Creating a financial profile test – factors that impact the financial risk tolerance of individuals and their financial profile classification

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Dissertation written under the supervision of Professor Rute Xavier, with the collaboration of industry expert Doutor Finanças

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Abstract

The research paper “Creating a financial profile test – factors that impact the financial risk tolerance of individuals and their financial profile classification” was written by Florentine Kügler and examines how to construct a financial profile test based on the concept of financial risk tolerance while considering other significant factors. Previous research has shown that the concept is multidimensional and is significantly affected by sociodemographic variables as well as the level of financial literacy. When assessing financial literacy, it is important to acknowledge that the self-assessment of financial literacy is barely representative of a person's actual level of knowledge. In this paper financial literacy was measured through self-assessment and three test questions on compound interest, inflation, and diversification. Financial risk tolerance was measured through a questionnaire, which assessed several dimensions. This allowed testing the impact of financial literacy and sociodemographic factors on financial risk tolerance. Afterwards, a cluster analysis was applied to characterize the financial profiles. The results showed that gender, income, and age have a significant impact on financial risk tolerance, as opposed to financial literacy and education, which is in strong contrast to existing research. In terms of financial profiling, the analysis found that individuals can be classified into low, medium, and high risk tolerance profiles in combination with income, gender, and age.

Keywords: financial risk tolerance, financial literacy, financial profile, financial risk assessment

O resumo

O trabalho de investigação "Teste de perfil financeiro - factores que influenciam a tolerância ao risco financeiro dos indivíduos e a classificação do seu perfil financeiro" foi escrito por Florentine Kügler e analisa a construção de um teste de perfil financeiro com base no conceito de tolerância ao risco financeiro, considerando outros factores significativos. Estudos anteriores mostraram que o conceito é multidimensional e significativamente afectado por variáveis sociodemográficas, bem como pelo nível de literacia financeira. Ao avaliar a literacia financeira, é importante reconhecer que a auto-avaliação da literacia financeira não corresponde ao nível real de conhecimentos de uma pessoa. Neste estudo, a literacia financeira foi medida através de uma auto-avaliação e de três perguntas sobre juros compostos, inflação e diversificação. A tolerância ao risco financeiro foi medida através de um questionário que avaliava várias dimensões. Isto permitiu examinar o impacto da literacia financeira e dos factores sociodemográficos na tolerância ao risco financeiro. Posteriormente, foi aplicada uma análise de clusters para caracterizar os perfis financeiros. Os resultados mostraram que o género, o rendimento e a idade têm um impacto significativo na tolerância ao risco financeiro, ao contrário da literacia financeira e da educação, o que contrasta fortemente com a pesquisa existente. Em termos de perfil financeiro, a análise revelou que os indivíduos podem ser classificados em perfis de tolerância ao risco baixo, médio e elevado, em combinação com o rendimento, o género e a idade.

Palavras-chave: tolerância ao risco financeiro, literacia financeira, perfil financeiro, avaliação do risco financeiro

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1) Introduction

In 2022, the Financial Conduct Authority reacted to the rise of social media channels promoting unregulated financial advice and removed over 8,000 misleading promotions. Compared with 2021, the number of removed ads increased by 14 times.[1] Social media accounts that advertise or give financial advice can spread financial content easily across a global audience. The result of following unregulated financial advice can be disastrous. Financial literacy, which the European Commission defines as "the knowledge and skills needed to make important financial decisions,"[2] reduces the impact of such trends and helps people develop a certain awareness through basic financial knowledge. Financial profile tests can help assess a person's financial literacy and are therefore particularly useful.

However, it is not sufficient to determine only the level of financial literacy if the next step is to take concrete financial actions. A financial risk tolerance assessment is the missing element in this scenario because it allows the user not only to understand a financial product or advice, as in the case of financial literacy, but also to determine whether that financial product or advice is consistent with their financial risk tolerance and, therefore, appropriate. The importance of financial risk tolerance is described by Hermansson and Jonsson (2021), who highlighted that it influences all economic decisions and also provides deep insights into individuals' financial behavior; in other words, it provides insights into the financial product that an individual is more likely to choose. A financial profile test that combines the assessment of financial literacy and financial risk tolerance is therefore valuable not only for users who want to evaluate the appropriateness of financial products but also for the company offering financial services, which could preselect possible products.

In reviewing the research to date, it is clear there are not just one but several factors that influence individuals' financial risk tolerance. These factors are not limited to psychological but also include sociodemographic and attitudinal characteristics (Carducci and Wong, 1998; Grable and Joo, 1997).

[1] Financial Conduct Authority (2023): https://www.fca.org.uk/news/press-releases/financial-watchdog-blocks-thousands-misleading-ads.
[2] European Commission: https://finance.ec.europa.eu/consumer-finance-and-payments/financial-literacy_en.

While the effects of general sociodemographic factors have been extensively studied, there is little research related to financial literacy, especially toward an assessment test that analyzes the financial literacy of an individual as well as their financial risk tolerance.

This research paper is part of a consulting project with Doutor Finanças, a credit broker in Lisbon, Portugal, founded in 2014 with the goal to improve the financial health of Portuguese families. Since then, the company has grown rapidly and now employs over 170 people. It offers customized financial services support for mortgage loans, consolidated and personal loans, life and property insurance, and energy efficiency and investment solutions. Through its customer service department, the company provides customers with assistance in loan applications and negotiations or generally answering questions related to personal finances. Additionally, Doutor Finanças offers various articles and tools on personal money management to improve financial literacy in Portugal.[3]

To target clients and prospects with more suitable financial products, Doutor Finanças requires deeper insights into the risk tolerance levels, demographics, and financial literacy of interested individuals. A financial profile test can provide this kind of information. Thus, this study examines how to create a financial profile test, focusing on how financial risk tolerance can be analyzed, which other factors of individuals' financial risk tolerance should be included as part of the assessment, and which evaluation methods exist to classify individuals into different financial risk profiles.

For this study, financial risk tolerance is defined as "the maximum amount of uncertainty that someone is willing to accept when making a financial decision" (Grable, 2000). In the context of this research, the following key questions are answered: Which models for testing financial risk profiles already exist? Which evaluation methods can be used to classify individuals into different financial risk tolerance profiles? Which sociodemographic factors may influence an individual's financial risk tolerance? What impact does financial literacy have on financial risk tolerance? To address these research questions, an assessment of the existing literature on financial risk tolerance tests for individuals is conducted. A particular focus is placed on existing financial risk profile tests, the factors included in them, and the categorization of financial risk profiles.

[3] Doutor Finanças: https://www.doutorfinancas.pt/sobre-doutor-financas/.

An online survey is then conducted to analyze the statistical significance of sociodemographic factors and financial literacy as they impact financial risk tolerance. Subsequently, the results of the survey and the existing research are compared to draw a conclusion and answer the question of how a financial profile test can be created.

2) Literature Review

2.1 Factors that impact financial risk tolerance

To develop a financial profile based on financial risk tolerance and financial literacy, it is important to closely consider existing research in these two areas. The factors that influence financial risk tolerance and how financial literacy and risk tolerance are assessed are of great relevance in this context. Immediately apparent is the significant role of sociodemographic variables within the financial risk tolerance assessment. For example, it is widely understood that gender has a significant impact on financial risk tolerance (Fisher and Yao, 2017; Grable, 2000; Brooks et al., 2019). Several studies have found that women tend to be more risk-averse than men. They also show a lower financial risk tolerance than men. In this context, however, it is important to note that gender itself is not the origin of this result but is influenced by other moderating variables such as income and financial knowledge (Fisher and Yao, 2017; Brooks et al., 2019).

Another important sociodemographic variable impacting financial risk tolerance is age. Brooks et al. (2018), Grable (2000) and Yao et al. (2011) have discovered a negative relationship between age and risk tolerance, although several variables influence this effect, for example, gender, education level, and wealth (Brooks et al., 2018). Some reasons that explain the decrease in risk tolerance with age are, first, the shorter investment horizon and the shortened timeframe people have to recover from losses, and second, the start of retirement, which shifts the focus more to wealth preservation rather than investment (Yao et al., 2011). More closely analyzing factors such as income and acquired education, it has also been established that individuals with higher income as well as a higher education have a higher risk tolerance than those with lower income and lower levels of education (Grable, 2000; Yao et al., 2011).

