Universidade do Minho
Escola de Economia e Gestão

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The Power of Nudging: Enhancing Financial Behavior

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The Power of Nudging: Enhancing Financial Behavior

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Master in Finance

Under the guidance of:
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Sofia Bento

STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration.

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Resumo

O principal objetivo deste estudo é analisar a literacia financeira da população portuguesa e o efeito que os "*nudges*" podem ter no comportamento financeiro, nomeadamente em termos de poupança e participação no mercado. A investigação começa por avaliar o nível de literacia financeira da amostra e verificar se variáveis como o nível de confiança, experiência financeira, perfil de risco e características sociodemográficas têm alguma influência nesse especto. Além disso, avalia-se a influência da literacia financeira em diferentes segmentos do comportamento de poupança e na participação no mercado. Posteriormente, o último objetivo foi explorar a eficácia dos "*nudges*" no comportamento de poupança e na participação no mercado.

Para alcançar os objetivos, foi realizado um questionário e um experimento, abrangendo 244 pessoas. O experimento pretende estudar os efeitos dos "*nudges*" de padrão e de informação no comportamento de poupança e na participação no mercado. Os participantes foram divididos aleatoriamente em grupo de controle e grupo de tratamento, onde este último recebeu os "*nudges*".

Os resultados confirmam os baixos níveis de literacia financeira, com maiores pontuações associadas a um maior perfil de risco, experiência financeira, renda, nível de educação e formação em economia. O comportamento de poupança e a participação no mercado foram baixos em geral e influenciados positivamente pela literacia financeira.

O estudo examinou a eficácia dos "*nudges*" de padrão e de informação e constatou que os "*nudges*" de padrão tiveram um impacto mais forte na participação no mercado e no comportamento de poupança. Os "*nudges*" de padrão aproveitam a inércia e influenciam positivamente a tomada de decisão, enquanto os "*nudges*" de informação foram menos eficazes.

Em geral, esta pesquisa contribui para a compreensão da literacia financeira, da participação no mercado e do comportamento de poupança em Portugal, destacando a eficácia dos "*nudges*" na promoção de decisões financeiras positivas.

Palavras-chave: literacia financeira, participação no mercado, comportamento de poupança, nudges, preconceitos comportamentais, finanças comportamentais

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Abstract

The main objective of this study is to analyze the financial literacy among the Portuguese population and the effect that nudging can have in the financial behavior, namely in terms of savings and market participation. The investigation starts by evaluating the sample's level of financial literacy and verifying whether variables such as confidence level, financial experience, risk profile and sociodemographic characteristics have any influence on it. Additionally, it evaluates the influence of financial literacy in different segments of saving behavior and in market participation of individuals. Thereafter, the last objective was to explore the effectiveness of nudges in saving behavior and market participation.

To achieve the objectives, a questionnaire and an experiment were conducted, involving 244 respondents. The experiment aimed to study the effects of default and information nudges on saving behavior and market participation. Participants were randomly divided into the control group and the treatment group, where the latter received the nudges.

The findings confirm the low levels of financial literacy, with higher scores associated with a greater risk profile, financial experience, income, education level, and background in economics. Saving behavior and market participation were low in general, and both positively influenced by financial literacy.

The study examined the effectiveness of default and information nudges and found that default nudges had a stronger impact on market participation and saving behavior. Default nudges leverage inertia and positively influence decision-making, while information nudges were less effective.

Overall, this research contributes to the understanding of financial literacy, market participation, and saving behavior in Portugal. It also highlights the effectiveness of nudges in promoting positive financial decision-making.

Keywords: financial literacy, market participation, saving behavior, nudges, behavioral biases, behavioral finance

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1. Introduction

Nowadays, people and companies are becoming more aware of the importance of their choices in a large range of areas, such as businesses, education, health, sustainability, and finance.

Focusing particularly on finance, we are currently in an environment much more globalized and risky, where people have greater concerns regarding their financial literacy, in order to make well-known financial decisions (Lusardi & Mitchell, 2011b). Thus, it is important to understand peoples' behavior in a general way, and what is the importance of nudging in the world and in behavioral finance itself.

The main objective of this study is to analyze the financial literacy among the Portuguese population and the effect that nudging can have in the financial behavior, namely in terms of savings and market participation.

I have chosen this topic for my dissertation due to the increasing significance of behavioral sciences and nudging in various governmental contexts. This study aims to shed light on the issue of low financial literacy, market participation, and saving behavior among the Portuguese population while addressing a literature gap by empirically examining the impact of nudges on individuals' engagement with these financial aspects. Through this research, I aim to contribute valuable insights to the existing literature on nudges. By exploring these areas, this study contributes to a better understanding of behavioral interventions that can be applied to improve financial decision-making and encourage responsible financial behaviors in the population.

On one hand it is known that behavioral sciences are increasingly being used for policy-making all around the world, with several European countries setting up behavioral insights teams (or are in the process of doing so). In addition, the World Bank and the Organization for Economic Co-operation and Development (OECD) have already published many reports emphasising the importance of identifying and addressing the behavioral elements in policy (Sousa Lourenço et al., 2016).

Furthermore, OECD together with the International Network on Financial Education (INFE) have caried out extensive research and surveys to critically analyze and compare financial literacy among countries throughout the years.

On the other hand, nudging process can be employed as a persuasion tool, and, as reported by Thaler and Sunstein (2008) in their book "Nudge: Improving Decisions About Health, Wealth, and Happiness", it is considered a way of influencing peoples' behavior without restricting other courses of action.

Financial literacy is currently a hot topic that has many definitions. In general, this topic refers to the ability of using knowledge and skills to manage financial resources effectively, which helps investors in making rational investment decisions (Mohamed Abdeldayem, 2016).

Financial literacy has already been deeply investigated by many researchers; however, nudging is a more recent topic, with scarce literature regarding the use of nudging techniques in finance to improve financial behavior in a sustainable way.

An additional aim of this investigation is to study the level of financial literacy of the Portuguese population, and the influence of financial literacy in saving behavior and market participation.

The specific objectives of this research are:

- Determine the level of financial literacy of the Portuguese population and what variables influence that level (sociodemographic characteristics, perceived financial literacy, confidence level, and financial experience, and risk profile).
- Analyze if financial literacy can guide individuals into certain financial decisions (saving behavior and market participation).
- Analyze if nudges can influence individuals into certain financial decisions (saving behavior, and market participation).

Sociodemographic factors such as nationality, age, gender, level and background of education, net income and others like perceived financial literacy, confidence level, financial experience and risk profile are going to be analyzed to determine which factors influence the financial literacy of the Portuguese population.

To gather the necessary data, a questionnaire will be used, followed by an experiment to gather the information needed.

The study utilized a comprehensive questionnaire distributed through online platforms, consisting mainly of multiple-choice questions. Convenience sampling was employed to obtain a sample of

Portuguese nationals aged 18 or older. The questionnaire served as the primary data collection tool, exploring various aspects of participants' financial behavior, covering topics such as saving behavior, market participation, financial literacy, confidence level, financial experience, and risk profile, along with sociodemographic variables (age, gender, marital status, level and background of education, and net income).

The study included an experiment in the questionnaire to assess the effectiveness of nudges on financial behavior. Respondents were divided into control and treatment groups. The control group answered questions without any specific manipulations, while the treatment group experienced two types of nudges: default and information nudges. The experiment allowed for an exploration of the influence of nudges on participants' financial behaviors and choices, by comparing the groups' responses.

Data was collected and analyzed using Microsoft Excel, and regression models like Probit and Ordered Probit were employed for binary and multiple ordered outcome variables, respectively.

The remaining of this proposal is structured as follows: Chapter 2 presents a review of the literature concerning financial literacy and nudging, chapter. The third chapter discusses the methodology that was implemented, and chapter 4 describes briefly the data used to analyze and reach the conclusions for the objective, chapter 5 present the schedule plan for the dissertation and finally chapter 6 lists the references.

2. Literature Review

2.1 Financial Literacy

2.1.1 Definition

Several studies investigated the financial literacy around the world, and this concept captured the interest of various groups including governments, companies, bankers, employers, community interest groups, financial markets, and individuals. The conceptual definitions of financial literacy evolved throughout the years, in response to the increasingly complexity of the economy, development of new financial products, increasing complexity of financial markets and changes in political, demographic and economic factors (Hassan Al-Tamimi & Anood Bin Kalli, 2009). Thus, it is important to approach several definitions that are present in literature regarding the meaning of financial literacy, to comprehend the different visions of the authors, the development of this term throughout the years, and the relevance of this study.

Even though all authors add something different to the literature, they all have something in common while defining financial literacy: financial literacy is all about achieving a long-term financial well-being. Some authors focus on the knowledge of a population, while others consider more dimensions, for example the behavior of the population and their incentives for behaving in a certain way.

This concept embraces the understanding, management, and planning of financial matters, whether at the individual, household, or professional level. According to the most quoted international definition introduced by Schagen (1997) and cited by the Banco de Portugal (2010) "financial literacy is the ability to make informed judgments and concrete decisions for managing money"(2010, p. 2).

Firstly, the OECD, which is an economic and international organization founded in 1961, has a goal to outline some policies to improve the well-being for everyone, such as prosperity, equality and opportunity. Together with the INFE have defined financial literacy as the knowledge and understanding of the financial concepts and risks inherent, as well as the skills, motivation and confidence to apply such knowledge in order to make effective decision across a range of financial contexts, with the goal of improving the financial well-being of individuals and enabling participation in economic life (Atkinson et al., 2015; OECD, 2014b).

A more recent definition for this concept is: “A combination of financial awareness, knowledge, skills, attitudes and behaviours necessary to make sound financial decisions and ultimately achieve individual financial well-being.”(OECD, 2022).

Financial literacy was first championed by the American corporation Jump$tart Coalition, founded in 1995, and in 1997 the corporation evolved into the Jump$tart Coalition for Personal Financial Literacy. This corporation defined financial literacy as “the ability to use knowledge and skills to manage one’s financial resources effectively for lifetime financial security”, and they have been doing surveys to measure the level of financial literacy, which are repeated biennially since the year 2000 (Mandell, 2008b).

The term “financial literacy” has been used to refer to a variety of things, such as the knowledge of financial products (e.g., stocks, bonds, loans, mortgages…), financial concepts (e.g., credit score, debit, leverage, inflation…) having the mathematical skills necessary for effective financial decision making and being engaged in certain activities such as financial planning (Hastings et al., 2013).

Vitt et al. (2000) defend that financial literacy is based on the ability to analyze, manage and communicate the various financial problems that citizens face on a daily basis, including the ability to differentiate financial choices, discuss financial matters without discomfort, and making plans for the future.

Perry and Morris (2005) provided a simpler definition, considering responsible financial behavior as the respondent’s ability to budget and save money, and the control of their spending’s.

The most fundamental definition of this term relates to “a person's competency for managing money”, as stated by (Remund, 2010). This author, alongside with the Program for International Student Assessment (PISA), which aims to measure the reading, science, and math skills of students over 15 years, identified five different categories to measure the level of financial literacy of an individual:

1. Knowledge of financial concepts.
2. Ability to communicate about financial concepts.
3. Ability in managing personal finances.
4. Skills in making suitable financial decisions.
5. Confidence in planning effectively for future financial needs.

2.1.2 The importance of financial literacy

In recent years, as a result of globalization, the complexity of modern financial markets, and the expansion of e-banking, there is a greater diversity and intricacy of financial products available in the market. As such, individuals are constantly challenged to be more and better informed when making financial decisions once they take ownership for their own financial wellbeing. Factors such as inadequate information or scarce financial literacy can lead to adverse events, as the last financial crises has clearly shown, poor savings and investment decisions can carry serious implications for long-term financial well-being of an individual and of society at large like bankruptcy, financial frauds or mortgage crises (Altıntaş, 2011; Lusardi et al., 2010a). Besides that, individuals have become increasingly active in financial markets, having easier access to highly complex financial instruments, without having a real notion of their risks or of which product best suits their needs. Therefore, consumer choices have become increasingly difficult and require greater consideration (Banco de Portugal, 2010; Hira, 2012; van Rooij, Lusardi, Alessie, et al., 2011).

The provision of financial information is crucial, however it does not necessarily lead to a better understanding of risks and returns of financial products, nor does it encourage a change in financial behavior. Better informed citizens with higher levels of financial literacy help oversee the markets and contribute to the stability of the financial system by choosing the products that suit their risk profile. Financial literacy becomes relevant in this context, as more financially literate individuals are more suited to engage in a wide range of recommended financial practices, are more likely to plan and invest in complex assets, promoting the creation and expansion of savings (Banco de Portugal, 2010; Hilgert et al., 2003; A. A. Hung et al., n.d.; Lusardi & Mitchell, 2011a; Neves, 2021).

The OECD also recognizes that measuring the levels of financial literacy in a population is a key component of success, enabling policy makers to identify gaps and create appropriate responses. This organization has started to give greater importance to this topic by raising public awareness of the need to increase financial literacy, once it is known that individuals with poor levels of literacy are prone to make poor investment decisions, and they may end up losing money (Lusardi & Mitchell, 2007; van Rooij, Lusardi, Alessie, et al., 2011).

In summary, financial literacy is a matter subject for governments and banks, given that the financial choices taken by individuals can have an impact across society. Furthermore, financial

intermediaries must possess complete mastery of financial products and exercise care when recommending to people, who may not have the same level of financial literacy (Neves, 2021).

2.1.2 Measuring Financial Literacy

As a result of the broad spectrum of conceptual definitions, authors have also measured the level of financial literacy in numerous different ways.

One of the most common methods used by several authors are the questionnaires (e.g., Banco de Portugal, OECD and INFE). Hilgert et al. (2003), used a questionnaire that contains over 28 true-false questions named "'What is your financial IQ?", addressing a variety of subjects (e.g., cash flow management, credit management, investing, saving, mortgage and other financial topics.). In addition, that, OECD together with INFE created a questionnaire named "Toolkit". It was designed to capture information about financial behavior as well as attitudes and knowledge of the population to measure the financial literacy and inclusion. Questions cover topics such as planning and managing finances, socio-demographic situation, choosing and using diversified financial products, experience of the population, financial knowledge, and behaviors that impact financial literacy and financial well-being of the population. The particularity of this method is that the toolkit was designed to measure not only the knowledge of the population, but also its behavior and inclusion, and it can also be used to provide comparative data across countries (OECD, 2009).

Other method for measuring financial literacy is the "Big Three", created by Lusardi and Mitchell (2011a). They designed a standard set of three questions based on fundamental financial concepts, which have been widely replicated around the world. The questions evaluate participants' knowledge on basic financial concepts, such as numeracy/interest rates, the effects of inflation, and the concept of risk diversification.

Nevertheless, the method I decided to use in my research is known as the "Big Five", used previously in research by several authors such as: Lusardi and Mitchel (2011b), Van Rooij et al. (2011), Anderson et al. (2017). This method consists in an extension of the Big Three, adding questions addressing topics like the difference between stocks and bonds, the function of the stock market, mortgages, and bond prices. One of the questions tests the understanding of interest rate

dependence on loan duration. The last question is more advanced and shows knowledge about the relationship between bond prices and yield (the market interest rate) (Lachance, 2014). Given that, this method provides a comprehensive assessment of the level of financial literacy, it will be employed in this study.

Financial literacy questions of the Big Five:

- Compound Interest

Suppose you had $100 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? 1) More than $102, 2) Exactly $102, 3) Less than $102, 4) Don't know, 5) Prefer not to say.

- 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? 1) More than today, 2) Exactly the same, 3) Less than today, 4) Don't know, 5) Prefer not to say.

- Bond Pricing

If interest rates rise, what will typically happen to bond prices? 1) They will rise, 2) They will fall, 3) They will stay the same, 4) There is no relationship between bond prices and the interest rate, 5) Don't know, 6) Prefer not to say.

- Mortgages

A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest paid over the life of the loan will be less. 1) True, 2) False, 3) Don't know, 4) Prefer not to say.

- Diversification

Buying a single company's stock usually provides a safer return than a stock mutual fund. 1) True, 2) False, 3) Don't know, 4) Prefer not to say.

2.1.3 Empirical evidence on financial literacy

Several studies have already demonstrated that the level of financial literacy is low in general but is not the same among all the population. Despite all the efforts made throughout the years by governments, financial illiteracy is still widespread, and it differs across different age groups. Being middle aged is associated with higher levels of knowledge, whilst the oldest and youngest members of the population usually being more illiterate. In addition, financial literacy also varies across gender and women usually display lower level of financially literacy when compared to men. Individuals with lower levels of education or that are unemployed also tend to have lower levels of literacy (Atkinsoni & Messy, 2012; Banco de Portugal, 2010; A. Hung et al., 2009; Lusardi & Mitchell, 2007, 2011b; Mändmaa, 2019a; Potrich et al., 2015; van Rooij, Lusardi, Alessie, et al., 2011).

Corroborating this theory is João Amadeu (2009) that made a study to assess if financial literacy has any influence on the decision-making processes regarding consumption, savings, and investment decisions of students. He found that students with higher level of financial literacy make financial decisions that better suit their needs. Apart from that, Chen & Volpe (1998) conclude that college students are not literate about personal finances, especially about issues concerning investments limiting their ability to make informed decisions.

On a study with high school students about financial literacy, Mandell (2008a) found that students from wealthy families tend to have greater financial resources, emphasizing the fact that financial literacy increases not only with education, but also with income (Johnson & Sherraden, 2007).

Furthermore, those who have low financial literacy are less likely to participate in the stock market and they tend to rely on family and friends as their main source of financial advice, being more prone to make poor financial decisions (van Rooij, Lusardi, Alessie, et al., 2011). In addition, Lusardi and Tufano (2015) found that people with low financial literacy are more likely to struggle with debt.

Previous researchers have found that students in the economic area have better financial literacy than students from other areas of stufy (Chen & Volpe, 1998; Mändmaa, 2019b). A recent study by Pires and Quelhas (2015) with portuguese students attending higher education programs provided the same results, according to which individuals attending programs in business sciences tend to reveal a higher level of financial literacy. Contrary to these findings, there is a study made by Altintas (2011) of

the level of financial literacy of Turkish students that found that the educational background does not have a significant impact on the overall financial knowledge of individuals.

Extensive research has been done about this topic throughout the years, and the most remarkable conclusion is that more literate individuals are more likely to exhibit positive financial behavior (e.g., thinking before making a purchase, paying bills on time, budgeting, saving for long-term, borrowing, investing, accumulating and managing wealth effectively, planning for retirement, choosing the best financial products...)(Atkinsoni & Messy, 2012; Hilgert et al., 2003; Lusardi & Mitchell, 2007, 2010).

Moreover, overconfidence has been identified as a significant factor with a negative impact on financial literacy. Research conducted by Allgood and Walstad (2016) suggests that individuals who perceive themselves as highly financially literate but have low actual financial literacy levels tend to exhibit overconfidence. Similarly, Mudzingiri et al. (2018) found that college students with lower financial literacy levels displayed higher levels of confidence compared to those with higher financial literacy levels, highlighting the negative relationship between overconfidence and financial literacy.

The influence of overconfidence extends beyond financial literacy and affects various financial decisions. Studies, such as those conducted by Lee and Hanna (2022) have demonstrated that overconfidence can impact both saving and investment decisions. Mudzingiri et al. (2018) developed a formula to measure confidence in their study on the financial behavior of university students. This formula considers the gap between financial perceptions and actual financial knowledge, represented as C = financial perceptions – financial literacy test score.

