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Abstract

Gender gap is a general outcome of financial literacy surveys, which also highlight that differences among men and women in the domain of financial capability are irrespective of country differences.

However, when considering the young and, particularly, college students, empirical results are rather mixed. Further research is therefore needed on the factors explaining the young's financial literacy; our study contributes to the literature investigating a homogeneous sample of freshmen of the same age and cohort enrolled in a large Italian Business School, where *ex ante* gender differences should not be expected. We deliberately concentrate on a sample of business students, i.e., a homogeneous sample of the youth population expected to exhibit a similar personal interest in economic and financial matters. No gender gap was found either considering an overall measure of financial literacy (Rasch measure) or considering the overall difficulty of the instrument (Differential Item Functioning). We argue that personal interests in financial matters overcome potential gender issues in financial literacy.

1 Introduction

The gender gap is a general outcome of financial literacy surveys aimed to quantify the level of objective financial knowledge or perceived financial attitudes and behaviour of an adult population or specific subgroups of it. Financial literacy differences among men and women arise irrespective of country differences (Bucher-Koenen *et al.*, 2012).

Gender disparities have been ascribed to the different roles undertaken within the household (Hsu, 2011; Fonseca *et al.*, 2010), with men specializing in financial decision-making and women in the traditional role of nursing and nurturing. Indeed, in former communist societies, where men and women had more equal roles, empirical evidence does not report gender differences in financial literacy (Klapper *et al.*, 2012; Bucher-Koenen *et al.*, 2012). In this respect, todays' younger generations should not present

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gender-related financial literacy disparities because women are more likely to participate in the job market, to be educated, and to aspire to a less traditional role in society. In other words, gender gap issues should fade away as the population evolves.

However, if a gender gap is still present in the younger cohorts of the population, other explanations will have to be offered, and specific actions should be undertaken. In fact, a gender gap in financial literacy is of particular concern for the potential outcomes on women' financial wellbeing. Indeed, women are more at risk than men of having inadequate retirement resource because they usually earn lower incomes during their working lives, are more likely to have interrupted employment histories and have longer life expectancies.

When considering the young, and in particular college students, empirical results are mixed. US studies tend to support the general findings that college females are less financially literate than their male peers (Danes and Hira, 1987; Markovich and DeVaney, 1997; Chen and Volpe, 2002; Lyons, 2004; Manton *et al.*, 2006; Borden *et al.*, 2008; Worthy *et al.*, 2010; Lusardi *et al.*, 2010; Ford and Kent, 2010). Outside the US, more recent surveys do not confirm gender differences: Wagland and Taylor (2009) suggested that gender was not a significant factor among Australian college students; analogously, Koshal *et al.* (2008) reported that gender differences were not significant among a sample of Indian MBA Students.

Further research is therefore needed on the factors explaining youth financial literacy; our study contributes to the literature investigating the financial literacy of a homogenous sample[1] of freshmen of the same age and cohort, where *ex ante* gender differences should not be expected. In fact, evidence from previous studies on college students demonstrates that along with gender differences, also a «Major gap» arises, with Business students performing better in financial literacy surveys. Therefore, an investigation conducted exclusively on business students would offer a unique opportunity to explore whether gender differences exist among a group of similar students. We deliberately concentrate on a sample of business students, i.e., a homogeneous sample of the youth population expected to present a similar personal interest in economic and financial matters. We expect that the decision to undertake a business curriculum of studies could overcome potential gender issues in financial attitudes and behaviours.

The study is organized as follows. The next section reviews the relevant literature and discusses our hypotheses; data collection and research methodologies are explained in the section after that. In the penultimate section, our empirical results are presented, while concluding remarks and implications are discussed in the final section.

2 Literature Review and Hypothesis Development

A burgeoning literature documents the low level of financial literacy of university students, which is not only widespread but also severe among female students. US studies

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[1] A homogeneous sample is a sample whose units (e.g., people, cases, etc.) share the same (or very similar) characteristics or traits (e.g., a group of people that are similar in terms of age, gender, background, occupation, etc.). A homogeneous sample is often chosen when the research question that is being address is specific to the characteristics of the particular group of interest, which is subsequently examined in detail.

conducted either several years ago or in more recent times share the same evidence: with respect to financial knowledge[2], female college students are less financially knowledgeable than their male counterparts (Chen and Volpe, 2002; Manton, 2006; Ford and Kent, 2010): they are less interested in learning about personal finance topics and are more intimidated by financial matters than collegiate males.

When financial behaviour[3] is investigated, there is mixed support for gender differences in financial practices. Female students are more likely to have a written budget, plan their spending, keep bills and receipts and save regularly and use credit cards wisely (Hayhoe *et al.*; 2000; Joo *et al.*, 2003). By contrast, other studies found evidence that females are more likely to engage in risky financial behaviours – such as mismanaging or misusing credit (Lyons, 2004; Worthy *et al.*, 2010).

Outside the US, the topic has recently received greater attention. In these more recent surveys, gender differences are not always confirmed. Wagland and Taylor (2009) examined the personal financial knowledge and understanding of financial terms plus decision-making skills among undergraduate students at the University of Western Sydney undertaking a bachelor of Business degree in 2004. The results indicated that Australian students displayed a reasonable level of general financial knowledge by both females and male, in contrast to a previous study by Beal and Delpachitra (2003)[4]. In the same vein, Koshal *et al.* (2008), surveying a sample of 494 Indian MBA students from five different institutions, concluded that gender had no significant influence on the economic and financial literacy of MBA Students. Similarly, Marriott *et al.* (2010) concentrating on first-year business school undergraduates studying at three UK universities find no significant difference between the mean test scores of male and female students.