2.2 The role of financial literacy and its data collection

Another important aspect repeatedly mentioned in combination with financial risk tolerance is a person's financial literacy. When analyzing the effects of financial literacy on financial risk tolerance, it has been shown that knowledge about personal finances does indeed influence financial risk tolerance to a high degree. Grable (2000) discovered in a survey questioning college students and staff at a university that respondents with higher levels of financial knowledge displayed a higher financial risk tolerance than those with less financial knowledge. Brooks et al. (2019) came to a similar conclusion and showed that the more financial knowledge a person has, the higher their risk tolerance is. When comparing gender, it is clear there is a significant difference. Razen et al. (2021), as well as Brooks et al. (2019), have found that male gender is positively associated with financial literacy. Women, on the other hand, tend to have less investment experience and financial literacy than men. Because of this gender gap and the importance of financial literacy in financial risk tolerance, the difference between men and women in terms of their risk tolerance can be easily explained. However, as soon as women have financial literacy, the differences in risk tolerance between men and women are reduced (Brooks et al., 2019).

Nonetheless, financial literacy without accounting for other variables, such as sociodemographic factors, has a strong effect on financial risk tolerance. Hermansson and Jonsson (2021) have found that both financial literacy and financial interest are positively associated with higher risk tolerance, although financial interest scored a slightly higher result in regard to the association. When assessing financial literacy, there is a basic understanding that self-assessments of one's own financial knowledge should be treated with caution. Kramer (2016) discovered that such self-assessment is not effective when evaluating the need for financial advice or determining the right financial product. However, when the self-assessment is combined with a measured approach, the result can be more representative of the actual knowledge levels. Moreover, Anderson et al. (2017) examined the connection among financial literacy, precautionary savings, and retirement planning. Their study also highlighted the problematic nature of self-assessment as it became clear that one's self-perception rarely reflects actual financial literacy knowledge.

2.3 Financial risk tolerance assessment models and risk profile classification

In regard to assessing financial risk tolerance, it is generally recommended to use multidimensional questionnaire assessments as financial risk tolerance consists of various dimensions that may vary depending on the model being applied. The Grable and Lytton scale (2003) has had a major impact on the assessment of individuals' financial risk tolerance. A multidimensional 13-item questionnaire was designed to examine portfolio composition, gender, education level, marital status, income, and ethnic background in relation to financial risk tolerance. Fundamental to this assessment is the recognition that equity assets such as stocks are considered high-risk and should therefore indicate a high risk tolerance, while cash assets for example, are not considered risky. The evaluation of the individual portfolio composition proved successful due to the positive correlation between financial risk tolerance and equity ownership. Bivariate and multivariate analyses were applied to assess significance levels between financial risk tolerance attitudes and behaviors, while regression analysis was used to further analyze risk tolerance and asset ownership (Grable & Lytton, 2003). However, the model cannot be applied to assess the risk tolerance of individuals who do not own investable assets or lack financial literacy.

Another approach that has been successfully employed to evaluate the risk tolerance of individuals is data envelopment analysis. Cooper et al. (2014) used a two-stage assessment through data envelopment analysis. To create a clear definition of financial risk tolerance and for the right assessment, Copper et al. (2014) defined the following dimensions as part of the risk tolerance concept: risk propensity, risk attitude, risk capacity, and knowledge. The decision to use the data envelopment analysis stems from the criticism that a simple scoring of financial risk tolerance based on the number of points an individual receives does not take into account relationships among questions in a risk tolerance test. Cooper et al. (2014) thus developed a questionnaire targeted for the data envelopment analysis that included a relative risk tolerance assessment tailored to the four dimensions. The results indicated that these dimensions had only a weak correlation with each other. However, like the Grable and Lytton (2003) scale, the model was designed for individuals who have at least limited knowledge about investing and financial concepts.

Carducci and Wong (1998) took a completely different approach when they categorized the respondents as Type A and Type B using a survey in which participants were exposed to various statements about financial risk situations in daily life. Based on the scores, ranging from 20 (low risk-taking) to 40 (high risk-taking), and their behavioral pattern, which was assessed with the Jenkins Activity Survey for Health Predictions (JAS; Jenkins et al., 1971), individuals were categorized into "Type A" and "Type B" profiles. "Type A" profiles exhibited a behavioral pattern with a tendency toward achievement-seeking and hostility in interpersonal relationships, which seemed to affect financial risk tolerance to a great degree. Based on this approach, Grable (2000) used the risk tolerance assessment to evaluate the influence of sociodemographic, psychological, and financial knowledge variables. Using a multidimensional survey, an average score was calculated for each respondent. Depending on the respondent's risk tolerance score, people were categorized into low-, average, or high-risk tolerance profiles. Additionally, the behavioral questionnaire for "Type A" and "Type B" classifications has been used to assess people within the two profiles.

A specific use case for financial advisors related to financial risk profile models was presented by Hartnett et al. (2019). Through a 25-item psychometric questionnaire, the financial risk tolerance and inter-item response variation were measured. The choice to include the inter-item response variation was based on the concern that widespread responses by an individual within the assessment would result in a central location of the overall index score, making the individual appear to be risk-neutral. In contrast to the previously mentioned financial risk tolerance definitions, the focus of Hartnett et al. (2019) was placed solely on psychological traits. The results clearly showed that, due to the inter-item response variation in combination with psychological factors, not every respondent displays a clear level of risk tolerance. Therefore, it was strongly recommended to combine the risk tolerance assessments with the inter-item response variation to account for low-trait risk tolerance. In addition, it was suggested to combine the survey with the displayed financial behavior as well as the portfolio composition of the individual to match the results with the risk tolerance assessment.

Grable et al. (2019) also focused on a psychometric assessment but in combination with a risk tolerance scale. Using the Barsky et al. (1997) questionnaire and the Grable and Lytton (1999) survey, respondents were asked about their household portfolio allocation in different asset classes and were categorized into low, below-average, average, above-average, or high-risk tolerance profiles.

While the Barsky et al. (1997) scale was found to be statistically insignificant in conjunction with the household's allocation to equities or equity securities, the Grable and Lytton (1999) scale showed a significant result in the direction of holding equities (positive correlation) and cash (negative correlation). As mentioned, the advantages of this assessment are mostly applicable to respondents with a basic understanding of financial concepts who own equity or other high-risk assets. However, for this research paper, a risk tolerance and financial literacy assessment must be conducted that also considers respondents with no previous financial literacy and assesses the behavior of individuals in daily financial situations. At the same time, financial literacy must include not only a self-assessment but also some questions about basic financial knowledge to reduce the probability of misjudging one's own abilities.

The Grable & Lytton (1999) survey includes, in addition to investment-related topics, a series of financial risk situations in which participants must choose a certain action. Based on their investing behavior and their behavior in financial risk situations, respondents score within an index of low to high risk tolerance. After Grable & Lytton (1999) conducted a factor analysis, the original 20-item questionnaire was reduced to 13 items covering the dimensions of investment risk, risk comfort and experience, and speculative risk. That 13-item questionnaire was used as the basis for this research and extended with questions regarding financial literacy assessment, which cover one self-assessment and three financial test questions.

3) Methodology

For the methodology, a quantitative approach was chosen, which is based on the data of an online survey collected through an online questionnaire. As this study is conducted as part of a consulting project with the credit broker Doutor Finanças, the financial risk tolerance as well as the financial literacy assessment should be as convenient as possible for (potential) customers and the customer service agents of Doutor Finanças. Using a questionnaire that can be filled out online, the method applied in this paper aligns with the goal of Doutor Finanças to create a convenient financial profile test. A quantitative approach through an online survey reflects this objective and can also capture a broader result by collecting multiple responses across different sociodemographic groups. Additionally, when referring to research papers about financial risk tolerance or financial literacy assessment, the quantitative approach of collecting data through questionnaires is the preferred method across all examined papers (Hartnett et al., 2019; Grable and Lytton, 1999; Hermansson and Jonsson, 2021; Kramer, 2016; Anderson et al., 2017).