Overall, the presence of overconfidence poses challenges to individuals' financial literacy, affecting their decision-making processes and potentially leading to suboptimal financial outcomes. It is crucial to acknowledge and address overconfidence as a factor in financial education and decision-making to promote better informed and responsible financial behavior.

With that being said, it is clearly understood that investing in improving financial literacy is a priority for all the financial intermediaries and governments, in order to help people better plan for their future needs and avoid consequences such as bankruptcy, mortgage crises, financial frauds, credit problems, debt, poor savings rate, and impulsive buying (Altıntaş, 2011; Perry & Morris, 2005). Informed individuals contribute to macroeconomic and financial system stability, as fluctuations in savings influence long-term economic growth and development (Banco de Portugal, 2010).

Due to the differences of literacy among a population, a one-size fits all approach is unlikely to be successful to improve overall literacy levels, thus a variety of financial education programs are being offered to target specific subgroups of the population (e.g., young people). In spite of this, a long road lies ahead of us, once it is not yet well defined the content and the learning objectives of such courses (Lusardi & Mitchell, 2007).

Furthermore, financial literacy should be considered as a lifetime fundamental and continuous process, taking into account the constant increase in complexity of markets, varying needs of people at different life stages, and increasingly complex information (OECD, 2005).

It is also important to notice that even when people have high levels of financial literacy, it does not necessarily mean that their behavior will change, because there are many human biases indicating that people do not always act rationally (Hira, 2012; Mändmaa, 2019a). As reported by the Banco de Portugal (2010), one practical example of this scenario is that, despite the fact that the Portuguese population think it is important to plan a family budget, most families do not present a long-term savings plan.

Strictly speaking, financial behavior refers to the act of spending, saving, and borrowing. The financial decisions that I am going to approach in detail in this study are saving behavior and market participation.

- Market participation- refers to the percentage of total asset value individuals allocate in securities.
- Saving behavior- measured in three different dimensions, first if individuals save or not, second how much of their net income they save, and third for how long they have an emergency fund to face a situation of unemployment or illness.

2.2. Nudging

2.2.1 Definition

Some authors argue that individuals, depending on certain mental patterns like human behavior and perceptions, are susceptible to make investment errors, which moves them away from the assumption of rationality (Fernandes & Martins, 2002). That is why nowadays many behavioral interventions are used to directly influence the decision-making process of the population.

It is important to understand that there are various policy tools that help people make decisions. Some of them take the form of mandates and bans, or economic incentives, others can be perceived as boosts, and others take the form of nudges.

One of the most prominent interventions used as policy tools are the nudges, that without delimiting any choice, encourage people into choosing the optimal option (Franklin et al., 2019).

Nudges have been implemented in a wide range of areas all around the world, and the authors Thaler and Sunstein (2008) define nudge as "any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives" (Thaler & Sunstein, 2008, p. 17).

Nudges can also be described as soft paternalism, once they steer people in a certain direction. The goal of nudges is to make life simpler, safer, and easier for people to make choices. Many nudges are intended to ensure that people do not struggle when they seek to achieve their goals (Sunstein, 2014).

Marchiori et al. (2017), define nudging interventions as "a rearrangement of a choice context that gently suggests a specific choice for individuals.". Like the definition of Thaler and Sunstein, they consider that nudging is basically a small and almost imperceptible change in the way that options are presented, by redesigning their environment, using specific methods of changing people's behavior in the decision-making process, allowing them to make better choices, without any restriction. Beyond this, to be considered as a nudge, the intervention must be easy and cheap to avoid, and it needs to maintain the freedom of choice of the decision-maker. Nudges never force people to make a certain decision. (Thaler & Sunstein, 2008).

Individuals are constantly required to make successive decisions in their routines in many different areas, and while facing limitations of time, information, motivation, and cognitive resources, some of

them are made through a very short period of time (Marchiori et al., 2017). This behavior can lead to a rush in the decision-making process, individuals don't have enough time to consider all the options they have available, and most of the time they deliberate decisions automatically and unwisely, using habits, heuristic processes, unconscious associations, automatic responses, or rules of thumb, rather than logical and rational processes (Hofmann et al., 2009; Kahneman, 2017; Smith & DeCoster, 2000).

Habits are considered an automatic response disposition that are cued by aspects of the performance context (i.e., environment or preceding actions). Experience-sampling studies indicate that much of our everyday action is characterized by the habit or repetition (Neal et al., 2006).

Choice architecture is another term used in this context, that refers to the setting of environment of choice, implying that the choice architect has a commitment to prepare the context in which the decisions are made. They have the responsibility to organize the context wherein people make decisions, and even without realizing it, they can influence people choices, for example, doctors describing treatments to patients, people organizing food in a cafeteria, human-resources administrators creating health-care plan enrollments, parents explaining educational options for teenagers and so on (Shafir, 2013; Thaler & Sunstein, 2008).

Depending on the organization that the choice architect implements, it can influence peoples' choices, which nudge consumers towards a certain option, as shown by Thaler and Sunstein (2008).

The main purpose of nudging that made private and public institutions implement these techniques around the world, was always to point out the best solutions and trigger choices associated with the individual's best interests. Some of the most outstanding advantages of nudging are its simplicity of implementation at a low cost, the fact that they lead to effective outcomes (sometimes have even greater impact than significant economic incentives), the fact that they maintain freedom of choice and they avoid coercion once they never take the form of manipulation or trickery. Nudges should also be transparent and open rather than hidden and covert (Sunstein, 2014; Verplanken & Wood, 2006).

For nudges to be effective they must follow a two-step process: firstly, they target behaviors that need to change, and then, the context in which people make decisions must be modified to make it easier for individuals to choose a better solution. For this to happen, the choice architect must make some alterations that affect the decision-making process by adding, removing or adjusting certain elements (Siemer, 2022).

2.2.2 Systems of thinking

The fact that there are so many different types of nudges makes it impossible to have only one single mechanism that explains how nudges work. However, nudges are based on the premise that people are imperfect decision-makers, and even though they have information available, they do not always make the best choices for themselves (e.g., quit smoking, having a healthy diet, saving for retirement...).

The author Daniel Kahneman (2017) adopted two systems to refer to the thinking processes of the humans, known as the dual-process theory:

- System 1: is automatic, intuitive, and quickly, with little or no effort and no sense of voluntary control.

- System 2: is slow, deliberate, and conscious, requires more concentration and allocates attention to mental activities that demand it, including complex computations.

System 1 guides large parts of our daily routines, specifically the things we do automatically, such as habits (e.g., taking a shower or brushing our teeth) and it relies on rules of thumb, heuristics, mental shortcuts and biases; while system 2 relies on a much greater mental effort, it is when we do something that does not come naturally or when we need to make important decisions (e.g., parking our vehicle in a tight space or choosing our master's degree), employing detailed multi-criteria evaluations (Lehner et al., 2016).

In daily life, individuals must make hundreds of decisions, and many times they don't have the necessary knowledge to make them clearly. Thus, heuristics-based nudges are compatible with system 1, since they serve to aid in quick decision-making allowing people to find a reasonable result. On the contrary, information based nudges are compatible with system 2 thinking, since they stimulate thinking and learning (Leal & Oliveira, 2021).

Ciccotello and Yakoboski (2014), defend that certain groups of people tend to accept nudges better than others, for example, millennials are relatively open to nudges when compared to people near retirement age. Thus, it is important to comprehend that nudges come in different forms, and it is crucial to choose wisely what type of nudging should be implemented, depending on the target.

2.2.3 Types of nudges

It is crucial to understand that there are a variety of nudges. They can be transparent (obvious) to the individual, or they can be non-transparent (hidden) from the individual. There is a debate that transparent nudge is more ethical than a non-transparent nudge because that disclosure allows the individual to decide based on his values, rather than being unknowingly influenced by the nudge. Nonetheless, just because a nudge is non-transparent, it does not mean that it is more or less effective nor it is inherently bad or manipulative (Wachner et al., 2020).

To proceed with this study some important nudges for purposes of policy are:

- Default nudges: automatic enrollment in programs, including education, health, and savings, is one of the most effective nudges because people tend to stick to the default options, since they tend to be passive decision-makers and rather not change the status quo, due to switching cost and loss aversion.
- Social norms/ Peer pressure: emphasizes and informs of what most people do or are engaged in certain behavior, when in doubt, individuals' decisions will(Thaler & Benartzi, 2004) seek to follow the crowd and align with normative group behaviors.
- Disclosure: in an explicit way this type of nudge presents the important information, ensuring that individuals are aware about all the crucial details prior to choice, reducing uncertainty by providing relevant information.
- Information: informing people of benefits or risks of certain options can influence their behavior.
- Framing: the way in which a choice is presented can influence how people feel about it, choices can be framed as either gains or losses.

(Costa & Kahn, 2013; Franklin et al., 2019; Momsen & Stoerk, 2014; Reisch & Sunstein, 2016; Siemer, 2022; Sunstein, 2014; Thaler & Sunstein, 2008)

Taking into consideration all these conclusions, this research intends to analyze what type of nudges are more effective in respect of saving behavior and market participation (default nudge or information nudge).

2.2.4. Effect of nudges in financial decisions

During the literature review I found some recent studies were found that have already approached the importance of nudging for long-term saving behavior. One recent paper made in Spain by García and Vila (2020) analyzes whether nudging has a relevant effect on financially literate individuals. The outcome of this experiment showed that financial literacy is not enough for individuals to act. So, two types of instruments are necessary to move individuals into action, financial literacy, and nudging.

The Ahorra+ program started in 2016 and was based on the SMART program (Save More Tomorrow) principles established by Thaler and Benartzi (2004). The essence of the program is for the employees to commit in advance to allocating a portion of their future salary increases toward retirement savings. Other studies were made based on this program all over the world, and all of them have shown that this type of automatic enrolment in retirement savings plans, with an opt-out option, is a very effective way of increasing pension saving, instead of waiting for people to decide on their own to opt-in in these programs. This type of opt-out option is considered a default nudge, and according to Sunstein (2014), this nudge may well be the most effective one.

Not to mention other studies already made in distinct areas such as health that also reveal that information on its own is not enough to make people act. Although health care professionals may be assumed to make healthier lifestyle choices than others because of their greater health literacy, a study made in 2015 proved that the rates in obesity, diabetes and hypertension, are still high among health professionals (Dayoub & Jena, 2015).

3. Methodology

This chapter details the methodology that will be implemented to analyze the level of financial literacy of the Portuguese population and how nudges can be used to influence saving behavior and market participation.

This study adopts quantitative research, and a hypothetical-deductive method will be used to test the hypotheses, once it intends to analyze the variables that influence individuals' behavior. With this method, following the formulation of the hypotheses under study, the review of the literature, the collection of the numerical data through the questionnaire and the use of mathematical models for analysis, it will be possible to establish a functional relationship between dependent and independent variables, thus achieving statistically significant results that will enable the creation of objective and reliable conclusions (Babbie, 2020; Creswell, 2014; Park et al., 2020; Williams, 2007).

This section will explain in detail all the relevant aspects of the methodology. The objectives and hypotheses are presented and explained in section 3.1 attached with the appropriate literature, section 3.2 contains the method to be used for data collection, section 3.3 explains in detail the questionnaire format and finally section 3.4 contains the explanation for all dependent and independent variables used in this research. To conclude, section 3.5 consists in the models that are going to be used to test the hypothesis and drawing conclusions from this study.

3.1 Objectives and Hypotheses

The aim of this research is to analyze the financial literacy level among Portuguese population and the effect that nudging can have in the financial behavior, namely in terms of savings and market participation. Considering this general objective, it is possible to create a set of specific objectives and thereafter a set of hypotheses to be tested.

The specific objectives of this research can be written as follows:

- Determine the level of financial literacy of the Portuguese population and what variables influence that level (sociodemographic characteristics, perceived financial literacy, confidence level, financial experience, and risk profile.)
- Analyze if financial literacy can guide individuals into certain financial decisions (saving behavior and market participation).

- Analyze if nudges can influence individuals into certain financial decisions (saving behavior, and market participation).

Several studies have already approached the differences across the level of financial literacy of a population, and there is a wide range of sociodemographic factors that influence this level as well as some factors like confidence level, risk profile and financial experience (Atkinsoni & Messy, 2012; Banco de Portugal, 2010; A. Hung et al., 2009; Lusardi & Mitchell, 2007, 2011b, 2014; Mändmaa, 2019a, 2019a; Potrich et al., 2015; Stolper & Walter, 2017; van Rooij, Lusardi, Alessie, et al., 2011).

The first hypothesis tests the impact of the independent variables related to confidence level, financial experience, risk profile, and sociodemographic factors on the level of financial literacy. As such, the hypothesis to be tested is:

H1: The level of financial literacy decreases with overconfidence, increases with risk profile, financial experience, age, income, level of education and is higher for men and people with studies on the economic area.

The authors, Perry and Morris (2005), Chen and Volpe (1998) , Hilgert et al. (2003), and others, found that individuals with higher levels of financial literacy are more likely to engage in financially responsible behavior (controlling their spendings, budgeting and planning for the future), meaning that financial literacy is a key concept to improve savings behavior of individuals.

To align the objectives with the literature, for this study I analyzed saving behavior in three different segments, first is if respondents save or not, second, if they do save, how much of their net income, and third consists in analyze for how long respondents have an emergency fund to face an unexpected situation, such as unemployment or illness.

Therefore, a hypothesis was created to test this condition:

H2: Financial literacy influences positively saving behavior.

Several authors found a strong relationship between financial literacy and the likelihood of engaging in several financial practices, such as opening appropriate bank accounts, planning and saving for the long-term, paying debts and bills on time, tracking expenses, budgeting, maintaining an emergency fund, setting financial goals (Amadeu, 2009; Banco de Portugal, 2010; Chen & Volpe, 1998; Hilgert et al., 2003; A. A. Hung et al., n.d.; Lusardi & Mitchell, 2011a; Neves, 2021; van Rooij, Lusardi, Alessie,

et al., 2011). Beyond these, Hogarth and Hilgert (2022) together with Van Rooij et al., (2011) defend that people with higher levels of financial literacy tend to make better decisions in what concerns stock market participation (e.g., plan and invest in complex assets, chose appropriate investments, portfolio diversification...). Hence, this investigation aims to find if market participation can be explained by financial literacy. For this study market participation is defined as the percentage of total asset value that respondents allocate into securities.

H3: Financial literacy influences positively market participation.

Regardless the importance of the financial literacy, some authors argue that even when individuals have high levels of financial literacy, it does not necessarily mean that their behavior will change, because there are many human biases indicating that people do not always act rationally (Hira, 2012; Mändmaa, 2019a), and when information seems incapable of moving people into action, the use of nudges is a key to improve this behavior (García & Vila, 2020).

With that, the last hypothesis under study intends to analyze if default nudge and information nudge have a positive influence in financial behavior of individuals (savings and market participation).

H4: Nudges influence positively financial behavior (saving behavior and market participation).

3.2 Research Method

This chapter focuses on the research method used to test the hypotheses and thereby reach the goal of the study. Based on the literature, the most frequent instrument used in quantitative research is the questionnaire (A Meadows, 2003; Babbie, 2020; Dillman et al., 2014).

This method has its advantages and disadvantages. Some advantages are that this type of questionnaire is low cost, minimal training is required by the person administering them, they facilitate comparisons and statistical aggregation of data, the responses are anonymous allowing people to feel more comfortable and provide honest answers, and they can be employed across a greater geographical area once they can circulate on the internet. However, it is important to note that there are also some disadvantages, such as systematic bias in data and the low response rates (Bucher-Koenen & Lusardi, 2011; Dillman et al., 2014; Jones et al., 2008).

In summary, the questionnaire used in the study was distributed through online platforms and mainly consisted of multiple-choice questions. The sample for the study was obtained through convenience sampling, targeting individuals of Portuguese nationality aged 18 or older. All participants were told that their decisions would not result in real monetary outcomes, and responding to all items was mandatory, although participants had the right to leave the study at any point. Informed consent was obtained from all participants.

The questionnaire included an important part that intended to test the effectiveness of nudges to improve financial behavior of individuals. To do that, an experiment was created, with questions regarding saving behavior and market participation, and two types of nudges were used, default nudge, and information nudge.

After collecting and organizing data using Microsoft Excel, the study employed various regression models to analyze the information, depending on the nature of the variables. Probit regressions were used for binary variables with two outcomes and Ordered Probit regressions for variables with multiple ordered outcomes. Marginal effects were calculated to simplify result interpretation. The statistical software Stata was used for the regression analysis. This approach allowed for a comprehensive examination of sociodemographic data, saving behavior, and market participation, leading to meaningful conclusions for the research. (Hoffmann, 2016; Wooldridge, 2012, 2016).

3.3 Questionnaire Design

It is important to refer that before publishing the questionnaire, it was submitted to a pre-test, which was answered by 6 individuals (close friends and family), with different sociodemographic characteristics, with the purpose of detecting errors, failures and difficulties when completing it. After receiving positive feedback, the respondents said that it was an extensive survey and suggested the addition of some phrases to help understanding better some of the questions. After that, the final questionnaire (see Appendix 1) was ready to be published (Franklin et al., 2019).

To reach as many people as possible the distribution of the questionnaire was done mainly through digital channels (institutional email of the University of Minho and social networks). To avoid biases resulting from the sample size being insufficient, the questionnaire was distributed outside the university, to reach population segments that are not present in these channels (especially older age groups).

The beginning of the questionnaire started with an initial disclaimer provided to the respondents, which served to inform them about the purpose of the study, its objectives, and assured them of the anonymity and confidentiality of their responses. Therefore, the survey was divided in the following parts:

- **Part I – Sociodemographic data**

Part I of the questionnaire intended to obtain a sociodemographic characterization of the sample through information such as nationality, gender, age, marital status, level of education, area of education, and net income. These data are going to be independent variables to test the hypotheses described in the previous chapter, except the nationality, once it was only asked to prove that the respondents were all part of the Portuguese population, and this section was based on previous studies, once it enables the characterization of the sample (Fisher et al., 2015; Lusardi & Mitchell, 2007, 2010).

It is possible to establish a connection between financial literacy, saving behavior, and market participation with the sociodemographic characteristics of the sample. According to Lusardi and Mitchell (2007, 2010), there is a trend of lower financial literacy among younger individuals and those with lower levels of education. Additionally, women are found to be less likely to answer financial questions correctly. Bucher-Koenen et al. (2011) further emphasize the lower stock market participation among women and attribute the gender disparity in financial literacy to factors such as male overconfidence and potential lack of confidence among women. This entails examining how factors such as age (Allgood & Walstad, 2016; Atkinsoni & Messy, 2012; A. Hung et al., 2009; Lusardi & Mitchell, 2011b; Mändmaa, 2019a; Potrich et al., 2015; Richardson & Kilty, 1989; Yao & Cheng, 2017), gender (Allgood & Walstad, 2016; Johannisson, 2008; Lusardi & Mitchell, 2014; Mauldin et al., 2016; Njung'e, 2013), background and level of education (Altıntaş, 2011; Bernheim & Scholz, 1993; Chen & Volpe, 1998; Lusardi & Mitchell, 2014; Mändmaa, 2019a; Pires & Quelhas, 2015), marital status (Fonseca et al., 2012; Grinstein-Weiss et al., 2006; Lusardi & Tufano, 2015; Mauldin et al., 2016), and net income (Johnson & Sherraden, 2007; Liao et al., 2017; Lusardi & Tufano, 2015; Stolper & Walter, 2017) interact with financial literacy, market participation, and saving behavior, as they play significant roles in shaping individuals' financial behaviors and outcomes.