However, surveys conducted in Continental Europe (Milioli *et al.*, 2011 and Tagliavini and Ronchini 2011 for Italy; Oanea and Dornean 2013 for Romania; Rodrigues *et al.*, 2012 for Portugal; Luksander *et al.*, 2014 for Hungary) indicate that male students generally have a higher level of financial literacy than female students.

Based on the existing literature on gender issue and financial literacy, we introduce the following hypothesis concerning the level of financial literacy of Italian university students.

H.1 (gender): *Female business students are as financially literate as male business students. The assumption is that students who enrol in business studies share from the very beginning a common core of financial knowledge and a common interest in financial matters.*

Apart from gender issues, it is widely acknowledged that the financial literacy of the young is influenced by socio-demographic aspects: work and financial experience, such as purchasing a financial product; parents' behaviour and background, such as their educational attainment; and the respondents' field of study.

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[2] Financial knowledge is defined as the basic knowledge of key financial concepts (for instance, time value of money, inflation, diversification of investments) and the ability to apply numeracy skills in financial situations (Atkinson and Messy, 2012).

[3] Financial behavior refers to one's ability in planning expenditure and building up a financial safety net, that is avoiding over-indebtedness.

[4] The main difference amongst the two studies, which may account for these divergent results, could be ascribed to the sample under investigation: Beal and Delpachitra surveyed students enrolled in a variety of faculties, ranging from Arts to Engineering, while Wagland and Taylor concentrated on students enrolled in a Business Degree.

Employment status positively influences both financial knowledge and financial attitudes and behaviours (Chen and Volpe, 2002; Beal and Delpachitra, 2003; Xiao *et al.*, 2007). Besides, more practical experience with financial markets and instruments helps individuals in perceiving financial matters as less intimidating (Goldsmith and Goldsmith, 1997; Ford and Kent, 2010).

As to the influence of social origin, a number of studies analyse the influence of parental background (such as schooling attainment) and behaviour (such as savings habits) on the acquisition of financial knowledge of the young. Their main findings are that financial literacy is significantly and positively influenced by social learning (Cude *et al.*, 2006; Mandell, 2008; Lusardi *et al.*, 2010; Gutter *et al.*, 2010).

The field of study is also an important predictor of higher financial literacy. Participation in courses of personal finance or undertaking a business major raises students' financial literacy: those who are exposed to financial education in high school or during college tend to show proper financial behaviours and attitudes. Findings suggest that students undertaking business studies perform better than other students (Chen and Volpe 1998; 2002; Bernheim *et al.*, 2001; Bernheim and Garrett 2003; Beal and Delpachitra 2003; Fox *et al.*, 2005; Mandell, 2008; Chinen and Endo, 2012). In particular, Chinen and Endo (2012) find that the concentration of numeracy subjects among business majors is relevant in influencing financial literacy: students enrolled in numerically oriented business majors (such as finance) achieved better scores than students enrolled in less-numerically oriented business majors (such as marketing or human resources). Nonetheless, the evidence is mixed: Cull and Whitton (2011) found that business students performed no better than average when answering a question on compound interest.

In light of these results, should gender gap hold true in general (i.e. H1 not confirmed), we expect that when some peculiar features are common to both gender groups (financial experience, work experience, choice of Finance as major, high school track, social origins), the gap in financial literacy fades away or disappears.

3 Sample and Instrument

For our study, we borrowed the definition used by Jump$tart Coalition for Personal Financial Literacy, that is «financial literacy is the ability to use knowledge and skills to manage one's financial resources effectively for lifetime financial security». The survey instrument consisted of 13 questions selected from the Jump$tart Coalition test of financial literacy (see Table 1). The multiple-choice test used in the 2008 Jump$tart Coalition Survey of College Students, which aimed at assessing the financial literacy of young American adults, was translated and adapted to the Italian context; note that in Table 1 the original wording is reported. According to the Jump$tart Coalition, such questions can be grouped into three specific areas: *a)* money management; *b)* saving and investing; *c)* spending and credit. They are meant to express the concepts underlying basic financial transactions, financial planning, day-to-day financial decision-making or functioning of the banking system up to more complex issues, such as risk and returns of different asset classes or retirement planning.