To answer the research questions about the evaluation method for the classification of individuals into different risk profiles, the influence of sociodemographic variables, and the impact of financial literacy on risk tolerance, the following research hypotheses were formulated for examination:

H1: Sociodemographic factors have a significant impact on financial risk tolerance.

H1a: Men are more risk-tolerant than women.

H1b: Respondents below the age of 45 have a higher risk tolerance than respondents at the age of 45 or older.

H1c: Participants who completed higher education have a higher financial risk tolerance than participants who did not complete higher education.

H1d: People with a high income have a higher financial risk tolerance than people with a lower income.

H2: Financial literacy has a significant impact on financial risk tolerance.

To investigate these hypotheses, a 26-item questionnaire was developed to analyze the respondents' financial risk tolerance, sociodemographic data, and financial literacy.
The questionnaire was provided in German and English and can be referred to in the appendix of this paper. The financial risk tolerance questions (see appendix: Q3–Q7 and Q9–16) were taken from Grable and Lytton's (1999) survey as the consistency and statistical power of the questionnaire has already been demonstrated (Kramer, 2016; Grable, 2019). Some of the questions were adapted to the current time and economic situation as well as to the euro currency since the survey was conducted in Lisbon, Portugal. The three test questions for the financial literacy assessment were taken from the "2004 Health and Retirement Study Module 8"[4] (see appendix: Q21-Q23) as they cover different dimensions of financial literacy such as compound interest, diversification, and inflation and have been shown to be reliable in assessing financial literacy (Anderson et al., 2017). The self-assessment question (see appendix: Q20) was adapted from Kramer (2016) who has successfully used this self-assessment question in combination with a financial literacy test.

[4] HRS: https://hrs.isr.umich.edu/documentation/questionnaires.

4) Data Analysis

The online survey was published on various social media channels, including LinkedIn and Instagram, and 1,054 responses were collected. After cleaning the dataset, n = 238 responses remained for further data analysis. All sociodemographic questions contained the option "prefer not to say." Of the response number of n = 238, 43.7% were from men and 52.5 % from women; 1.3% of responses belong to nonbinary/third-gender respondents, and 2.5% of responses came from individuals who chose the option "prefer not to say."

Regarding the age structure, the following distribution within the age groups was found: under 18 years old (1.3%), 18–24 years old (25.6%), 25–34 years old (41.6%), 35–44 years old (15.1%), 45–54 years old (6.3%), 55–64 years old (5%), and 65+ years old (2.9%). The "prefer not to say" option accounted for 2.1% of the responses.

When asked about the highest level of education completed, the majority of respondents indicated they have a bachelor's degree (35.3 %). The second largest group is represented by the option "some university but no degree" (23.9%). In third place is a graduate or professional degree (13.9%). Vocational training or similar was completed by 12.6% of the respondents. The lowest percentages were found for "some secondary education" (2.1%), "completed secondary school" (9.2%), and "prefer not to say" (2.9%).

In terms of total income before taxes during the past 12 months, the distribution is lowest at the income end of the scale, with 2.5% of respondents earning more than 200,000 euros per year and 2.5% earning between 100,000 and 199,999 euros per year. Participants with an annual income of 50,000–99,999 euros per year comprised 27.7%. The income range of 25,000–49,999 euros per year accounts for 27.30% of the respondents, and 16.8% indicated an income range of 20,000–24,999 euros per year. The income range below 20,000 euros per year was represented by 16% of the respondents.

Category	Subcategory	Frequency	Percent
Gender	Male	104	43.70%
	Female	125	52.50%
	Nonbinary / third gender	3	1.30%
	Prefer not to say	6	2.50%
Age	Under 18 years old	3	1.30%
	18–24 years old	61	25.60%
	25–34 years old	99	41.60%
	35–44 years old	36	15.10%
	45–54 years old	15	6.30%
	55–64 years old	12	5%
	65 + years old	7	2.90%
	Prefer not to say	5	2.10%
Education	Some secondary education	5	2.10%
	Completed secondary school	22	9.20%
	Vocational or similar	30	12.60%
	Some university but no degree	57	23.90%
	Graduate or professional degree	33	13.90%
	Prefer not to say	7	2.90%
Income	Less than 20,000 euros per year	38	16.00%
	20,000–25,000 euros per year	40	16.80%
	25,000–49,999 euros per year	65	27.30%
	50,000–99,999 euros per year	66	27.70%
	100,000–199,999 euros per year	6	2.50%
	More than 200,000 euros per year	6	2.50%
	Prefer not to say	17	7.10%
Total		238	100%

Figure 1. Sociodemographic data (Source: Survey data)

To determine the number of correct answers for each question of the financial literacy test, three nominal variables were created for the test questions (see appendix: Q21–Q23) on compounding, inflation, and diversification, each with two levels (1 = correct answer or 0 = incorrect answer).

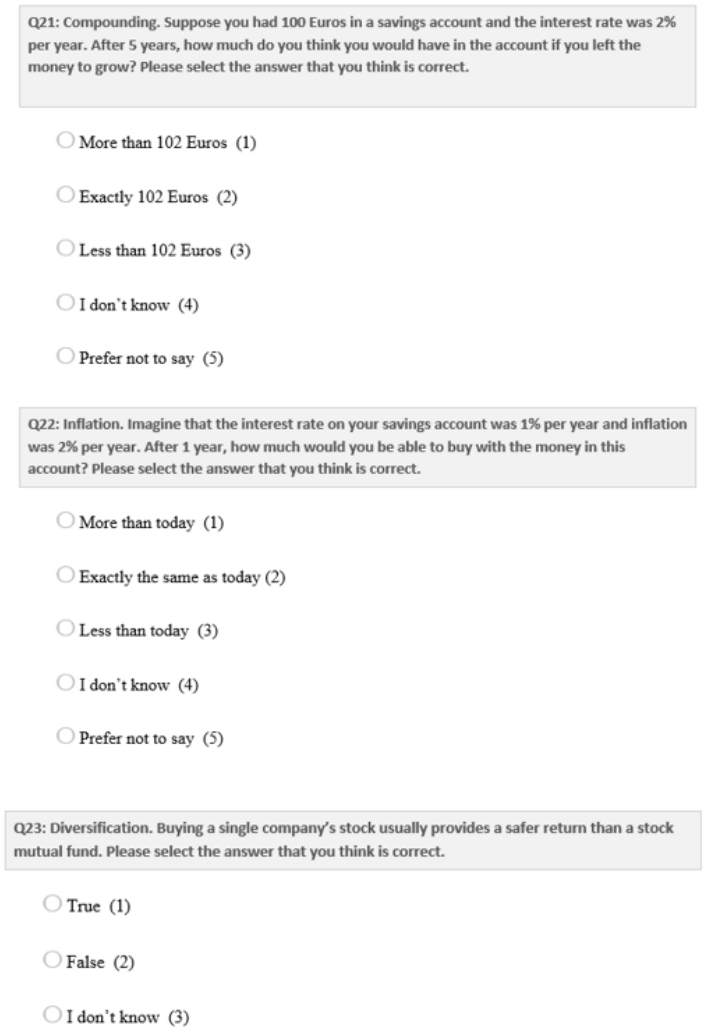

Figure 2. Financial literacy test questions (Source: Survey Script & Health and Retirement Study, 2004)

The financial literacy test score was formed from these three nominal variables by adding the number of cases (1 = correct answer or 0 = wrong answer) for the variables. This newly created four-level ordinal variable consists of the levels "no financial literacy measured (0/3 questions)," "low financial literacy (1/3 questions) measured," "medium-level of financial literacy (2/3 questions) measured," and "high level of financial literacy (3/3 questions) measured."

To compare the financial literacy test score with the seven-level interval variable "Self-assessment of financial literacy" (see appendix: Q18), an ordinal regression was conducted. For this method, the financial literacy self-assessment variable is defined as an independent variable to determine the predictability of the self-assessment in relation to the financial literacy test score.