By exploring these relationships, it is possible to gain a deeper understanding of how sociodemographic factors influence individuals' financial decisions and behaviors and identify any patterns or trends that may emerge. This analysis provides meaningful insights and implications regarding the relationship between sociodemographic factors and financial outcomes in the context of this sample.

- **Part II – Nudge Experiment**

The second step of this work was to create and experiment, and it was conducted using only two nudges, default nudge and information nudge, to avoid systemic bias.

Respondents were divided into two groups randomly: the control group (Group 0) and the treatment group (Group 1), and to assure the randomization of the groups, a specific tool of the software was used, and even though the balancing of the group was not perfect, the randomization proved to be effective during the results analysis.

Individuals in the control group were asked two questions related to saving behavior and two questions about market participation. On the other hand, individuals in the treatment group were also asked the same set of questions, but with an additional manipulation introduced before each question. This manipulation involved the use of default and information nudges.

In the control group, respondents were presented with two specific questions. The first question asked whether they would save for retirement in response to a hypothetical 10% increase in their salary. The second question captured their opinion on the appropriate period for maintaining an emergency fund. Regarding market participation, the control group respondents were asked how they would allocate a hypothetical lottery winning of €10,000 in the stock market. Following this, they were asked whether they would be willing to invest any part of their assets in the stock market, and if they answered affirmatively to this question, they would be further asked about the percentage of their total asset value they would be willing to invest in the stock market.

In the treatment group, two different types of nudges were implemented to study their effect on saving behavior and market participation. For the saving behavior component, the treatment group participants were exposed to a default nudge. The bank proposed automatically adding 50% of a

hypothetical 10% salary increase to a retirement account. This default nudge aimed to encourage individuals to save more for their retirement by leveraging the automatic contribution feature. Regarding market participation, the bank proposed investing 100% of the hypothetical lottery earnings (€10,000) in the stock market. This default nudge intended to promote a higher level of investment in the stock market by presenting it as the default option. In addition to the default nudge, the treatment group participants were also exposed to an information nudge. Before answering the set of questions, individuals were asked to carefully read a statement related to each topic (saving behavior and market participation) and indicate whether they had prior knowledge about it. This information nudge aimed to create awareness and provide additional information to participants before making their decisions.

The set of questions asked in the treatment group was the same as in the control group, including questions about the recommended period for having an emergency fund and their willingness to invest in the stock market. These questions were all based on previous literature (García & Vila, 2018, 2020; Thaler & Benartzi, 2004).

By implementing these nudges in the treatment group, the objective is to understand how default and information nudges influence individuals' decisions in the context of saving behavior and market participation.

This experimental design allows for a comparison between the control and treatment groups, providing insights into the impact of nudges on financial decision-making.

- **Part III – Perceived Financial Literacy, Financial Experience, and Risk Profile**

The Part III of the questionnaire has a couple of questions regarding topics such as perceived financial literacy, confidence level, financial experience, and risk profile of the sample.

  - Perceived financial literacy: Is an alternative way to measure financial literacy by self-assessment, this focuses on what people think they know about personal finance when compared to the population in general, thus it measures financial confidence (Allgood & Walstad, 2016).The current literature defends that perceived financial literacy may be as important as actual financial literacy, linked with peoples' confidence. Zou and Deng (2019) and Allgood and Walstad (2016), found that perceived financial literacy has a positive effect in financial market participation and ind financial planning.

- Financial experience: Questions were asked to find out if people have ever invested in financial markets (i.e. stocks, corporate bonds, government bonds, mutual fund units, futures, options, CFD (contracts for differences), other derivatives, complex financial products, among others) and if people hold any investment in financial markets in the present (Atkinsoni & Messy, 2012; Gajewski et al., 2022; Hilgert et al., 2003; Lusardi & Mitchell, 2007, 2010; van Rooij, Lusardi, Alessie, et al., 2011).
- Risk profile: individuals were asked to say what type of investor profile do they most identify with. Liao et al. (2017) found that individuals with higher levels of financial literacy tend to hold riskier assets thus, there is a positive relation between the risk profile of individuals and their level of financial literacy. When individuals hold products that generate more value, they also come with higher risk levels. Financial literacy affects the level of risk tolerance, thus individuals with a more aggressive risk profile tend to display a higher willingness to invest In the securities market (Mishra, 2018; van Rooij, Lusardi, Alessie, et al., 2011).

- **Part IV – Saving behavior and Market participation**

Saving behavior is known as the sacrifice of current consumption to produce accumulation of capital that can be used for consumption or investments in the future (Fisher et al., 2015; Gersovitz, 1988). To allow for better interpretation of the results further on this research, saving behavior was organized in 3 different segments: first is if respondents save or not, second, how much of their net income they save, and third consists in analyzing for how long respondents have an emergency fund to face a situation of unemployment or illness.

The goal of this stage is to understand if people with high levels of financial literacy have better saving behaviors.

Xu et al. (2022) found that in general financial literacy positively impacts participation in financial markets, and as stated before, for this research market participation is defined as whether respondents have any percentage of their total assets invested in the financial market. It serves as an indicator of individuals' engagement in investment activities and their involvement in financial markets. By examining market participation, it is possible to gain insights into individuals' level of financial engagement and their willingness to allocate their assets in investment opportunities.

- **Part V – Effective financial literacy – Big Five**

This segment of the questionnaire attempts to measure the respondents' level of financial literacy. Several studies show the existence of relationships between financial literacy and different financial behaviors (Hilgert et al., 2003; Lusardi & Tufano, 2015).

Therefore, the instrument chosen was the "Big Five", a set of five questions developed by Annamaria Lusardi and Olivia Mitchell and which are present in several works in the literature. These five questions introduce the topics of inflation, compound interest, and risk diversification, three economic concepts that individuals should have at least some basic knowledge of if they want to make proper financial decisions (Lusardi & Mitchell, 2011a).

In relation to the 5 questions used as a starting point, some questions were formulated differently, so that it was possible to create more alternative answers and, in turn, allow greater credibility of the individuals' answers. By counting the number of correct and incorrect responses given by each respondent, it will be possible to say if a person has good financial literacy or not (Atkinsoni & Messy, 2012).

Beyond this, to assess individuals' self-perceived accuracy in answering the Big Five questionnaire, a question regarding their confidence level was included. The confidence level variable was created to capture respondents' perception of how many questions they believe they answered correctly.

It categorizes confidence as follows: neutral, underconfident, or overconfident, and it was created by subtracting the number of respondents' corrected answers on the Big Five questionnaire from the number of responses they believed to be correct. A neutral categorization is assigned when the respondent's answer matches the number of correct answers, indicating a balanced level of confidence. Underconfident categorization occurs when the respondent's answer falls short of the number of correct answers, reflecting a lack of confidence in their responses. Alternatively, an overconfident categorization is given when the respondent's answer exceeds the number of correct answers, indicating an excessive level of confidence in their answers.

Analyzing this variable provides insights into individuals' confidence levels, allowing for an examination of the potential impact of confidence on decision-making and behavior. Moreover, there is a contradiction in the existing literature concerning this variable, some authors defend that individuals

with higher levels of self-confidence score higher in financial literacy tests and others state that overconfident individuals present lower levels of financial literacy (Arellano et al., 2014; Avdeenko et al., 2019; Lee & Hanna, 2022; Mudzingiri et al., 2018)

- **Part VI – Nudges preferences**

In the end of the questionnaire, respondents were asked to classify on a Likert scale how relevant they thought default and information nudges were [unimportant (1); slightly unimportant (2); neutral (3); slightly important (4); and important (5)].

. These questions did not follow any theoretical background, given the lack of literature in this area. With this information, it was possible to assess which type of nudges the respondents valued more, by analysing which of them had a higher score in points.

3.4 Model Variables

With the data obtained through the questionnaire, it was possible to draw the variables that were used to meet the objectives of this dissertation This section aims to provide a detailed description of the variables that were used to perform the statistical analysis and how they were computed. It follows in two subsections: 3.4.1. where the dependent variables were described and 3.4.2 where independent variables are explained.

3.4.1 Dependent Variables

The hypothesis of this study aims to find what variables can explain financial literacy levels, market participation, saving behavior and what nudges are more efficient when it comes to market participation and saving behavior.

With that being said, there are ten dependent variables under study (see table 1), one resembles the level of financial literacy (fl_score), three of them are related to saving behavior (save_dummy; save_percentage; emergency_fund), one is related to market participation (market_participation), and five of them are related to the nudge experiment (savings_default; savings_info; mkt_part_default; mkt_part_info; mkt_part_info2).

Table 1 Description of the dependent variables

Variable	Description	Variable type
fl_score	Measured by the number of correct answers to the "Big Five" financial literacy questions thus, the variable assumes values from zero to five according to each respondent answers.	categorical
save_dummy	Resembles the single questions asking if respondents save or not: 0= do not save; 1= save	dummy
save_percentage	Measured in a scale of 3, where respondents were asked what percentage of their net income they save: 1= do not save any percentage of net income; 2= saves unitl 20% of net income; 3= save more than 20% of net income	categorical
emergency_fund	Measured for how long respondents have an emergency fund to face a situation of unemployment or illness: 1= do not have na emergency fund/do not know/do not want to answer; 2= fund for 3 months; 3= fund for 6 months; 4= fund for more than 6 months	categorical
market_participation	Measures if respondents have any percentage of their total asset value invested in the securities market 0= respondents do not have any percentage of their total asset value allocated in securities; 1= respondents have some percentage of their total asset value allocated in securities	dummy
savings_default	Resembles to the hypothetical question of the experiment regarding saving behavior, where individuals were asked if they would save for retirement if they suffer 10% increase in the salary: 0= would save until 25% for retirement ; 1= would save more than 25% for retirement	dummy
savings_info	Captures the respondents' opinion on the appropriate period for maintaining an emergency fund: 0= less than 6 months' worth of expenses saved; 1= more than 6 months' worth of expenses saved.	dummy
mkt_part_default	Examines how individuals would allocate their lottery winnings of €10,000 in the stock market: 1= allocate less than 50% of their winnings in the stock market; 2= allocate exactly 50% of their winnings in the stock market; 3= allocate more than 50% of their winnings in the stock market	categorical
mkt_part_info	Measures if individuals are willing to invest any part of their assets in the stock market: 0= not willing to invest any part of their assets in the stock market; 1= willing to invest any part of their assets in the stock market	dummy
mkt_part_info2	If respondents answered affirmatively to the previous question, they would be further asked about the percentage of their total asset value that they would be willing to invest in the stock market: 1= willingness to invest between 0% and 25%; 2= willingness to invest between 26% and 50%; 3= willingness to invest between 51% and 75%	categorical

3.4.2 Independent Variables

To gather the necessary data for the objectives of this dissertation, 11 independent variables were used in total, and they are summarized in table 2.

Table 2 Description of the independent variables

Variable	Description	Variable type
perceived_fl	Derives from the question where individuals were asked to assess their financial knowledge in financial literacy when compared to the population in general: 1 – Well below average; 2 – below average; 3 –equal to the average; 4 – above average; 5 – well above average.	categorical
confidence_level	Was determined by comparing participants' self-perceived performance on the Big Five questionnaire to their actual performance: 1= neutral; 2= overconfident; 3=underconfident	categorical
financial_experience	Was assessed by asking if people have ever invested in the financial markets: 0 = never invested in financial markets: 1 = has invested in financial markets	dummy
risk_profile	Derives from the questions where individuals were asked to say what risk profile they most identify with: 1= conservative; 2= balanced; 3= dynamic; 4= aggressive	categorical
age	1= 18-25years old; 2= 26-35years old; 3= 36-45years old; 4= 46-55 years old, 5= more than 55 years old	ordinal
gender	0= female respondent; 1= male respondent	dummy
marital_status	0= not single; 1= single	dummy
education_level	1= basic education; 2= high school; 3= university	categorical
education_area	1= Sciences; 2= Engineering; 3= Others (architecture and construction, arts, languages, humanities, life and physical sciences, law, sports, enology and other)	categorical
net_income	1= no net income; 2= until 749€; 3= more than 749€	categorical
group	Assumes the two different groups present in the experiment: 0= control group; 1= treatment group	dummy

3.5 Model's Description

Given the objectives and the hypotheses to be analyzed on this research, three main models were used. This section presents all the different models employed and it is divided into three subsections: the first focuses on the model used to analyze the influence of the independent variables (see section 3.4.2) on individuals' financial literacy, the second encompasses the models related to the study of saving behavior and market participation and, while the last integrates the models related to the study of the effect of nudges on respondents' behavior.

3.5.1 Financial Literacy

The first objective is to study if financial literacy could be explained by confidence level, financial experience, risk profile, and by sociodemographic characteristics (age, gender, marital status, education level, education area, and net income). It is, therefore, necessary to emphasize that in this model, the financial_literacy variable corresponds to the dependent variable, contrary to what happens throughout the paper. The relation of the independent variables with financial literacy was analyzed through the following model:

$$\begin{aligned}\text{financial\_literacy} = {} & \alpha_0 + \alpha_1 \text{confidence\_level} + \alpha_2 \text{financial\_experience} + \\ & \alpha_3 \text{risk\_profile} + \alpha_4 \text{age} + \alpha_5 \text{gender} + \alpha_6 \text{marital\_status} + \\ & \alpha_7 \text{educational\_level} + \alpha_8 \text{education\_area} + \alpha_9 \text{net\_income} + \varepsilon \end{aligned} \quad (1)$$

where ε is the error term

3.5.2 Market Participation and Saving Behavior

The next step of this research aimed to better understand what can explain financial behavior, focusing particularly on saving behavior and market participation. It is important to highlight the fact that saving behavior is going to be analyzed in three different segments. Hence, the dependent variables are save_dummy, save_percentage, emergency_fund, and market_participation. On the other hand, the independent variables account for the same as the previous model, with the addition of fl_score.

Accordingly, the next models to test hypothesis 2 and hypothesis 3 are:

$$\begin{aligned}\text{save\_dummy} = {} & \alpha_0 + \alpha_1 \text{fl\_score} + \alpha_2 \text{confidence\_level} + \alpha_3 \text{financial\_experience} + \\ & \alpha_4 \text{risk\_profile} + \alpha_5 \text{age} + \alpha_6 \text{gender} + \alpha_7 \text{marital\_status} + \alpha_8 \text{educational\_level} + \\ & \alpha_9 \text{education\_area} + \alpha_{10} \text{net\_income} + \varepsilon \end{aligned} \quad (2)$$

where ε is the error term

$$\text{save\_percentage} = \alpha_0 + \alpha_1 \text{fl\_score} + \alpha_2 \text{confidence\_level} + \alpha_3 \text{financial\_experience} + \alpha_4 \text{risk\_profile} + \alpha_5 \text{age} + \alpha_6 \text{gender} + \alpha_7 \text{marital\_status} + \alpha_8 \text{educational\_level} + \alpha_9 \text{education\_area} + \alpha_{10} \text{net\_income} + \varepsilon \quad (3)$$

where ε is the error term

$$\text{emergency\_fund} = \alpha_0 + \alpha_1 \text{fl\_score} + \alpha_2 \text{confidence\_level} + \alpha_3 \text{financial\_experience} + \alpha_4 \text{risk\_profile} + \alpha_5 \text{age} + \alpha_6 \text{gender} + \alpha_7 \text{marital\_status} + \alpha_8 \text{educational\_level} + \alpha_9 \text{education\_area} + \alpha_{10} \text{net\_income} + \varepsilon \quad (4)$$

where ε is the error term

$$\text{market\_participation} = \alpha_0 + \alpha_1 \text{fl\_score} + \alpha_2 \text{confidence\_level} + \alpha_3 \text{financial\_experience} + \alpha_4 \text{risk\_profile} + \alpha_5 \text{age} + \alpha_6 \text{gender} + \alpha_7 \text{marital\_status} + \alpha_8 \text{educational\_level} + \alpha_9 \text{education\_area} + \alpha_{10} \text{net\_income} + \varepsilon \quad (5)$$

where ε is the error term

3.5.3 Nudges

The last goal of this study was to analyze if the use of nudges had a positive effect in guiding individuals towards a better financial behavior.

It was relevant to test whether being in the treatment group, and consequently receiving the questions with nudges, had a positive effect in guiding individuals to choose better options. As such, it is going to be tested if the use of nudges produced a positive effect in saving behavior and market participation – meaning that if individuals would receive default / information nudges it would create a difference in their behavior in what concerns savings and market participation.

The following model was regressed to test H4 and H5:

$$\begin{aligned}\text{Nudge Variables} *= \ & \alpha 0 + \alpha_1 \text{group} + \alpha_2 \text{fl\_score} + \alpha_3 \text{confidence\_level} + \\ & \alpha_4 \text{financial\_experience} + \alpha_5 \text{risk\_profile} + \alpha_6 \text{age} + \alpha_7 \text{gender} + \\ & \alpha_8 \text{marital\_status} + \alpha_9 \text{educational\_level} + \alpha_{10} \text{education\_area} + \\ & \alpha_{11} \text{net\_income} + \varepsilon\end{aligned} \quad (6)$$

where ε is the error term

*Nudge_variables assumed the following variables: savings_default, savings_info, mkt_part_default, mkt_part_info, and mkt_part_info2.

These regressions allowed an estimation of the average treatment effect for each nudge using Ordered Probit, where the coefficients on the dummies showed the average treatment effect for each nudge.

4. Data

This study focuses on the influence that nudging can have on financial decisions of the Portuguese population with different backgrounds, and how it can complement the financial literacy that people have when it comes to financial decisions, such as: market participation and saving behavior. Therefore, this research focuses specifically on the Portuguese population, which means that all individuals who took part in this study were required to be Portuguese nationals. Beyond this, respondents had to be 18 years of age or older to be able to participate in the survey, this criterion was established based on the legal definition of adulthood, which grants individuals the capacity to make decisions and assume responsibility for their financial affairs, including their market participation and saving behavior. There were no other limitations applied to the sociodemographic factors, as it was necessary to obtain a reliable and good-sized sample, to analyze and validate the impact of the previously mentioned factors in the approached aspects of financial behavior.

Similarly, the sampling approach used in this study was convenience sampling, where participants were selected based on their availability and willingness to participate (Bryman, 2016). Convenience sampling is a non-probability sampling method commonly employed in social science research. However, it is important to note that convenience sampling has its limitations. Some researchers argue that convenience samples may suffer from selection bias, as they may disproportionately represent certain groups while underrepresenting others. Additionally, convenience samples may not accurately reflect the broader population of interest, which can limit the generalizability of the study's findings (Dillman et al., 2014).

4.1 Sample

This study target are individuals of Portuguese nationality, and the only significant restriction for participation is their minimum age requirement of 18 years. This limitation arises once the questionnaire is written in Portuguese, and the research aims to specifically analyze the financial behaviors of the Portuguese population. The decision to set the minimum age criterion at 18 is based on legal considerations, as individuals at this stage of life are legally recognized as adults. As such, they possess the capacity to make informed financial decisions and take responsibility for their financial management, savings behavior, and participation in the financial market.

Beyond these specific criteria, there were no other significant restrictions imposed on the selection of participants based on sociodemographic factors. The intention was to form a diverse and substantial sample size to explore and analyze various aspects, including the influence of different sociodemographic variables on financial literacy levels and other relevant aspects examined throughout the entire study.

