Economics Letters 145 (2016) 130–135

Contents lists available at ScienceDirect

Economics Letters

journal homepage: www.elsevier.com/locate/ecolet

Gender differences in financial risk taking: The role of financial literacy and risk tolerance☆

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HIGHLIGHTS

- Financial risk taking is examined via standard and sophisticated financial investments.
- Standard investment decisions are positively associated with both actual and perceived financial knowledge for men, but only with actual knowledge for women.
- Sophisticated investments increase along with higher perceived financial knowledge, particularly for women.
- Higher risk tolerance relates positively to both standard and sophisticated investments for men, but only to standard investments for women.

ARTICLE INFO

Article history:
Received 16 March 2016
Received in revised form
24 May 2016
Accepted 31 May 2016
Available online 11 June 2016

JEL classification:
D91
G11
D83
J26

Keywords:
Financial risk taking
Financial literacy
Risk tolerance
Gender
Household finance

ABSTRACT

We study financial risk taking via standard and sophisticated financial investments. Using survey data on 2047 individuals, we find that standard investments are strongly associated with both actual and perceived financial literacy for men, but only with actual literacy for women. Sophisticated investments, in contrast, are significantly related to perceived financial literacy with an even stronger association for women than for men. Interestingly, there is no relation between risk tolerance and women's sophisticated investments.

1. Introduction

There is a large literature documenting a gender gap in financial risk taking (cf. Charness and Gneezy, 2012). This gap is of enormous economic importance: If women are less willing to invest in risky financial assets, they are expected to accumulate lower wealth over time. Combined with lower labor income and a longer life span on average, this renders women more vulnerable to poverty in old age.

The gender gap in stock market participation is usually explained either by women's lower financial knowledge (Van Rooij et al., 2012; Lusardi and Mitchell, 2008), lower numeracy (Almenberg and Dreber, 2015), lack of familiarity with financial products (Prast et al., 2014) or lower risk tolerance (Croson and Gneezy, 2009; Dohmen et al., 2011). We extend this literature in three ways. First, we examine a larger investment universe by comparing the willingness to invest in risky but fairly standard financial assets (stocks and real estate funds) with the decision to invest in riskier, more sophisticated assets (discount certificates, hedge funds etc.). Second, we consider different dimensions of financial knowledge (actual and perceived financial literacy) to provide more nuanced insights on how literacy relates to risk taking. And third, we look at the combined role that financial literacy and risk tolerance play for men's and women's investment decision.

☆ We are grateful to Dennis Sinzig and Danic Seiwert for their research support.
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http://dx.doi.org/10.1016/j.econlet.2016.05.033
0165-1765/

Results are derived from the SAVE panel, a representative survey on German households' financial behavior. We find that women and men differ in the impact that financial literacy has on their investment decisions: For men both actual and perceived financial knowledge are positively (and individually) associated with standard investments, for women only actual literacy is. With respect to sophisticated investments, in contrast, perceived financial knowledge plays an important role for both men and women. Interestingly, the relation between sophisticated investments and perceived literacy is even stronger for women than for men.

We also observe a diverging role of risk tolerance. Higher risk tolerance correlates with men's willingness to invest in both standard and sophisticated financial products. For women, in contrast, risk tolerance plays a role only for standard investments but not for sophisticated investments.

Sound actual financial knowledge hence appears to be a prerequisite for women's financial risk taking: It is positively associated with standard investments and thus helps to counterbalance the curtailing effect of women's comparatively weak risk tolerance. Riskier, more sophisticated investments, in contrast, are driven by strong perceptions about financial knowledge. For women, this even renders risk tolerance irrelevant, while it is still an important covariate for men.

2. Data and method

Our main data is from the 2009 SAVE panel, a representative survey of German households conducted by the Munich Center for the Economics of Aging (MEA).[2] Our dataset consists of 2047 responses. The survey contains a question on the subjective perception of financial literacy (on a seven-point scale), which we use as the perceived literacy score, and a set of nine objective questions related to basic numeracy and more advanced concepts of financial knowledge (see Appendix A). We take the sum of correct answers to these questions as the score of actual literacy. Respondents are also asked to assess their willingness to take risks with respect to financial matters (on a ten-point scale). We employ this as our risk tolerance score.[3] For a definition of variables, see Appendix B.