For the calculation of the financial risk tolerance score, each answer to every financial risk tolerance question (see appendix: Q3–Q7 and Q9–Q16) was assigned a value from 1, indicating the lowest financial risk tolerance score, to 4, indicating the highest financial risk tolerance score. To calculate the financial risk tolerance score, all scores obtained for every single risk tolerance question were added together. This approach was chosen because it has already been validated by Grable and Lytton (1999). Afterward, the interval variable "financial risk tolerance score" was created, ranging from the lowest score of 13 points to the highest score of 47 points. To account for potential interaction effects between the sociodemographic and the financial literacy score variables that might influence the effect on financial risk tolerance, an N-way ANOVA test was conducted. In particular, the variables "financial literacy" and "income" were considered as moderators of the relationship between "gender" and "financial risk tolerance score." As further moderator variables, "gender," "education," and "income," as well as their possible interaction effect on the relationship between "age" and "financial risk tolerance score," were considered. Because these moderator variables have been identified in different research papers on financial risk tolerance, they are particularly relevant for this analysis (Fisher & Yao, 2017; Brooks et al., 2019; Brooks et al., 2018).

To measure whether there is a statistically significant result with the N-way ANOVA test, the p-value must be below the threshold of $\alpha = 0.05$. Responses of "prefer not to say" were kept in all sociodemographic variables within the test to account for potential effects. These sociodemographic variables were coded into different levels (Fig. 3) to, first, account for the research interest in the hypotheses and, secondly, to form groups where the number of responses does not vary significantly in size. In the N-way ANOVA as well as in the multivariate regression analysis, the "Nonbinary/third gender" responses were merged with the "prefer not to say" responses within the "gender" category due to the lack of representation in this study as well as the focus of this study on differences between male and female respondents.

Variable	Level	Frequency	Percent
Gender	Male	104	43.70%
	Female	125	52.50%
	Other	9	3.80%
Total		238	100%
Age	Under 18–24 years old	64	26.90%
	25–34 years old	99	41.60%
	35–44 years old	36	15.10%
	45 years old and older	34	14.30%
	Prefer not to say	5	2.10%
Total		238	100%
Education	Secondary education and/or vocational training	57	23.90%
	Some university but no degree	57	23.90%
	Graduate or professional degree	117	49.20%
	Prefer not to say	7	2.90%
Total		238	100%
Income	Less than 20,000–24,999 euros per year	78	32.80%
	25,000–49,999 euros per year	65	27.30%
	50,000 euros per year or above	78	32.80%
	Prefer not to say	17	7.10%
Total		238	100%
Financial Literacy	No financial literacy measured	47	19.10%
	Low financial literacy measured	59	24.80%
	Medium financial literacy measured	67	28.20%
	High financial literacy measured	65	27.30%
Total		238	100%

Figure 3. N-way ANOVA variables (Source: Survey data)

For the multivariate regression analysis, several dummy variables were created to determine the impact of sociodemographic factors and financial literacy on the financial risk tolerance score. “Prefer not to say” responses were recoded into separate dummy variables to distinguish between specified sociodemographic characteristics and their effect on financial risk tolerance while also taking into account potential effects from undisclosed sociodemographic characteristics. Based on the hypotheses, the dummy variables contained the same levels as determined in the N-way ANOVA test but are split into binary variables so that each level within the N-Way ANOVA was created as a separate binary variable:

- **Gender dummy variables:** female; other (“prefer not to say” and “nonbinary / third gender”); impact variable: male
- **Age dummy variables:** 25–34 years old; under 18–24 years old; 35–44 years old; prefer not to say; impact variable: 45 years old or older
- **Income dummy variables:** under 20,000–24,999 euros per year; 25,000–49,999 euros per year; prefer not to say; impact variable: 50,000 euros per year or above
- **Education dummy variables:** secondary school education and/or vocational training; some university but no degree; prefer not to say; impact variable: college or professional degree (bachelor, master, MBA, PhD, etc.)
- **Financial literacy dummy variable:** no financial literacy (score: 0/3) measured; low financial literacy (score: 1/3) measured; medium financial literacy (score: 2/3) measured; impact variable: high financial literacy (score: 3/3) measured

To reject H0, the p-value must be below $\alpha = 0.05$. Collinearity diagnostics and the Durbin-Watson test were included in the analysis. Based on the significance of the results, a two-step cluster analysis was conducted, including the “financial risk tolerance score” variable and the sociodemographic variables as well as the “financial literacy score” variable from the multivariate regression analysis, if a significant result was recorded. To better control potential outliers in the cluster analysis and to properly characterize the clusters, all selected sociodemographic variables excluded “prefer not to say” responses, while the variable “gender” also excluded the “third gender” responses. This allowed us to characterize the clusters not only by the level of financial risk tolerance but also by sociodemographic characteristics, while at the same time improving the noise handling of outliers.

The decision for the two-step cluster analysis stems from the fact that most of the examined independent variables are categorical, which makes a two-step cluster analysis ideal. SPSS, the statistical software used for data analysis, determined the number of clusters automatically.

For the cluster analysis, the categorical variables had the same levels as the variables used in the N-way ANOVA and in the multivariate regression, only without the "prefer not to say" and "nonbinary/third gender" responses, namely, gender (I: male, II: female), age (I: under 18–24 years old, II: 25–34 years old, III: 35–44 years old, IV: 45 years old or older), income (I: under 20,000–24,999 euros per year, II: 25,000–49,999 euros per year, III: 50,000 euros per year or above), education (I: vocational training or secondary education, II: some university but no degree, III: college or professional degree), financial literacy (I: no financial literacy measured, II: low financial literacy measured, III: medium financial literacy measured, IV: high financial literacy measured).

5) Results

5.1 Ordinal regression—the financial literacy score

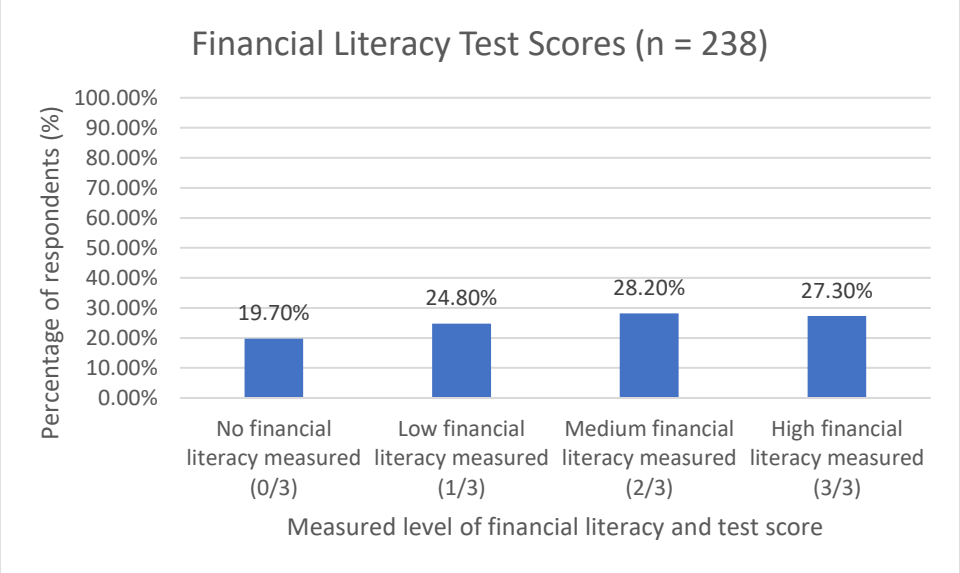

Figure 4. Financial literacy test scores (Source: Survey data)

Analyzing the results of the respondents' financial literacy test, it is immediately clear that the majority answered at least two questions correctly (28.20%), while respondents who answered all three questions correctly comprise the second largest percentage (27.30%). Moreover, 24.8% of respondents got one answer correct, while the smallest percentage belongs to respondents who had no answer correct or did not know the solution (19.7%).