Table 1: The Survey instrument

Item	Question	Correct answers (%)	Area of literacy
Q1	Inflation can cause difficulty in many ways. Which group would have the greatest problem during periods of high inflation that last several years? a) Older, working couples saving for retirement. b) Older people living on fixed retirement income.* c) Young couples with no children who both work. d) Young working couples with children. e) Not enough information to be able to answer	36.1	Money Management
Q2	Rebecca has saved $12,000 for her college expenses by working part-time. Her plan is to start college next year, and she needs all of the money she saved. Which of the following is the safest place for her college money? a) Locked in her closet at home. b) Stocks. c) Corporate bonds. d) A bank savings account.* e) Not enough information to be able to answer	71.5	Savings and Investments
Q3	Which of the following types of investment would best protect the purchasing power of a family's savings in the event of a sudden increase in inflation? a) A 10-year bond issued by a corporation. b) A certificate of deposit at a bank. c) A twenty-five year corporate bond. d) A house financed with a fixed-rate mortgage.* e) Not enough information to be able to answer	51.7	Savings and Investments
Q4	Many people put aside money to take care of unexpected expenses. If Juan and Elva have money put aside for emergencies, in which of the following forms would it be of LEAST benefit to them if they needed it right away? a) Invested in a down payment on the house.* b) Checking account. c) Stocks. d) Savings account. e) Not enough information to be able to answer	32.7	Savings and Investments
Q5	David just found a job with a take-home pay of $2,000 per month. He must pay $900 for rent and $150 for groceries each month. He also spends $250 per month on transportation. If he budgets $100 each month for clothing, $200 for restaurants and $250 for everything else, how long will it take him to accumulate savings of $600. a) 3 months. b) 4 months.* c) 1 month. d) 2 months. e) Not enough information to be able to answer	90.7	Savings and Investments
Q6	Sara and Joshua just had a baby. They received money as baby gifts and want to put it away for the baby's education. Which of the following tends to have the highest growth over periods of time as long as 18 years? a) A checking account. b) Stocks.* c) A US Govt. savings bond. d) A savings account. e) Not enough information to be able to answer	10.5	Savings and Investments
Q7	Rob and Mary are the same age. At age 25 Mary began saving $2,000 a year while Rob saved nothing. At age 50, Rob realized that he needed money for retirement and started saving $4,000 per year while Mary kept saving her $2,000. Now they are both 75 years old. Who has the most money in his or her retirement account? a) They would each have the same amount because they put away exactly the same amount. b) Rob, because he saved more each year c) Mary, because she has put away more money d) Mary, because her money has grown for a longer time at compound interest* e) Not enough information to be able to answer	43.9	Savings and Investments

Table 1: (follow)

Item	Question	Correct answers (%)	Area
Q8	Which of the following statements is NOT correct about most ATM (Automated Teller Machine) cards? a) You can generally obtain cash 24 hours-a-day. b) You can generally obtain information concerning your bank balance at an ATM machine. c) You can obtain cash anywhere in the world with no fee.* d) You must have a bank account to have an ATM Card. e) Not enough information to be able to answer	66.1	Spending and Credit
Q9	Savings programs are protected by the Fondo Interbancario di Tutela. Which of the following is guaranteed protection? a) Commercial papers b) A checking account at the bank.* c) A bond issued by a bank d) A Treasury Bond. e) Not enough information to be able to answer	18.3	Savings and Investments
Q10	If each of the following persons had the same amount of take home pay, who would need the greatest amount of life insurance? a) An elderly retired man, with a wife who is also retired. b) A young married man without children. c) A young single woman with two young children.* d) A young single woman without children e) Not enough information to be able to answer	82.7	Money Management
Q11	Which of the following instruments is NOT typically associated with spending? a) Debit card. b) Certificate of deposit.* c) Cash. d) Credit card. e) Not enough information to be able to answer	88.8	Spending and Credit
Q12	Which of the following statements is true? a) Banks and other lenders share the credit history of their borrowers with each other and are likely to know of any loan payments that you have missed.* b) People have so many loans it is very unlikely that one bank will know your history with another bank c) Your bad loan payment record with one bank will not be considered if you apply to another bank for a loan. d) If you missed a payment more than 2 years ago, it cannot be considered in a loan decision. e) Not enough information to be able to answer	53.7	Spending and Credit
Q13	John started his career in banking in 1995, and he earns € 2,000 per month. If he retires when he is 65 years old, what will be the likely amount of his public pension, in % of his last salary? a) 30%-35% b) 80-100% c) 50% d) 60% * e) Not enough information to be able to answer	27.1	Money Management

The table reports the items of the questionnaire used in the survey. Correct answers are indicated with a *, and the area of literacy under investigation is also included.

Furthermore, the survey instrument included three sections covering: *a*) demographic variables (e.g., gender, nationality, age, educational attainment); *b*) family characteristics (e.g., parents' educational attainment; parents' occupational position); *c*) 8 questions

Table 2: Sample distribution ($n = 366$)

Variable	Overall sample (%)	Males (%)	Females (%)	
Gender				
Male	51.1			
Female	48.9			
Nationality				
Italian	86.9	90.4	83.2	
Other	13.1	9.6	16.8	
Living				
With parents	85.0	90.4	79.3	***
On their own	15.0	9.6	20.7	
Financial experience (1)				
Yes	64.2	64.7	63.7	***
No	35.8	35.3	36.3	
Work experience (2)				
Yes	55.5	57.2	53.6	
No	44.5	42.8	46.4	
Major				
Finance	40.7	47.1	34.1	**
Other majors (less numerical)	59.3	52.9	65.9	
Type of education				
Academic track (liceo)	46.4	57.8	34.6	***
Non-academic track (technical institutes)	53.6	42.2	65.4	
Parents' educational attainment (highest level of the two)				
College degree or higher	19.7	23.0	16.2	
Up to high school diploma	80.3	77.0	83.8	
Parents' Social level (3)				
High	31.7	29.9	33.5	
Medium-Low	68.3	70.1	66.5	

The table summarizes main socio-demographic characteristics of the overall sample and the partition between females and males. ***, ** and * denotes 1%, 5% and 10% significance levels in a t-test of mean comparison.
(1) Financial experience is measured by asking the respondents whether they possess the simplest form of financial instruments, i.e., a checking account.
(2) The respondents were asked whether they have /(had) any sort of work experience (fixed term, part-time or temporary).
(3) The social level of a family is measured in terms of job position of the family. High social level includes managerial staff, executives, professionals, entrepreneurs.

related to students' past experience with financial instruments, such as the use of payment instruments or insurance instruments, incurrence of debt, and ability to program cash flows.