As dependent variables in our regressions, we employ the decision to invest in standard asset classes, which are defined as individual stocks, stock mutual funds and real estate funds, and to invest in more sophisticated asset classes such as discount certificates or hedge funds. We furthermore require sophisticated investments to be in addition to standard investments, so that respondents investing in the riskier, sophisticated assets have already been exposed to the experience of holding standard assets as well. Both types of investment decisions are coded as dichotomous 0-1 variables.

Table 1 in Appendix C reports the summary statistics for our dataset. The sample consists of 54% women. The average age is 53 years. Education is roughly equally divided between basic schooling, an intermediate degree and the highest degree that qualifies for tertiary education. 10% of respondents attained a university degree. Total gross wealth includes financial and real estate wealth.[4] 23% of respondents hold standard investments and 4% invest in sophisticated assets. These are 10% of the individuals that invest in standard assets.

Our main focus is on the relation of financial literacy and risk tolerance with the two types of investment decisions. In order to unveil the subtle effects that actual and perceived literacy may have, we use a composite, two-part measure of financial knowledge following Allgood and Walstad (2016). To this end, we first split the sample along the average actual financial literacy into the groups of high, respectively low, actual literacy. We then do the same for the perceived financial literacy to create the groups of high, respectively low, perceived literacy. From these two splits we create four distinct groups of respondents: perceived low/actual low (I), perceived low/actual high (II), perceived high/actual low (III), perceived high/actual high (IV).[5]

Table 2 shows that men display significantly higher actual and perceived financial literacy than women. The table also reports the sample split into the four different literacy groups. Though we see that most respondents are in the perceived high/actual high group, the difference between men and women is here also particularly stark (44% vs. 29%). The perceived low/actual low group, in contrast, is the smallest group for men but the second largest for women. Interestingly, women are more numerous than men in the perceived high/actual low group, implying that it is more likely for women than for men to perceive their financial literacy as above average even though it is actually below average.

As may have been expected, risk tolerance in our sample is significantly higher for men than for women. To treat financial literacy and risk tolerance similarly in our analysis, we employ dummy variables that indicate whether an individual holds above- or below-average risk tolerance. Splitting the sample along the mean, we hence find that 40% of all men display a risk tolerance that is above average, while only 29% of all women do.

3. Results

Table 3 summarizes the results from a linear probability regression model on the decision to invest in standard assets with the composite financial literacy measures and risk tolerance as explanatory variables. Our choice of control variables follows Van Rooij et al. (2011). Additionally, we employ the financial education of respondents' parents as a proxy for peer influence, which Hong et al. (2004) found to be a relevant factor for financial market participation. Column (1) presents the results for the total sample, where we use the female dummy to control for gender effects. Columns (2) and (3) refer to the male, respectively female, subsamples.

Interestingly, we see from column (1) that the female dummy is not significant if we control for financial literacy and risk tolerance. This is in contrast to most of the literature on stock market participation (cf. Allgood and Walstad, 2016 and Van Rooij et al., 2011) where risk tolerance is usually not taken into account, but it supports Almenberg and Dreber (2015) who explicitly control for risk taking preferences.

[2] For more information on the SAVE panel data, see Börsch-Supan et al. (2009). The panelized structure of the data allows us to match complementary information on the financial education of respondents' parents (from wave 2007) to the respective unit.

[3] Though survey questions are usually not incentive compatible, which could render the self-assessments unreliable due to various biases, Dohmen et al. (2011) show that the question on risk tolerance is a valid proxy for actual risk attitudes.

[4] When used as control variable on the right-hand side of our regressions, we reduce total gross wealth by the amount of investment holdings, i.e., our left-hand-side variable.