The questionnaire was carried out using the Qualtrics tool, being open from 27/01/2023 to 04/02/2023. For this study a total of 216 responses were collected, however, only 213 of these responses were valid.

The data was then exported to a Microsoft Excel file, and it was statistically treated in the Stata program. At the end of this work, the objective is to analyze whether the nudges effectively influence behavior. Table 3 presents a summary of the demographic data of the sample.

For the experiment, the sample was divided in 2 groups. Group 1 was the control group (no nudges were applicated) and group 0 was the treatment group (with 2 nudges). The sample was divided randomly between each group. Group 1 had 111 people, and group 0 had 102 people.

There is a wide range of ages in the sample, with a minimum age of 18 and a maximum of 91 years old. There are two main groups in this sample, 30,05% of respondents are young (with ages between 18 and 25 years) and 48,36% are older (people older than 45). Comparing the sample with the Portuguese population that in general characterizes itself as a relatively old population (Pordata, 2021), with a mean age of 46,2 years old, the mean of the sample is slightly younger, with a value of 40,3 years old.

Mainly the sample is feminine (121 respondents) and 54,93% of the respondents were married/unmarried, divorced/separated, or widower, and 45,07% are single, this also represents the disparity of ages of the sample. Beyond that, 67,14% of the participants have higher education (bachelor's degree, professional higher technical course, master's degree, post-graduation or MBA, PhD) mainly in social sciences (45.07%), meaning that the samples have higher education rates when compared to the Portuguese population which in general only has an education level equal to the obligatory schooling (high school). The income of the sample is mainly higher than 749€, and the average income of the Portuguese population is between €1001 and €1500.

Analyzing the variable age as a continuous variable instead of a categorical variable, it is obvious to see that despite the fact the mean of age is 41,30 years, this is due to the disparity of the minimum (18 years) and maximum age registered (91 years) on the sample. Despite that fact, it is possible to infer from a standard deviation of 16,32 that the age of individuals is spread out and vary considerably, with some individuals being significantly younger or older than the mean age of 41,3 years. Beyond these, the age that has a more representative percentage in this sample is from people with 25 years old, and this value does not correctly represent the Portuguese population. Therefore, the differences in education level and income level were expected.

It should be noted that the findings of this study may not be directly applicable to the entire Portuguese population due to the differences between the sample and the general population, so it is necessary to be cautious while making assumptions.

However, the analysis of this sample is interesting, as by analyzing a diverse age range, this study can provide valuable insights into the financial behaviors, priorities, and challenges of individuals at different life stages. This can aid with the identification of age-specific patterns and trends in financial decision-making and planning. Also, the sample includes individuals who are at a critical life stage for developing financial habits and making important financial decisions. Younger adults, for example, may have unique financial concerns related to education, career building, and early-stage investments. Understanding their financial behaviors can contribute to targeted interventions and support. As technology, education, and access to information have advanced, the financial behaviors and preferences of younger individuals may differ from older generations.

Table 3 Summary of the sample's sociodemographic variables

	Treatment Group		**Control t Group**		**Total**	
Variable	**Frequency**	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Age						
18-25	33	32,35%	31	27,93%	64	30.05%
26-35	16	15,69%	7	6,31%	23	10.80%
36-45	10	9,80%	13	11,71%	23	10.80%
46-55	20	19,61%	37	33,33%	57	26.76%
Older than 55	23	22,55%	23	20,72%	46	21.60%
Total	102	100,00%	111	100,00%	213	100.00%

Gender						
Female (0)	55	53,92%	66	59,46%	121	56.81%
Male (1)	47	46,08%	45	40,54%	92	43.19%
Total	102	100,00%	111	100,00%	213	100.00%
Marital Status						
Not Single (0)	49	48,04%	68	61,26%	117	54.93%
Single (1)	53	51,96%	43	38,74%	96	45.07%
Total	102	100,00%	111	100,00%	213	100.00%
Education Level						
Elementary School	7	6,86%	8	7,21%	15	7.04%
High School	28	27,45%	27	24,32%	55	25.82%
Higher Education	67	65,69%	76	68,47%	143	67.14%
Total	102	100,00%	111	100,00%	213	100.00%
Education Area						
Social ciences	49	48,04%	47	42,34%	96	45.07%
Engineering	15	14,71%	16	14,41%	31	14.55%
Others	38	37,25%	48	43,24%	86	40.38%
Total	102	100,00%	111	100,00%	213	100.00%
Net Income						
No Income	25	24,51%	22	19,82%	47	22.07%
Up to €749	11	10,78%	11	9,91%	22	10.33%
More than €749	66	64,71%	78	70,27%	144	67.61%
Total	102	100,00%	111	100,00%	213	100.00%

4.2 Reliable Consistency Analysis

As this study was only based on the sample size collected with a questionnaire, it was relevant to assess its reliability by testing the internal consistency between the multiple elements. For this the Cronbach's Alpha coefficient was employed, since it is typically used to assess the reliability of a scale, being the most widely used in the literature. (Cronbach, 1951).

The Cronbach's alpha was computed using Stata software, and the value of alpha can range from 0 to 1, with higher values indicating better internal consistency. It is considered that an α with a minimum value of 0.7 presents good reliability (Maroco & Garcia-Marques, 2013).

Based on the Stata output provided, it shows that a statistical analysis was conducted using variables related to 20 financial and demographic factors. The output indicates the scale reliability coefficient was 0.7056 (see table 4). As a rule of thumb, an alpha value of 0.70 or higher is often considered acceptable for research purposes, so this value indicates moderate to high internal

consistency reliability of the scale, which translates to good reliability and validity, meaning that good and solid conclusions can be inferred from this work.

Table 4 Cronbach's Alpha

Variable	Average interitem covariance	Cronbach's Alpha	Number of Items
Scale	.0547225	0.7056	20

4.3 Multicollinearity Analysis

After collecting the data from the questionnaire and testing for a consistent analysis, it is also necessary to assess its reliability and test for internal consistency by testing for multicollinearity issues. The presence of multicollinearity occurs when there is a high or perfect correlations among two or more independent variables in a multiple regression model.

If two variables are high or perfectly correlated, it can lead to skewed or misleading conclusions, through the biased results obtained, which can cause errors when a researcher is trying to ascertain the impact of the independent variables on a dependent variable in statistical models. That is, in general, multicollinearity can lead to wider confidence intervals, which can lead to not concrete conclusions or errors in judgment of the importance of a specific independent variable (Gujarati & Porter, 2009; Thompson et al., 2017).

Table 5 shows the correlation matrix among the independent variables of this study, which was computed with the Pearson coefficient. This coefficient is a measure of the linear relationship between two variables, ranging from -1 (perfect negative correlation) to 1 (perfect positive correlation), with 0 indicating no correlation. A positive value indicates a positive correlation (as one variable increases, so does the other), while a negative value indicates a negative correlation (as one variable increases, the other decreases). The magnitude of the correlation coefficient indicates the strength of the relationship between them. Again, there is no definitive value from the existing literature from which it is possible to state the presence of multicollinearity, however, several authors defend that 0.8 is the limit for non-existence of these issues.

The coefficients present in table 5 are lower than recommended, meaning that the presence of multicollinearity is not a problem for this study.

Overall, there seem to be some significant correlations between certain variables in this dataset, however, it's important to keep in mind that correlation does not necessarily imply causation, and further analysis is needed to determine the nature of these relationships.

To deeply study multicollinearity, a set of OLS regressions with the same variables were created to compute the variance inflation factors (VIF), an indicator that presents the growth of certain variance in the presence of multicollinearity, meaning that it demonstrates how variances tend to be inflated by multicollinearity. Again, there is no formal value for deciding when a VIF is too large, but a generic value is accepted to define when a multicollinearity turns into a problem, and that is when VIF>10 (Wooldridge, 2012; Yu et al., 2015).

Looking at the tables that present the VIF computation for all models used (see Appendix 2), it was possible to conclude that there was only one variable with significantly high correlation in some of the models (vif > 10), that is perceived financial literacy (perceived_fl). With that being said, that variable will be disregarded for all the models to obtain good and reliable results.

Table 5 Pearson Coefficient - Correlation Matrix

	age	gender	marital_status	education_level	education_area	net_income	perceived_fl	financial_experience	risk_profile	confidence_level
age	1									
gender	-0.0615	1								
marital_status	-0.774***	-0.00885	1							
education_level	-0.179**	-0.0966	0.112	1						
education_area	0.361***	-0.0481	-0.322***	-0.264***	1					
net_income	0.622***	-0.0217	-0.576***	0.0890	0.261***	1				
perceived_fl	0.0721	0.320***	-0.0496	0.161*	-0.270***	0.147*	1			
financial_experience	0.465***	0.198**	-0.387***	0.00784	0.0247	0.367***	0.347***	1		
risk_profile	-0.204**	0.316***	0.170*	-0.0185	-0.230***	-0.138*	0.334***	0.190**	1	
confidence_level	-0.0819	-0.0580	0.105	-0.0501	-0.00865	-0.0743	0.0506	0.0239	-0.0148	1

Note. This table presents the correlations between each independent variable. *p<0.05, ** p<0.01, *** p<0.1

4.4 Data Description

By categorizing the questionnaire responses into a treatment group and a control group, it became possible to analyze the data separately for each group. This allowed for a comparison between the two groups. By doing this, it was possible to determine if the random assignment of participants to each group was successful in ensuring a balanced and unbiased representation.

Table 6 displays the mode, average, and standard deviation for financial variables present in this study. The results indicate that the average financial literacy level was 3 out of a maximum of 5. This holds true for both the treatment and control groups, as well as the overall sample.

The mode value for financial experience was 0, indicating that participants have lower levels of market participation. This suggests a significant lack of financial experience in the sample.

Additionally, the average risk-profile for the entire sample was close to 2, indicating a balanced risk profile.

Looking at the confidence level variable, in both groups, the mode value is 2. On average, the treatment group reported a confidence level of 2.059, while the control group reported an average of 1.910. The standard deviation values of 0.701 and 0.695 for the treatment and control groups, respectively, indicate a relatively moderate dispersion of confidence levels within each group. Overall, the total sample exhibited an average confidence level of 1.889, with a standard deviation of 0.725. The confidence levels ranged from a minimum of 1 to a maximum of 3 across the entire sample, and these findings suggest that the participants generally had an overconfidence level of their financial knowledge and decision-making abilities. This approach allowed to examine the participants' subjective assessment of their own knowledge and skills compared to their objective performance.

Table 6 Mode, Average and Std. Dev. for financial variables

	Treatment Group			Control Group			Total Sample			Range	
	Mode	Average	Std. Dev	Mode	Average	Std. Dev	Mode	Average	Std. Dev	Min	Max
Perceived Financial Literacy	3	3,284	0,905	3	3,072	0,871	3	3,173	0,933	1	5
Confidence Level	2	2,059	0,701	2	1,910	0,695	2	1,889	0,725	1	3
Financial Experience	0	0,422	0,496	0	0,459	0,501	0	0,441	0,498	0	1
Risk Profile	2	1,735	0,659	1	1,577	0,596	1	1,642	0,677	1	4
Financial Literacy	4	2,902	1,525	3	2,811	1,511	4	3,123	1,435	0	5

Note. This table presents the mode, average and standard deviations for perceived financial literacy, confidence level, financial experience, risk profile and financial literacy of the sample divided by the treatment group, control group and total sample.

Table 7 presents a descriptive statistic regarding financial behavior under analysis in this study, namely market participation and saving behavior across the treatment group, control group, and the total sample.

Regarding the variable "save_dummy," the mode was 1 in both the treatment and control groups, indicating that most participants reported saving money. The average value was 0.892 in the treatment group and 0.820 in the control group, with standard deviations of 0.312 and 0.386, respectively. This suggests a relatively consistent level of saving behavior among participants.

For the variable "save_percentage," the mode was 2 in both groups, indicating that the most common response was that individuals save up to 20% of their net income.

Contrary to expectations, in the case of "emergency_fund," the mode was 1 in the treatment group and 4 in the control group, indicating different saving patterns between the two groups. The average value was 2.510 in the treatment group and 2.577 in the control group, with standard deviations of 1.233 and 1.180, respectively. This suggests a wider range of responses and variability in saving behavior, particularly in the control group.

In what concerns market participation, it is possible to emphasize the fact that the mode of respondents in both the treatment and control groups is zero, indicating that the most common response was non-participation in the financial markets.

There could be several reasons why the treatment group, despite receiving behavioral nudges to help them save more, did not report better results. It is important to note that most of the sample of the treatment group is younger that the sample of the control group, and that leads to less net income. If people earn less, they have less possible ways to save money. Factors beyond the scope of the study or the behavioral nudges may have influenced the saving behavior of the treatment group. Economic conditions, personal financial circumstances, or unexpected events could have affected participants' ability or motivation to save, thereby attenuating the impact of the behavioral nudges. Saving behavior is complex and influenced by various individual factors, habits, and attitudes. Participants may have faced challenges or personal circumstances that hindered their ability or willingness to adopt the recommended saving strategies.

Despite the fact that the treatment groups received behavioral nudges to influence them into better saving behavior, it did not report better result than the control group. Several factors may explain

this outcome. Firstly, the treatment group consisted mostly of younger individuals with lower net income, which limits their ability to save. Economic conditions, personal financial circumstances, and unexpected events outside the study's scope could have also influenced participants' saving behavior, reducing the impact of the nudges. Saving behavior is complex and influenced by individual factors, habits, and attitudes, which may have posed challenges for participants in adopting the recommended saving strategies. Additionally, the effectiveness of the behavioral nudges may have varied among individuals, as different people respond differently to such interventions. Moreover, self-reported data on saving behavior may have limitations and biases, potentially creating discrepancies between reported and actual outcomes. Further analysis and research are necessary to gain a more comprehensive understanding of the reasons behind the treatment group's lack of improved results.

Table 7 Summary statistics for Financial Behavior (save_dummy, save_percentage, emergency_fund, mkt_participation)

	Treatment Group			Control Group			Total Sample			Range	
	Mode	Average	Std. Dev.	Mode	Average	Std. Dev.	Mode	Average	Std. Dev.	Min	Max
save_dummy	1	0,892	0,312	1	0,820	0,386	1	0,854	0,353	0	1
save_percentage	2	2,216	0,623	2	2,018	0,572	2	2,113	0,604	1	3
emergency_fund	1	2,510	1,233	4	2,577	1,180	4	2,545	1,203	1	4
mkt_participation	0	0,363	0,483	0	0,360	0,482	0	0,362	0,482	0	1

Note. This table presents the summary statistics of market participation and saving behavior for the sample divided in treatment group, control group and, total sample.

Table 8 presents the mode, average and standard deviations regarding the information and default nudge preferences of the respondents. For both nudges the mode was the same for both groups (5-very important), meaning that individuals give importance to receiving information and recommendations with default about financial decisions. The mode being the same for both groups indicates a shared preference for these two types of nudges. The average values and standard deviations provide insights into the level of agreement and variability in these preferences among participants. These findings suggest that individuals generally value receiving information to guide their financial decisions, as well as having default settings that can assist them financially.

Overall, the table highlights that information nudges were the ones with higher average, for both the treatment group, the control group and the total sample, meaning that, even though the mode is the same for all nudges, information is the nudge individuals value more.

Table 8 Summary statistics of Nudge preferences

	Treatment Group			Control Group			Total Sample		
	Mode	Average	Std. Dev	Mode	Average	Std. Dev	Mode	Average	Std. Dev
information nudge	5	4,141	0,859	5	3,982	1,048	5	4,058	0,963
default nudge	5	4,078	0,919	5	3,901	1,099	5	3,986	1,019

Note. This table presents the mode, average and standard deviations for the importance given to the information nudge and default nudge by the sample divided by tretament group, control group and, total sample.

Table 9 presents a detailed analysis of the variables that were subjected to nudges, specifically focusing on saving behavior and market participation for the treatment group, control group, and total sample.

In terms of savings behavior with the default nudge, the objective was to examine whether respondents would allocate a portion of their salary increase towards retirement savings. The control group showed a mode of zero, indicating that they did not allocate any money for this purpose. In contrast, the treatment group had a mode of one, indicating agreement with the default nudge that automatically allocated a percentage of the salary increase into retirement savings. These results suggest that the default nudge was effective in encouraging savings in this context.

However, when it comes to savings behavior with the information nudge, the mode for both the treatment group, control group, and total sample was one, indicating that the information nudge did not produce the same impact as the default nudge.

With reference to market participation, the mode for market participation with the default nudge was three in the treatment group, indicating a preference for active market involvement with default options. In contrast, the mode for the control group was one, suggesting a preference for less active market participation. These findings highlight those individuals who experienced a default nudge, where their lottery winnings were automatically allocated to market participation, tended to be more receptive to this default option compared to those who had the choice to randomly allocate their winnings between securities or deposits. Thus, the default nudge appears to be effective in increasing market participation.

For market participation with information (mkt_part_info), the mode was one in the treatment group and zero in the control group, indicating a preference for participating in securities market among individuals exposed to the nudge.

However, for the last nudge (market_participation2), both groups had a mode of one, indicating a similar preference for market participation. This suggests that the specific information nudge employed did not have a significant impact on the market participation of individuals.

Overall, the table provides valuable insights into the outcomes of nudges on saving behavior and market participation. However, further analysis is required to gain a deeper understanding of the underlying factors influencing these choices and their broader implications.

Table 9 Summary statistics for Nudges

	Treatment Group			Control Group			Total Sample			Range	
	Mode	Average	Std. Dev.	Mode	Average	Std. Dev.	Mode	Average	Std. Dev.	Min	Max
savings_default	1	0,644	0,481	0	0,468	0,501	1	0,552	0,498	0	1
savings_info	1	0,608	0,491	1	0,636	0,483	1	0,623	0,486	0	1
mkt_part_default	3	2,216	0,875	1	1,541	0,784	1	1,864	0,893	1	3
mkt_part_info	1	0,578	0,496	0	0,450	0,500	1	0,512	0,501	0	1
mkt_part_info2	1	1,441	0,565	1	1,400	0,571	1	1,422	0,566	1	3

Note. This table presents the mode, average and standard deviations for each nudge of the experiment (default and information nudge for market participation and saving behavior) by the sample divided by treatment group, control group and, total sample.

5. Results

This section focuses on the presentation and discussion of the results derived from the statistical analysis of the questionnaire data and regression models developed earlier. The section is divided into three subsections: 5.1 examines the findings related to the financial literacy level of the sample, corresponding to the first objective of the study, while 5.2 covers the results concerning the financial behaviors of the sample, addressing the subsequent objectives of the study regarding market participation, and saving behavior. Lastly, subsection 5.3 addresses the final objective and provides an analysis of the studied nudges.

5.1 Financial Literacy

The primary objective of this research is to examine the degree of financial knowledge among the Portuguese population and investigate the various factors that could potentially impact it. These factors include individuals' confidence level, the level of experience in financial matters, their risk profile, as well as sociodemographic attributes such as age, gender, marital status, background and level of education, and net income. This section intends to analyze the financial literacy of the Portuguese population.

Table 10 presents the summary statistics for the financial literacy score of the sample. The average financial literacy score of the sample was found to be 57.09%. These findings highlight the low financial literacy levels among the Portuguese population, and it indicates that there is significant room for improvement in financial literacy matters within the country.