The survey was conducted on a sample of 400 undergraduate students[5] at the University of Milan-Bicocca, who were taking a Bachelor's degree in Business Studies and attending their first semester at college[6]. In general, even in their first year, Business Studies students score better in financial literacy tests than other college students (Chen and Volpe 1998; 2002; Bernheim *et al.*, 2001; Bernheim and Garrett 2003; Beal and Delpachitra 2003; Fox *et al.*, 2005; Mandell, 2008; Chinen and Endo, 2012). However, differences may arise among business students depending on the choice of major, e.g., management, finance,

[5] Our sample is representative of the entire population of freshmen enrolled at University of Milan-Bicocca Business School, with respect to the Major and Gender covariates.
[6] The rationale for this choice was that business students are expected to improve their financial knowledge as they complete further years of study.

marketing, or economics. In fact, when business schools offer different majors (like in Italy), students have to make a choice on enrolment. In particular, at the University of Milan-Bicocca, these majors tend to be quite different from each other, being designed to specialize students in one specific subject area. Therefore, freshmen can choose to major in marketing, finance, or management, on the understanding that any major except for finance will offer hardly any finance-related subjects. Furthermore, finance is the major with a higher numerical content in Business School. Because we assume that students are aware of this and make choices that reflect a personal interest in financial matters, we would expect the choice of major to be significant in predicting differences among business students and helping our results gain a broader insight into the explicative factors underlying financial literacy levels.

The test was administered during class time, and students had no prior warning of being tested on financial topics. After discarding for missing values, we ended up with 366 observations, with a balanced distribution between male and female, mostly aged 19, predominantly Italian, living at home (more than 80%), as reported in Table 2.

With respect to our partition, females have a more international status; as a consequence are less likely to live with their parents. They have a lower financial experience and a lower propensity to engage in a numerical major, probably owing to their high school background (more females attended technical schools).

4 Methodology

This study adopts a metric new to the domain of financial literacy, i.e., IRT models. As a matter of fact, while considerable progress has been achieved in the design of surveys aimed at identifying individual levels of financial literacy (Atkinson and Messy, 2012), the process of data analysis has been to date less explored in existing studies. Both bivariate and multivariate techniques are usually applied; in general, responses to the proposed questions are simply summed up to generate an index (score) of financial literacy, which typically ranges between zero and the maximum number of correct answers. More recent studies have applied factor analysis (van Rooij *et al.*, 2011); it is widely acknowledged, however, that more work is needed. To the best of our knowledge, only two studies have explored the viability of adopting IRT models for the assessment of financial literacy (Bongini *et al.*, 2012; Knoll and Houts 2012). IRT models, and in particular, Rasch models, measure variables such as ability, attitudes and personal traits and are widely adopted in educational research[7] and psychometrics (see Liu *et al.* 2008 for a review of the literature). The specific feature that has led to these models being employed increasingly in many areas of research is the presence of a metric, which considers both the level of test difficulty and the respondent's specific abilities.

The Rasch model, based on item response theory, assumes that the probability of a given student answering correctly an item is a logistic function of the difference between

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[7] For instance, PISA surveys have been adopting Rasch models since 2000.

the *n-th* person's level of financial knowledge (θ) and the level of financial difficulty expressed by the *i-th* item (β); that is,

$$(1) \qquad \frac{\ln p_{ni}}{1 - p_{ni}} = \theta_n - \beta_i$$

According to Rasch models, a student's response to a binary item (i.e., right/wrong, true/false, agree/disagree) is determined by the individual's level of financial knowledge (ability) (θ_p) and by the level of financial difficulty expressed by the *i-th* item (β_i).

Rasch models define the score (number of items responded correctly) of a particular student as a probability function of his/her ability and item difficulty. The student ability can then be interpreted as the logistic ratio of the correct responses against wrong responses. If a student scores 50% of correct responses, his/her ability is set to zero on the logistic scale, i.e., the student's ability is zero logits. If a student scores more than 50% of items correctly, his ability is positive in terms of logits. Similarly, the item difficulty can be interpreted as the logistic ratio of the number of students who did not give correct responses against those who responded correctly. For items where 50% of the students responded correctly, the item difficulty is set to zero on the logistic scale. For easy items, i.e., those for which more than 50% of the students answered correctly, the item difficulty is negative in terms of logits.

A typical representation of the difference between the two locations, ($\theta_p - \beta_i$), is an 'item/person map' where the item difficulties can be placed as points along a line and the person's ability as a point along the same line. Generally speaking, the Rasch model converts raw scores into linear and reproducible measurement.

Rasch models are also powerful methods to investigate whether the «probability of a correct response among equally able test takers is different for various subgroups identified by race, gender, ethnics or other characteristics» (Westers and Kelderman, 1991). Differential item functioning (DIF) is a method that can uncover whether certain subgroups have an advantage or disadvantage in educational and psychological testing. Therefore, a variety of statistical methods have been suggested for detecting DIF in the Rasch model. Most of these methods are designed to compare the item parameters estimates between pre-specified focal and reference groups, such as males and females (Paek and Wilson 2011).