[5] Employing this composite measure allows to consider the *total* effect of financial literacy by accounting for an objective and subjective assessment at the same time and in combination. Similar procedures are well-known from studies of, e.g., voting behavior or consumer research (McDonald and Tolbert, 2012; Carlson et al., 2009).

Table 1
Descriptive statistics. The table presents summary statistics (means, standard deviations, minimum and maximum values) for all dependent and independent variables. The description and construction of all variables can be found in Appendix B.

	Mean	Std.dev.	Minimum	Maximum
Female	0.54	0.50	0	1
Age	52.67	16.01	22	97
Education dummies				
Low level	0.35	0.48	0	1
Intermediate level	0.38	0.48	0	1
High level	0.28	0.45	0	1
Married	0.58	0.49	0	1
Number of children	1.72	1.39	0	10
Ln(household income)	7.46	0.75	0	10.23
Total gross wealth	177,395.70	455,368	0	11,200,000
d_university	0.10	0.30	0	1
Parents' financial education	4.58	1.67	1	7
d_standardinvestments	0.23	0.42	0	1
d_sophisticatedinvestments	0.04	0.20	0	1
Number of observations	2047			

Table 2
Actual and perceived financial literacy. The table reports the means of actual and perceived financial literacy and the distribution of the two-part literacy measures (in four distinct groups) across gender. The adjusted Wald statistic tests for significant differences between the male and female respondent groups.

	All	Male	Female	Diff.
Actual financial literacy (mean)	5.587	6.081	5.159	*Adj. Wald test* $(1) = 51.93$; $(p = 0.000)$
Perceived financial literacy (mean)	4.578	4.756	4.425	*Adj. Wald test* $(1) = 22.36$; $(p = 0.000)$
Perceived low/actual low (I)	0.217	0.150	0.275	*Adj. Wald test* $(1) = 37.28$; $(p = 0.000)$
Perceived low/actual high (II)	0.222	0.227	0.219	*Adj. Wald test* $(1) = 0.14$; $(p = 0.7070)$
Perceived high/actual low (III)	0.204	0.183	0.222	*Adj. Wald test* $(1) = 3.77$; $(p = 0.0523)$
Perceived high/actual high (IV)	0.357	0.441	0.285	*Adj. Wald test* $(1) = 44.34$; $(p = 0.000)$
Risk tolerance	2.25	2.57	1.98	*Adj. Wald test* $(1) = 20.22$; $(p = 0.000)$
Above-average risk tolerance	0.34	0.40	0.29	*Adj. Wald test* $(1) = 22.36$; $(p = 0.000)$
Number of observations	2047	986	1061	

Using the perceived high/actual high group (IV) as omitted category, we find differential effects of the composite literacy measure on men's and women's decisions to invest in standard assets: Both actual and perceived financial literacy are related to men's standard investments, but only actual literacy appears to play a role for women. More precisely, we see the largest negative effect on the standard investment decision for men if actual literacy falls from above average to below average (groups I and III). This effect is irrespective of whether perceived literacy falls as well, i.e. there is no significant difference in the coefficients pertaining to groups I and III. Essentially, moving from an actual financial literacy above to below average reduces the probability of investing in standard assets by between 18% and 20% for men. A drop only in perceived financial literacy (group II) also has a negative, albeit slightly smaller effect on men's standard investments (−13%).

For women, in contrast, we only see a significant decrease in the decision to invest in standard assets if actual financial literacy falls from above to below average (I and III). The corresponding effect is of size between 16% and 19% and, thus, not much smaller than the effect for men. A change in perceived literacy is not related at all to women's standard investment decision. This can be seen both from the insignificant coefficient of the composite literacy measure of group II and from the insignificant difference between the coefficients of groups I and III.

Regarding the relation between risk tolerance and standard investment decisions (and using the above-average risk tolerance group as omitted category), we observe a significant effect for both men and women. The negative impact of a below-average risk tolerance appears to be larger for men than for women, however: Moving from above- to below-average risk tolerance decreases the probability of investing in standard assets for men by 11% and for women by 8%.