Table 10 Summary statistics of Financial Literacy score of the total sample

	Total Sample				Range	
	Mode	Average	Average (%)	Std. Dev.	Min	Max
Financial Literacy	4	2,854	57,09%	1,515	0	5

Note. This table presents the mode, average (in absolute value and percentage), standard deviation, minimum and maximum values for financial literacy level of the total sample.

Table 11 provides a comprehensive overview of the financial literacy scores within the total sample. The results indicate that the majority of individuals in the sample exhibit some level of financial literacy, with 26.29% of respondents scoring a four, which reflects a reasonable understanding of financial concepts as demonstrated by answering four out of the "Big Five" financial literacy questions correctly.

The results also indicate that 9.86% of the sample scored 0 in financial literacy, suggesting a lack of basic understanding in financial concepts. Similarly, 11.27% scored 1, indicating a limited grasp of financial knowledge. As the scale moves up, the percentage of individuals with higher financial literacy scores gradually increases. Finally, 13.62% of the sample obtained a perfect score of 5, signifying a high level of financial literacy.

Analyzing the accumulated frequency column, we observe that approximately 60.09% of the sample achieved a financial literacy score of 3 or lower, while 86.38% scored 4 or lower. This highlights the prevalence of individuals with moderate to lower levels of financial literacy in the sample. These findings emphasize the importance of promoting financial education and literacy initiatives to address the knowledge gaps and enhance financial competence among individuals. A comprehensive approach is necessary to improve financial literacy levels across the population and equip individuals with the necessary skills to make informed financial decisions.

Table 11 Summary statistics of the sample's Financial Literacy Scores

	Total Sample		
Financial Literacy	**Frequency**	**Percentage**	**Acum. Freq.**
0	21	9,86%	9,86%
1	24	11,27%	21,13%
2	34	15,96%	37,09%
3	49	23,00%	60,09%
4	56	26,29%	86,38%
5	29	13,62%	100,00%

Note. This table presents the financial literacy scores, as well as the absolute values and percentage of individuals that had each score, for the total sample.

Table 12 shows the number and percentage of correct answers to each of the "Big Five" financial literacy questions. When analyzing each question individually it is representative of which financial domains are lacking and which are more acknowledged by the population. The results demonstrate that the highest percentage of correct answers was obtained for the question of interest rates, revealing itself as the domain where most people choose the right option (71,83%), which implies a high level of understanding among the sample about this topic. On the other hand, the lowest percentage of correct answers was obtained for the question about bond prices and interest rates (18,78%), which suggests the existence of a necessity for improvement in financial education and awareness.

Table 12 Number and percentage of correct/incorrect answers to each of the "Big five" questions

	Total Sample			
	frequency		percentage	
	0	1	0	1
Question				
Interest rates	60	153	28,17%	71,83%
Inflation	66	147	30,99%	69,01%
Bond prices/interest rates	173	40	81,22%	18,78%
Mortgages/ interest rates	88	125	41,31%	58,69%
Portfolio Diversification	70	143	32,86%	67,14%

Note. This table shows the number of correct answers of the total sample to each of the Big Five questions, with the respective relative frequency.

Table 13 represents the results of the ordered Probit regression for financial literacy, reporting for each category of the independent variables the marginal effect on the probability of affecting the financial literacy level. This regression contains all the independent variables approached by this study (except for perceived financial literacy, that was dropped as explained previously), according to model 1, that was computed to test Hypothesis 1. The results obtained show that the variables to explain financial literacy scores that are statistically significant are confidence level, financial experience, risk profile, age, gender, education level, education area, and net income (confidence_level, financial_experience, risk_profile, age, gender, education_level, education_area, and net_income).

In table 13, the coefficients for "confidence level" are statistically significant in most models. Overall, the results indicate that individuals who perceive themselves as overconfident tend to have lower financial literacy scores, while those who perceive themselves as underconfident tend to have higher financial literacy scores compared to individuals with a neutral confidence level. The first coefficient for overconfident individuals is 0.1264, meaning that individuals who perceived themselves as overconfident (believing they know more than what they do) are 12,64% more likely to have zero correct answers, indicating lower financial score compared to those who have a neutral confidence level. On the contrary, overconfident individuals are 14,81% less likely to have all 5 answers correct. Beyond these, individuals who are underconfident (believing they know less than what they actually do) are 13,77% more likely to have higher financial literacy (all answers correct) when compared to those with a neutral confidence level. With these results it is possible to confirm that overconfident individuals tend to display lower levels of financial literacy (Mudzingiri et al., 2018).

With respect to financial experience, it is possible to infer that individuals with financial experience (participated in the market) are presumably more knowledgeable about financial matters, having more correct answers regarding financial literacy, agreeing with the existing literature (Mishra, 2018; van Rooij, Lusardi, Alessie, et al., 2011). Holding other variables constant, individuals who have invested in the past are 5,89% less likely to have low financial literacy compared to those without any financial experience. Beyond these, individuals are 9,37% more likely to have all answers correct, translating into more financial literacy.

Assessing the risk profile, the coefficient of an aggressive risk profile is statistically significant in all models, ranging from -0.0937 to -0.3052 across models. The negative signal of the coefficients suggests that individuals that have an aggressive risk profile are 9,37% less likely to have zero answers correct and are 30,52% more likely to have all of them correct, when compared to individuals that are more conversative. This means that people that are more tolerant to risk, also have more financial literacy (Damayanti & Wicaksana, 2021; Liao et al., 2017; Mishra, 2018).

Analyzing the sociodemographic factors, it is possible to find that marital status is not statistically significant in influencing financial literacy. Among the statistically significant variables, only one category of age (age 2 = 26-35 years) demonstrates significance. Contrary to expectations, as age increases, it does not lead to an increase in the level of financial literacy. Individuals between the ages of 26 and 35 are 5.58% less likely to answer all five questions correctly and are 7.90% more likely to answer zero questions correctly compared to individuals between the ages of 18 and 25. These findings do not align with the existing literature, but it is important to consider that the data may not be sufficiently diverse in terms of age, potentially leading to different results from the literature. Several justifications can be proposed, for example the educational background: Individuals between 26-35 years old may have completed their formal education but may not have received specific education or training in financial literacy. Besides that, these individuals may be undergoing significant life transitions such as starting careers or families, which can introduce financial responsibilities and commitments. These transitions may limit the time and resources available for acquiring financial literacy knowledge. Additionally, considering the level of education within each category, where category 1 (18-25 years) has a higher proportion of individuals with university studies compared to category 2 (26-35 years), and this may help explain the difference observed and reconcile it with the existing literature. To gain a deeper understanding of the lower financial literacy levels in individuals between

26 and 35 years old, further research or analysis is recommended, by exploring additional factors such as education levels or net income can provide additional insights into the observed differences.

Moving on to the next variable, the coefficient for the dummy variable gender (where 1=male), is statically significant in most models, indicating a difference in financial literacy between males and females, being in accordance with most of the literature. Overall, the results suggest that there is evidence of a gender difference in financial literacy, with males tending to have higher financial literacy scores when compared to females. In more detail, table 13 shows that male individuals are 9,78% more likely to have all answers correct in financial literacy, with a significance level of 1%, translating in more financial literacy, whilst being 6,39% less likely to have zero answers correct, when compared to females (Atkinsoni & Messy, 2012; Cupák et al., 2018; Fonseca et al., 2012; A. Hung et al., 2009).

When it comes to education level, overall, the results indicate that people with high school or university studies, tend to have more correct answers, which indicates more financial knowledge when compared to those with high school education or lower. These results are reflected within the existent literature, once individuals that completed high school are 12,76% more likely to have all answers correct (holding other variables constant) and people with university studies are a further 12,11% more likely to have all answers correct, both values with a significance level of 1%. This is an outcome reported by several authors in other studies (Chen & Volpe, 1998; Cupák et al., 2018; Mändmaa, 2019a; Pires & Quelhas, 2015).

With results from table 13, it can also be inferred that the education area of individuals is statistically significant, people who have others studies (architecture, construction , arts, languages , humanities, law, sports, enology and others) are 9,57% less likely to answer correctly all questions of financial literacy , and are 7,47% more likely to have zero answers correct, meaning that they are less financial literate when compared to individuals who have studies in the social sciences area , which is consistent with the literature, that defends that people who have studies regarding economics and social sciences are more financial literate than others (Corsini & Giannelli, 2021; Hastings et al., 2013).

Regarding net income, it is possible to conclude that individuals with more net income (more than the minimum wage) have more financial literacy, once they are 6,17% more likely to have all answers correct, when compared to the category base (no net income). This also matches the literature, once it

defends that people that earn more money, tend to have more financial literacy (Johnson & Sherraden, 2007; Mandell, 2008b; Perry & Morris, 2005).

In conclusion, hypothesis 1 is not rejected for overconfidence, risk profile, financial experience, age, income, level and background of education, and gender. However, hypothesis 1 is rejected for the gender variable

Table 13 Marginal Effects of Ordered Probit regression for Financial Literacy

VARIABLES	0	1	2	3	4	5
Confidence Level (base group: Neutral)						
Overconfident	0.1264***	0.1374***	0.1035***	-0.0152	-0.2040***	-0.1481***
	(0.0253)	(0.0273)	(0.0242)	(0.0190)	(0.0293)	(0.0327)
Underconfident	-0.0157**	-0.0338**	-0.0567***	-0.0629**	0.0314*	0.1377***
	(0.0070)	(0.0143)	(0.0208)	(0.0269)	(0.0175)	(0.0528)
Financial Experience (base group: Never invested in securities market)						
Invested	-0.0589***	-0.0470**	-0.0361**	-0.0118	0.0600**	0.0937**
	(0.0221)	(0.0205)	(0.0176)	(0.0076)	(0.0275)	(0.0370)
Risk Profile (base group: Conservative)						
Balanced	-0.0238	-0.0172	-0.0119	-0.0026	0.0218	0.0337
	(0.0184)	(0.0139)	(0.0097)	(0.0024)	(0.0175)	(0.0257)
Dynamic	-0.0176	-0.0124	-0.0084	-0.0015	0.0162	0.0237
	(0.0319)	(0.0236)	(0.0167)	(0.0040)	(0.0297)	(0.0461)
Aggressive	-0.0937***	-0.0935***	-0.0957***	-0.0720***	0.0497**	0.3052***
	(0.0188)	(0.0206)	(0.0233)	(0.0230)	(0.0247)	(0.0674)
Age (base group: 18-25)						
26-35	0.0790*	0.0322	0.0169	-0.0072	-0.0651*	-0.0558*
	(0.0425)	(0.0203)	(0.0110)	(0.0080)	(0.0350)	(0.0317)
36-45	-0.0564	-0.0367	-0.0265	-0.0121	0.0435	0.0881
	(0.0437)	(0.0248)	(0.0182)	(0.0104)	(0.0295)	(0.0654)
46-55	-0.0420	-0.0257	-0.0178	-0.0068	0.0337	0.0587
	(0.0445)	(0.0243)	(0.0165)	(0.0076)	(0.0324)	(0.0595)
+55	-0.0602	-0.0398	-0.0291	-0.0138	0.0458	0.0971
	(0.0453)	(0.0254)	(0.0184)	(0.0109)	(0.0295)	(0.0688)
Gender (base group: Female)						
Male	-0.0639***	-0.0492***	-0.0351***	-0.0082	0.0585***	0.0978***
	(0.0176)	(0.0145)	(0.0124)	(0.0061)	(0.0178)	(0.0268)
Marital Status (base group: Not Single)						
Single	-0.0337	-0.0241	-0.0167	-0.0029	0.0298	0.0476
	(0.0304)	(0.0222)	(0.0148)	(0.0028)	(0.0262)	(0.0417)

Education Level (base group: Basic education)						
High School	-0.2563***	-0.0966***	-0.0245	0.0647*	0.1851***	0.1276***
	(0.0796)	(0.0280)	(0.0162)	(0.0360)	(0.0451)	(0.0272)
University	-0.2523***	-0.0929***	-0.0221	0.0652*	0.1809***	0.1211***
	(0.0783)	(0.0256)	(0.0149)	(0.0360)	(0.0421)	(0.0209)
Education area (base group: social sciences)						
engineering	0.0090	0.0089	0.0079	0.0031	-0.0102	-0.0187
	(0.0198)	(0.0195)	(0.0169)	(0.0061)	(0.0227)	(0.0393)
others	0.0747***	0.0579***	0.0404***	0.0010	-0.0783***	-0.0957***
	(0.0225)	(0.0191)	(0.0130)	(0.0067)	(0.0251)	(0.0246)
Net Income (base group: No Income)						
Until 749€	-0.0098	-0.0052	-0.0029	-0.0000	0.0083	0.0096
	(0.0417)	(0.0222)	(0.0125)	(0.0009)	(0.0350)	(0.0418)
More than 749€	-0.0483*	-0.0299*	-0.0189*	-0.0046	0.0400*	0.0617*
	(0.0291)	(0.0168)	(0.0099)	(0.0034)	(0.0238)	(0.0323)
Observations (Total=213)	21	24	34	49	56	29
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pseudo R2	0.1920	0.1920	0.1920	0.1920	0.1920	0.1920

Note. This table presents the marginal effects of the ordered Probit regression for model 1. To correct for heteroscedasticity, the robust standard errors were computed, and they are presented in parenthesis. *** p<0.01, ** p<0.05, *p<0.1

5.2 Saving Behavior

The subsequent hypothesis was examined using three different models, namely Model 3, Model 4, and Model 5. Each model was employed to assess the impact of the variables "save_dummy," "save_percentage," and "emergency_fund", respectively. For each model, three separate regression analyzes were conducted. The initial regression solely included the financial literacy variable, followed by the second regression that incorporated additional variables such as confidence level, financial experience, and risk profile. Finally, the third regression included sociodemographic characteristics such as age, gender, marital status, education level and background, and net income. This step-by-step approach allowed for the examination of the statistical significance of financial literacy within models featuring an increasing number of independent variables, mirroring the methodology utilized to assess market participation.

5.2.1 Save Dummy

This section intends to analyze if individuals save or not, as defined previously.

Table 14 displays the marginal effects of three probit regressions for Model 2, on the variable " save_dummy" that is a dummy variable, assuming the value of zero if respondents do not save and one if they do. Most of the independent variables in the table are not statistically significant for the dependent variable, so it is possible to take some conclusions by analyzing the variables that are statistically significant.

In the initial regression analysis, it was found that financial literacy holds a significant influence on saving behavior. Specifically, individuals with low financial literacy, as indicated by only one correct response out of the five questions, are 20.24% less likely to engage in saving activities. This suggests a positive impact of financial literacy on saving behavior.

Moving on to the second regression analysis, financial literacy continues to exhibit statistical significance in relation to saving behavior. Individuals with low financial literacy are now 18.21% less likely to save. However, no other variables in this regression display statistical significance. Consequently, Model 3 does not reject Hypothesis 3 for both the first and second regressions, reinforcing the importance of financial literacy in influencing saving behavior (Abdul Jamal et al., 2015; Beckmann, 2013).

However, in the third regression analysis, the variable of financial literacy no longer maintains statistical significance. This implies that when other variables are introduced to the regression model, the impact of financial literacy on saving behavior diminishes or becomes less pronounced.

Despite this, there are other variables in this regression that are statistically significant for saving behavior nor important to highlight.

The variable age is statistically significant in category 3 (36-45 years old). Respondents in this age group are 8.90% more likely to save compared to younger individuals (ages 18-25). This finding could be attributed to several factors, once people in their late 30s and early 40s often have increased financial responsibilities (such as mortgages, family expenses, and others) which may motivate them to save more money.

The variable gender represents the difference in savings habits between gender. It is possible to infer that males are 20,22% less likely to save when compared to females. Some research suggests that women tend to prioritize saving and have a greater inclination toward long-term financial planning due to factors such as risk aversion, social norms, and financial caregiving responsibilities (Bucher-Koenen & Lusardi, 2011; Nelson, 2012). On the other hand, males may exhibit higher risk-taking behavior or have different spending priorities, leading to a lower propensity for saving.

About the education area it is interesting to highlight that respondents that have studies in other areas rather than economics or engineering are 13,95% less likely to save. These findings are consistent with the literature, suggesting a link between educational background and financial knowledge (Bernheim & Scholz, 1993).

Concerning the variable net income, it is statistical significant,meaning that people that earn until 749€ tend to be 14,90% more likely to save. These findings align with the idea that respondents with higher net income are more prone to save (Browning & Lusardi, 1996).

Hypothesis 2 is not rejected for the first and second regressions, in this dimension of “save_dummy”.

Table 14 Marginal Effects of Probit regression for Save Dummy

VARIABLES	Save#1	Save#2	Save#3
Financial Literacy (base group: 0 answers correct)			
1 answer correct	-0.2024**	-0.1821*	-0.1697
	(0.1001)	(0.1065)	(0.1032)
2 answers correct	-0.1583*	-0.1369	-0.1410
	(0.0837)	(0.0950)	(0.1002)
3 answers correct	-0.0748	-0.0294	0.0197
	(0.0661)	(0.0837)	(0.0823)
4 answers correct	-0.0595	-0.0388	0.0023
	(0.0623)	(0.0939)	(0.0946)
5 answers correct	-0.1248	-0.0768	-0.0179
	(0.0843)	(0.1164)	(0.1069)
Confidence level (base group= Neutral)			
Overconfident		0.0613	0.0777
		(0.0656)	(0.0564)
Underconfident		-0.0134	-0.0857
		(0.0760)	(0.0833)
Financial Experience (base group: Never invested in securities market)			
Invested		0.0417	0.0929
		(0.0692)	(0.0667)
Risk Profile (base group: Conservative)			
Balanced		-0.0147	-0.0039
		(0.0476)	(0.0446)
Dynamic		-0.0832	-0.0782
		(0.1039)	(0.0960)
Aggressive		-	-
Age (base group: 18-25)			
26-35			0.0890*
			(0.0475)
36-45			0.0278
			(0.0815)
46-55			-0.1544
			(0.0975)
+55			-0.0745
			(0.1064)
Gender (base group: Female)			
Male			-0.2022***
			(0.0574)
Marital Status (base group: Not Single)			
Single			-0.0257
			(0.0788)
Education Level (base group: Basic education)			
High School			0.0047
			(0.0765)
University			-0.1050
			(0.0741)
Education area (base group: social sciences)			
engineering			-0.0582
			(0.0749)

others			-0.1395** (0.0597)
Net Income (base group: No Income)			
Until 749€			0.1490* (0.0839)
More than 749€			0.0897 (0.0776)
Observations	182	182	182
Prob > chi2	0.0666	0.0666	0.0666
Pseudo R2	0.1888	0.1888	0.1888

Note. This table presents the marginal effects of the Ordered Probit regression for model 4. #1 presents the first regression, #2 presents the second regression, and R#3 presents the third regression. To correct for heteroscedasticity, the robust standard errors were computed, and they are presented in parenthesis. *** p<0.01, ** p<0.05, *p<0.1

5.2.2 Save Percentage

This section intends to analyze the percentage individuals save, analysing how much of their net income they save, as defined previously.

Table 15 idisplays the marginal effects of Model 4 on the variable "save_percentage," which represents the percentage of income saved and has three categories: 1=does not save, 2=saves up to 20%, and 3=saves more than 20%. The findings reveal the impact of different variables on the likelihood of the percentage of savings.