The simplest form of the Rasch DIF model can be integrated as follows:

$$(2) \qquad \frac{\ln p_{ni}}{1 - p_{ni}} = \theta_n - \beta_i + \gamma_1 \cdot G$$

where g_i is the DIF index parameter for item *i* and *G* indicates either the reference group or the focal group[8]. Under this model presentation, g_i is the item difficulty difference between the focal group and the reference group.

If DIF is detected, the results can be interpreted as which items are the easiest or hardest to solve for which group, providing valuable information about psychological sources of the differential functioning of items.

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[8] In general, G = 1 for the reference group, and G = 0 for the focal group.

In this study, we follow Strobl *et al.* (2013), who propose a new approach to detect groups of subjects exhibiting DIF: in fact, they are not pre-specified, and they are the result of combinations of observed covariates through a recursive partitioning method (Breiman *et al.*, 1984). Model-based recursive partitioning is a semi-parametric approach whose aim is to detect differences in the parameters of a statistical model between groups of subjects defined by combination of covariates. The partitioning part of the model pertains to the method of classification trees (Breiman *et al.*, 1984; Zeileis *et al.*, 2010) where the subjects are recursively partitioned into groups according to the values of a categorical or a continuous response variable. Therefore, it is the parameters of a parametric model – rather than the values of a single response variable – that vary between groups. Such parameters could be, e.g., intercept and slope parameters in a linear regression model or, as in our case, the item parameters (e.g., item difficulty) of a Rasch model that may vary between groups of subjects.

Technically, the following consecutive steps are used to infer the structure of a Rasch tree from the data:

1. Estimate the item parameters jointly for all subjects (students in our case) in the sample, starting with the full sample.
2. Assess the stability of the item parameters with respect to each available covariate (gender, field of study, work or financial experience, social origin in our study).
3. If there is significant instability, split the sample along the covariate with the strongest instability and at the cutpoint[9] leading to the highest improvement of the model fit.
4. Repeat Steps 1-3 recursively in the resulting sub-samples until there are no more significant instabilities (or the sub-sample becomes too small).

What is important to note here is that the entire structure identified by the Rasch tree is not pre-specified and provided to the algorithm, but is learned from the data in an exploratory way. This is a key feature of the model-based recursive partitioning approach employed here, which makes it very flexible for detecting groups with DIF and distinguishes it from parametric regression models, where only those main effects and interactions that are explicitly included in the specification of the model are considered.

5 Empirical Analysis[10]

Table 3 reports the results of the Rasch analysis, utilising model (1). The one-dimensionality required by the Rasch model was confirmed by the correspondence with an adequate proportion of explained inertia by the first dimension (63.5%). The Cronbach alpha, which expresses the internal consistency of the test and ranges between zero and one, is equal to 0.68. This means that the reliability of the test is more than acceptable and the questions

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[9] The optimal cutpoint is determined by maximizing the partitioned log-likelihood (i.e., the sum of the log-likelihoods for two separate models: one for the observations to the left and up to the cutpoint, and one for the observations to the right of the cutpoint) over all candidate cutpoints within the range of this variable. (Strobl *et al.*, 2013).
[10] The results were obtained employing the R package for statistical computing plus the add-on *Psychotree*.

Table 3: Rasch analysis

Item	Total Score	Measure	Model SE	Infit		Outfit	
				MNSQ	ZSTD	MNSQ	ZSTD
Q1	137	0.723	0.118	0.961	−0.91	0.939	−0.91
Q2	265	−0.857	0.107	1.024	0.45	1.095	1.1
Q3	189	0.109	0.113	1.034	0.89	1.025	0.48
Q4	117	0.978	0.186	1.047	0.98	1.022	0.31
Q5	336	−2.402	0.163	0.794	−1.55	0.506	−2.71
Q6	39	2.393	0.107	1.013	0.16	1.413	2.02
Q7	159	0.457	0.111	0.933	−1.73	0.963	−0.63
Q8	239	−0.502	0.132	0.964	−0.75	0.934	−0.96
Q9	68	1.729	0.140	0.917	−1.11	1.009	0.11
Q10	306	−1.565	0.172	0.826	−2.12	0.825	−1.34
Q11	330	−2.189	0.107	0.856	−1.19	0.722	−1.52
Q12	199	−0.012	0.116	0.923	−2.02	0.894	−1.99
Q13	105	1.411	0.120	0.920	−1.55	0.927	−0.84

The table reports results of the Rasch analysis applying model (1). Total score represents the number of students answering correctly to the proposed questions; the Rasch measure indicates the level of difficulty of each item. Low values imply a higher probability of correct answer and therefore, lower item difficulty. Infit and outfit statistics indicate a fairly good accuracy or predictability of the data to fit the model.

measure the same thing, i.e., financial knowledge[11]. The Andersen's test for goodness-of-fit with mean split criterion shows that the model fits the data[12]. Moreover, we need to evaluate the validity of the item estimates. Validity refers to the accuracy of the measurement and can be assessed with fit statistics, namely *Infit* (information-weighted fit statistic) and *Outfit* (outlier-sensitive fit statistic) indexes (Bond and Fox, 2007). The fit statistics are normalized mean square residuals (across items for each person or across persons for each item). *Infit* mean square residuals (MSNQ) and *Outfit* mean square residuals (MSNQ) determine the extent that the observed responses fit the expected responses from the Rasch model. The *Infit* statistics emphasizes residuals for items that are close to the person's ability, while the *Outfit* statistic reflects large differences between observed and expected values for items that are far from the person's ability. An *Infit* or *Outfit* MSNQ value lower than 0.70 is considered overfitting, suggesting the items may be providing redundant information. Mean square values greater than 1.30 are considered misfitting, suggesting the item is not as closely related to the overall construct. In our case, all items do not present problems of overfitting as far as *Infit* MSNQ statistic concerns; nonetheless, with respect to *Outfit* MSNQ statistics, item Q5 and item Q6 exhibit overfitting and misfitting, respectively. Since *Outfit* problems are less of a threat to measurement issues than Infit ones, we can state that our mean-square fit statistics indicates that the estimated measures are valid.