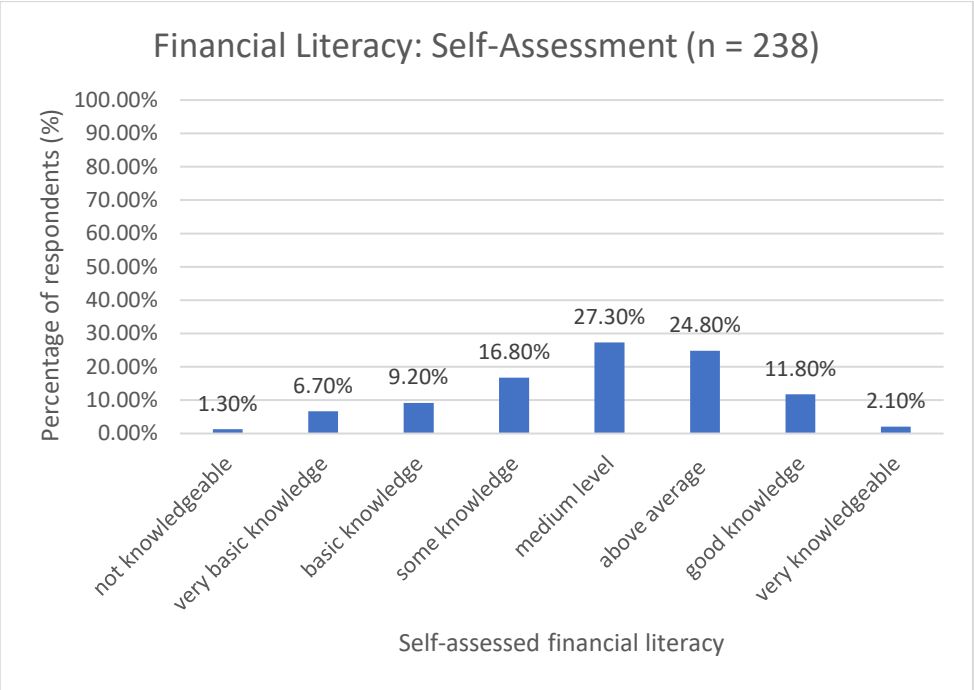

Figure 5. Financial literacy self-assessment (Source: Survey data)

Regarding the self-assessment, most respondents indicated a medium knowledge level (27.3%), while the second largest group rated their knowledge as "above average." Since it is assumed, there is a correlation between the self-assessment and the actual level of knowledge tested in the financial literacy questions, the ordinal regression provides information on whether this assumption holds. The model fitting information table of the ordinal regression indicates a nonsignificant result (p-value = 0.106 > α = 0.05), showing that adding the self-assessment variable does not improve the model's overall fit. In terms of the goodness-of-fit table, the significant results of the Pearson Chi-Square (p-value = 0.821) and the Deviance Chi-Square tests (p-value = 0.823) are above α = 0.05, indicating there is no significant deviation from the expected values. The Nagelkerke Pseudo-R-Square value is relatively low, showing that the model only explains 1.2 % of the variance in the dependent variable. The test of parallel lines revealed a nonsignificant p-value = 0.425 > α = 0.05. As a result, the null hypothesis of parallel lines cannot be rejected.

Ordinal Regression - Parameter Estimates

							95% Confidence Interval	
		Estimate	Std. Error	Wald	df	Sig.	Lower Bound	Upper Bound
Threshold	[FL_Score = .00]	-0.901	0.339	7.041	1	0.008	-1.566	-0.235
	[FL_Score = 1.00]	0.292	0.332	0.772	1	0.380	-0.359	0.943
	[FL_Score = 2.00]	1.496	0.346	18.689	1	0.000	0.818	2.174
Location	Financial Literacy Self-Assesment (Q18)	0.129	0.078	2.731	1	0.098	-0.024	0.281

Figure 6. Ordinal regression—The effect of self-assessment on the financial literacy score (Source: Survey data)

Regarding the effect of the financial literacy self-assessment, it was shown that a higher value of the self-assessment is associated with a slightly higher probability of a higher financial literacy test result; however, the effect was found to be nonsignificant (p-value = 0.098 > α = 0.05). Therefore, it can be concluded that the self-assessment of one's financial literacy has only a limited effect on predicting the financial literacy score as defined in this paper.

5. 2 N-way ANOVA and multivariate regression analysis

The N-way ANOVA test shows an equality of error variances within Levene's test (p-value = 0.081 > α = 0.05), which means the assumption of homogeneity of variances was not violated. The lack-of-fit test (p-value = 0.815 > α = 0.05) indicates that the model applied is appropriate. Concerning the interaction effects between the "gender" variable and the dependent variable "financial risk tolerance score," there are no significant interaction effects between the "income" variable and the "gender" variable (p-value = 0.387 > α = 0.05), the "financial literacy" and "gender" variables (p-value = 0.800 > α = 0.05), or the three variables combined (p-value = 0.620 > α = 0.05). A similar result is observed for the "age" variable. There is no significant interaction effect between "age" and "gender" (p-value = 0.240 > α = 0.05), "age" and "education" (p-value = 0.457 > α = 0.05), "age" and "income" (p-value = 0.671 > α = 0.05), or the four variables (p-value = 0.728 > α = 0.05) combined. For the multivariate regression analysis, the impact of "gender," "age," "income," "education," and "financial literacy" on the dependent variable "financial risk tolerance score" has been examined as well as their correlation with each other. A total of n = 238 participants were included in the analysis, after which it is clear there is no correlation among the variables as all Pearson Correlation values are below the critical value of 0.8.

The R-square indicates that the model explains 20.1% of the variance of the dependent variable "financial risk tolerance score." The significance of the model is represented in the ANOVA table by a p-value = < 0.001 < α = 0.05. When examining the effect of gender on financial risk tolerance, a significant effect was found for the dummy variable "female gender" (p-value = 0.002 < α = 0.05). The direction of the effect points toward the "male gender" (Unstandardized B = -2.094). Therefore, it can be concluded that the hypothesis H1a: "Men are more risk-tolerant than women" is supported by the significant result. The variable consisting of "prefer not to say" and "third gender" paired with the "gender male" did not display a significant p-value (p-value = 0.699 > α = 0.05; Unstandardized B = -0.699).

Regarding the "age" variable and its effect on financial risk tolerance, there is a significant difference related to the age group "45 years old or older" in comparison with the group "under 18–24 years old" (p-value = 0.034 < α = 0.05). The positive coefficient (Unstandardized B = 2.517) indicates that 18–24-year-olds have on average a higher financial risk tolerance score. The age group "25–35 years old" in comparison with the "45 years old or older" participants and its effect on the financial risk tolerance is also statistically significant (p-value = 0.002 < α = 0.05; Unstandardized B = 3.248). In this case, the positive coefficient also suggests that, on average, 25–35-year-olds have a higher financial risk tolerance than respondents in the 45 and older age group. Finally, there is also a statistically significant difference between the age group of the 35–44-year-old respondents and the 45 years old and older participants on the level of financial risk tolerance (p-value = 0.008 < α = 0.05; Unstandardized B = 3.272). In this context, it is worth noting that there was no statistical difference between the younger age groups in terms of their impact on financial risk tolerance. When considering the "prefer not to say" variable with the pairing of the age group 45 years and older, there was also a significant p-value = 0.006 < α = 0.05, while the Unstandardized B (6.966) also pointed toward the "prefer not to say" respondents as having a higher financial risk tolerance on average than people of 45 years and older. As a result, hypothesis H1b: "Respondents below the age of 45 years have a higher risk tolerance than participants age 45 and older" was supported by the significant p-values and the positive coefficients.

A completely different outcome within a sociodemographic variable was registered for education. Interestingly, there seems to be no significant effect concerning the level of education and its effect on financial risk tolerance. The variable "college or professional degree" is paired with the variable "vocational training and/or secondary education" (p-value = 0.070 > α = 0.05; Unstandardized B = 1.597) and the variable "some university but no degree" (p-value = 0.990 > α = 0.05; Unstandardized B = 0.010). In both cases, the p-value is above α = 0.05 and therefore not significant. The variable "prefer not to say" also registered a nonsignificant p-value = 0.569 < α = 0.05 (Unstandardized B = 1.228). Consequently, the hypothesis H1c: "Participants who completed higher education have a higher financial risk tolerance than participants who did not complete higher education" could not be confirmed by the data.

