Article

The Influence of Gender on Individuals' Ability to Predict Their Own Risk Tolerance: Evidence from a European Country

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Abstract: The literature on individuals' ability to predict their own level of risk tolerance is scarce and presents divergent results. Utilizing both differential prediction models and logit models on a sample of 391 individuals in Portugal, this study demonstrates that respondents' gender play a crucial role in this predictive ability. Men tend to overestimate their level of risk tolerance, while women tend to believe they are less risk-tolerant than they actually are. Furthermore, the results reveal that men's ability to correctly predict their level of risk tolerance is significantly higher. Being a man implies a 20% higher probability of being consistent in this prediction compared to being a woman, even after controlling for a set of sociodemographic factors. The finding of a systematic inconsistency between measures of subjective and objective risk tolerance suggests that the choice between the two measures of risk propensity is not indifferent. Our findings have relevant implications in the fields of corporate finance, financial investment, and various other spheres of economic life.

Keywords: risk tolerance; subjective risk tolerance; objective risk tolerance; survey; gender; Portugal; psychometric tests

1. Introduction

In a global context where new risks are emerging (climate risks, pandemic risks, risks associated with artificial intelligence, etc.), understanding how individuals perceive their risk tolerance and whether their choices align with these perceptions becomes increasingly important. Risk, along with investment returns, is a crucial dimension in financial decision-making, particularly in the proper allocation of resources between risk-free and risky assets (Ghysels et al. 2005). Additionally, individuals' risk tolerance plays a significant role in various other financial decisions, such as financial debt contraction, financing consumer products, or allocating family income between fixed and variable expenses (Gomes et al. 2021).

Risk tolerance can be defined as the level of risk exposure an individual feels comfortable with, reflecting the individual's willingness to accept a higher level of volatility associated with variations in the value of an investment. Risk tolerance is the inverse of risk aversion, which means that a lower risk tolerance implies a higher risk aversion (Adhikari and O'Leary 2011; Gibson et al. 2013).

This study aims to investigate the accuracy of individuals in estimating their risk tolerance, with a primary focus on the impact of the gender variable. For this purpose, we compare the subjects' self-assessment of risk tolerance (subjective risk tolerance) with the risk tolerance obtained from a psychometric test (objective risk tolerance) developed by Grable and Lytton (1999, 2003). The determinants of deviations between objective and subjective risk tolerances are analyzed using differential prediction models and models with limited dependent variables (logit models). Our sample includes 391 students from a Portuguese university. To the best of our knowledge, this study is the first conducted in the context of a European country on the theme of individuals' ability to predict their risk tolerance.

Our results show that respondents' gender is a key variable in their predictive ability. Men tend to overestimate their level of risk tolerance, while women tend to believe

they are less risk-tolerant than they actually are. Moreover, men's ability to accurately predict their level of risk tolerance is found to be significantly higher. In fact, being a man implies a 20% higher probability of consistency in this prediction compared to being a woman, even after controlling for a set of sociodemographic factors, including household income, the level of education of the respondent's parents, and perceived knowledge about financial investments.

While numerous studies have explored the determinants of individuals' risk tolerance (e.g., Kesavayuth et al. 2020; Muktadir-Al-Mukit 2022; Lobão 2022), there is a notable lack of empirical evidence concerning individuals' capacity to predict their own risk tolerance. An accurate assessment of the level of risk tolerance is essential for constructing investment portfolios that are adequate to individuals' preferences. Therefore, if there is a bias in estimating risk tolerance, this may lead individuals to accept financial risks that are mismatched with their preferences. The research on the ability to correctly estimate individual risk tolerance is of great interest not only to the decision-makers themselves but also to entities such as financial advisors who use information related to this dimension for advising or making investment decisions on behalf of their clients (Hallahan et al. 2003; Faff et al. 2008). Financial advisors, in theory, have various tools to assess their clients' risk tolerance, but it has been reported that investment decisions are often based on a limited number of client responses, leading to less accurate assessments (Moreschi 2005; Roszkowski and Grable 2007).

In a global environment witnessing significant growth in the financial sector, with an increasing variety of products and investment alternatives available, the risk associated with financial choices has progressively shifted to individuals themselves (Davis and Kim 2015). Furthermore, the literature has reported significant deviations between the financial decisions made by individuals and those predicted by normative models of behavior (Baker and Nofsinger 2010; Hirshleifer 2015), suggesting that these agents may not be capable of making the best financial decisions. For all these reasons, there continues to be an urgent need to study individuals' accuracy in assessing their risk tolerance compared to indications obtained through psychometric tests (Grable et al. 2009a).

The remaining sections of the article are organized as follows: the next section conducts a review of the relevant literature on the topic; Section 3 describes the sample and the methodological approach adopted for the empirical study; Section 4 presents the results of the empirical study; Section 5 discusses the results, presenting their implications for various agents, including corporate managers and financial analysts; finally, Section 6 outlines the main conclusions of the article and mentions some limitations and suggestions for future research.