Employing a Rasch metric, the two situations' *easiest item* and *most difficult item* correspond, as scores, respectively, to the values of -2.40 and 2.39[13]. These values correspond, respectively, to items Q5 and Q6. Both belong to the area of savings and investments, yet the latter tests students' ability in the domain of stock market investing, while the former examines their ability in defining cash flow in and cash flow out. Item Q6, with a logit value of 2.39, suggests that only 8.4% of the students were able to answer correctly to a

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[11] It is customary to deem the test valid with a value over 0.60.
[12] Test value: 11.243, pvalue = 0.423, *df* = 11.
[13] Lower values of the item parameters imply higher probabilities of correct answers.

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     <more> -------------------- Person    -+-    Item --------------------- <rare>
  4                                          +                                          4
                                             |
       Persons with the highest             |              Most difficult items
       financial ability                    |
                                       .     |
  3                                          +T                                         3
                                             |
                                    .#       |     x6
  2                               T +         |     x9                                  2
                              .#######       |S
                                             |     x13
            ################### S            |     x4
  1                                    +      |     x1                                  1
               .##################            |
                                             |     x7
          .######################            |
  0                                    M +M   x12 x3                                    0
           .####################### M         |M
                                             |
              .###############       S |     x8
 -1                               .######### +     x2                                   -1
                                             |S
                                  ##### T |   S   x10
 -2                                          +                                          -2
                                             |     x11
                                       .     |     x5
 -3                                          +T                                         -3
                                             |
       Persons with the lowest         .     |              Least difficult items
       financial ability
 -4                                    .     +                                          -4
     <less> -------------------- Person    -+-    Item --------------------- <frequent>
```
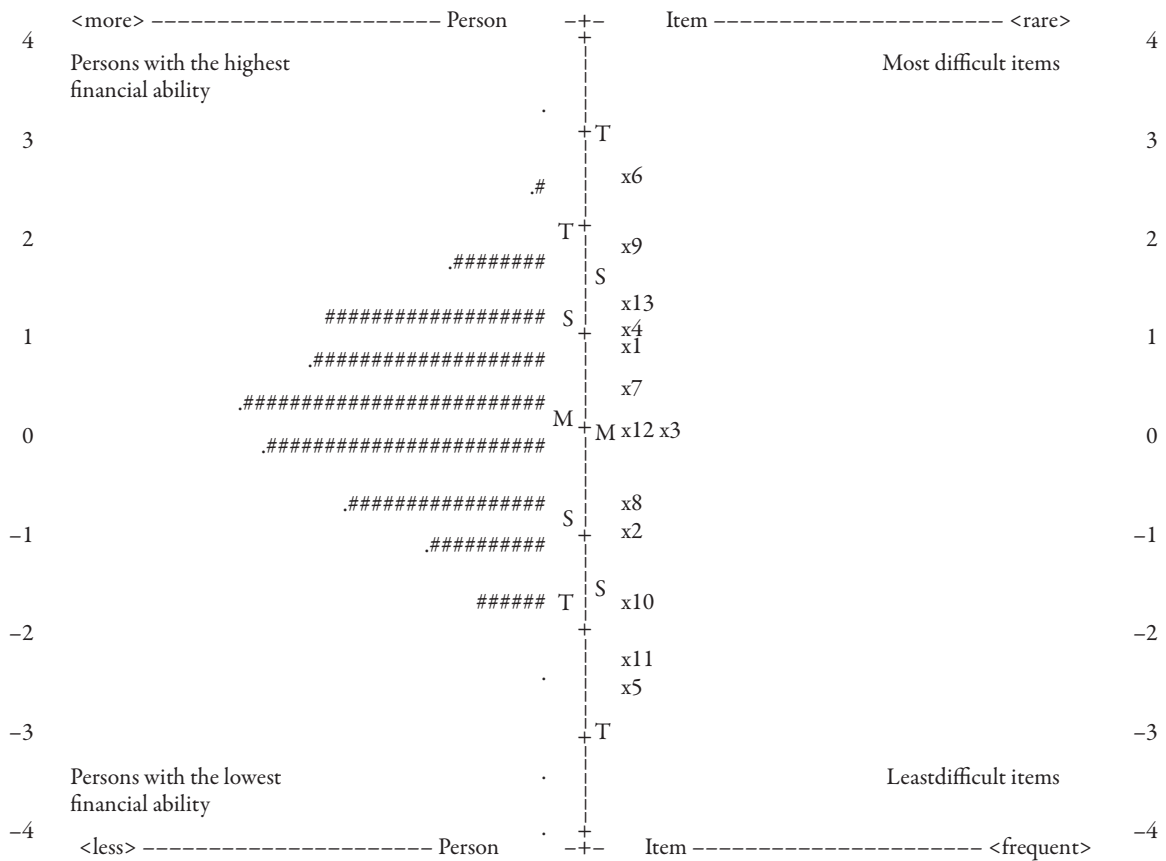
Figure 1: Map of persons and items.

question regarding stock market investments. In sum, our students show a high level of numeracy, yet they display a limited knowledge of more sophisticated financial issues.

With respect to students' ability to answer our questionnaire, we see that no student answered incorrectly to the overall questionnaire, and no student was able to correctly answer to every question in the test. As before, a score of −4.26 is given to the least able student while a score of 3.18 refers to the most able student. On average, our students display a score equal to −0.37, just below the value of zero, which on the logistic Rasch scale represents the ability to correctly answer 50% of the questionnaire items. In other words, our students score below the average performance (Tab. 3).

Figure 1 reports the Item-Person Map, in which both types of information can be evaluated simultaneously: maps produced by the Rasch statistical method can be used to quickly communicate complex information and in a presentation format that is easily understood. The Rasch item-person map shown in Figure 1 orders the level of tested financial literacy of the students in our study (left side) and the difficulty of the multiple-choice questions (right side). Questions at the top of the scale are more difficult to answer to. The test becomes easier to perform further down the scale. Individuals with the least financial ability (at the bottom of the scale) have difficulty even with the easiest notions (e.g., numeracy test); individuals with more financial literacy (at the top of the scale) have no difficulty performing any of the activities implied by the questions. In particular, students on the upper left are said to be «better» or «smarter» than the items on the lower right, which means these easier items are not difficult enough to challenge highly

