate bubbles or bank runs). These differences are visible across cohorts when analysing cross-sectional data, but it might be challenging to separate the effect of age, education or other historical factors.

There is also a documented correlation between income level, wealth and financial literacy (Guiso and Jappelli, 2008; Van Rooij, Lusardi and Alessie, 2012). Generally speaking, individuals with higher incomes tend to have more financial assets, which might motivate them to invest more energy into understanding how to manage their money to maximise long-term benefits. Cultural elements relating to class structure might also be important since wealthy households might place more emphasis on money management skills. A reverse relationship has also been hypothesised, whereby higher levels of financial literacy may lead to higher wealth accumulation due to knowledge and access to better saving mechanisms (Lusardi, Michaud and Mitchell, 2017).

Employment status has also been seen to influence the acquisition of financial knowledge, as employed individuals have more opportunities to learn about finance in the workplace, particularly if their job is finance-related (Lusardi, 2014). Those actively engaged in the workforce may be more up to date with certain financial topics when compared to inactive or retired individuals, as they might enjoy more access to financial services, financial training programmes or company benefits which expose them to financial concepts (such as pension schemes).

Higher levels of formal education are shown to positively influence financial literacy (Lusardi and Mitchell, 2007, 2014 and 2023). It is commonly observed that, on average, individuals with a university degree perform better on financial literacy tests compared to those with only primary or secondary education. Advancing through different stages of education enlarges individuals' cognitive abilities (including reading comprehension and numeracy skills) and capacity to understand more complex topics, which can lead to positive spillovers for financial literacy. Educational attainment and income level can be closely related.

Other factors such as interactions with the financial sector, family background or cultural norms and expectations could also play a role in shaping individuals' life choices, opportunities and financial literacy (Hastings, Madrian and Skimmyhorn, 2013). For example, individuals who have been more exposed to financial intermediaries or products may acquire practical knowledge that complements their formal education. At the same time, early exposure to financial concepts can significantly influence financial knowledge, attitudes and behaviours (Alcalde and Stupariu, 2025).

When it comes to numeracy skills, there appears to be a positive association with financial skills that has been analysed from different perspectives throughout the years (Chen and Volpe, 2002; Lusardi, 2012; Tanase and Lucey, 2017; Skagerlund, Lind, Strömbäck, Tinghög and Västfjäll, 2018; Indefenso and Yazon, 2020; Sunderaraman, Baker, Chapman and Cosentino, 2022; Thevenet, 2023; OECD, 2024). There is evidence that numeracy is associated with multiple aspects of cognition and is one of the strongest predictors of financial decision-making (Sunderaraman, Baker, Chapman and Cosentino, 2022). This area of research is relevant for a number of reasons, not least because differences in financial knowledge across individuals with heterogeneous numeracy skills can inform the design of financial education programmes that are better suited to meet different individual needs.

In this paper, we examine the relationship between financial knowledge and numerical abilities across the population of university graduates by focusing on the differences between those from fields with a higher mathematical component and those who completed other types of undergraduate studies such as healthcare or humanities. This approach does not allow us to identify specific mathematical abilities at the individual level but can serve as an approximation to a broad-based concept of numerical ability involving both reasoning and computation. We find that, on average, economics and science graduates outperform graduates of other disciplines. Their financial knowledge is similar, with certain differences depending on the topic.

We devote the last section of this paper to discussing the implications of our findings for financial literacy measurement and financial education programme design. In a world where adult numeracy skills appear to be declining or stagnating (OECD, 2024c), recognising the importance of numeracy as a foundational element for financial literacy is crucial for enhancing overall financial competence.

3 Financial knowledge across sociodemographic variables

We draw information from the SFC conducted by the Banco de España every five years. This survey assesses the knowledge and understanding of financial concepts among the Spanish population aged 18 to 80. The SFC provides a comprehensive set of sociological, demographic and economic variables that offer insight into how financial knowledge is distributed among the general population (more information is available on the Banco de España website).[2] It uses a questionnaire developed by representatives from various countries within the International Network for Financial Education (INFE), coordinated by the OECD, complemented with numerous additional items that are relevant to the Spanish context. The survey is conducted on a representative sample of the Spanish population provided by the INE.[3] In this section we present a series of descriptive statistics regarding financial literacy across sociodemographic groups and academic backgrounds and discuss additional variables that may be related to financial literacy.