2. Literature Review

2.1. Theoretical Framework

According to Russo and Schoemaker (1992), effective decision-making requires more than mere knowledge of the relevant facts and concepts related to the issue at hand. It also demands a satisfactory level of metaknowledge, meaning an understanding of the limits of one's own knowledge. However, self-assessment is an intrinsically challenging task for two main reasons. Firstly, the forces influencing social behavior are complex, and individuals often do not have all the necessary information at their disposal for self-assessment. There are many unknown factors that prevent a proper evaluation of one's personality. Learning processes in this regard also do not seem to be favored, as individuals' assessments of their own nature are often not closely related to performance in tasks that should reflect those personality traits (Dunning et al. 2004). Secondly, self-assessments are usually inaccurate because individuals tend to ignore some pieces of relevant information in order to maintain their self-esteem (Baumeister and Newman 1994; Dunning 2001). As a result of these factors, it is plausible to assume that individuals assessing their own risk tolerance will be influenced by a series of distortions related to their self-esteem and the representation they want to convey to others and themselves.

Some literature appears to attribute differences between men and women in their relationship with risk to reasons of a biological nature, aligning with theories of sexual selection and species evolution (White et al. 2007; Coates and Herbert 2008; Levy 2015). According to these arguments, behaviors with greater aggression and a higher propensity for risk-taking were more functional for men than for women in their evolutionary past. Risk-taking would promote not only the physical skills of male individuals but also their social status. The elevation of social status would, in turn, lead men to increase their control over valuable resources, facilitating their access to privileged groups. Joining these groups would probably support key objectives for males, such as minimizing competition among them and increasing access to reproductive opportunities. This is because women generally prefer partners who have access to greater resources (Fischer and Mosquera 2001; Ellis et al. 2012). A subsidiary approach to evolutionary theory suggests that women may be particularly sensitive not only to risk but also to the possibility of losses. If women invest more heavily in raising children, they may develop a particular aversion to strategies that involve the possibility of negative outcomes. Children in immature age are more sensitive to variations in resources and are more likely to perish due to food scarcity. Therefore, it is plausible to assume that women are more likely to exhibit loss aversion behavior compared to males.

Other theories highlight the role of social influence and learning in defining gender-attributable behaviors. For example, authors like Lott and Maluso (2001), Meier-Pesti and Penz (2008), and Booth and Nolen (2012a, 2012b) consider gender to incorporate the attributes that a given culture attributes to each sex. In their perspective, gender is essentially a socially constructed variable, reflecting how the society in question interprets the roles of masculinity and femininity. According to this view, individuals learn which behaviors and beliefs are socially acceptable for men and women and subsequently adopt their conduct in accordance with socially accepted norms.

2.2. Empirical Evidence

There is abundant empirical literature identifying factors that influence the risk tolerance levels of financial decision-makers. Among sociodemographic factors, gender, income level, and individuals' educational attainment stand out. Regarding gender, evidence suggests that women are generally less risk-tolerant than men (e.g., Sarin and Wieland 2016; Borghans et al. 2009; Lobão 2022). Income levels seem to exhibit a positive relationship with risk tolerance levels, as higher income levels provide a greater capacity to assume risks (e.g., Cicchetti and Dubin 1994; Hartog et al. 2002; Kochaniak and Ulman 2020; Fang et al. 2021). Individuals' educational levels are another demographic factor that appears to explain risk tolerance levels, as it is plausible to consider that individuals with more comprehensive academic backgrounds are better equipped to adopt riskier financial behaviors (e.g., Sjoberg 2000; Larkin et al. 2013). Beyond sociodemographic factors, other determinants of risk tolerance have been identified, such as the national culture, in which decision-makers operate (e.g., Pyles et al. 2016; Illiashenko 2019), and experiences in adverse macroeconomic conditions, especially those marked by financial crises (e.g., Malmendier and Nagel 2011; Sahm 2012; Cunha and Lobão 2022).

There is evidence that women's greater risk aversion manifests in various domains of financial decision-making. In the field of corporate finance, for instance, there are indications that firms with female directors take on less debt and make less risky financing and investment choices (Huang and Kisgen 2013; Faccio et al. 2016). Additionally, they are less likely to initiate acquisition bids and tend to make acquisitions with lower bid premiums: each additional female director is associated with 7.6% fewer bids, and each additional female bidder director reduces bid premiums by 15.4% (Levi et al. 2014). In the realm of investments, it has been reported that wealth holdings of non-professional women investors are less risky than those of men with similar economic status (Jianakoplos and Bernasek 1998; Neelakantan 2010).

The empirical evidence about individuals' ability to predict their own risk tolerance is more limited. Some studies suggest that the majority of individuals tend to underestimate their risk tolerance. For example, Hallahan et al. (2003) compared individuals' self-attributed risk tolerance with values obtained through a 25-item risk tolerance measurement scale. The results indicated that 73% of respondents underestimated their risk tolerance, while 23% overestimated it, and only 4% made a correct estimation. However, Grable et al. (2009a) reached different conclusions. Analyzing the accuracy of estimates of risk tolerance and their consistency with individuals' investment choices, the authors concluded that individuals assess their risk tolerance quite accurately. Grable et al. (2009b) studied the effect of age on individuals' risk tolerance estimates, finding that young adults tend to overestimate their risk tolerance compared to older adults. Gilliam et al. (2010) reported that older individuals with less formal education and lower income tend to underestimate their risk tolerance, which is attributed to these individuals' lesser experience in dealing with financial investments. Marinelli et al. (2017) concluded that the inconsistency between subjective and objective risk tolerance is associated with low levels of financial literacy, high income levels, and the absence of children. More recently, Mazzoli and Palmucci (2023) addressed the discrepancies between individuals' self-reported risk tolerance and that captured by psychometric tests, proposing a risk tolerance estimation model applicable in the banking sector context.