: Anova test

	Mean Rasch measure	SD	n	p-value (ANOVA)
Gender				*0.246*
Male	0.037	0.618	187	
Female	−0.037	0.614	179	
Living				*0.81*
With parents	0.003	0.615	55	
On their own	−0.018	0.627	311	
Major				*0.282*
Finance	0.042	0.553	217	
Other majors (less numerical)	−0.028	0.655	149	
Type of education				*0.356*
Academic track (liceo)	−0.032	0.62	170	
Non-academic track (technical institutes)	0.0279	0.613	196	
Parents' educational attainment				*0.062**
College degree or higher	0.121	0.606	72	
Up to high school diploma	−0.03	0.616	294	
Parents' Social level				*0.67*
High	0.027	0.656	77	
Medium-Low	−0.007	0.606	289	
Financial experience				*0.035***
Yes	0.05	0.599	236	
No	−0.091	0.639	130	
Work experience				*0.341*
Yes	0.028	0.587	203	
No	−0.034	0.651	163	

The Table presents mean Rasch scores for each of our covariate and the p-values of an ANOVA test of differences between mean values. ***, ** and * denotes 1%, 5% and 10% significance levels

proficient students. However, items on the upper right outsmart students on the lower left, which implies that these tough items are beyond these students' ability level.

We now turn our attention to the evaluation of differences in Rasch scores for our sample of females and male students. Table 4 presents mean Rasch scores for each of our covariate and the p-values of an ANOVA test of differences between mean values. First of all, we note that the negative sign of the Rasch metric for the female sample (compared to a positive Rasch score of males) appears to imply a lower financial ability by female students. However, such a finding is not statistically significant: the difference between the two means is close to zero.

The only significant differences in means are to be found with respect to financial experience and parents' educational attainment. This means that being familiar with financial instruments and having highly educated parents are associated with higher financial ability and helps the respondent in dealing with every day financial matters. This is true for both males and females. The conclusion is that no gender gap arises in our sample of Business college students and H1 is confirmed.

6 Robustness Check

To deliver more robust results, we test whether our sample experienced different levels of difficulty in answering each of the items of the questionnaire. We are interested
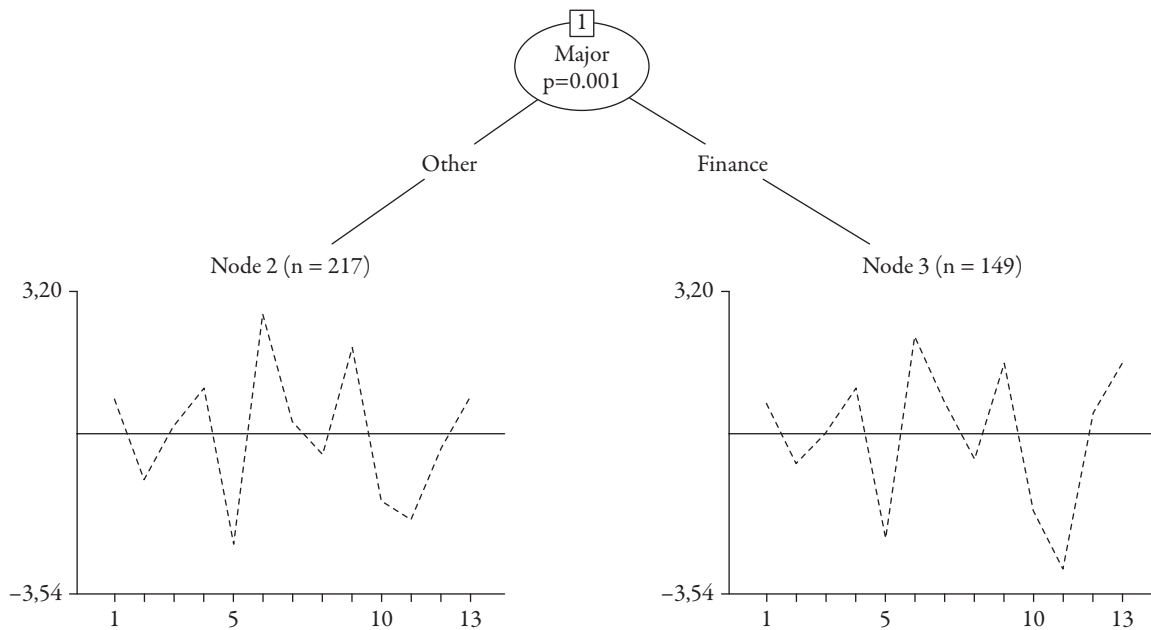
Figure 2: The recursive partitioning of the DIF model.

Figure 2 represents the Rasch tree that detects whether a specific group (defined by the covariates) is at disadvantage or advantage with respect to the entire issue (financial literacy) under investigation.

in uncovering whether our subgroups of college students - males and females - have an advantage or a disadvantage when dealing with specific financial matters. This step of analysis would uncover potential differences in approaching specific financial matters that an average score is not able to distinguish.

In Bongini *et al.* (2012), each item's difficulty was evaluated with respect to each relevant covariate, such as gender, major, field of study, job or financial experience. The interesting result was that each relevant group was associated with different items: no item was as similarly difficult for each group, and for each group, one specific item was the hardest to answer to. In the framework of our analysis, it is worth noting that our questionnaire presented just one item (Q6) for which females found greater difficulty to answer, with respect to their male colleagues[14].

In this study, we go further and apply the Rasch tree to jointly assess the item responses and detect whether a more complex interaction structure for the covariates is present. Such a methodology helps detecting whether a specific group is at a disadvantage or advantage with respect to the whole issue (financial literacy) under investigation.

Figure 2 illustrates the Rasch tree results: it has splits only in the variable «major», indicating DIF in this covariate; all other covariates, including gender, do not exert influence on the test performance. To conclude, diverse abilities and different degrees of difficulty in answering the proposed questions are found with respect to Group 1 (node