There are various methods for measuring financial literacy. For example, Lusardi and Mitchell (2008 and 2014) employ three questions related to concepts such as compound interest, inflation and risk diversification, widely known as the "Big Three". Kadoya and Khan (2019) employ these questions and an additional one regarding the relationship between bond prices and interest rates. Van Rooij, Lusardi and Alessie (2011) use five similar questions, while others, such as Stango and Zinman (2009) rely on a single question. When more information is available, more complex indices can be constructed (Lusardi and Mitchell, 2023).

The depth of the Spanish survey allows us to compute several alternative measures that we will use in our analysis. First, an index based on the well-known Big Three questions (Big3). A second extended index is defined using seven additional questions aside from the Big Three (Index10_prob). It includes two questions on inflation (one of which is part of the Big Three), three on interest rates (one included in the Big Three), two on returns on investment, two on probability and one on risk and diversification (also part of the Big Three). The questions on probability do not directly capture financial knowledge, but a basic grasp of this concept is fundamental for understanding risk. These questions are rather conceptual and require relatively simple calculations to produce the correct answer. We also consider another version of the extended index (Index10_fin) where we exclude the questions on probability (Q9 and Q10), since individuals from technical fields may have an advantage in answering these, and we include two additional questions that require respondents to identify the most favourable interest rate values applied to a loan and to savings (Q11 and Q12). When computing the scores for each index, correct answers are assigned one point and the total number of correct answers serves as an indicator of financial literacy. The questions are as follows:

Q1. High inflation means that the cost of living is rising rapidly.

a) True; b) False; c) Does not know; d) Does not answer

Q2. Imagine that five siblings receive a prize of €1,000 and have to wait one year to receive their share. Inflation for that year was 1%. Within one year they will be able to buy:

a) More than they could buy today with their share of the money; b) The same amount; c) Less than they could buy today; d) It depends on the kind of things they want to buy (this option is not read by the interviewer, but is considered correct if the respondent spontaneously replies in this way); e) Does not know; d) Does not answer

Q3. A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest paid over the life of the loan will be lower.

a) True; b) False; c) Does not know; d) Does not answer

Q4. Suppose you deposit €100 in a savings account with a fixed interest rate of 2% per year. There are no commissions or taxes on this account. If you do not make any other deposits to this account or withdraw any money, how much money will there be in the account at the end of the first year, once the interest is paid.

a) Numerical value (…); b) Does not know; c) Does not answer

Q5. Suppose you deposit €100 in a savings account with a fixed interest rate of 2% per year. There are no commissions or taxes on this account. If you do not make any deposits or withdraw any money, once the interest payment is paid, how much money will there be in the account after five years?

a) More than €110; b) Exactly €110; c) Less than €110; d) It is impossible to say with the information given; e) Does not know; f) Does not answer

Q6. An investment with a high return is also likely to be high risk.

a) True; b) False; c) Does not know; d) Does not answer

Q7. The market value of three investment funds in which €10,000 was invested six years ago is shown (on a chart): assuming fees and expenses are the same for all funds, which fund had the best performance at the end of six years?

a) Investment fund 1; b) Investment fund 2; c) Investment fund 3; d) Does not know; e) Does not answer

Q8. In a lottery, the probability of winning a prize is 1%. How many people do you think will win a prize if 1,000 people buy a single ticket each?

a) Numerical value (...); b) Does not know; c) Does not answer

Q9. The following message was printed on a medicine: "Warning: there is a 15% chance of developing a rash when applied on skin areas". Which of the following statements is the best interpretation of this warning?

a) Do not use this medication on your skin - you are almost certain to develop a rash; b) For applications on the skin, use only 15% of the recommended dose; c) If a rash develops, it will probably occur on only 15% of the skin; d) Approximately, 15 out of every 100 people using this medication develop a rash; e) Does not know; f) Does not answer

Q10. It is generally possible to reduce the risk of investing in the stock market by buying a wide variety of stocks.

a) True; b) False; c) Does not know; d) Does not answer

Q11. Which interest rate would be preferable for a couple looking to take out a mortgage in order to buy a house?

a) An interest rate of 1%; b) An interest rate of 3%; c) Does not know; d) Does not answer

Q12. Which interest rate would be preferable for a couple transferring money to their savings account each month?

a) An interest rate of 1%; b) An interest rate of 3%; c) Does not know; d) Does not answer

Questions Q2 (on inflation), Q5 (on compound interest) and Q10 (on diversification) make up the Big Three.