Studies on the role of gender in individuals' ability to predict risk tolerance are even scarcer. Noteworthy works in this regard include those by Moreschi (2005), Grable and Roszkowski (2007), and Pyles et al. (2016). Moreschi (2005) was the first to conduct a direct test of the relationship between individuals' self-estimates of risk tolerance and those obtained through psychometric tests. Using an Australian database, the author documented that gender and formal education are the factors with the greatest impact on estimates. Specifically, male respondents and those with higher levels of formal education tend to present lower estimation errors. In a subsequent study, Grable and Roszkowski (2007) used data from an online survey conducted in the United States to show that women systematically underestimated their risk tolerance measured by psychometric tests, while men overestimated their risk-taking propensity. More recently, Pyles et al. (2016) investigated the explanatory factors for individuals' ability to predict their level of risk tolerance, focusing the analysis on the role of national culture. Using samples with students from the United States and China, the authors concluded that students from the Asian country were less consistent in predicting their risk tolerance, and being a female contributed significantly to having greater accuracy in this prediction.

It seems clear that there is a lack of consensus regarding the impact of the gender variable on the accuracy of individuals' risk tolerance estimates. Some studies suggest that men tend to show greater accuracy in this estimate (Moreschi 2005), while in other cases, greater accuracy has been attributed to females (Pyles et al. 2016). These conflicting results justify the need for additional studies on the issue.

Our study contributes to the literature by investigating, for the first time, the role of gender in individuals' risk tolerance estimates in the cultural context of a European country.

3. Data and Methodology

This research employs a survey methodology. The questionnaires were distributed to students enrolled in the Master's in Finance and Master's in Management programs at the Faculty of Economics of the University of Porto, Portugal. The questionnaires were drafted in English, the language in which the mentioned master's programs are taught, and data were collected between the years 2018 and 2023. Student participation in the survey was voluntary and conducted anonymously to minimize potential response biases. Responses were obtained from 391 individuals, with 177 (45.27% of the sample) identifying as male and 214 (54.73%) as female.

All participants were requested to complete a questionnaire comprising three sections. The first section consists of a single question, prompting self-assessment regarding indi-

viduals' risk tolerance (subjective risk tolerance). The question capturing subjective risk tolerance is as follows:

Please assess yourself with regard to taking on risk:

(a) Aggressive
(b) Moderately aggressive
(c) Moderately conservative
(d) Conservative

The responses to this question were coded as follows: (a) = 4, (b) = 3, (c) = 2, and (d) = 1, with higher values corresponding to greater risk tolerance. Only 1.54% of respondents described themselves as aggressive in risk-taking. Nearly half of the respondents (47.69%) considered themselves to be conservative. 28.46% of individuals saw themselves as moderately aggressive, while 22.31% were willing to describe themselves as moderately conservative.

The second section includes the 13 items from the psychometric test proposed by Grable and Lytton (1999, 2003), which assesses respondents' risk tolerance (objective risk tolerance). The test scale ranges from 0 to 47, with higher values indicating greater risk tolerance. In our study, results varied between 15 and 38, with a mean, median, and standard deviation of 26.36, 26.00, and 4.14, respectively.

There are several possible methods to gauge the level of risk tolerance. Grable (2008) proposed a list containing six different methods for measuring risk tolerance, emphasizing the potentialities and limitations of each of these methods. Among the alternatives suggested, Grable (2008) argued that the best choice lies in psychometric tests. The adoption of psychometric tests to assess individual risk tolerance is also supported by Faff et al. (2008). These authors compared the results of psychometric tests and a lottery experiment, demonstrating, from a sample of 162 individuals, that the results of the two approaches are significantly aligned. The psychometric test by Grable and Lytton (1999, 2003), which is adopted in our study to assess the level of risk tolerance, was tested by Grable and Lytton (1999), showing high levels of validity and reliability, especially compared to alternative measures such as the "Survey of Consumer Finances (SCF)", for example. Grable and Lytton (2003) empirically confirmed the accuracy of their psychometric test in explaining individuals' investment behaviors in a sample with 303 valid cases. In a more recent study, Kuzniak et al. (2015) reviewed the results obtained with the Grable and Lytton (1999, 2003) test from 2007 to 2013, concluding that the risk-tolerance scale's reliability and validity have remained robust since the scale was first developed. The 13 items of the Grable and Lytton (1999, 2003) test are presented in Appendix A.

The third section of the questionnaire is dedicated to collecting information about the perceived level of knowledge in the area of financial investments and the sociodemographic situation of the respondents' households. Regarding individuals' knowledge as investors, the question posed is as follows:

I consider my knowledge of investments to be:

(a) Very high
(b) Somewhat high
(c) Somewhat low
(d) Very low

The responses to this question were coded as follows: (a) = 1, (b) = 2, (c) = 3, and (d) = 4, with higher values corresponding to a lower level of knowledge. The results indicate that the majority of respondents (53.20%) consider themselves to have a low level of knowledge about financial investments. Only 2.56% and 3.58% of individuals considered their knowledge level to be very high or very low in this matter, respectively.