However, the impact of the income variable on the dependent variable proved to be significant. When the income category of "50,000 euros per year or more" is paired with lower income categories such as the category "under 20,000–24,999 euros per year," there is a significant effect on the level of financial risk tolerance (p-value < 0.001 < α = 0.05; Unstandardized B = -3.528). The same applies to the pairing "25,000–49,999 euros per year" with the higher income group of "50,000 euros per year or more" (p-value < 0.001 < α = 0.05; Unstandardized B = -2.972). For both pairing variations of the lower income brackets with the highest income bracket, the p-value was below α = 0.05 and the coefficient (Unstandardized B) was negative, indicating that on average, people with an income of 50,000 euros per year or more have a higher financial risk tolerance score than their comparison groups. When compared with the income variable "prefer not to say," the result was also significant (p-value = 0.001 < α = 0.05; Unstandardized B = -4.519). As a result, the hypothesis H1d: "People with a high income have a higher financial risk tolerance than people with a low income" is supported by the data.

Finally, when analyzing the influence of financial literacy on financial risk tolerance and more closely examining the high financial literacy scores compared with the lower scores, no significant effect on financial risk tolerance was found. When the maximum financial literacy score is paired with lower scores, such as zero out of three questions (p-value = 0.225 > α = 0.05; Unstandardized B = -1.231), one out of three questions (p-value = 0.680 > α = 0.05; Unstandardized B = 0.398), or two out of three questions (p-value = 0.723 > α = 0.05; Unstandardized B = -0.317), no p-value was found to be significant.

Therefore, hypothesis H2: "Financial literacy has a significant impact on financial risk tolerance" could not be supported, and the null hypothesis could not be rejected.

5.3 Two-step cluster analysis

Due to the significant results of the multivariate regression, the sociodemographic variables "gender," "income," and "age" were selected in addition to the variable "financial risk tolerance score." The results of the two-step cluster analysis created six clusters. The predictor importance indicates that "income" (predictor importance = 1.0) and "financial risk tolerance" (predictor importance = 0.96) have the strongest influence on the creation of the clusters, with "gender" (predictor importance = 0.43) in third and "age" (predictor importance = 0.33) in fourth place. The ratio of sizes (largest to smallest cluster) is 2.29.

Clusters	1	2	3	4	5	6
Cluster Size	18.7 %	15.8%	18.2%	14.4%	10.0%	23.0%
Income (Predictor Importance: 1.0)	25,000–49,999 euros/ year (51.3%)	50,000 euros per year or more (51.5%)	25,000–49,999 euros/ year (73.7%)	50,000 euros per year or more (96.7%)	under 20,000–24,999 euros per year (95.2%)	under 20,000–24,999 euros per year (100%)
Financial Risk Tolerance (Predictor Importance: 0.96)	Medium (79.5%)	Medium (97%)	Low (65.8%)	High (100%)	Low (100%)	Medium (64.6%)
Gender (Predictor Importance: 0.43)	Male (100%)	Female (100%)	Female (68.4%)	Male (63.3%)	Female (100%)	Male (58.3%)
Age (Predictor Importance 0.33)	25–34 years old (66.7%)	25–34 years old (45.5%)	45 years old and older (39.5%)	25–34 years old (46.7%)	under 18–24 years old (61.9%)	under 18–24 years old (56.2%)

Figure 7. Two-step cluster analysis - Clusters (Source: Survey data)

Three of the six clusters are characterized by a medium financial risk tolerance score, while clusters 3 and 5 have been assigned a low financial risk tolerance score. In both cases, most respondents in these two clusters are women, while income ranges from 25,000–49,999 euros per year in cluster 3 and under 20,000–24,999 euros per year in cluster 5. The "age" distribution differs immensely between clusters 3 and 5 as the largest age group in the former consists of respondents aged 45 years or older, while in cluster 5 the largest age group includes participants under 18–24 years old.

Cluster 4 is the only one characterized by a high financial risk tolerance score. Most of the respondents sorted into this cluster are men (63.3%) age 25–34 with an income of 50,000 euros per year or more. Clusters 1, 2, and 6 are characterized by a medium financial risk tolerance score. Income in these clusters varies considerably, from under 20,000-24,999 euros per year in cluster 6 to 25,000–49,999 euros per year in cluster 1, and to 50,000 euros per year or more in cluster 2. In all three cases, the participants are below the age of 35 (cluster 1: 25–34 years old, cluster 2: 25–34 years old, and cluster 6: under 18–24 years old). The "gender" distribution also varies among clusters. In clusters 6 and 1, most of the respondents are male (cluster 6: 58.3% and cluster 1: 100%), while in cluster 2, only female respondents are represented (100%).

6) Discussion, Implications, Limitations and Recommendations

6.1 Assessment of financial literacy

The nonsignificant result (p-value = 0.098 > α = 0.05) of the ordinal regression analysis comparing the predictability of the financial literacy self-assessment with the actual financial literacy knowledge level is consistent with the status quo in terms of the assessment of financial literacy. Kramer (2016) and Anderson et al. (2017) have argued that the self-assessment of one's financial literacy hardly represents the actual knowledge level. As can be seen from the analysis, self-assessment does not predict the financial literacy score, which means there seems to be a gap between the self-assessment and actual measured financial literacy. Kramer (2016) also discovered a divergence between self-assessment and actual knowledge and was even able to attribute this difference to one particular group consisting of participants who were categorized into a high-self-measured but low-test-score group. Although this group had the lowest test scores, they surprisingly also had the lowest financial advice-seeking behavior, which Kramer (2016) explained as overconfidence. When applying the results of Kramer's (2016) analysis to the results of the ordinal regression, it is important to recognize that the lack of predictability from the self-assessment question in relation to the financial literacy score does not allow for interpretation of a potential direction; however, the divergence between these two variables seems to be consistent across different research studies. In addition, it should be highlighted that the assessment used in this study also varied from Kramer's (2016) approach, which used 10 assessment questions and one self-assessment question, whereas the questionnaire for this study contained three test questions and one self-assessment question.

The questions are also not all identical when compared with Kramer's (2016) assessment question. Anderson et al. (2017) used the same assessment questions as those used in this paper. However, they extended them with two other questions about mortgage rates and bond pricing. Their results also suggest that individuals with lower financial risk tolerance tend to overestimate their financial literacy skills.

6.2 Factors that impact financial risk tolerance

In general, this study's findings on sociodemographic factors and their impact on financial risk tolerance are consistent with the status quo. Fisher and Yao (2017), Grable (2000), and Brooks et al. (2019) have shown that men tend to be more risk-tolerant than women. This finding is also supported by the multivariate regression analysis, which clearly shows a significant effect of gender on financial risk tolerance, with men on average displaying higher financial risk tolerance scores than women.

What differs from the status quo is that Fisher and Yao (2017) and Brooks et al. (2019) have identified significant interaction effects that influence the relationship between gender and financial risk tolerance, for example, financial literacy or income. However, this is not the case for the "gender" variable investigated in this study. No moderator variable could be identified because no significant p-value for the variables "income" or "financial literacy" was recorded. A similar divergence from current research was discovered for the interaction effect on the independent "age" variable. Brooks et al. (2018) identified several interaction effects that influenced the relationship between the independent variable age and the dependent variable financial risk tolerance. The identified moderators were gender, education level, and wealth. This result, however, could not be replicated within the analysis of this paper. There were no significant interaction effects among age, gender, education, or income. A possible explanation for this is the age distribution of the dataset used in this paper as well as the group categorization. Due to the smaller respondent number, the age group of 45-year-old or older participants had to be merged, whereas Brooks et al. (2018) had more than 10,000 respondents for different age groups above 45 years old. On the other hand, Brooks et al. (2018) did not differentiate among groups below the age of thirty, while in this analysis, the below-30-year-old respondents were divided into different age groups.

The impact of age on the "financial risk tolerance score" as an independent variable was found to be significant. Like Brooks et al. (2018), Grable (2000), and Yao et al. (2011), the analysis conducted in this study showed that, on average, older participants (45 years old or older) tend to have a lower financial risk tolerance than younger age groups. Interestingly, this effect was visible whenever the oldest age group (45 years old or older) was compared with younger age groups (under 18–24 years old, 25–34 years old, 35–44 years old), while the younger age groups showed no significant differences when compared with each other. The reason for this discrepancy is still somewhat unclear, but by considering other research, one reason could be the shorter time horizon for recovering from financial losses or the start of retirement (Yao et al., 2011), although it should be taken into account that the oldest age group studied in this paper covers a rather wide age range, which makes the start of retirement as a potentially influential factor rather unlikely, even though the preparation for retirement might play a role.