Table 1 illustrates financial literacy measured with the three indices and segmented by education level, age and gender, highlighting disparities across these variables. Index10_prob is the extended index that contains two questions on probability and Index10_fin is the version where the questions on probability have been replaced by Q11 and Q12 laid out above.

Among individuals who completed only primary or secondary education, financial literacy tends to be lower across all age groups when compared to individuals who hold an undergraduate degree, regardless of the index we use to measure it. This gap persists and even widens in older age groups. The data also reveal the documented gender gap in financial literacy. Among those who did not complete higher education, men score higher, on average, compared to women on all indices. This trend is also present among individuals who completed higher education, with men outperforming women by a similar margin. Although university education improves scores for both genders, the gender gap persists, possibly due to the interacting factors mentioned in the previous section.

Financial literacy by education level, age and gender

	Non-university education			University education		
	Big3	Index10_prob	Index10_fin	Big3	Index10_prob	Index10_fin
Age						
18-34	1.5	6.2	6.4	1.9	7.5	7.6
35-64	1.6	6.1	6.7	2.2	8.0	8.3
> 65	1.4	5.0	5.8	2.1	7.6	8.0
Gender						
Female	1.4	5.4	6.0	1.9	7.3	7.7
Male	1.7	6.4	6.9	2.3	8.4	8.6

SOURCE: Survey of Financial Competences (2021).

Table 2 illustrates financial literacy for the entire population and across different stages of formal education. Focusing on the Big Three questions, the average score for the entire population is 1.6 out of 3. The average scores for the extended indices are 6.4 and 6.9 out of 10. This indicates room for improvement when it comes to financial literacy in Spain. When examining scores across different stages of formal education, we observe a considerable increase as we move from the group with primary education only to those who completed higher education (at the undergraduate, Master's or PhD level). Here, vocational training refers to training available only to students that have completed secondary education.

To further analyse financial literacy for the university-educated population, we segmented the sample by field of study and computed the average scores for each field. The group labelled "Humanities" consists of individuals who hold a degree in fields such as history, arts, language and literature or teaching.[4] The category "Social" includes those who specialised in social and legal disciplines, such as psychology, sociology, journalism or law. The group "Science" is composed of individuals who studied engineering and experimental sciences, including architecture, electronics, mechanics, physics, mathematics, chemistry or biology. The category "Health" consists of individuals who studied medicine and nursing. Finally, "Eco" comprises individuals who pursued degrees related to economics, business administration or finance. The SFC also disaggregates fields of study for vocational training graduates. However, in this case the field groupings do not allow us to clearly differentiate fields with a higher mathematical content.

When comparing average scores for these five fields of study, we observe lower values for the Humanities, Health and Social groups. Conversely, the Science and Economics groups achieve the highest scores, with Science graduates slightly outperforming Economics graduates in the two extended indices.

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4 Specifically, individuals who train to teach primary education (ages 6-12 in Spain).

Table 2

Financial literacy by education level and field of study

	Big3	Index10_prob	Index10_fin
Total	1.6	6.4	6.9
Primary	1.4	5.2	6.0
Secondary	1.7	6.6	7.0
Vocational training	1.8	7.1	7.4
University	2.1	7.8	8.1
Humanities	1.9	7.1	7.4
Health	1.8	7.4	7.7
Social	2.0	7.7	8.0
Science	2.3	8.5	8.6
Eco	2.3	8.2	8.5

SOURCE: Survey of Financial Competences (2021).

Table 3

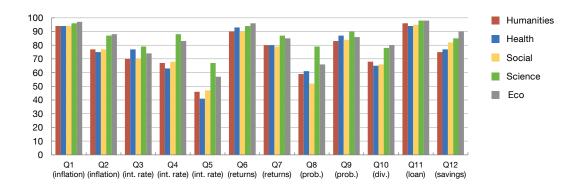**Percentage of correct responses to individual questions, by education level**

	Non-university Education	University Education
Q1 (inflation)	88	95
Q2 (inflation)	60	82
Q3 (interest rate)	62	75
Q4 (interest rate)	42	76
Q5 (intetest rate)	38	53
Q6 (returns)	82	92
Q7 (returns)	63	83
Q8 (probability)	38	65
Q9 (probability)	60	86
Q10 (diversification)	55	73
Q11 (interest rate: loan)	86	95
Q12 (interest rate: savings)	68	80

SOURCE: Survey of Financial Competences (2021).