The section related to the sociodemographic situation of the family includes questions about the formal education levels of the respondents' father and mother, as well as the family's income level. The academic qualifications of the father and mother are assessed through one question for each parent, with the response categories being: (i) less than Secondary Education, (ii) Secondary Education, (iii) Bachelor's Degree, (iv) Master's Degree,

and (v) Ph.D. The responses to this question were coded as follows: (i) = 1, (ii) = 2, (iii) = 3, (iv) = 4, and (v) = 5, with higher values corresponding to higher education levels. In the case of respondents' mothers, the predominant category is Secondary Education (34.18%), followed by a Bachelor's Degree (27.30%), while fathers predominantly have a Bachelor's Degree (30.36%) or have completed Secondary Education (29.34%). The Ph.D. level covers only 3.06% of mothers and 4.08% of fathers of the respondents. The annual combined income level of the parents is captured by the respective question, where the response categories are as follows: (i) less than 20,000 euros, (ii) between 20,000 and 50,000 euros, (iii) between 50,000 and 100,000 euros, (iv) between 100,000 and 250,000 euros, and (v) more than 250,000 euros. The responses to this question were coded as follows: (a) = 4, (b) = 3, (c) = 2, and (d) = 1, with higher values matching higher income levels. The most frequent responses correspond to the category between 20,000 and 50,000 euros (48.53%), followed by less than 20,000 euros (27.35%). Only 1.07% of respondents state that they live in a family with annual income exceeding 250,000 euros.

Throughout this study, differential prediction models estimated by the least squares method will be used to test gender differences in the perception of risk tolerance, and models with a limited dependent variable (logit models) will be employed to investigate the consistency between individuals' subjective and objective tolerance levels. Models with limited dependent variables are frequently adopted in the recent literature to study individuals' risk tolerance (e.g., Pyles et al. 2016; Kochaniak and Ulman 2020; Fang et al. 2021; Brous and Han 2022). The gender data of the respondents were coded using a binary variable, assuming the following form: males (1) and females (0). As control variables in the regressions, we adopted a set of sociodemographic variables commonly used as proxies for the psychological processes underlying investment choices, such as the academic qualifications and incomes of the respondents' parents and the individuals' knowledge about financial investments (Noussair et al. 2014; Brooks et al. 2018; Lobão 2022). Given the considerable homogeneity in the age of the respondents, control for the age variable is unnecessary, although this factor is sometimes referred to in the literature as a determinant of the level of risk tolerance (e.g., Brooks et al. 2018; Kesavayuth et al. 2020; Muktadir-Al-Mukit 2022).

4. Results of Empirical Study

In Section 4.1, we begin by investigating the role of respondents' gender in underestimating or overestimating their risk tolerance, while Section 4.2 will focus on the influence of gender on the consistency individuals demonstrate between subjective and objective versions of risk tolerance.

4.1. Underestimation and Overestimation of Risk Tolerance

To investigate the role of gender in underestimating or overestimating risk tolerance, we start by applying a differential prediction model, in which an OLS regression is calculated to predict the level of subjective tolerance (*TolRisk_Sub*), with the objective risk tolerance values (*TolRisk_Obj*) as the explanatory variable. The result of such regression is as follows:

$$TolRisk\_Sub_i = \begin{array}{cc} -0.505993 & + & 0.0889987 \\ (-2.133)\ ** & & (9.665)\ *** \end{array} *TolRisk\_Obj_i \tag{1}$$

** and *** represent statistical significance at the 5% and 1% significance levels, respectively.

The average forecast of the regression was 1.084, with approximately 17.05% of the variance being explained by the model. The residual value, defined as the difference between the level of subjective risk tolerance indicated by individuals and the level of tolerance predicted by the model, was recorded for each respondent. A TA positive residual can be interpreted as meaning that the individual overestimated their level of risk tolerance. Conversely, a negative residual corresponds to an underestimation of the level of risk tolerance.

The results show significant differences in how individuals of both genders assess their risk tolerance. The majority of men (62.15%) overestimate their risk tolerance, while this situation corresponds to only 39.25% of cases among female respondents. For women, the mean deviation in the sample was −0.176, while for men, the mean deviation was 0.213. Thus, the results suggest that, on average, women tend to underestimate their level of risk tolerance, while men tend to consider their level of risk tolerance to be higher than it actually is. To test the statistical significance of the difference in residuals between the two genders, we conducted a two-tailed *t*-test. The difference is shown to be highly statistically significant, as the t-statistic = 4.853 has a *p*-value < 0.001. The frequency distribution of observed deviations in both genders is represented in Figure 1.
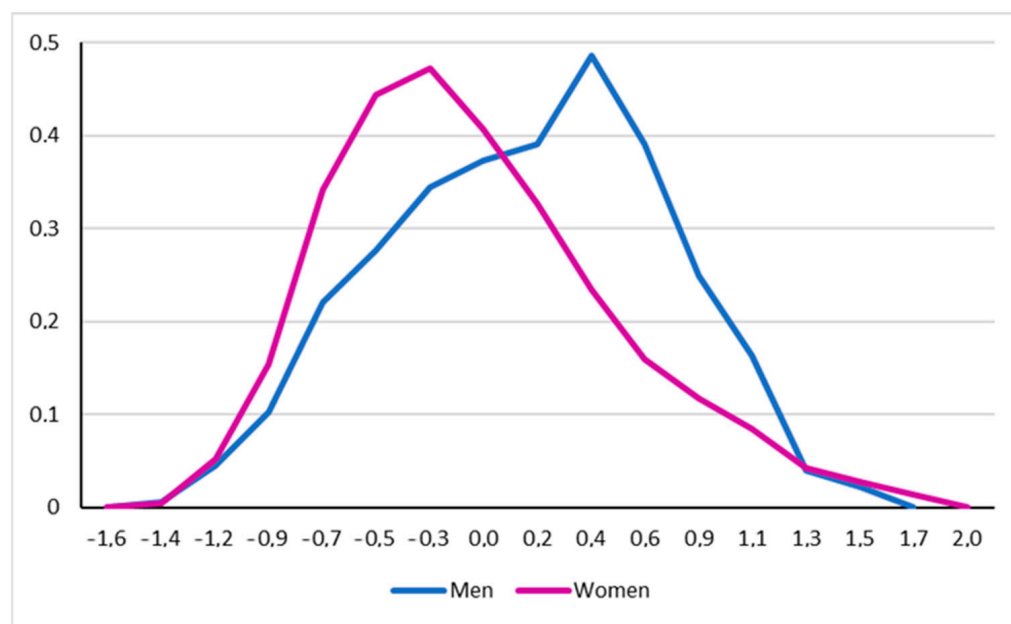