Another significant sociodemographic factor is a person's income. Grable (2000) and Yao et al. (2011) have shown that individuals with a higher income have on average, a higher risk tolerance than individuals with lower incomes. This result was also observed in the analysis conducted in this study. When the highest income bracket (50,000 euros per year or more) was compared with lower income brackets, there was a significant difference with both smaller income brackets (under 20,000–24,999 euros per year and 25,000–49,999 euros per year).

Interestingly, the level of education did not indicate a significant effect on the financial risk tolerance score, which is a different outcome than shown in other research. Grable (2000) and Yao et al. (2011) found that a higher level of education is positively related to a higher financial risk tolerance. However, as shown in the analysis, this could not be proven. Even the relationship between the group with vocational training or/and secondary education and the group of respondents with a college or professional degree did not display a significant p-value. Another surprising discovery from the analysis was that the level of financial literacy had no significant impact on the financial risk tolerance score. This is unexpected as it has been repeatedly shown in other research that financial literacy does indeed influence financial risk tolerance (Grable, 2000; Brooks et al., 2019; Hermansson and Jonsson, 2021).

6.3 Cluster profiles of financial risk tolerance

The automatically determined cluster profiles categorized the participants into clusters with medium, high, and low financial risk tolerance, and the medium financial risk tolerance clusters appeared in three of the six clusters. Within the cluster analysis, income and financial risk tolerance displayed the highest predictor importance regarding the creation of the clusters. Generally, the determined clusters align with the status quo. Clusters with the highest income bracket as defined in this paper (50,000 euros per year or more) have a high or at least a medium level of financial risk tolerance, which is identical to the results of Grable (2000) and Yao et al. (2011), who found that individuals with higher income have a higher risk tolerance than people with lower income. This is also true for the result of the analysis in this paper for the lowest income bracket (under 20,000–24,999 euros per year), which has been sorted with a low financial risk tolerance score (cluster 5) or a medium financial risk tolerance score (cluster 6). The medium income bracket (25,000–49,999 euros per year) is also associated with a low risk tolerance score (cluster 3) or a medium risk tolerance score (cluster 1) but, interestingly, not with a high financial risk tolerance score.

Examining the distribution of gender within the clusters, it should be noted that the male gender was only categorized into clusters with a medium or high financial risk tolerance. Within the high risk tolerance cluster, the male gender accounts for 63.3%, while 36.7% is of the female gender. On the other hand, the female gender dominates both low financial risk tolerance clusters and one medium-level risk tolerance cluster. The distribution of gender within the clusters, therefore, is aligned with the result of the data analysis conducted in this study as well as the status quo, which showed that men tend to be more risk-tolerant than women.

The age variable displays a similar output. The oldest age group is classified into one of the clusters with the lowest financial risk tolerance, while most younger age groups are sorted into clusters with a medium financial risk tolerance (clusters 1, 2, and 3) or even the cluster with the highest financial risk tolerance (cluster 4). Similar to the results of the analysis of the findings from other research (Brooks et al., 2018); Grable, 2000; Yao et al., 2011), the age distribution within the clusters is in line with the general understanding that older age groups tend to be less risk-tolerant than younger ones. However, it is essential to highlight that in the case of cluster 5, which was assigned a low financial risk tolerance score, the dominant age group consists of respondents below 18–24 years old.

In this case, the statement about older age groups being less risk-tolerant than younger age groups cannot hold for cluster 5. This divergence from the status quo and the conducted analysis might be caused by the predictor's importance as age has the lowest impact in terms of constructing the clusters.

6.4. Managerial implications for Doutor Finanças

When developing a financial profile test, it is important to acknowledge the multidimensionality of financial risk tolerance and financial literacy. As a result, it is essential to include questions that cover multiple dimensions of financial risk tolerance and financial literacy in the questionnaire. The concept of financial literacy should be evaluated with a self-assessment question in combination with test questions that ideally cover multiple areas of financial literacy such as inflation, investing, diversification, or interest rates. This has not only been proven by several research findings (Hermansson and Jonsson, 2021; Anderson et al., 2017; Kramer, 2016) but also by the analysis conducted in this paper, which showed that self-assessment does not predict the financial literacy test result.

The questionnaire used for the analysis, which was first developed by Grable and Lytton (1999), allowed a multidimensional assessment of financial risk tolerance and has not only proven to be reliable in other research (Kramer, 2016; Grable, 2019) but also supported the analysis of the financial risk tolerance assessment. In the end, the results were strongly aligned with the existing research. This suggests that when developing a financial risk tolerance-focused test, it is important to consider the significant impact of sociodemographic factors. For example, men tend to be more risk-tolerant than women, and respondents with a higher income tend to have more risk tolerance than those in lower income brackets, as well as the fact that older respondents tend to have a lower financial risk tolerance than younger ones. When creating financial risk tolerance assessment questions, sociodemographic questions should therefore be included.

Considering sociodemographic factors and validating the level of financial risk tolerance through the assessment questions offer deep insights into the risk-tolerance level of an individual. The assessment of financial literacy in combination with financial risk tolerance allows Doutor Finanças to categorize its clients and adapt its product offerings to their needs.

It is also an important opportunity to identify potential blind spots within the area of financial literacy so that clients can receive tailored information and educational material based on their financial knowledge. This insight can also help customer service agents adapt their communication to the clients' needs.

6.5 Limitations and recommendations for future research

One of the limitations of this study is undoubtedly the sample size and the distribution of the respondents across sociodemographic variables. Due to the low number of respondents above the age of 45, all participants within this age range were merged into one group. The age range between 45 years old and 65 years old is quite large and might result in significant differences within this age group alone, especially when considering that people who are about to start or have already started retirement are compared with people who are still completely immersed in the labor market. The sample additionally consisted of a majority of people who had at least some exposure to higher education. A more equal distribution, especially within the area of people who received vocational training, might create more diverse insights. The second limitation is the assessment of financial literacy. Even though the questions have been validated by Kramer (2016), the feedback received from some of the respondents indicated a very high level of difficulty when answering them. Thus, it is recommended for future research to include more than three questions assessing financial literacy and also to cover more dimensions of it, which might include, for example, understanding of budgeting, saving, or spending. Future research should also focus on the replication of the results and test how age, gender, income, education, and financial literacy affect financial risk tolerance as such an analysis may reveal major differences concerning some of the variables (i.e., financial literacy and education).

7) Conclusion

This study showed how a financial profile test based on the concept of financial risk tolerance can be created. For the classification of individuals into different financial risk tolerance profiles, a multidimensional financial risk tolerance questionnaire can be used to identify the underlying risk tolerance preference. For the actual risk profile classification method, cluster analysis in combination with sociodemographic factors allowed a deeper characterization of the risk profiles. The reasoning behind the inclusion of these factors is based on the results of this study. It indicated that financial risk tolerance is significantly impacted by age, gender, and income. Unlike the results of the status quo, however, financial literacy and education had no significant impact on financial literacy. Finally, when assessing an individual's financial literacy, it is important to measure not only their self-perception but also their actual level of financial risk tolerance by using test questions.

Appendix

Survey Script - Financial Profile Test

Q1: Study for assessing financial risk tolerance and financial literacy

Dear participant,

About the survey: The survey is being conducted as part of a master thesis for the master's degree in management at Católica Lisbon School of Business and Economics. For any questions related to the survey, you can reach out to the following e-mail address: s-fkuegler@ucp.pt

Voluntary participation and right to withdraw: Your participation in this survey is completely voluntary. The identity of every participant will remain anonymous, and the collected data will be kept confidential and used only for an academic purpose. You have the option to cancel the survey at any time by closing the browser window.

Duration of the survey: ca. 11 minutes

By clicking on the blue button in the right corner, you indicate that you understand the information in this consent form and that you agree to participate in this survey. If you do not agree with the terms of the study, please close this window to exit the study.

Thank you very much in advance!

Assessment of financial literacy

Q2: In the following question blocks, your financial risk tolerance will be evaluated. Every question will describe a different scenario. You will be offered a certain number of options. Please choose the option you feel most comfortable with.