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[14] Question 6 requires respondents to understand and know the functioning of financial markets, namely bond and stock performance over a long time horizon. It is undeniable that one's preference between bonds and stocks is influenced by personal risk aversion, which is typically higher amongst females (Sapienza *et al.*, 2009). Notwithstanding this, item 6 targeted whether students were knowledgeable of the fact that over long time horizon stocks investing delivers the highest returns with respect to all other types of financial investments.

2), composed of 217 students who chose business majors other than finance, and Group 2 made up of 149 Finance freshmen, presenting the highest financial literacy score. The variable «Major» does not mask gender differences, as males and females are similarly distributed among all different business courses[15]. Therefore, males and females do not find different degrees of difficulties in approaching our construct of financial literacy.

7 Conclusions and Future Work

Our paper analysed the issue of gender gap in the domain of the financial literacy of university students.

Our study contributes to the literature by means of a sample of freshmen of a large Italian Business School, where *ex ante* gender differences should not be expected. We deliberately concentrate on a sample of business students, i.e., a homogeneous sample of the youth population, expected to demonstrate a similar personal interest in economic and financial matters. This allowed the authors to investigate the question of gender in a different setting with respect to other studies insofar conducted both abroad and in Italy and whether any gender differences were discernible when bias towards financial matters are excluded.

The principal limitation of this study is the investigation of individual financial literacy drawn from one Business School. It could be considered a pilot study to be enriched using a larger sample of undergraduates from different Business Schools; it should also consider the issue of financial literacy (and gender gap) amongst people of the same age as our target group but not studying; an issue insofar neglected in the literature most probably due to practical difficulties in addressing this specific group of population.

Our sample of college students displays, on average, a limited, though not poor, level of financial literacy: our results confirm the outcomes of other surveys done both in Italy and in other countries.

No gender gap was found either considering an overall measure of financial literacy (Rasch measure) or considering the overall difficulty of the instrument (Differential Item Functioning). Our results strengthen the evidence from studies that, similarly to our study, concentrate on a homogeneous sample of young college students majoring in Business. In this very specific case, the average financial knowledge of young men does not exceed that of women in the same age group.

Interestingly, we found that, *ceteris paribus*, the decision to undertake a finance curriculum of studies is associated with a higher level of financial literacy. Even among business students, the major choice is critical in defining their ability to correctly answer the items. We believe that the major choice could be considered as a proxy for students' interest in financial issues, and such interest in financial issues is relevant for both males and females.

As far as the methodology adopted in this paper, we have demonstrated that Rasch analysis has the advantage of simultaneously measuring both the respondents' ability

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[15] This included 41% females and 59% males in Finance, 54% females and 46% males in other Majors.

and the test items' difficulty, with respect to traditional methods of assessing an index of financial literacy. Our findings support the opportunity of adopting such techniques in measuring financial literacy: the set of information provided is not limited to a crude figure, indicating whether the respondents have passed or failed the test; on the contrary, it provides useful information on the specific areas where deficiencies are occurring the most and which specific group presents the highest knowledge deficit. These outcomes could be crucial in designing financial education, e.g., the natural following step of any attempt to measure financial literacy. In general, we can say that our results reveal the need to raise youth interest in financial matters, most probably in the lower levels of the education system: the interest raised in the young when they are pupils could present its positive effects as they mature, enabling them to enter adulthood with a higher level of financial literacy.

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