For the first and second regressions, it is possible to conclude that individuals with low financial literacy are 21,64% and 19,44% less likely to save more than 20% of their net income, respectively, which is aligned with the literature stating that individuals with more financial literacy are more prone to save more money (Beckmann, 2013; Hilgert et al., 2003; Letkiewicz & Fox, 2014)

In the context of the third regression analysis, it can be summarized that the variable of financial literacy loses its statistical significance. Instead, the variables that demonstrate a notable impact on the percentage of income saved are age, gender, and education levels. These variables emerge as significant determinants of saving behavior in this regression model.

Regarding age, significant effects are observed in categories 3 and 4 (people older than 36 years old). Individuals between 36 and 45 years old are 11.26% more likely to not save and 23.20% less likely to save a substantial amount saved (more than 20%). Similarly, individuals between 46 and 55 years old are 23.79% more likely to not save and 33.25% less likely to save a significant amount compared to those between 18 and 25 years old. Summarizing, age has a negative effect, as

individuals age, the more likely they are of not saving, and the less likely they become of allocating a higher portion of their net income towards savings, when compared with younger individuals.

Gender is an interesting factor as it affects the percentage of income saved. Overall, males are 8.30% more likely to not save money and 11.54% less likely to save a substantial amount compared to females, suggesting that women tend to save more money. These results follow the literature, that states that usually men save more than women (Fisher, 2010; Fisher et al., 2015; Grossbard & Pereira, 2010; Njung'e, 2013).

Education level is significant when individuals have university studies, as they are 9.44% more likely to not save money compared to those with only basic education, presenting a negative effect.

Net income only presents significance for individuals with a net income above the minimum wage, as they are 2.69% less likely to save up to 20% of their income compared to those with no income.

In summary, the variables in the table demonstrate varying effects on the percentage of income saved across different models, indicating the complex nature of saving behavior and the importance of considering multiple factors in understanding individuals' saving habits.

With that, it is possible to conclude that regression one and two do not reject the hypothesis 2.

Table 15 Marginal Effects of Ordered Probit regression for Save Percentage

	Save #1			Save #2			Save #3		
VARIABLES	No Savings	Saves until 20%	Saves more than 20%	No Savings	Saves until 20%	Saves more than 20%	No Savings	Saves until 20%	Saves more than 20%
Financial Literacy (base group: 0 answers correct)									
1 answer correct	0.1526*	0.0638	-0.2164**	0.1417	0.0527	-0.1944*	0.1158	0.0198	-0.1356
	(0.0876)	(0.0601)	(0.1070)	(0.0882)	(0.0655)	(0.1089)	(0.0897)	(0.0521)	(0.1044)
2 answers correct	0.0803	0.0668	-0.1471	0.0749	0.0551	-0.1300	0.0643	0.0252	-0.0894
	(0.0557)	(0.0575)	(0.1043)	(0.0573)	(0.0588)	(0.1065)	(0.0615)	(0.0437)	(0.0984)
3 answers correct	0.0311	0.0405	-0.0716	0.0201	0.0249	-0.0450	-0.0168	-0.0168	0.0335
	(0.0432)	(0.0624)	(0.1042)	(0.0488)	(0.0661)	(0.1143)	(0.0584)	(0.0529)	(0.1109)
4 answers correct	0.0525	0.0561	-0.1086	0.0445	0.0436	-0.0881	0.0176	0.0120	-0.0296
	(0.0437)	(0.0589)	(0.0994)	(0.0547)	(0.0647)	(0.1174)	(0.0685)	(0.0513)	(0.1195)
5 answers correct	0.0758	0.0656	-0.1415	0.0718	0.0544	-0.1262	0.0204	0.0135	-0.0339
	(0.0575)	(0.0580)	(0.1069)	(0.0773)	(0.0639)	(0.1342)	(0.0830)	(0.0571)	(0.1395)
Confidence level (base group= Neutral)									
Overconfident				-0.0351	-0.0127	0.0478	-0.0597	-0.0230	0.0827
				(0.0485)	(0.0174)	(0.0645)	(0.0469)	(0.0183)	(0.0615)
Underconfident				-0.0395	-0.0153	0.0549	-0.0242	-0.0046	0.0288
				(0.0511)	(0.0254)	(0.0742)	(0.0555)	(0.0137)	(0.0678)
Financial Experience (base group: Never invested in securities market)									
Invested				0.0187	0.0086	-0.0273	-0.0513	-0.0244	0.0757
				(0.0467)	(0.0213)	(0.0678)	(0.0470)	(0.0246)	(0.0701)
Risk Profile (base group: Conservative)									
Balanced				-0.0475	-0.0237	0.0712	-0.0073	-0.0037	0.0110
				(0.0331)	(0.0204)	(0.0516)	(0.0343)	(0.0179)	(0.0522)
Dynamic				0.0231	0.0028	-0.0259	0.0667	0.0098	-0.0765
				(0.0884)	(0.0059)	(0.0924)	(0.0898)	(0.0133)	(0.0865)
Aggressive				0.0485	0.0014	-0.0499	0.0082	0.0034	-0.0117
				(0.0645)	(0.0097)	(0.0594)	(0.0702)	(0.0266)	(0.0968)
Age (base group: 18-25)									
26-35							-0.0052	-0.0152	0.0204
							(0.0322)	(0.0966)	(0.1287)
36-45							0.1126*	0.1194*	-0.2320*
							(0.0618)	(0.0673)	(0.1209)

46-55							0.2379***	0.0946	-0.3325***
							(0.0724)	(0.0580)	(0.1092)
+55							0.1444*	0.1211*	-0.2654**
							(0.0763)	(0.0627)	(0.1258)
Gender (base group: Female)									
Male							0.0830**	0.0324**	-0.1154**
							(0.0423)	(0.0157)	(0.0516)
Marital Status (base group: Not Single)									
Single							0.0318	0.0135	-0.0453
							(0.0610)	(0.0230)	(0.0835)
Education Level (base group: Basic education)									
High School							0.0548	0.0783	-0.1332
							(0.0497)	(0.1000)	(0.1468)
University							0.0944**	0.0974	-0.1917
							(0.0471)	(0.0976)	(0.1408)
Education area (base group: social sciences)									
engineering							0.0796	0.0243	-0.1039
							(0.0648)	(0.0173)	(0.0691)
others							0.0339	0.0186	-0.0525
							(0.0394)	(0.0210)	(0.0593)
Net Income (base group: No Income)									
Until 749€							0.0385	-0.0064	-0.0322
							(0.0971)	(0.0190)	(0.0810)
More than 749€							-0.0878	-0.0269*	0.1147
							(0.0753)	(0.0145)	(0.0807)
Observations	28	133	52	28	133	52	28	133	52
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pseudo R2	0.1920	0.1920	0.1920	0.1920	0.1920	0.1920	0.1920	0.1920	0.1920

Note. This table presents the marginal effects of the Ordered Probit regression for model 4. #1 presents the first regression, #2 presents the second regression, and R#3 presents the third regression. To correct for heteroscedasticity, the robust standard errors were computed, and they are presented in parenthesis. *** p<0.01, ** p<0.05, *p<0.1

5.2.3 Emergency Fund

This section intends to analyze the emergency fund behavior of individuals, by for how long respondents have an emergency fund to face a situation of unemployment or illness, as defined previously.

Table 16 displays the marginal effects three ordered probit regressions of Model 4, on the variable "emergency_fund," which represents the length of the emergency fund in months. The categories are 1= no emergency fund, 2= fund for 3 months, 3= fund for 6 months, and 4= fund for more than 6 months. The findings reveal the impact of different variables on the likelihood of having an emergency fund.

In the initial regression, it is observed that respondents with higher financial literacy (correctly answering all five questions on the big five questionnaire) are 33.49% more likely to possess an emergency fund that covers more than 6 months' worth of expenses. This effect persists in the second regression, where individuals with a high level of financial literacy exhibit a 45.62% greater likelihood of having an emergency fund for more than 6 months. Similarly, the third regression reinforces this effect, with respondents having a high level of financial literacy being 42.37% more likely to maintain an emergency fund that spans more than 6 months.

In summary, the three regression analyzes do not reject Hypothesis 2, which states that financial literacy positively influences saving behavior (Babiarz & Robb, 2014; Fan & Zhang, 2021; Nguyen, 2023).

It is of interest for the study to also analyze the remaining variables. In the second regression analysis, several noteworthy effects can be observed along with possible reasons for each result.

Overconfident individuals exhibit a 15.07% higher likelihood of possessing an emergency fund that covers more than 6 months and are 14.40% less likely to lack an emergency fund. This could be attributed to their tendency to have a stronger belief in their ability to handle financial uncertainties, leading them to prioritize and plan for contingencies.

Furthermore, individuals that have invested in the past demonstrate a 12.21% higher likelihood of having an emergency fund for more than 6 months. This can be related to their familiarity with financial planning, as they might have acquired more financial knowledge and skills over time, being more likely to recognize the importance of saving. Similarly, individuals who currently hold investments exhibit a

26.09% greater probability of possessing an emergency fund for a longer period. This suggests that their active engagement in investments may reflect a broader financial mindset, including the recognition of the importance of having emergency funds.

Additionally, respondents with a higher risk profile are more prone to maintaining an emergency fund for more than 6 months, and this can be justified by their inclination to prioritize risk mitigation and financial security.

Moving on to the third regression analysis, the same effects persist, and several sociodemographic factors emerge as statistically significant. Those are, age, gender, education area and net income.

About age, individuals between 26 and 35 years old, are 12,28% less likely to lack an emergency fund, and individuals from the group age of 36 and 45 years old, are 18,31% more likely to have an emergency fund for more than 6 months. This could be attributed to varying life stages and financial responsibilities, where individuals in their late twenties and early thirties may be focused on building their careers and accumulating wealth, while those in their mid-thirties and forties may prioritize financial stability and preparedness.

In agreement with the literature, the variable of gender has a negative effect on saving behavior, with males being 8.43% less likely to maintain an emergency fund for an extended period, when compared to women. The results suggest that being female is associated with a higher likelihood of saving, which could be attributed to various factors such as differences in financial attitudes, risk preferences, or cultural norms regarding savings behavior (Fisher, 2010; Fisher et al., 2015; Grossbard & Pereira, 2010).

Furthermore, respondents from non-economic educational backgrounds, such as engineering or other fields, are less likely to possess an emergency fund for a longer duration compared to individuals from the economic area. This discrepancy could be related to variations in financial literacy, exposure to financial planning concepts, or differing financial priorities among different educational backgrounds (Fan & Zhang, 2021).

Lastly, higher net income is associated with a greater likelihood of possessing an emergency fund for more than 6 months. This result aligns with the expectation that individuals with higher incomes have greater financial capacity to allocate resources towards saving and building financial reserves (Nguyen, 2023).

Overall, these findings highlight the influence of various factors, including overconfidence, investment experience, risk profile, age, gender, educational background, and income level, on individuals' propensity to maintain an emergency fund and exhibit responsible saving behavior.

Concluding, all regressions do not reject hypothesis 2, for the positive influence of saving behavior in the dimension of emergency fund.

Table 16 Marginal Effects of Ordered Probit regression for Emergency Fund

	Save 1				Save 2				Save 3			
VARIABLES	None	3 months	6 months	mora than 6months	None	3 months	6 months	mora than 6months	None	3 months	6 months	mora than 6months
Financial Literacy (base group: 0 answers correct)												
1 answer correct	0.0423	-0.0022	-0.0111	-0.0289	-0.0833	0.0104	0.0237	0.0491	-0.0682	0.0064	0.0195	0.0424
	(0.1261)	(0.0079)	(0.0333)	(0.0861)	(0.1213)	(0.0168)	(0.0344)	(0.0725)	(0.1215)	(0.0147)	(0.0348)	(0.0744)
2 answers correct	-0.0401	-0.0004	0.0096	0.0309	-0.1434	0.0122	0.0389	0.0923	-0.1082	0.0070	0.0298	0.0714
	(0.1126)	(0.0037)	(0.0271)	(0.0863)	(0.1080)	(0.0162)	(0.0297)	(0.0688)	(0.1183)	(0.0151)	(0.0332)	(0.0752)
3 answers correct	-0.1186	-0.0096	0.0247	0.1036	-0.2907***	-0.0094	0.0626**	0.2376***	-0.2535**	-0.0148	0.0544*	0.2139***
	(0.0973)	(0.0093)	(0.0229)	(0.0785)	(0.0982)	(0.0196)	(0.0279)	(0.0680)	(0.1133)	(0.0182)	(0.0316)	(0.0776)
4 answers correct	-0.1915**	-0.0302*	0.0313	0.1905**	-0.2987***	-0.0119	0.0630**	0.2476***	-0.2900**	-0.0275	0.0553*	0.2622***
	(0.0964)	(0.0176)	(0.0222)	(0.0859)	(0.1049)	(0.0208)	(0.0281)	(0.0785)	(0.1195)	(0.0201)	(0.0312)	(0.0904)
5 answers correct	-0.2786***	-0.0768**	0.0205	0.3349***	-0.4224***	-0.0769*	0.0431	0.4562***	-0.3826***	-0.0789**	0.0378	0.4237***
	(0.0987)	(0.0391)	(0.0266)	(0.1170)	(0.1031)	(0.0396)	(0.0317)	(0.1118)	(0.1195)	(0.0360)	(0.0327)	(0.1179)
Confidence level (base group= Neutral)												
Overconfident					-0.1440**	-0.0233**	0.0166*	0.1507***	-0.1500***	-0.0236**	0.0181*	0.1555***
					(0.0569)	(0.0103)	(0.0088)	(0.0576)	(0.0566)	(0.0095)	(0.0094)	(0.0555)
Underconfident					0.0786	-0.0016	-0.0165	-0.0605	0.0560	-0.0008	-0.0118	-0.0435
					(0.0682)	(0.0046)	(0.0146)	(0.0520)	(0.0692)	(0.0039)	(0.0149)	(0.0526)
Financial Experience (base group: Never invested in securities market)												
Invested					-0.1119*	-0.0247	0.0144	0.1221*	-0.0946	-0.0218	0.0123	0.1040
					(0.0613)	(0.0180)	(0.0092)	(0.0704)	(0.0649)	(0.0182)	(0.0095)	(0.0739)
Risk Profile (base group: Conservative)												
Balanced					0.1092**	0.0189**	-0.0123**	-0.1157**	0.0787*	0.0149	-0.0096	-0.0841*
					(0.0436)	(0.0094)	(0.0060)	(0.0468)	(0.0458)	(0.0098)	(0.0059)	(0.0497)
Dynamic					0.2467***	0.0156	-0.0416*	-0.2207***	0.2242***	0.0141	-0.0408*	-0.1975***
					(0.0955)	(0.0147)	(0.0229)	(0.0690)	(0.0847)	(0.0138)	(0.0213)	(0.0621)
Aggressive					-0.2134***	-0.1954***	-0.1873***	0.5961***	-0.2259***	-0.2047***	-0.1858***	0.6164***
					(0.0328)	(0.0259)	(0.0272)	(0.0412)	(0.0347)	(0.0273)	(0.0276)	(0.0419)
Age (base group: 18-25)												
26-35									-0.1228*	-0.0225	0.0172	0.1281
									(0.0709)	(0.0200)	(0.0142)	(0.0798)
36-45									-0.1627*	-0.0377	0.0173	0.1831*

									(0.0940)	(0.0252)	(0.0149)	(0.1066)
46-55									-0.0814	-0.0113	0.0137	0.0790
									(0.0937)	(0.0137)	(0.0177)	(0.0893)
+55									-0.0579	-0.0067	0.0105	0.0541
									(0.1067)	(0.0132)	(0.0202)	(0.0995)
Gender (base group: Female)												
Male									0.0834*	0.0124*	-0.0114	-0.0843*
									(0.0469)	(0.0070)	(0.0075)	(0.0460)
Marital Status (base group: Not Single)												
Single									-0.0673	-0.0122	0.0071	0.0724
									(0.0702)	(0.0129)	(0.0065)	(0.0768)
Education Level (base group: Basic education)												
High School									0.0718	0.0201	-0.0040	-0.0879
									(0.0909)	(0.0302)	(0.0053)	(0.1197)
University									0.0970	0.0244	-0.0072	-0.1141
									(0.0858)	(0.0293)	(0.0046)	(0.1147)
Education area (base group: social sciences)												
engineering									0.1524*	0.0282**	-0.0159	-0.1647**
									(0.0830)	(0.0118)	(0.0155)	(0.0781)
others									0.1345**	0.0271**	-0.0126*	-0.1490**
									(0.0524)	(0.0119)	(0.0068)	(0.0588)
Net Income (base group: No Income)												
Until 749€									-0.0534	0.0025	0.0146	0.0362
									(0.1000)	(0.0064)	(0.0275)	(0.0681)
More than 749€									-0.2220***	-0.0251**	0.0460**	0.2011***
									(0.0802)	(0.0118)	(0.0230)	(0.0601)
Observations	59	47	39	68	59	47	39	68	59	47	39	68
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pseudo R2	0.1920	0.1920	0.1920	0.1920	0.1920	0.1920	0.1920	0.1920	0.1920	0.1920	0.1920	0.1920

Note. This table presents the marginal effects of the Ordered Probit regression for model 5. #1 presents the first regression, #2 presents the second regressio, and R#3 presents the third regression. To correct for heteroscedasticity, the robust standard errors were computed, and they are presented in parenthesis. *** p<0.01, ** p<0.05, *p<0.1

5.3 Market Participation

This section intends to analyze the market participation behavior of individuals, by analysing respondents' percentage of their total asset value allocated in securities, as defined previously.

Table 17 presents the results of the marginal effects of three Probit regression for the dependent variable market participation, which is a dummy variable and assesses whether individuals hold any securities or not. This model was operated with various independent variables, such as, level of financial literacy, confidence level, financial experience, risk profile, and sociodemographic characteristics (age, gender, education level, education area, and net income).

Hypothesis 3 was tested performing model 5. The first regression was estimated using only the variable of financial literacy, subsequently, the second regression added variables of confidence level, financial experience, and risk profile, and finally the last regression added the remaining sociodemographic variables. The separation of these variables had the objective of testing whether the variable of financial literacy would be statistically significant in a model with a greater number of independent variables.

To begin the analysis of table 17, the results from the first regression show that financial literacy is a statistically significant variable when it comes to market participation. An additional point in financial literacy makes individuals 30,95% less likely to have any percentage of their total asset value allocated in securities. This result is consistent with the literature, once people with low financial literacy are less likely to invest in the market (Hsiao & Tsai, 2018; van Rooij, Lusardi, & Alessie, 2011). With this regression, hypothesis 3 is not rejected for financial literacy.

For the second regression it is interesting to note that only for respondents with 2 correct answers the variable financial literacy becomes statistically significant, similarly to the previous analysis, respondents with low financial literacy exhibit a 15.80% lower likelihood of engaging in the market.

Additionally, the findings indicate that individuals with a balanced risk profile are 8.14% less likely to participate in the market, while those with an aggressive risk profile are 57.51% more likely to do so. These outcomes are consistent with existing literature, which suggests that individuals with a greater tolerance for risk are more inclined to participate in the market (Bollen & Posavac, 2018; Hsu et al., 2021; Mishra, 2018). To conclude, for the second regression, hypothesis 3 is not rejected for financial literacy.

For the last regression it is crucial to emphasize the fact that, by adding other variables, financial literacy becomes statistically insignificant.