Figure 1. Frequency distribution of deviations between reported subjective risk tolerances and those predicted by the psychometric test in individuals of male and female genders.

The figure illustrates a noticeable difference between the responses of males and females. Negative residuals tend to be much more frequent in the subsample composed of female individuals, corroborating the conclusion that women tend to underestimate their risk tolerance. In fact, across the entire range of residual values [−1.6; +0.1], the frequency of responses given by women is higher. On the other hand, men tend to overestimate their risk tolerance, as positive residuals are more frequent in the subsample that only includes male individuals. Note that in the range of residual values [+0.1; +1.3], the frequency of male individuals is higher, with the difference being particularly pronounced around the residual value of +0.4.

In general, our result that men tend to overestimate their risk tolerance while women tend to consider themselves less risk-tolerant than indicated by the psychometric test of Grable and Lytton (1999, 2003) is consistent with the evidence obtained by Grable and Roszkowski (2007) for a sample collected in the United States.

Since the observed difference in underestimation/overestimation of risk tolerance between the two genders may be due not to gender itself but to differences in the sociodemographic profiles of men and women, multivariate regression was applied. Multivariate regression aims to study the relationship between overestimation/underestimation of risk tolerance and the gender of respondents, controlling the results for the educational level of the individuals' parents, household income, and knowledge regarding the universe of financial investments. The results of the regressions are presented in Table 1.

Table 1. Results of regressions on the role of gender in underestimation/overestimation of the level of risk tolerance.

	Model (1)	Model (2)	Model (3)	Model (4)
Const.	2.010 *** (<0.01)	2.154 *** (<0.01)	2.146 *** (<0.01)	3.269 *** (<0.01)
Male	0.469 ** (0.046)	0.518 ** (0.043)	0.504 * (0.059)	0.435 * (0.063)
Income	-	−0.058 (0.760)	−0.141 (0.512)	−0.136 (0.477)
Education_Father	-	-	0.219 (0.260)	0.221 (0.337)
Education_Mother	-	-	−0.141 (0.468)	−0.191 (0.378)
Knowledge	-	-	-	−0.401 ** (0.030)
Adjusted R^2	0.079	0.072	0.054	0.177

Notes: Regressions are estimated by the method of least squares with consistent standard deviations. The dependent variable is the deviation between subjective risk tolerance and risk tolerance indicated by the differential prediction model. Subjective risk tolerance is captured by the survey response, in which the individual assesses their risk tolerance, considering the following categories: aggressive (4 points), moderately aggressive (3 points), moderately conservative (2 points), and conservative (1 point). The variable "Male" is a binary variable that takes the value 1 if the individual is male and 0 if female. "Income" is a categorical variable that captures the income levels of respondents' parents according to the survey response, assuming the following categories: less than 20,000 euros (1 point), between 20,000 and 50,000 euros (2 points), between 50,000 and 100,000 euros (3 points), between 100,000 and 250,000 euros (4 points), and more than 250,000 euros (5 points). "Education_Father" and "Education_Mother" are categorical variables that capture, respectively, the academic qualifications of the respondent's father and mother, adopting the following categories: less than secondary education (1 point), secondary education (2 points), bachelor's degree (3 points), master's degree (4 points), and doctorate (5 points). "Knowledge" is a categorical variable indicating the perceived level of knowledge in the area of financial investments, in the following categories: very high (1 point), high (2 points), low (3 points), and very low (4 points). *p*-values are in parentheses. *, **, and *** refer to cases where the estimated coefficient is different from zero at significance levels of 10%, 5%, and 1%, respectively.

The results confirm that male individuals tend to overestimate their level of risk tolerance compared to female respondents. The effect is statistically significant at the 5% significance level in models (1) and (2). When controls related to the levels of parents' education and knowledge about investments are introduced, the variable of interest continues to be statistically significant but only at the 10% significance level.

It is also noteworthy to highlight the effect of knowledge about investments on the underestimation/overestimation of the level of risk tolerance. The introduction of this control variable produces an increase in the adjusted R^2 of model (4) compared to model (3), indicating the statistical relevance of this variable. The coefficient of the variable in question is negative and statistically significant at the 5% significance level, suggesting that a higher perceived level of knowledge in the area of investments is associated with a greater overestimation of risk tolerance.