Table 4 reports results from a linear probability regression on the decision to invest in sophisticated assets. Again, we find that when controlling for financial literacy and risk tolerance, gender does not play a significant role for the investment decision in the total sample. In contrast to standard investments, however, we see that the decision to invest in sophisticated assets is more strongly related to perceived financial literacy. As such, we find that a drop in perceived literacy from above to below average is associated with a 9% lower probability of sophisticated investment for men, provided that actual literacy remains high (group II). For women, we observe an even stronger effect of perceived literacy. Moving from above- to below-average perceptions goes along with a decrease in sophisticated investment decisions of between 9% (if actual literacy remains high, i.e. group II) and 14% (if actual literacy decreases to below-average as well, i.e. group I). It should be noted, however, that even though the economic difference between these two effects appears high, it is statistically insignificant.

Table 3
Standard investments. The table reports OLS estimates of the effects of actual and perceived financial literacy and several control variables on standard investments. The dependent variable is d_standardinvestments. Column 1 reports effects for all respondents, column 2 (3) only for male (female) respondents. The last six rows report the Chi-squared statistic of a Wald test that the marginal effects are different from each other.

	All (1)	Male (2)	Female (3)
Low_Low (I)	−0.1851***	−0.2008***	−0.1612***
	(0.0250)	(0.0377)	(0.0334)
Low_High (II)	−0.0758***	−0.1313***	−0.0125
	(0.0273)	(0.0377)	(0.0397)
High_Low (III)	−0.1913***	−0.1824***	−0.1893***
	(0.0259)	(0.0403)	(0.0329)
Below-average risk tolerance	−0.0937***	−0.1083***	−0.0779***
	(0.0212)	(0.0314)	(0.0269)
Female	−0.0313		
	(0.0190)		
Age	0.0003	0.0006	0.0001
	(0.0007)	(0.0011)	(0.0008)
Education dummies			
Intermediate level	0.0433**	0.0676**	0.0120
	(0.0215)	(0.0332)	(0.0275)
High level	0.0893***	0.1141**	0.0487
	(0.0310)	(0.0448)	(0.0407)
Married	−0.0066	−0.0509	0.0228
	(0.0220)	(0.0357)	(0.0265)
Number of children	−0.0012	0.0013	−0.0025
	(0.0064)	(0.0107)	(0.0081)
Ln(household income)	0.0489**	0.0289	0.0825***
	(0.0232)	(0.0325)	(0.0259)
Second wealth quartile	0.0951***	0.0788**	0.1070***
	(0.0239)	(0.0382)	(0.0310)
Third wealth quartile	0.1560***	0.1976***	0.1079***
	(0.0252)	(0.0413)	(0.0300)
Fourth wealth quartile	0.2049***	0.2347***	0.1691***
	(0.0291)	(0.0453)	(0.0378)
d_university	0.0228	0.0619	−0.0433
	(0.0396)	(0.0570)	(0.0552)
Parents' financial education	0.0007	−0.0036	0.0068
	(0.0052)	(0.0080)	(0.0065)
Observations	1955	933	1022
F-stat.	25.94	13.67	12.61
R^2	0.1651	0.1637	0.1702
Wald tests			
(I)–(II)	16.47	2.94	17.57
P1	0.0001	0.0867	0.0000
(I)–(III)	0.07	0.20	1.23
P2	0.7846	0.6532	0.2674
(II)–(III)	17.05	1.37	24.71
P3	0.0000	0.2425	0.0000

Note: Standard errors in parentheses.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

Table 4
Sophisticated investments. The table reports OLS estimates of the effects of actual and perceived financial literacy and several control variables on sophisticated investments. The dependent variable is d_sophisticatedinvestments. Column 1 reports effects for all respondents, column 2 (3) only for male (female) respondents. The last six rows report the Chi-squared statistic of a Wald test that the marginal effects are different from each other.