Despite this, the variable risk profile remain statistically significant, individuals with a more aggressive risk profile are more likely to participate in the market (Alves, 2022; Mishra, 2018; van Rooij, Lusardi, Alessie, et al., 2011). Individuals with an aggressive risk profile are 48,75% more likely to have market participation when compared to individuals with a conservative risk profile. it is statistically significant, (with a significance level of 1%), as it is reported on the literature (Bollen & Posavac, 2018; Hsiao & Tsai, 2018).

Moving on to sociodemographic factors, age, is a variable with statistical significance, with a positive effect, as older individuals are more likely to participate on the market, when compared to the base group (individuals between 18 and 25 years) (Hsiao & Tsai, 2018). As it is a categorical variable, individuals of ages between 36 and 45 years old are 16,10% more likely to have market participation when compared to people between 18 and 25 years old. Beyond this, it is possible to notice that individuals with +55 years old are only 13,42% more likely to participate in the market. This difference can be related to the fact that individuals between 36 and 45 years old tend to have more studies than older people, and that also means that their market participation tends to be higher than people with less studies. Career advancement and increased earning potential in the 36-45 age group may lead to higher market participation. Specific financial goals, like retirement or education savings, may also motivate individuals to be actively involved in the securities market (van Rooij, Lusardi, Alessie, et al., 2011).

Marital status is also significant, with a negative effect once single respondents are 7,46% less likely to participate on the market when compared to others. Additionally, respondents that have low level of education (high school) are 23,87% less likely to participate in the market.

There are several possible explanations for this negative effect observed in this analysis. Individuals with only high school education may avoid market participation due to a preference for safer, low-risk options and concerns about market uncertainties. Their age (usually over 46) may also contribute, as older individuals tend to be less risk-tolerant and hesitant to invest in the securities market compared to younger groups.

Other variables like net income, education area, and gender are not statistically significant for this

sample.

To conclude, the first and second regression accepted hypothesis 2, however, when adding other variables in the third regression, the variable financial literacy stops having statistical relevance.

Table 17 Marginal Effects of Probit regression for Market Participation

	Market #1	Market #2	Market #3
VARIABLES	1	1	1
Financial Literacy (base group: 0 answers correct)			
1 answer correct	-0.3095**	-0.0848	-0.0469
	(0.1332)	(0.0966)	(0.0716)
2 answers correct	-0.2703**	-0.1580*	-0.0829
	(0.1295)	(0.0912)	(0.0910)
3 answers correct	-0.2517**	-0.0957	-0.0337
	(0.1245)	(0.0887)	(0.0796)
4 answers correct	0.0060	-0.0419	0.0597
	(0.1281)	(0.0949)	(0.0950)
5 answers correct	0.1445	0.1422	0.1823
	(0.1417)	(0.1270)	(0.1187)
Confidence level (base group= Neutral)			
Overconfident		0.0812	0.0603
		(0.0602)	(0.0554)
Underconfident		-0.0248	0.0431
		(0.0587)	(0.0565)
Financial Experience 1 (base group: Never invested in securities market)			
Invested		0.0723	-0.0318
		(0.0669)	(0.0498)
Risk Profile (base group: Conservative)			
Balanced		-0.0814*	-0.0552
		(0.0428)	(0.0412)
Dynamic		-0.0140	0.0540
		(0.1047)	(0.1299)
Aggressive		0.5751***	0.4875***
		(0.0404)	(0.1049)
Age (base group: 18-25)			
26-35			0.0716
			(0.0522)
36-45			0.1610**
			(0.0748)
46-55			0.1481**
			(0.0743)
+55			0.1342*
			(0.0772)
Gender (base group: Female)			
Male			0.0672
			(0.0514)
Marital Status (base group: Not Single)			
Single			-0.0746*

			(0.0420)
Education Level (base group: Basic education)			
High School			-0.2387** (0.1078)
University			-0.1503 (0.1029)
Education area (base group: social sciences)			
engineering			-0.0108 (0.0517)
others			0.0360 (0.0445)
Net Income (base group: No Income)			
Until 749€			-0.0781 (0.0816)
More than 749€			0.0230 (0.0536)
Observations	77	77	77
Prob > chi2	0.0000	0.0000	0.0000
Pseudo R2	0.1920	0.1920	0.1920

Note. This table presents the marginal effects of the Ordered Probit regression for model 3. #1 presents the first regression, #2 presents the second regression, and R#3 presents the third regression. To correct for heteroscedasticity, the robust standard errors were computed, and they are presented in parenthesis. *** p<0.01, ** p<0.05, *p<0.1

5.4 Nudges

The last objective of this research consisted in studying if there is a positive influence of nudges in saving behavior and market participation.

Model 6 was regressed to test whether the use of nudges impacts the behavior of respondents.

The next tables show the marginal effects of the regressions used for each nudge. The first regression only contains the group variable, and the second regression contains all variables under study.

This approach attempts to establish if the nudge effect remains the same even with more variables in the regression.

5.4.1 Saving Behavior with Default Nudge

This section intends to analyze the effect of default nudge in saving behavior of individuals, by analysing if individuals would save for retirement, as defined previously.

Table 18 shows the marginal effects of two probit regressions for the dependent variable saving behavior with a default nudge (savings_default). The models used were the same as the other regressions.

It is possible to conclude that being in the treatment group had a positive effect in the saving behavior, and respondents from this group are 17,86% more likely to save more than 25% of an increase in earnings for retirement.

On the second regression it is possible to conclude that the nudge effect remains positive for the dependent variable even when adding other variables. The only variable that is also statistically significant is gender, being that males are 12,51% less likely to save more than 25% of an increase in earnings for retirement.

It is worth noting that the experiment encountered a minor error in this particular question, as it was not marked as mandatory, resulting in one respondent failing to provide an answer. However, fortunately, this mistake did not have any detrimental impact on the overall results.

Both regressions do not reject H4, with the default nudge influencing positively saving behavior.

Table 18 Marginal Effects of Probit regression for Saving Behavior with Default Nudge

	Default- Saving Behavior #1	**Default- Saving Behavior #2**
VARIABLES	More than 25%	More than 25%
Group (base group: control group)		
treatment group	0.1786***	0.2147***
	(0.0671)	(0.0651)
Financial Literacy (base group: 0 answers correct)		
1 answer correct		-0.1725
		(0.1417)
2 answers correct		0.0633
		(0.1385)
3 answers correct		-0.1025
		(0.1439)
4 answers correct		-0.0957
		(0.1532)
5 answers correct		-0.0853
		(0.1842)
Confidence level (base group= Neutral)		
Overconfident		-0.1031
		(0.0927)
Underconfident		-0.0118
		(0.0957)
Financial Experience (base group: Never invested in securities market)		
Invested		0.0992
		(0.0960)

Risk Profile **(base group: Conservative)**		
Balanced		0.1265 (0.0775)
Dynamic		0.1542 (0.1353)
Aggressive		-
Age **(base group: 18-25)**		
26-35		-0.1305 (0.1251)
36-45		-0.2254 (0.1545)
46-55		-0.0290 (0.1429)
+55		-0.2305 (0.1580)
Gender **(base group: Female)**		
Male		-0.1251* (0.0750)
Marital Status **(base group: Not Single)**		
Single		-0.1070 (0.0958)
Education Level **(base group: Basic education)**		
High School		-0.0746 (0.1583)
University		-0.0189 (0.1498)
Education area **(base group: social sciences)**		
engineering		0.1699* (0.0943)
others		0.0333 (0.0820)
Net Income **(base group: No Income)**		
Until 749€		-0.0166 (0.1251)
More than 749€		-0.1519 (0.1062)
Observations	117	117
Prob > chi2	0.0666	0.0666
Pseudo R2	0.1888	0.1888

Note. This table presents the marginal effects of the Probit regression for model 6. #1 presents the first regression and #2 presents the second regression. To correct for heteroscedasticity, the robust standard errors were computed, and they are presented in parenthesis. *** p<0.01, ** p<0.05, *p<0.1

5.4.2 Saving Behavior with Information Nudge

This section intends to analyze the effect of information nudge in saving behavior of individuals, by capturing the respondents' opinion on the appropriate period for maintaining an emergency fund, as defined previously.

Table 19 shows the marginal effects of two probit regressions for the dependent variable saving behavior with information nudge (savings_info). The models used were the same as the other regressions.

Upon analyzing both regressions, it can be inferred that the information nudge does not exhibit statistical significance in influencing saving behavior. Instead, the variables related to sociodemographic factors emerge as the statistically significant determinants.

Regarding age, it is evident that individuals above the age of 25 are more inclined to engage in saving behavior for a period exceeding 6 months. This finding suggests a positive correlation between age and saving behavior, whereas individuals grow older, they tend to prioritize and engage in long-term saving practices. This observation aligns with existing literature that highlights the role of life stage and increasing financial responsibilities as motivators for saving behavior with age (Demery & Duck, 2006).

Furthermore, individuals from non-economic educational backgrounds display a lower propensity to save for more than 6 months. This result indicates that individuals with educational backgrounds outside the economic domain may have relatively lower financial literacy or exposure to financial planning concepts. Consequently, they may face challenges in effectively managing and accumulating savings over an extended period. This finding resonates with previous research that has emphasized the influence of financial literacy and education on saving behavior (Lusardi et al., 2010b).

Moreover, individuals with lower incomes exhibit a reduced likelihood of saving for more than 6 months. This result is consistent with the income-saving relationship established in the literature. Lower income levels often restrict individuals' capacity to allocate significant resources towards savings, making it more challenging to accumulate funds for an extended period (Beckmann, 2013; Browning & Lusardi, 1996; Lusardi, 2008).

In summary, the findings suggest that the information nudge does not play a significant role in shaping saving behavior. Instead, sociodemographic variables such as age, educational background, and income level emerge as influential factors.

Table 19 Marginal Effects of Probit regression for Saving Behavior with Information Nudge

	Information - Saving Behavior #1	Information - Saving Behavior #2
VARIABLES	More than 6 months	More than 6 months
Group (base group: control group)		
treatment group	-0.0228 (0.0668)	-0.0416 (0.0634)
Financial Literacy (base group: 0 answers correct)		
1 answer correct		-0.1506 (0.1528)
2 answers correct		-0.0337 (0.1519)
3 answers correct		-0.0892 (0.1494)
4 answers correct		0.0020 (0.1547)
5 answers correct		-0.0860 (0.1861)
Confidence level (base group= Neutral)		
Overconfident		0.1241 (0.0932)
Underconfident		0.0750 (0.0965)
Financial Experience (base group: Never invested in securities market)		
Invested		-0.0083 (0.0934)
Risk Profile (base group: Conservative)		
Balanced		0.0282 (0.0697)
Dynamic		-0.0054 (0.1213)
Aggressive		-
Age (base group: 18-25)		
26-35		0.4891*** (0.0991)
36-45		0.6128*** (0.0933)
46-55		0.5160*** (0.0973)
+55		0.5389*** (0.1020)
Gender (base group: Female)		
Male		-0.1053 (0.0718)
Marital Status (base group: Not Single)		
Single		0.0892 (0.0907)
Education Level (base group: Basic education)		
High School		0.1094

		(0.1572)
University		0.0075
		(0.1496)
Education area (base group: social sciences)		
engineering		0.0468
		(0.0892)
others		-0.1596**
		(0.0756)
Net Income (base group: No Income)		
Until 749€		-0.2519**
		(0.1024)
More than 749€		-0.2017**
		(0.0797)
Observations	132	132
Prob > chi2	0.0666	0.0666
Pseudo R2	0.1888	0.1888

Note. This table presents the marginal effects of the Probit regression for model 6. #1 presents the first regression and #2 presents the second regression. To correct for heteroscedasticity, the robust standard errors were computed, and they are presented in parenthesis. *** p<0.01, ** p<0.05, *p<0.1

5.4.3 Market Participation with Default Nudge

This section intends to analyze the effect of default nudge in market participation behavior of individuals, by analysing how individuals would allocate their lottery winnings of €10,000 in the stock market, as defined previously.

Table 20 shows the marginal effects of two ordered probit regressions for the dependent variable market participation with a default nudge (mkt_part_default). The models used were the same as the other regressions.

The findings of the first regression indicate that being in the treatment group has a positive influence on market participation, once respondents from the treatment group are 32.26% more likely to allocate more than 50% of their lottery earnings in the stock market.

In the second regression, the treatment group variable continues to have a similar effect, with respondents from the treatment group being 25.69% more likely to allocate more than 50% of their lottery earnings in the stock market. These results support the acceptance of Hypothesis 4, for both regressions, suggesting that the default nudge has a positive impact on market participation (Choi et al., 2003; Hagman et al., 2015; Momsen & Stoerk, 2014; Thaler & Benartzi, 2004; Thaler & Sunstein, 2008; Wachner et al., 2020).

Additionally, there are other variables in the second regression that exhibit statistical significance and are worth highlighting. Financial literacy has a positive effect on market participation, as respondents with a high level of financial literacy are 39.11% more likely to allocate more than 50% of their lottery earnings in the stock market. This finding aligns with previous research, indicating that individuals with greater financial knowledge and understanding are more inclined to engage in stock market activities (Hsiao & Tsai, 2018; Lusardi & Mitchell, 2014; Mishra, 2018; van Rooij, Lusardi, Alessie, et al., 2011).

Underconfident respondents are 20.45% more likely to allocate more than 50% of their lottery earnings in the stock market. This result suggests that individuals who exhibit lower levels of confidence in their financial decisions participate less in the stock market and they may be more open to following defaults or recommendations, such as the default nudge in this study, which encourages market participation (Calvet et al., 2009; Glaser & Weber, 2007; Xia et al., 2014).

Risk profile also demonstrates a positive relationship with market participation. As the level of risk profile increases, the coefficient for this variable in allocating more than 50% of the lottery earnings in the stock market also increases. This finding suggests that individuals with a higher risk tolerance may be more willing to take part in stock market activities (Calvet et al., 2009; Glaser & Weber, 2007).

However, it is worth noting that older people are 21.90% less likely to allocate a higher percentage in the stock market. This result may be attributed to various factors, including risk aversion, a preference for more conservative investment options, and a focus on capital preservation rather than seeking higher returns.

Table 20 Marginal Effects of Ordered Probit regression for Market Participation with Default Nudge

	Default - Market Participation #1			**Default - Market Participation #2**		
VARIABLES	<= 50% in stocks	50% in stocks	>= 50% in stocks	<= 50% in stocks	50% in stocks	>= 50% in stocks
Group (base group: control group)						
treatment group	-0.3519***	0.0293**	0.3226***	-0.2865***	0.0296**	0.2569***
	(0.0591)	(0.0149)	(0.0558)	(0.0591)	(0.0130)	(0.0533)
Financial Literacy (base group: 0 answers correct)						
1 answer correct				0.2522***	0.0190	-0.2711**
				(0.0945)	(0.0243)	(0.1053)
2 answers correct				0.2684***	0.0173	-0.2857***
				(0.0992)	(0.0241)	(0.1102)
3 answers correct				0.2949***	0.0140	-0.3090***
				(0.0956)	(0.0229)	(0.1095)
4 answers correct				0.2486**	0.0193	-0.2679**

				(0.1073)	(0.0214)	(0.1215)
5 answers correct				0.3962***	-0.0051	-0.3911***
				(0.1370)	(0.0263)	(0.1367)
Confidence level (base group= Neutral)						
Overconfident				-0.1254	0.0213	0.1042
				(0.0800)	(0.0159)	(0.0652)
Underconfident				-0.2302***	0.0257*	0.2045***
				(0.0830)	(0.0150)	(0.0751)
Financial Experience (base group: Never invested in securities market)						
Invested				0.0401	-0.0042	-0.0359
				(0.0831)	(0.0090)	(0.0742)
Risk Profile (base group: Conservative)						
Balanced				-0.1563**	0.0208*	0.1354**
				(0.0651)	(0.0112)	(0.0559)
Dynamic				-0.4079***	-0.0160	0.4238***
				(0.0994)	(0.0340)	(0.1257)
Aggressive				-0.5824***	-0.1806***	0.7629***
				(0.0474)	(0.0263)	(0.0398)
Age (base group: 18-25)						
26-35				-0.0879	-0.0057	0.0936
				(0.0952)	(0.0109)	(0.1029)
36-45				0.1407	-0.0114	-0.1293
				(0.1257)	(0.0130)	(0.1154)
46-55				0.1033	-0.0062	-0.0971
				(0.1092)	(0.0073)	(0.1039)
+55				0.2552**	-0.0362*	-0.2190**
				(0.1205)	(0.0202)	(0.1052)
Gender (base group: Female)						
Male				0.0497	-0.0051	-0.0445
				(0.0627)	(0.0072)	(0.0558)
Marital Status (base group: Not Single)						
Single				0.0842	-0.0081	-0.0761
				(0.0783)	(0.0080)	(0.0708)
Education Level (base group: Basic education)						
High School				-0.0957	0.0062	0.0895
				(0.1012)	(0.0103)	(0.0924)
University				0.0038	-0.0005	-0.0034
				(0.0940)	(0.0112)	(0.0829)
Education area (base group: social sciences)						
engineering				0.0396	-0.0048	-0.0348
				(0.0881)	(0.0117)	(0.0766)
others				-0.0248	0.0022	0.0226
				(0.0682)	(0.0060)	(0.0622)
Net Income (base group: No Income)						
Until 749€				0.0592	-0.0057	-0.0535
				(0.1076)	(0.0113)	(0.0969)
More than 749€				0.0350	-0.0029	-0.0321
				(0.0902)	(0.0068)	(0.0835)
Observations	101	40	72	101	40	72
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pseudo R2	0.1920	0.1920	0.1920	0.1920	0.1920	0.1920

Note. This table presents the marginal effects of the Probit regression for model 6. #1 presents the first regression and #2 presents the second regression. To correct for heteroscedasticity, the robust standard errors were computed, and they are presented in parenthesis. *** p<0.01, ** p<0.05, *p<0.1

5.4.4 Market Participation with Information Nudge

This section intends to analyze the effect of two questions of the questionnaire regarding information nudge in market participation behavior of individuals. First by analysing if individuals are willing to invest any part of their assets in the stock market, and second, if respondents answered affirmatively, they would be further asked about the percentage of their total asset value that they would be willing to invest in the stock market, as defined previously.

Table 21 shows the marginal effects of two probit regressions for the dependent variable market participation with an information nudge (mkt_part_info). The models used were the same as the other regressions.

The results of the first regression reveal that being in the treatment group has a positive impact on market participation, once respondents from the treatment group are 12.80% more likely to participate in the stock market when compared to individuals in the control group (who did not receive the nudge).

This suggests that the information nudge effectively influences market participation, and a result, the first regression does not reject H4 for information nudge (Benartzi & Thaler, 2007; Madrian & Shea, 2001; Thaler & Benartzi, 2004).

In the second regression, it is possible to notice that the treatment group variable loses its statistical significance. While the first regression supports the positive impact of the information nudge on market participation, the second regression does not provide sufficient evidence to draw a conclusive result. This indicate that the effect of the information nudge is not consistent when adding more independent variables to the regression (DellaVigna, 2009; Sunstein, 2016).

Furthermore, there are additional variables in the second regression that show statistical significance. For instance, overconfident individuals are 21.31% more likely to participate in the stock market. This finding suggests that individuals who display higher levels of confidence in their financial decision-making are more inclined to engage in market participation (Barber & Odean, 2001; Gervais & Odean, 2001).

Additionally, individuals with a low risk profile are 32.60% more likely to participate in the market.