4.2. Consistency in Predicting Risk Tolerance

To investigate the consistency between the subjective risk tolerance indicated by individuals and the risk tolerance measured by the psychometric test of Grable and Lytton (1999, 2003), we adopted the equivalence grid proposed by Pyles et al. (2016). According to these authors, individuals' choices should be considered consistent if they fall into one of the categories shown in Table 2.

Table 2. Categories of consistency between subjective and objective risk tolerance.

Individuals report that, regarding risk, they consider themselves to be (subjective risk tolerance):	And individuals record a result in the Grable and Lytton (1999, 2003) test within the following range:
Conservative	[0–22]
Moderately conservative	[19–28]
Moderately aggressive	[23–32]
Agressive	[29–47]

Source: Adapted from Pyles et al. (2016).

For example, an individual who classifies himself as moderately aggressive will have an opinion consistent with his objective risk tolerance if he scores between 23 and 32 points on the Grable and Lytton (1999, 2003) test.

Following these criteria, just over half of the individuals (51.15%) correctly predicted their level of risk tolerance. This percentage is significantly lower than the 65% observed by Pyles et al. (2016) in a sample that included students in China and the United States. Our conjecture is that students included in Pyles et al.'s (2016) sample have more frequent exposure to activities that allow them to assess their level of risk tolerance compared to the students in our sample. In the case of the United States, it is expected that contact with investments in the capital market is more frequent, given the importance of this institution in the country. In the case of respondents in China, the literature reports that gambling activity is common, which may contribute to individuals in this country exercising their prediction of risk tolerance (Tse et al. 2010).

The results regarding respondents' consistency in predicting their risk tolerance once again suggest that the gender variable is important. In the subsample composed of male individuals, the percentage of correct predictions reaches 58.19%, while in the subsample that includes female individuals, this percentage does not exceed 45.33%. This difference is statistically significant at the 5% significance level (p-value = 0.0113).

To verify if this gender difference in the degree of consistency in predicting risk tolerance can be attributed to the gender variable and not to differences in the sociodemographic characteristics of individuals, a multivariate analysis was conducted. Table 3 presents the results of logistic regressions regarding the accuracy of respondents in assessing risk tolerance, where the dependent variable is a binary variable that takes the value of one when the individual is consistent in this assessment and zero when the choice is not consistent.

The results of the regressions highlight the central role of the respondents' gender in determining the probability of individuals being consistent in predicting their level of risk tolerance. Thus, overall, these results corroborate the conclusions of the univariate analysis. The coefficient associated with the respondents' gender is the highest among all variables, demonstrating the central importance of this explanatory factor. Male individuals are more consistent in their predictions, even when controlling for variables that account for household income, the level of academic qualifications of the respondents' parents, and the knowledge individuals claim to have about investments in financial markets. The coefficient value in model (4) related to gender indicates that being male implies a roughly 20% higher probability of successfully predicting one's risk tolerance compared to being female, even after controlling for various sociodemographic variables. The difference between the two genders is statistically significant at a 1% level of statistical significance.

Regarding the control variables introduced in models (2) to (4), it is noteworthy that household income level, according to model (2), has a negative effect on the percentage of correct predictions by individuals (statistically significant results at a 10% significance level). However, this effect ceases to be statistically significant at the conventional levels of significance when additional control variables are introduced in models (3) and (4).

In general, our finding that being male is associated with a higher probability of making a correct prediction regarding the level of risk tolerance is consistent with the evidence reported by Moreschi (2005) for a sample from Australia and conflicts with the

results presented by Pyles et al. (2016) in a sample that includes students from the US and China.

Table 3. Results of logistic regression on the role of gender in the accuracy of assessing the level of risk tolerance.

	Model (1)	Model (2)	Model (3)	Model (4)
Const.	0.330 ** (0.030)	0.823 *** (<0.01)	0.981 *** (<0.01)	0.853 (0.141)
Male	0.518 ** (0.011)	0.643 *** (<0.01)	0.647 *** (<0.01)	0.664 *** (<0.01)
Income	-	−0.217 * (0.086)	−0.133 (0.368)	−0.123 (0.407)
Education_Father	-	-	−0.075 (0.566)	−0.081 (0.539)
Education_Mother	-	-	−0.062 (0.626)	−0.055 (0.668)
Knowledge	-	-	-	0.041 (0.813)
Adjusted R^2	0.004	0.009	0.004	0.0007

Notes: Logistic regressions with consistent standard errors are used, where the dependent variable is a binary variable that takes the value of 1 if the individual's subjective risk tolerance level is consistent with the objective risk tolerance level detected by the psychometric test of Grable and Lytton (1999, 2003) and 0 otherwise. Refer to Table 2 to check the categories of consistency between subjective and objective risk tolerance. Subjective risk tolerance is captured by the survey response where the individual assesses his own risk tolerance considering the following categories: aggressive (4 points), moderately aggressive (3 points), moderately conservative (2 points), and conservative (1 point). The variable "Male" is a binary variable that takes the value of 1 if the individual is male and 0 if the individual is female. "Income" is a categorical variable that captures the income levels of the respondents' parents according to the survey response, assuming the following categories: less than 20,000 euros (1 point), between 20,000 and 50,000 euros (2 points), between 50,000 and 100,000 euros (3 points), between 100,000 and 250,000 euros (4 points), and more than 250,000 euros (5 points). "Father's Education" and "Mother's Education" are categorical variables that capture the academic qualifications of the respondent's father and mother, respectively, adopting the following categories: less than Secondary Education (1 point), Secondary Education (2 points), Bachelor's degree (3 points), Master's degree (4 points), and Doctorate (5 points). "Knowledge" is a categorical variable indicating the perceived level of knowledge in the area of financial investments, in the following categories: very high (1 point), high (2 points), low (3 points), and very low (4 points). *p*-values are in parentheses. *, **, and *** refer to cases where the estimated coefficient is different from zero at significance levels of 10%, 5%, and 1%, respectively.