Table 3 presents the percentage of correct responses to each of the financial literacy questions included in the indices. As the table shows, questions Q1 (on inflation), Q6 (on investment returns) and Q11 (on the best interest rate on a loan) have the highest percentage of correct answers, with more than 82% of respondents answering correctly, both in the complete sample and for university-educated individuals. By contrast, the questions on interest rates (especially Q4 and Q5) have the lowest share of correct answers, followed by Q8 (on probability).

Legend: Humanities, Health, Social, Science, Eco

X-axis labels: Q1 (inflation), Q2 (inflation), Q3 (int. rate), Q4 (int. rate), Q5 (int. rate), Q6 (returns), Q7 (returns), Q8 (prob.), Q9 (prob.), Q10 (div.), Q11 (loan), Q12 (savings)

SOURCE: Survey of Financial Competences (2021).

Chart 1 presents the percentage of correct answers to the ten questions, segmented by field of study. We observe significant variations in performance across the different fields, with the Science and Economics groups outperforming the rest on all topics.

A high percentage of individuals across all groups give the correct response to Q1 on the cost of living (above 94%). For Q2, which addresses a more complex aspect of inflation, the Science and Economics groups obtain a higher share of correct answers than the Humanities, Health and Social groups. Comprehension of interest rates (Q3, Q4 and Q5) differs notably across disciplines; this is especially evident in Q4 and Q5 which address the maths of simple and compound interest. Science graduates have the highest percentage of correct responses to these questions. Graduates from all fields perform well on the first question related to returns (Q6), with the Economics group outperforming the rest. The share of correct responses to the second question on returns (Q7), which involves interpreting a simple chart, is also high in all cases, although Science and Economics graduates stand out. Science graduates outperform the rest on the questions regarding probability (Q8 and Q9), especially Q8. On the matter of risk diversification (Q10), Economics and Science again score similarly and outperform the rest, with Economics leading over Science. Finally, with respect to the questions on the best interest rate for a loan and for savings (Q11 and Q12), the proportion of correct responses to Q11 is above 90% across all groups. However, quite surprisingly, the percentage of correct responses to Q12 drops considerably across most groups, with Economics achieving the highest (around 90%).

4 Regression analysis

Drawing on the literature and the descriptive statistics presented up to this point, we carry out regression analyses to further explore the association between financial knowledge and sociodemographic variables, including respondents' field of undergraduate studies. We use linear regression models as specified below in matrix form.

$$Y = X\beta + \varepsilon$$

These models are structured as follows:

- Model 1: The dependent variable (Y) is the score obtained on the Big3 index.

- Model 2: The dependent variable is the score obtained on the 10-question index including the questions on probability (Index10_prob).

- Model 3: The dependent variable is the score obtained on the 10-question index excluding the questions on probability and including the additional questions on interest rates (Index10_fin).

Regressors: For models 1 to 3, the regressors (X) are those detailed below, considering higher education at the aggregate level (i.e. not disaggregating by field of study).

- Model 4: The dependent variable is the Big3 index.

- Model 5: The dependent variable is Index10_prob.

- Model 6: The dependent variable is Index10_fin.

Regressors: For models 4 to 6 the regressors (X) are those detailed below, excluding higher education at the aggregate level and including instead five dummy variables corresponding to each of the five fields of study described in the previous section.

The regressors include the following variables:

- *Male:* a dummy variable equal to 1 if the respondent is male and 0 otherwise.

- *Age:* a continuous variable with values between 18 and 80.

- *Age65:* a dummy variable equal to 1 if the individual is older than 65 and 0 otherwise.

- Education: three dummy variables equal to 1 as indicated below (the omitted category refers to individuals who did not complete any stage of formal education or only completed primary education).

— *Educ2* is equal to 1 if the respondent completed only secondary education.

— *Vt* is equal to 1 if the respondent completed vocational training for which secondary education is mandatory (does not include university graduates).

— *Educ3* is equal to 1 if the respondent graduated from university (including undergraduate degrees, Masters' and PhD programmes).

- Field of study: higher education is disaggregated using five dummy variables corresponding to each of the five fields described in the previous section (labelled *Humanities, Social, Science, Health* and *Eco*). These variables are only included in the specifications where higher education at the aggregate level is excluded (models 4 to 6).

- *Employed:* dummy variable equal to 1 if the respondent is employed and 0 otherwise (the omitted category corresponds to those unemployed and inactive).