In this survey, financial risk tolerance is understood as the maximum level of risk exposure that someone is willing to accept when making a financial decision.

Q3: If you unexpectedly received 20,000 Euros to invest, what would you do?

- ○ Deposit it in a bank account (1)
- ○ Invest it in safe high-quality bonds or bond mutual funds (2)
- ○ Invest it in stocks or stock mutual funds (3)

Q4: In terms of experience, how comfortable are you investing in stocks or mutual funds?

- ○ Not at all comfortable (1)
- ○ Somewhat comfortable (2)
- ○ Very comfortable (3)

Q5: If you had to invest 20,000 Euros, which of the following investment choices would you find most appealing?

- ○ 60% in low-risk investments 30% in medium-risk investments 10% in high-risk investments (1)
- ○ 30% in low-risk investments 40% in medium-risk investments 30% in high-risk investments (2)
- ○ 10% in low-risk investments 40% in medium-risk investments 50% in high-risk investments (3)

Q6: Suppose a relative left you an inheritance of 100.000 Euros, stipulating in the will that you invest ALL the money in ONE of the following choices. Which one would you select?

- ○ A savings account (1)
- ○ A mutual fund that includes stocks and bonds (2)
- ○ A portfolio of 15 common stocks (3)
- ○ Commodities for example gold, silver or oil (4)

Q7: Imagine you had to choose between the four investment options listed below. For each investment option, there is either the best or the worst-case scenario. Which choice would you prefer?

- ○ 200 Euros gain best case OR 0 Euros gain/ loss worst case (1)
- ○ 800 Euro gain best case OR 200 Euros loss worst case (2)
- ○ 2,600 Euro gain best case OR 800 Euros loss worst case (3)
- ○ 4,800 Euro gain best case OR 2,400 Euro loss worst case (4)

Q8: How would you rate your willingness to take risks in financial matters (0 – no willingness for taking risks to 10 – maximum willingness for taking risks)?

	0 1 2 3 4 5 6 7 8 9 10
Your willingness to take risks in financial matters ()	

Q9: In general, how would your best friend describe you when it comes to your willingness to take risks?

- ○ A real risk taker (1)
- ○ Willing to take risks after completing adequate research (2)
- ○ Cautious (3)
- ○ A real risk avoider (4)

Q10: When you think of the word “risk” which of the following words comes to mind first?

- ○ Loss (1)
- ○ Uncertainty (2)
- ○ Opportunity (3)
- ○ Thrill (4)

Q11: Please imagine the following scenario: Some experts are predicting prices of stocks and mutual funds to increase in value; bond prices may fall; however, experts tend to agree that government bonds are relatively safe. Imagine that most of your investment assets are now in high interest government bonds. What would you do?

- ○ Hold the bonds (1)
- ○ Sell the bonds, put half the proceeds into savings accounts, and the other half into stocks and/or mutual funds (2)
- ○ Sell the bonds and put the total proceeds into stocks and/or mutual funds (3)
- ○ Sell the bonds, put all the money into stocks and/or mutual funds, and borrow additional money to buy more (4)

Q12: Please imagine the following scenario: Your trusted friend and neighbour, an experienced tech entrepreneur, is putting together a group of investors to fund an exploratory Artificial Intelligence startup. The startup could pay back 50 to 100 times the investment if successful. If the startup fails, the entire investment is worthless. Your friend estimates the chance of success is only 20%. If you had the money, how much would you invest?

- ○ Nothing (1)
- ○ One month's salary (2)
- ○ Three month's salary (3)
- ○ Six month's salary (4)

Q13: Imagine, 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 (1)
- ○ Take a much more modest vacation (2)
- ○ Go as scheduled, reasoning that you need the time to prepare for a job search (3)
- ○ Extend your vacation because this might be your last chance to go first-class (4)

Q14: Imagine that in addition to whatever you own until this point, you have been given 1,000 Euro. You are now asked to choose between the following two options:

- ○ A sure gain of additional 500 Euros (1)
- ○ A 50% chance to gain additional 1,000 Euros and a 50% chance to gain nothing (3)

Q15: Imagine that in addition to whatever you own, you have been given 2,000 Euros. You are now asked to choose between the following two options:

- ○ A sure loss of 500 Euros (1)
- ○ A 50% chance to lose 1,000 Euros and a 50% chance to lose nothing (3)

Q16: You are on a TV game show and can choose one of the following. Which would you take?

- ○ Take 1,000 Euros in cash now (1)
- ○ A 50% chance at winning 5,000 Euros (2)
- ○ A 25% chance at winning 10,000 Euros (3)
- ○ A 5% chance at winning 100,000 Euros (4)

Q17: Please select the number 7 for quality purposes

0 1 2 3 4 5 6 7 8 9 10

Please select number 7 for quality purposes ()	

The Financial Literacy Assessment

Q18: The next 6 questions will be about financial literacy. Financial literacy is the understanding of basic financial concepts that include, for example, a basic understanding of budgeting, investing, or personal financial management. It varies from person to person and with the following questions we would like to know more about your financial literacy.

Q19: How would you assess your own financial literacy on a scale of 0 (not knowledgeable) to 7 (very knowledgeable)

	0	1	2	3	4	5	6	7
Your level of financial literacy ()								

Q20: How did you acquire your level of financial literacy?

- ☐ Higher education (i.e. through business/finance/economics courses) (1)
- ☐ Work experience (2)
- ☐ Vocational training (3)
- ☐ Self-taught (i.e. through webseminars, courses, books etc.) (4)
- ☐ Taught by parents, partners, friends (5)
- ☐ Other: (6) _____

Q21: Compounding. Suppose you had 100 Euros in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow? Please select the answer that you think is correct.

- ○ More than 102 Euros (1)
- ○ Exactly 102 Euros (2)
- ○ Less than 102 Euros (3)
- ○ I don't know (4)
- ○ Prefer not to say (5)

Q22: Inflation. Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account? Please select the answer that you think is correct.

- ○ More than today (1)
- ○ Exactly the same as today (2)
- ○ Less than today (3)
- ○ I don't know (4)
- ○ Prefer not to say (5)

Q23: Diversification. Buying a single company's stock usually provides a safer return than a stock mutual fund. Please select the answer that you think is correct.

- ○ True (1)
- ○ False (2)
- ○ I don't know (3)
- ○ Prefer not to say (4)

Sociodemographic questions

Q24: How do you describe yourself?

- ○ Male (1)
- ○ Female (2)
- ○ Non-binary/third gender (3)
- ○ Prefer not to say (4)

Q25: How old are you?

- ○ Under 18 (1)
- ○ 18-24 years old (2)
- ○ 25-34 years old (3)
- ○ 35-44 years old (4)
- ○ 45-54 years old (5)
- ○ 55-64 years old (6)
- ○ 65+ years old (7)
- ○ Prefer not to say (8)

Q26: What is the highest level of education you have completed?

- ○ Some Secondary (1)
- ○ Completed Secondary School (2)
- ○ Vocational or Similar (3)
- ○ Some University but no degree (4)
- ○ Bachelor's Degree (5)
- ○ Graduate or professional degree (MA, MS, MBA, PhD, JD, MD, DDS) (6)
- ○ Prefer not to say (7)

Q27: What was your total income before taxes during the past 12 months in Euros?

- ○ Less than 20,000 Euros per year (1)
- ○ 20,000 - 24,999 Euros per year (2)
- ○ 25,000 - 49,999 Euros per year (3)
- ○ 50,000 - 99,999 Euros per year (4)
- ○ 100,000 - 199,999 Euros per year (5)
- ○ More than 200,000 Euros per year (6)
- ○ Prefer not to say (7)

Q28: What best describes your employment status over the last three months?

- ○ Working full-time (1)
- ○ Working part-time (2)
- ○ Unemployed and looking for work (3)
- ○ A homemaker or stay-at-home parent (4)
- ○ Student (5)
- ○ Retired (6)
- ○ Prefer not to say (7)
- ○ Other: (8) _____

Q29: What is your nationality?

- ○ Portuguese (1)
- ○ German (2)
- ○ Italian (3)
- ○ Spanish (4)
- ○ Other: (5) _____
- ○ Prefer not to say (6)

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