5. Discussion

This paper examines individuals' ability to predict their risk tolerance using a sample of 391 students from a Portuguese university. Our results suggest that the gender of the respondents is a key variable in their predictive ability. Men tend to overestimate their level of risk tolerance, while women, in general, consider their risk propensity to be lower than revealed through a psychometric test. Furthermore, the results reveal that the consistency of men in this prediction is considerably higher than that of women.

In general, our findings align with previous research. Men typically overestimate their risk tolerance, which is consistent with Grable and Roszkowski's (2007) findings in a sample from the United States. Additionally, our discovery that being male increases the likelihood of accurately predicting risk tolerance levels echoes the findings of Moreschi (2005) in an Australian sample but contradicts the results presented by Pyles et al. (2016) in a sample that includes students from the US and China.

Our results have important implications in different domains. Regarding research on the topic, the inconsistency between subjective and objective risk tolerance indicates that the choice between the two measures of risk propensity is not indifferent. Therefore, empirical analyses and results may be affected by the chosen measure, and caution should be exercised to avoid drawing incorrect conclusions.

Our findings carry important implications for the field of corporate finance. The literature shows that women tend to issue less debt and adopt a more conservative stance regarding corporate acquisitions (Huang and Kisgen 2013; Levi et al. 2014; Faccio et al. 2016). Furthermore, the presence of women on Boards of Directors has been associated with a decrease in firms' bankruptcy risk and litigation risk (Liu 2018; Cho et al. 2021; Zheng and Wang 2023). According to our results, the behavior of female members of the board in this case does not adequately reflect their preferences. In fact, our results suggest that these individuals perceive themselves as less tolerant than they truly are. Consequently, it can be inferred that the strategies followed by female corporate managers should be more aggressive to better align with their underlying preferences.

A mistaken perception of one's own level of risk propensity can have other significant financial consequences. If an individual expresses a preference for a risk level that is, in reality, excessively high or low relative to their latent preferences, it is expected that analysts and financial advisors, given the available information, may recommend investment and savings alternatives that do not align with the individual's preferences. The prevalence of individuals with excessive exposure to financial risk, manifested through an exaggerated investment in assets with high volatility, can lead to significant social problems, particularly during periods of heightened financial market instability.

Our results also indicate that financial advisors are more likely to recommend excessively risky investments to male individuals and overly prudent investments to female individuals. This can help us understand empirical evidence concluding that investment portfolios held by men tend to exhibit significantly higher levels of risk than those held by women (Jianakoplos and Bernasek 1998; Neelakantan 2010; Montford and Goldsmith 2016). Additionally, there are indications that portfolio diversification, measured by the number of stocks it comprises, is less efficient in the case of male investors, although the evidence in this regard is less conclusive (e.g., Abrahamson 2016). To this extent, a better understanding of the determinants of inconsistencies in assessing risk tolerance will also be useful for the financial services sector, particularly in countries where regulations require the assessment of clients' risk profiles. This is the case in the United States and European Union countries, where standards and directives mandate that financial intermediaries evaluate their clients' risk propensity to present the most suitable investment solutions. Our results can be useful for analysts and financial advisors, as they indicate sociodemographic characteristics, particularly in terms of gender, that are associated with a higher probability of incorrectly assessing individuals' risk tolerance levels.

The evidence presented in the current paper also has implications in non-financial domains. For example, in the field of medicine, it is plausible to assume that doctors may recommend treatments to their patients to reflect the preferences expressed by these individuals regarding the acceptable level of risk. Our results suggest that clinicians are more likely to recommend treatments involving excessive risk to male individuals, as they tend to overestimate their risk tolerance. These findings align with empirical evidence indicating that men undergo more aggressive treatments than women with the same pathology (Chu et al. 1996; Gan et al. 2000). Concerning consumer choices, the evidence that men tend to overestimate their level of risk tolerance suggests that they are more likely to exhibit less brand loyalty. This is because they may be more inclined to take risks and try different products, even if, ultimately, these choices may not align with their true interests.

6. Conclusions, Limitations, and Suggestions for Further Research

This study investigates individuals' capacity to anticipate their risk tolerance, using a sample of 391 students from a university in Portugal. To the best of our knowledge, this is the first study on the subject conducted in the context of a European country. Our findings, obtained through the use of differential prediction models and models employing limited dependent variables (logit models), indicate that respondents' gender significantly influences their predictive accuracy. Specifically, men tend to overestimate their risk tolerance, while women generally perceive their propensity for risk as lower

than indicated by psychometric evaluations. Moreover, the results highlight a notable disparity in predictive consistency between genders, with men demonstrating considerably higher consistency than women. Male gender correlates with a 20% higher likelihood of maintaining consistency in predicting risk tolerance compared to female counterparts, even after adjusting for various sociodemographic factors.