- *Empl_fin:* dummy variable equal to 1 if the respondent reports having a job that is related to finance and 0 if their job is related to another area.

- *Income:* categorical variable with values between 1 and 6, representing the annual income brackets available in the data.[5]

- *Wealth:* a proxy variable for the respondent's wealth, which equals 1 if the respondent owns both the property they use as their main residence and additional real estate assets. The variable is equal to zero if the respondent does not own their main residence and other real estate assets.

- *Books:* a proxy variable for respondents' sociocultural background. Since our database does not include detailed information on this topic, we use the number of books in the household when the respondent was 10 years old as a proxy. A dummy variable is created and set to 1 if the respondent remembers there being more than 100 books in their home when they were 10. If the respondent reports less than 100 books, the variable is equal to zero.

- *Fined:* a dummy variable is created and set to 1 if the individual reports having received any type of financial education or declares having learned about finances by themselves using books or other resources and 0 when the responded reports not having received financial training.

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5 The six categories included in the SFC are: less than €9,500; between €9,501 and €15,000; between €15,001 and €27,000; between €27,001 and €47,000; between €47,001 and €71,000; and more than €71,000.

5 Results

Table 4 presents a summary of the estimates for the four models. With respect to the models that include higher education at the aggregate level (models 1 to 3), we find that, as expected, individuals who completed an undergraduate degree at least are, on average, more financially knowledgeable. The coefficient associated with the variable *Educ3* indicates that university-educated individuals score, on average, around 0.6 points higher on the Big3 index and 2 and 1.7 points higher on the alternative indices, when compared to individuals who only completed primary education. The association between financial knowledge and having completed higher education is stronger than for any other regressor.

The rest of the parameters estimated also reflect the expected association between financial knowledge and gender (on average, men score higher than women), age (on average, younger individuals score lower than older individuals, with the over-65s scoring lower, on average, than younger cohorts) and income (on average, higher-income individuals score higher). We also observe a positive association between wealth, sociocultural

Table 4

Relationship between financial knowledge, education level and field of study

Variables	(1) Big3	(2) Index10_prob	(3) Index10_fin	(4) Big3	(5) Index10_prob	(6) Index10_fin
Male	0.281***	0.873***	0.801***	0.264***	0.841***	0.776***
Age	0.008***	0.008***	0.022***	0.008***	0.008***	0.022***
Age65	-0.208***	-0.619***	-0.715***	-0.201***	-0.620***	-0.711***
Edusec	0.283***	1.072***	0.909***	0.280***	1.042***	0.886***
Eduvoc	0.371***	1.582***	1.298***	0.372***	1.559***	1.282***
Eduni	0.608***	2.067***	1.713***			
Income	0.096***	0.411***	0.339***	0.095***	0.406***	0.335***
Wealth	0.043*	0.131**	0.122**	0.046*	0.136**	0.127**
Employed	-0.079**	-0.038	0.075	-0.077**	-0.036	0.076
Empl_fin	0.124***	0.326***	0.345***	0.101**	0.303***	0.307***
Fined	0.220***	0.528***	0.525***	0.211***	0.519***	0.512***
Books	0.101***	0.400***	0.288***	0.102***	0.401***	0.290***
Humanities				0.526***	1.759***	1.447***
Social				0.525***	1.898***	1.595***
Science				0.769***	2.376***	1.952***
Health				0.461***	1.966***	1.582***
Eco				0.682***	2.107***	1.818***
_cons	0.458***	2.754***	3.048***	0.481***	2.817***	3.100***
N	7,542	7,323	7,348	7,540	7,321	7,346
R-sq	0.16	0.35	0.32	0.16	0.36	0.32
R-sq adjust.	0.16	0.35	0.31	0.16	0.35	0.31
p-value F test	0.000	0.000	0.000	0.000	0.000	0.000

SOURCE: Survey of Financial Competences (2021).

background and having received financial education. In models 1 and 4 we observe a negative association between financial literacy and being employed when controlling for the rest of the specified sociodemographic characteristics, which is contrary to most findings in the literature. However, this coefficient is not statistically significant in the other models.