	All (1)	Male (2)	Female (3)
Low_Low (I)	−0.1081***	−0.0111	−0.1395***
	(0.0412)	(0.0738)	(0.0419)
Low_High (II)	−0.0729**	−0.0882**	−0.0868*
	(0.0303)	(0.0363)	(0.0504)
High_Low (III)	−0.0381	−0.0045	−0.0726
	(0.0494)	(0.0672)	(0.0651)
Below-average risk tolerance	−0.0849***	−0.1493***	0.0096
	(0.0288)	(0.0395)	(0.0391)
Female	0.0133		
	(0.0275)		
Age	0.0006	−0.0005	0.0023
	(0.0010)	(0.0013)	(0.0015)
Education dummies			
Intermediate level	0.0328	0.0465	−0.0133
	(0.0344)	(0.0459)	(0.0522)
High level	−0.0107	−0.0278	−0.0098
	(0.0368)	(0.0499)	(0.0595)
Married	−0.0358	0.0046	−0.0523
	(0.0356)	(0.0436)	(0.0538)
Number of children	−0.0109	−0.0363**	0.0228
	(0.0130)	(0.0152)	(0.0193)
Ln(household income)	0.0237	0.0251	0.0194
	(0.0192)	(0.0201)	(0.0604)
Second wealth quartile	0.0963**	0.0379	0.1684***
	(0.0375)	(0.0517)	(0.0583)
Third wealth quartile	0.0533	0.0451	0.1099*
	(0.0335)	(0.0465)	(0.0562)
Fourth wealth quartile	0.1231***	0.1480***	0.1146*
	(0.0369)	(0.0529)	(0.0611)
d_university	0.0786*	0.0564	0.1415*
	(0.0465)	(0.0576)	(0.0856)
Parents' financial education	−0.0015	−0.0031	−0.0047
	(0.0089)	(0.0111)	(0.0148)
Observations	519	297	222
F-stat.	3.07	2.27	1.50
R^2	0.075	0.1493	0.0882
Wald tests			
(I)–(II)	0.71	0.95	1.41
P1	0.3988	0.3288	0.2356
(I)–(III)	1.44	0.00	1.02
P2	0.2305	0.9486	0.3121
(II)–(III)	0.41	1.44	0.04
P3	0.5204	0.2306	0.8340

Note: Standard errors in parentheses.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

With respect to the role of risk tolerance, we observe the usual negative effect for men: When risk tolerance decreases from above- to below-average, the probability of an investment in sophisticated assets decreases by 15%. Surprisingly, we find no such effect for women's sophisticated investments. Rather, there is no significant association at all between risk tolerance and sophisticated investments for female respondents.

Our results are confirmed when actual and perceived financial literacy enter the regressions as individual covariates.[6] However, this disregards the subtle interrelation between the two dimensions of literacy that appears to be non-negligible at least with regard to sophisticated investments.

[6] Results from these additional tests are available online from https://www.cf.bwl.uni-mainz.de.

4. Concluding remarks

Our results suggest that both actual and perceived financial literacy are relevant for financial risk taking, with different nuances for men and women. To reduce the gender gap in standard investments it appears to be important to raise women's actual literacy and risk tolerance. Sophisticated financial decisions, in contrast are more strongly related to perceived rather than actual financial knowledge. Whether they should be promoted as well is debatable, however.

Appendix A. Wording of financial literacy questions

The table provides a translation of financial literacy questions in the 2009 SAVE questionnaire based on Dick and Jaroszek (2013). Correct answers are in bold font.