Our study presents some limitations. For instance, one could discuss the validity of using samples with students in our analysis, raising the objection that the values obtained for the indicators are probably not representative of financial decision-makers in the broader population This is due to the fact that students typically lack financial independence and professional investment experience. As a result, their perception of financial decisions may deviate from reality, particularly when these decisions are made with the aim of achieving financial stability and advancement. However, there are reasons to argue that this is not a significant problem, since various analyses involving samples with non-student participants have validated results obtained in student samples. For example, in dictator, ultimatum, and trust games, Carpenter et al. (2003) and Falk et al. (2012) found no significant differences in results between student participants and other individuals. More directly related to the theme of our article, Yang (2004) applied the Grable and Lytton (1999, 2003) test to a group of adult individuals and a group of undergraduate students, finding no significant differences in reliability between the results obtained in each of the two groups.

Another possible limitation is that the perceived level of risk tolerance by individuals is probably not a static variable, as it may vary over time and in reaction to historically significant events. For instance, Sahm (2012) and Cunha and Lobão (2022) showed that macroeconomic conditions and the occurrence of financial crises have a significant impact on the risk tolerance levels of economic agents.

There are also some limitations inherent to the survey method adopted in this study. As argued by Schooley and Worden (1996) and Kimbal et al. (2007), questions using expressions like "substantial", "above average", and "average" may carry a significant dose of subjectivity, leading them to be interpreted differently by various respondents. Being aware of this issue is crucial, even though overcoming it is inherently challenging due to its prevalence in most questionnaires designed to assess individuals' risk tolerance levels.

There is still much to study regarding individual perceptions of risk tolerance. In future research, it would be interesting to explore the impact of variables such as financial literacy, national culture, or the presence of distinct cognitive profiles (including behavioral biases such as overconfidence or optimism) on how individuals perceive their capacity to embrace risk. Furthermore, it would be beneficial to employ alternative data analysis methods, such as machine learning techniques and mixed models, to more effectively explore the presence of complex and non-linear relationships among the variables considered in studying the topic.

Appendix A. Questionnaire Created by Grable and Lytton (1999, 2003) to Assess Respondents' Risk Tolerance

1. In general, how would your best friend describe you as a risk taker?

___ A real gambler

___ Willing to take risks after completing adequate research

___ Cautious

___ A real risk avoider

2. You are on a TV game show and can choose one of the following. Which would you take?

___ €1000 in cash

___ A 50% chance of winning €5000

___ A 25% chance of winning €10,000

___ A 5% chance of winning €100,000

3. You have just finished saving for a "once-in-a-lifetime" vacation. Three weeks before you plan to leave, you lose your job. You would:

___ Cancel the vacation

___ Take a much more modest vacation

___ Go as scheduled, reasoning that you need the time to prepare for a job search

___ Extend your vacation, because this might be your last chance to go first-class.

4. If you unexpectedly received €20,000 to invest, what would you do?

___ Deposit it in a bank account

___ Invest it in safe high quality bonds or bond mutual funds

___ Invest it in stocks or stock mutual funds

5. In terms of experience, how comfortable are you investing in stocks or mutual funds?

___ Not at all comfortable

___ Somewhat comfortable

___ Very comfortable

6. When you think of the word "risk" which of the following words come to mind first?

___ Loss

___ Uncertainty

___ Opportunity

___ Excitement

7. Some experts are predicting prices of assets such as gold, jewels, collectibles, and real estate (hard assets) to increase in value; although bond prices may fall, experts tend to agree that government bonds are relatively safe. Most of your investment assets are now in high interest government bonds. What would you do?

___ Hold the bonds

___ Sell the bonds, put half the proceeds into bank accounts, and the other half into hard assets.

___ Sell the bonds and put the total proceeds into hard assets.

___ Sell the bonds, put all the money into hard assets, and borrow additional money to buy more.

8. Given the best and worst case returns of the four investment choices below, which would you prefer?

___ €200 gain best case; €0 gain/loss worst case

___ €800 gain best case; €200 loss worst case

___ €2600 gain best case; €800 loss worst case

___ €4800 gain best case; €2400 loss worst case

9. In addition to whatever you own, you have been given €1000. You are now asked to choose between:

___ A sure loss of €500

___ A 50% chance to lose €1000 and a 50% chance to lose nothing.

10. In addition to whatever you own, you have been given €2000. You are now asked to choose between:

___ A sure loss of €500

___ A 50% chance to lose €1000 and a 50% chance to lose nothing.

11. Suppose a relative left you an inheritance of €100,000, stipulating in the will that you invest ALL the money in ONE of the following choices. Which would you select?

___ A savings account or money market mutual fund

___ A mutual fund that owns stocks and bonds

___ A portfolio of 15 common stocks

___ Commodities like gold, silver, and oil

12. If you had to invest €20,000, which of the following investment choices would you find the most appealing?

___ 60% in low-risk investments, 30% in medium-risk investments, and 10% in high-risk investments

___ 30% in low-risk investments, 40% in medium-risk investments, and 30% in high-risk investments

___ 10% in low-risk investments, 40% in medium-risk investments, and 50% in high-risk investments.

13. Your trusted friend and neighbor, an experienced geologist, is putting together a group of investors to fund an exploratory gold mining venture. The venture could pay back 50 to 100 times the investment if successful. If the mine is a failure, the entire investment is worth nothing. Your friend estimates the chance of success is 20%. If you had the money, how much would you invest?

___ Nothing

___ One month's salary

___ Three month's salary

___ Six month's salary

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