Regarding models 4 to 6, which include the disaggregation by field of study, we observe that the coefficients corresponding to the sociodemographic variables are similar to those in the first models. When we break down the analysis by field of study, we observe that individuals from the Science and Economics groups have, on average, a higher level of financial knowledge than graduates from other disciplines, which mirrors the results presented in Section 3 (since the field of study is available for practically all university-educated individuals, the variable *Educ3* is replaced by the five variables reflecting the different fields of study). It stands to reason that Economics graduates would be more familiar with economic concepts, although, on average, they do not outperform the Science group on the questions included in the SCF.[6] The individuals in the remaining groups (Humanities, Health and Social) display, on average, a lower level of financial literacy.

We perform Wald tests on the five coefficients corresponding to each field of study to gauge whether they are statistically different from each other. The null hypothesis is rejected when testing for joint equality. With respect to the pairwise comparisons, we obtain the results displayed in Table 5, where the figures refer to the p-values of the F statistic associated with the test.

In the case of the model where the Big3 index is the dependent variable, the division of the five fields of study into two groups appears reasonable. The first group comprises Science and Economics graduates, who, on average, are more financially knowledgeable. The second group includes graduates belonging to the Humanities, Health and Social categories, who, on average, score lower on the test questions.

In the model where the dependent variable is the extended index containing the questions on probability, these groups are slightly less clear-cut, especially the distinction between Economics and the Health and Social categories. The null hypothesis can be consistently rejected for the parameter associated with the Science field, indicating evidence that this parameter is distinct from the rest. However, we cannot reject the parameter associated with Economics being distinct from the ones associated with the Health and Social categories at a 5% significance level.

When the dependent variable is the extended index including only questions on financial topics, we can reject the Science parameter being equal to those associated with the Humanities, Social and Health categories. When comparing the Economics and Science parameters, we

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6 The fields of study included in the Science category are not equally maths-intensive, and therefore the results should be interpreted as an average for the group that might not apply to each individual field. This is also true for the Economics category, since not all areas are equally quantitative.

Wald test p-values for the coefficients associated to the field of study

	Dependent variable Big3				
	Humanities	Social	Science	Health	Eco
Humanities	—				
Social	0.978	—			
Science	0.000	0.000	—		
Health	0.308	0.334	0.000	—	
Eco	0.013	0.013	0.148	0.002	—

	Dependent variable Index10_prob				
	Humanities	Social	Science	Health	Eco
Humanities	—				
Social	0.238	—			
Science	0.000	0.000	—		
Health	0.121	0.623	0.002	—	
Eco	0.008	0.114	0.031	0.348	—

	Dependent variable Index10_fin				
	Humanities	Social	Science	Health	Eco
Humanities	—				
Social	0.183	—			
Science	0.000	0.000	—		
Health	0.282	0.922	0.003	—	
Eco	0.003	0.072	0.255	0.095	—

SOURCE: Survey of Financial Competences (2021).

cannot reject them being equal. At the same time, we cannot reject the parameter associated with Economics graduates being equal to that associated with the Social or Health categories, at least not at a high confidence level. A plausible interpretation is that the Science parameter is statistically different from the rest, but the status of the Economics parameter in relation to the others remains uncertain.

On a final note, when assessing the R^2 of the six models we observe that a large share of the variation in financial literacy remains unexplained, as is generally the case in empirical assessments of this kind. This indicates the potential relevance of other factors not accounted for, such as personal idiosyncrasies related to patience and impulsiveness, individual motivation or other characteristics related to individuals' social background not captured by our proxy variables (Hastings, Madrian and Skimmyhorn, 2013). Unfortunately, most of these factors are not readily quantifiable.

6 Conclusions

Numeracy skills aid in understanding the most quantitative aspects of financial literacy. To manage money and purchase financial products effectively, one must be able to understand and compare interest rates, as well as grasp the effects of inflation on savings and the link between high inflation and variable loan rates, among other aspects. Consumers are often shown tables, charts or diagrams when purchasing financial products and are expected to assess different types of financial risks, which requires some ability to comprehend and work with numerical data. Possessing such skills might significantly influence financial decision-making.

Our analysis shows that, as is commonly observed in the literature, graduates of higher education exhibit greater financial knowledge than those with lower levels of education. However, when disaggregating by field of study, we find that, on average, graduates from scientific fields and economics outperform their peers from other fields. In our view, these findings are relevant to both financial literacy measurement and financial education programme design.