Label	Question
Numeracy	Suppose you own 100 Euro in a savings account. This balance yields interest of 2% per year and you leave it on this account for 5 years. What do you think: What is the deposit account balance after 5 years? [**more than 102 Euro**; exactly 102 Euro; less than 102 Euro; Do not know]
Interest compounding	Suppose you had 100 Euro in a savings account and the interest rate is 20% per year and you leave it on this account for 5 years. What do you think: What is the deposit account balance after 5 years? [**More than 200 Euro**; Exactly 200 Euro; Less than 200 Euro; Do not know]
Inflation	Assuming your savings account yields interest of 1% per year and inflation amounts to 2% per year. What do you think: Will you be able to buy more, less, or as much as today with your deposit account balance after one year? [More; As much as today; **Less**; Do not know]
Money illusion	Suppose that in the year 2012 your income has doubled and prices of all goods have doubled too. How much will you be able to buy with your income in 2012? [More than today; **As much as today**; Less; Do not know]
Risk diversification	Is the following statement right or wrong: An investment in a single stock is less risky than an investment in an equity mutual fund? [Right; **False**; Do not know]
Return volatility	Which of the following assets exhibits the highest return volatility? [Savings books, bonds, **stocks**, Do not know]
Stock market	What is the main task of the stock market? [The stock market predicts stock gains, the stock market increases stock prices; **The stock market is the place where equity demand meets equity supply**; None of the above; Do not know]
Balanced funds	Which of the following statements is correct? [If you invest in a balanced fund, you cannot withdraw money within the first year of your investment; **Balanced funds invest in several asset classes like stocks and bonds**; Balanced funds guarantee a fixed interest rate which is based on past performance; None of the above statements is correct; Do not know]
Bond prices	How does a fixed-coupon bond price react to decreasing interest rates? [**Bond price increases**; Bond price remains constant; Bond price decreases; Do not know]

Appendix B. Variable definitions

Variable	Definition
Actual financial literacy	Number of correct answers to the nine financial literacy questions listed in Appendix A
Perceived financial literacy	Self-rating ranging from [1] "very low" to [7] "very high" on the following question: "How would you assess your understanding of financial matters?"
Perceived literacy split	(a) Perceived high = *self-rating* > *mean*; (b) Perceived low = *self-rating* ≤ *mean*
Actual literacy split	(a) Actual high = *testscore* > *mean*; (b) Actual low = *test score* ≤ *mean*
Financial literacy groups	(I) Low_Low = *self-rating* ≤ *mean* and *test score* ≤ *mean*; (II) Low_High = *self-rating* ≤ *mean* and *testscore* > *mean*; (III) High_Low = *self-rating* > *mean* and *testscore* ≤ *mean*; (IV) High_High = *self-rating* > *mean* and *testscore* > *mean*
Risk tolerance	Self-assessment ranging from [0] "completely disagree" to [10] "completely agree" on the following statement: "I do not mind taking risks with respect to financial matters"
Below-average risk tolerance	Dummy = 1 if respondent's self-rated risk *tolerance* < *mean*
Age	Age of respondent
Female	Dummy = 1 if respondent is female
Education dummies	
Low level	Dummy = 1 if respondent has lower secondary education (9 years of schooling)
Intermediate level	Dummy = 1 if respondent has intermediate level of education (10 years of schooling)
High level	Dummy = 1 if respondent has high level of education (12 or 13 years of schooling)
Married	Dummy = 1 if respondent is married
Number of children	Number of children living within or outside the household
Ln(household income)	Logarithm of average monthly disposable household income
Total gross wealth	Amount of financial wealth (deposits held in savings accounts, building savings contracts, fixed income securities, life insurance contracts, private and employer-based pension wealth) plus home and business

(*continued on next page*)

Variable	Definition
	equity, real estate and other real assets (e.g. jewelery, antiques etc.) (on the basis of portfolios held at the end of 2008)
Parents' financial education (2010)	Score ranging from [1] "very low" to [7] "very high" on the following question: How would you assess the understanding of financial matters of your parents?
d_university	Dummy = 1 if respondent has university degree
d_standardinvestments	Dummy = 1 if respondent owns individual stocks, stock mutual and/or real estate funds
d_sophisticatedinvestments	Dummy = 1 if respondent owns risky financial assets (e.g. discount certificates, hedge funds, money market funds)

Appendix C. Tables

See Tables 1–4.

Appendix D. Supplementary data

Supplementary material related to this article can be found online at http://dx.doi.org/10.1016/j.econlet.2016.05.033.

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