When measuring financial knowledge, it is useful to also check for individuals' ability to perform basic calculations, understand concepts such as probability and interpret charts, as this can reveal knowledge gaps that are not directly related to finances but may still be important for understanding finance. At the same time, it might be useful to separate an individual's understanding of a financial concept from the calculations related to that concept. This point is illustrated by questions Q1 and Q2, which address inflation from different angles. Most respondents seem to grasp the meaning of inflation as an increase in the cost of living (Q1). But a considerable share of respondents finds it challenging to understand the relationship between inflation and purchasing power when there are some calculations involved (Q2). At the same time, questions that require calculations seem to pose difficulties, especially for individuals who did not complete higher education, even when the underlying financial concept is relatively straightforward, such as simple interest (Q4).

Policymakers and organisations pursuing financial education should take into account that individuals from diverse educational backgrounds may have widely varying levels of understanding of maths and quantitative concepts closely linked to finance and economics. Many adults lack a strong foundation in high school-level mathematics. This often translates into anxiety and apprehension when confronted with quantitative financial topics. Consequently, it may not suffice to merely teach financial concepts. For those with diminished numeracy abilities, financial education courses must be tailored to build and reinforce fundamental maths skills alongside financial knowledge. By doing so, these courses can alleviate the anxiety associated with quantitative financial topics and, perhaps, help people to engage with them more confidently.

Online simulators and calculators developed by financial education providers are likewise useful tools to help simplify otherwise complex financial calculations.[7] Financial

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7 See, for example, the simulators available on the Banco de España's Bank Customer Portal.

education programmes could focus on teaching individuals how to effectively take advantage of such tools, many of which are available free of charge.

Numeracy skills can also be strengthened in primary and secondary school curricula, which would likely have positive spillovers on financial literacy and support the development of financial skills throughout the life cycle.

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Table A1 presents a statistical summary of all the variables used in this study. The results are based on a sample of 7,764 observations corresponding to the 2021 wave of the SFC, weighted to reflect the total Spanish population. The sample composition is 50.7% women and 49.3% men. The average age of respondents is 47.9 years, with a minimum age of 18 and a maximum age of 80. Around 15% of the sample completed only primary education or lower (*educ1*), 50% completed secondary education (*educ2*), 10% completed vocational training programmes for which secondary education is mandatory (*vt*) and 24% completed higher education consisting of undergraduate, Master's or PhD studies (*educ3*).

Regarding annual income, Table A1 reflects the distribution of a categorical variable ranging from 1 to 6 reflecting six income brackets for which the SFC provides information. The underlying data can be summarised as follows: 27% of individuals earn less than €15,000, 28% earn between €15,001 and €27,000, 27% report earning between €27,001 and €47,000 and 18% earn more than €47,000.

Table A1

Summary statistics for the variables analysed

Variables	Obs.	Mean	Standard deviation	Min.	Max.
big3	7.607	1.67	0.93	0	3
Index10_prob	7.385	6.38	2.24	0	10
Index10_fin	7.411	6.88	2.00	0	10
male	7.764	0.49	0.50	0	1
age	7.764	47.93	16.13	18	80
employed	7.764	0.57	0.49	0	1
empl_fin	7.755	0.08	0.27	0	1
income	7.764	3.33	1.31	1	6
wealth	7.762	0.34	0.48	0	1
books	7.711	0.25	0.43	0	1
fined	7.760	0.41	0.49	0	1
educ1	7.764	0.15	0.36	0	1
educ2	7.764	0.50	0.50	0	1
educ3	7.764	0.24	0.43	0	1
vt	7.764	0.10	0.30	0	1
humanities	7.762	0.06	0.23	0	1
science	7.762	0.06	0.25	0	1
health	7.762	0.03	0.17	0	1
eco	7.762	0.04	0.20	0	1
social	7.762	0.05	0.21	0	1

SOURCE: Survey of Financial Competences (2021).

Additional variables included in the table refer to the employment status of the respondent (the variable *employed*, which takes the value 1 if the person is employed at the time of the survey and 0 otherwise), whether they work in a finance-related job (*empl_fin*), a proxy variable for wealth (taking the value 1 if the respondent owns the property where they are living and also other real estate assets and 0 otherwise), a proxy variable indicating the sociocultural status of the respondents' family (called *books*, which is equal to 1 if there were more than 100 books in the house where the respondent grew up) and a variable indicating whether the individual has attended any type of financial training (*fined*, which is equal to 1 if the respondent mentions having attended financial education courses or having researched information on financial topics on their own). *Big3* and *Index10* refer to two different ways of quantifying financial knowledge that are explained above.

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