This indicates that individuals who exhibit lower aversion to risk are more willing to engage in stock market activities (Mishra, 2018).

Age, however, demonstrates a negative influence on market participation. As age increases, the coefficient in the regression associated with market participation becomes increasingly negative. This result could be attributed to various factors, such as risk aversion, reduced financial obligations, or a preference for more conservative investment options among older individuals (Hastings et al., 2013).

Table 22 shows the marginal effects of two ordered probit regressions for the dependent variable market participation with an information nudge 2 (mkt_part_info2). The models used were the same as the other regressions.

The results of both regressions reveal that being in the treatment group does not has statistical significance. This suggests that the information nudge may not have a significant impact on the specific question regarding allocation in financial markets for the sample.

However, there are other variables worth noting in the second regression. Individuals with a high-risk profile and with university studies are 46.70% and 4,52% (respectively) more likely to invest between 51-75 % in the stock market (Johnson & Sherraden, 2007; Mandell, 2008b).

Table 21 Marginal Effects of Probit regression for Market Participation with Information Nudge

VARIABLES	**Information - Market Participation #1**	**Information - Market Participation #2**
Group (base group: control group)		
treatment group	0.1280*	0.0572
	(0.0681)	(0.0553)
Financial Literacy (base group: 0 answers correct)		
1 answer correct		-0.2027
		(0.1419)
2 answers correct		-0.0566
		(0.1351)
3 answers correct		0.1114
		(0.1372)
4 answers correct		0.1667
		(0.1454)
5 answers correct		0.1843
		(0.1669)
Confidence level (base group= Neutral)		
Overconfident		0.2131***
		(0.0683)
Underconfident		0.0751
		(0.0768)

Financial Experience (base group: Never invested in securities market)		
Invested		0.0206 (0.0881)
Risk Profile (base group: Conservative)		
Balanced		0.3260*** (0.0712)
Dynamic		0.4998*** (0.1132)
Aggressive		-
Age (base group: 18-25)		
26-35		-0.2179* (0.1135)
36-45		-0.3433** (0.1631)
46-55		-0.3205** (0.1325)
55		-0.4085*** (0.1431)
Gender (base group: Female)		
Male		-0.0661 (0.0610)
Marital Status (base group: Not Single)		
Single		-0.0861 (0.0908)
Education Level (base group: Basic education)		
High School		0.0712 (0.1259)
University		0.0994 (0.1197)
Education area (base group: social sciences)		
engineering		0.1056 (0.0924)
others		0.0274 (0.0762)
Net Income (base group: No Income)		
Until 749€		-0.0806 (0.1270)
More than 749€		-0.1192 (0.1052)
Observations	109	109
Prob > chi2	0.0666	0.0666
Pseudo R2	0.1888	0.1888

Note. This table presents the marginal effects of the Probit regression for model 6. #1 presents the first regression and #2 presents the second regression. To correct for heteroscedasticity, the robust standard errors were computed, and they are presente

Table 22 Marginal Effects of Ordered Probit regression for Market Participation with Information Nudge2

	Information Nudge 2 Market Participation #1			Information Nudge 2 Market Participation #2		
VARIABLES	0-25	26-50	51-75	0-25	26-50	51-75
Group (base group: control group)						
treatment group	-0.0349	0.0276	0.0073	-0.0264	0.0213	0.0051
	(0.0901)	(0.0717)	(0.0187)	(0.0869)	(0.0703)	(0.0168)
Financial Literacy (base group: 0 answers correct)						
1 answer correct				0.0255	-0.0191	-0.0064
				(0.3047)	(0.2293)	(0.0755)
2 answers correct				0.1667	-0.1339	-0.0328
				(0.2218)	(0.1688)	(0.0558)
3 answers correct				0.0774	-0.0597	-0.0177
				(0.2303)	(0.1727)	(0.0582)
4 answers correct				0.1434	-0.1141	-0.0293
				(0.2418)	(0.1833)	(0.0599)
5 answers correct				-0.0805	0.0562	0.0243
				(0.2660)	(0.1897)	(0.0773)
Confidence level (base group= Neutral)						
Overconfident				-0.0679	0.0523	0.0155
				(0.1245)	(0.0955)	(0.0297)
Underconfident				0.1331	-0.1126	-0.0206
				(0.1185)	(0.0999)	(0.0206)
Financial Experience (base group: Never invested in securities market)						
Invested				-0.0295	0.0237	0.0057
				(0.1775)	(0.1433)	(0.0342)
Risk Profile (base group: Conservative)						
Balanced				-0.1762*	0.1590*	0.0173
				(0.1005)	(0.0927)	(0.0109)
Dynamic				-0.5291***	0.3912***	0.1379
				(0.1621)	(0.1053)	(0.0900)
Aggressive				-0.7466***	0.2796*	0.4670**
				(0.1030)	(0.1501)	(0.1825)
Age (base group: 18-25)						
26-35				-0.2642*	0.1986*	0.0656
				(0.1581)	(0.1057)	(0.0606)
36-45				-0.2088	0.1629	0.0459
				(0.2345)	(0.1697)	(0.0676)
46-55				-0.0497	0.0419	0.0078
				(0.1642)	(0.1378)	(0.0265)
+55				-0.1817	0.1440	0.0377
				(0.1756)	(0.1357)	(0.0421)
Gender (base group: Female)						
Male				-0.0388	0.0315	0.0073
				(0.0942)	(0.0772)	(0.0173)
Marital Status (base group: Not Single)						
Single				-0.1211	0.0971	0.0240
				(0.1358)	(0.1107)	(0.0265)
Education Level (base group: Basic education)						

High School				-0.2871**	0.2588**	0.0283
				(0.1288)	(0.1180)	(0.0176)
University				-0.3681***	0.3229***	0.0452**
				(0.1015)	(0.0955)	(0.0204)
Education area (base group: social sciences)						
engineering				0.1489	-0.1280	-0.0209
				(0.0947)	(0.0822)	(0.0154)
others				-0.1382	0.1045	0.0337
				(0.1314)	(0.0953)	(0.0385)
Net Income (base group: No Income)						
Until 749€				-0.1561	0.1031	0.0530
				(0.1349)	(0.0910)	(0.0508)
More than 749€				0.1187	-0.0945	-0.0242
				(0.1291)	(0.0991)	(0.0315)
Observations	67	38	4	67	38	4
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pseudo R2	0.1920	0.1920	0.1920	0.1920	0.1920	0.1920

Note. This table presents the marginal effects of the Probit regression for model 6. #1 presents the first regression and #2 presents the second regression. To correct for heteroscedasticity, the robust standard errors were computed, and they are presented in parenthesis. *** p<0.01, ** p<0.05, *p<0.1

6. Conclusion

The main objective of this research was to assess the effectiveness of nudges in influencing individuals' saving behavior and market participation.

Concerning saving behavior, it was measured in three different ways, if individuals save, how much of their net income they save, and for how long do they have an emergency fund to face a situation of unemployment or illness. Regarding market participation, this study was focused on the percentage of total asset value that individuals allocate in the securities market. In addition, several specific objectives were incorporated to enhance the investigation. These objectives included examining the impact of variables such as confidence level, financial experience, risk profile, and sociodemographic characteristics (such as age, gender, marital status, education level, education area, and net income) on financial literacy and in financial behavior (savings and market participation).

By conducting these analyzes, this study not only reinforces the existing evidence of low levels of financial literacy, market participation, and saving habits among the Portuguese population but also addresses the literature gap by empirically investigating the influence of nudges on individuals' engagement with market participation and saving behavior.

To achieve such results, a questionnaire was applied to a set of 213 Portuguese individuals, aged 18 years or older, that also included an experiment where the sample was divided in two groups: a control group and a treatment group, which received the same set of questions with the addition of two different nudges, default, and information. The questionnaire encompassed the following sections: sociodemographic data, followed by the experiment that was composed with questions regarding saving behavior and market participation, and then the questionnaire follows with questions of perceived financial literacy, financial experience, market participation, risk profile, saving behavior, financial literacy – big five, and nudge preference. In methodological terms, it was used quantitative research, econometric models, most notably Ordered Probit and Probit regressions.

The results regarding financial literacy scores were consistent with previous literature and showed that the levels are low in the general sample, increasing with higher risk profile, financial experience, income, level of education and is also higher for men and people with studies on the economic area (Corsini & Giannelli, 2021; Cupák et al., 2018; Kiril, 2020; Liao et al., 2017; OECD, 2014a, 2022). By

contrast, overconfident individuals tend to have lower levels of financial literacy (Lusardi & Mitchell, 2011b; Mudzingiri et al., 2018).

Regarding the several dimensions of saving behavior under analysis, the results demonstrate that, overall, financial literacy has been found to have a significant positive effect on savings behaviors, a result which aligns with previous studies (Abdul Jamal et al., 2015; Beckmann, 2013; Hilgert et al., 2003; Letkiewicz & Fox, 2014; van Rooij, Lusardi, & Alessie, 2011).

In respect of other variables under study, overall, risk profile presented a positive effect in savings behavior. These conclusions were confirmed by the literature (Babiarz & Robb, 2014; Fan & Zhang, 2021; Fisher, 2010; Fisher et al., 2015; Grossbard & Pereira, 2010; Nguyen, 2023), except for overconfidence, that did not aligned with the literature. Previous research defends that overconfident individuals are underestimating emergency funds, however, a negative relation between this factor and the third dimension of saving behavior (emergency funds) was not found in this study (Lee & Hanna, 2022).

Considering sociodemographic factors, overall, the results were aligned with the literature (Abdul Jamal et al., 2015; Babiarz & Robb, 2014; Beckmann, 2013; Benartzi & Thaler, 2007; Bernheim & Scholz, 1993; Browning & Lusardi, 1996; Fan & Zhang, 2021; Fisher, 2010; Grossbard & Pereira, 2010; Hilgert et al., 2003; Johannisson, 2008; Letkiewicz & Fox, 2014; Lusardi, 2008; Njung'e, 2013), with age, marital status, education level and area, and net income, having a positive relationship with some dimensions of savings' behavior. As for the variable gender, it had a negative effect on the variable of savings. The research found that female respondents are more prone to save when comparing with their male counterparts in several dimensions of savings' behavior, a result that is in line with prior research (Johannisson, 2008; Njung'e, 2013).

Regarding market participation, it is low in the general sample, and is positively influenced by financial literacy, financial experience, risk profile, age and background of education (Alves, 2022; Bollen & Posavac, 2018; Hsiao & Tsai, 2018, 2018; Hsu et al., 2021; Mishra, 2018; van Rooij, Lusardi, & Alessie, 2011).

The last part of the study, aimed to examine the effectiveness of two types of nudges, default nudges and information nudges, in influencing saving behavior and market participation.

The findings revealed that default nudges had a stronger impact compared to information nudges,

as respondents in the treatment group who received default nudges were more likely to choose better options in both market participation and saving behavior when compared to respondents in the control group. This finding is consistent with previous literature on nudges, which has highlighted the effectiveness of default nudges in shaping individuals' decision-making behavior (Choi et al., 2003; Costa & Kahn, 2013; Gajewski et al., 2022; Hagman et al., 2015; Momsen & Stoerk, 2014; Thaler & Benartzi, 2004; Thaler & Sunstein, 2008; Wachner et al., 2020).

Default nudges leverage the power of inertia and the tendency for individuals to stick with the default option, resulting in a higher likelihood of desired outcomes. By setting default options that align with desirable choices, default nudges can effectively steer individuals towards more optimal decisions without restricting their freedom of choice. This approach has been widely adopted in various domains, including retirement savings, organ donation, and investment decisions, with consistent evidence of its positive impact.

On the contrary, information nudges, which provide individuals with additional information or education to guide their decision-making, were found to be less effective in influencing market participation and saving behavior in this study. Although information nudges can enhance individuals' understanding and knowledge, they may not always translate into actual behavioral changes. Other factors such as cognitive biases, emotional factors, and external constraints can limit the impact of information nudges on decision making.

Overall, the findings of this study contribute to the existing body of literature on nudges and provide empirical evidence supporting the effectiveness of default nudges in promoting desired outcomes in both saving behavior and market participation.

Nevertheless, it is important to acknowledge the limitations of this study. Firstly, the sample size was relatively small and skewed towards a younger demographic, which may limit the generalizability of the findings to the broader Portuguese population. The study's focus on a specific group of individuals associated with the University of Minho further restricts the diversity of the participants and may introduce bias. Moreover, certain results deviated from the existing literature, which could be attributed to the limitations mentioned above and the use of self-assessment questions that may not accurately reflect participants' actual behaviors. Therefore, caution should be exercised when interpreting the study's findings, and future research should aim to address these limitations to ensure more reliable and valid results.

Furthermore, the design and implementation of the questionnaire may have introduced biases. The division of participants into only two groups and applying all the nudges to the same group could have influenced the responses due to sequence effects.

In conclusion, this study offers recommendations for future research. Firstly, expanding the sample size and including participants from a wider range of age groups, educational backgrounds, and socioeconomic statuses would enhance the representativeness of the results. Using a more structured and comprehensive questionnaire would allow for more precise data collection on financial literacy, saving behavior, and market participation.

Future research could also consider utilizing a questionnaire divided into multiple groups, with each group exposed to a single type of nudge. This would enable a more nuanced understanding of the effects of different nudges. Finally, testing the implementation of nudges in real investment scenarios, such as through collaborations with banking institutions, would provide valuable insights into their practical applicability.

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8. Appendices

Appendix 1. Questionnaire

Questionário:

No âmbito da Unidade Curricular de Dissertação de Mestrado em Finanças na Universidade do Minho, venho solicitar a sua colaboração para uma investigação sobre o comportamento financeiro através do preenchimento do presente questionário.

De acordo com o novo Regulamento Geral de Proteção de Dados (Regulamento (EU) 2016/679), é garantido a todos os inquiridos a segurança e o anonimato das suas respostas.

O presente questionário foi concebido de maneira a ser preenchido de forma simples e breve, devendo o seu preenchimento demorar aproximadamente 10 a 15 minutos. A informação fornecida destina-se exclusivamente para fins estatísticos da presente investigação académica.

Caso seja necessário qualquer tipo de esclarecimento relativamente ao estudo pode entrar em contacto com a responsável do estudo, Ana Sofia Bento, através do email pg46173@uminho.pt .

Agradeço desde já a sua participação.

Parte 1: Caracterização sociodemográfica

1. Nacionalidade
    - Portuguesa
    - Outra (se a resposta for outra encerrar questionário)

2. Idade _____

3. Gendero
    - Masculino
    - Feminino

4. Qual o seu estado civil?
    - Solteiro
    - Casado / União de facto
    - Divorciado/ Separado
    - Viúvo

5. Indique o nível mais alto de escolaridade completo
    - 1º ciclo (4º ano)
    - 2º ciclo (6º ano)
    - 3º ciclo (9ª ano)
    - Ensino secundário (12º ano)
    - Licenciatura, curso técnico superior profissional
    - Mestrado, Pós-graduação ou MBA
    - Doutoramento

6. Área de estudos

- Ciências empresariais (economia, gestão, negócios, finanças, contabilidade e afins)
- Arquitetura e Construção
- Engenharias
- Informática
- Artes, Línguas e Humanidades
- Ciências da vida e físicas
- Ciências Veterinárias
- Saúde
- Serviços Sociais
- Matemática e Estatística
- Direito
- Desporto
- Enologia
- Outra

7. Qual o seu rendimento mensal líquido?
    - Sem rendimento próprio
    - Até 299€
    - Entre 300€ e 449€
    - Entre 450€ e 749€
    - Entre 750€ e 999€
    - Entre 1000€ a 1499€
    - Entre 1500€ e 1999€
    - Entre 2000€ e 2500€
    - Mais de 2500€

Parte 2: Experimento

Leia com atenção as seguintes perguntas, e indique qual a sua reação num cenário hipotético

1. **<u>Default nudge – Saving Behavior</u>**

Grupo de Controlo (Sem Nudge):

Imagine que todos os anos sofre um aumento salarial de 10%. Indique a percentagem desse valor que alocaria a uma poupança para a reforma [em que 0% significa que não alocaria qualquer valor e 100% significa que alocaria a totalidade do valor]

- 0%
- Entre 1 a 25%
- Entre 25% a 50%
- Entre 50% e 70%
- Entre 70% e 85%
- Entre 85% e 99%
- 100%

Grupo de teste (Com Nudge):

Imagine que todos os anos sofre um aumento salarial de 10%. O seu banco propõe alocar automaticamente 50% do seu aumento a poupança para a reforma por considerar que será útil para as suas poupanças, a não ser que você opte explicitamente por não o fazer. O que faria nesta situação?

- Concordaria com a recomendação do banco
- Optaria por outra opção.

Indique a percentagem desse valor que alocaria a uma poupança para a reforma [em que 0% significa que não alocaria qualquer valor e 100% significa que alocaria a totalidade do valor]

- 0%
- Entre 1 a 25%
- Entre 25% a 50%
- Entre 50% e 70%
- Entre 70% e 85%
- Entre 85% e 99%
- 100%

2. Default nudge – Market participation

Grupo de Controlo (Sem Nudge):

Imagine um cenário em que ganhou 10.000€ numa lotaria. Pode optar entre colocar o dinheiro numa conta poupança ou investi-lo no mercado de ações [investimento direto em ações e/ou fundos de investimento em ações].

O seu banco propõe-lhe as 2 opções abaixo.

Para cada opção é indicado o nível de risco numa escala de 1 a 7, onde 1 é o menos arriscado e 7 é o mais arriscado.

Da mesma forma, é indicado um nível de rendimento financeiro esperado numa escala de 1 a 7, sendo 1 o rendimento mais baixo e 7 o rendimento mais alto.

Nome	Risco	Rendimento
Mercado de Ações	3	5
Depósito Bancário	0	1

Indique a percentagem que atribuiria a cada uma das opções, sendo que a percentagem total precisa de ser igual a 100%

Nome	Percentagem alocada
Mercado de Ações	?
Depósito Bancário	?
Total	100%

Grupo de teste (com nudge):

Imagine um cenário em que ganhou 10.000€ numa lotaria. Pode optar entre colocar o dinheiro numa conta poupança ou investi-lo no mercado de ações [investimento direto em ações e/ou fundos de investimento em ações].

O seu banco propõe-lhe as 2 opções abaixo.

Para cada opção é indicado o nível de risco numa escala de 1 a 7, onde 1 é o menos arriscado e 7 é o mais arriscado.

Da mesma forma, é indicado um nível de rendimento financeiro esperado numa escala de 1 a 7, sendo 1 o rendimento mais baixo e 7 o rendimento mais alto.

Nome	Risco	Rendimento
Mercado de Ações	3	5
Depósito Bancário	0	1

O seu banco já pré-definiu a forma ideal de alocar o seu dinheiro de acordo som o seu perfil de risco, se concordar carregue em seguinte, se não faça as alterações necessárias.

3. Information Nudge- Saving Behavior

Grupo de controlo (sem nudge):

Indique para quanto tempo acha relevante ter um fundo de emergência que cubra uma diminuição de rendimento mensal da família provocado, por exemplo, por uma situação de desemprego ou doença.

- Até um mês
- 2 a 3 meses
- 3 a 4 meses
- 5 a 6 meses
- Mais de 6 meses

Grupo de teste (com nudge):

Leia com atenção a seguinte noticia:

"Com o aumento dos preços dos bens e serviços essenciais, as famílias portuguesas enfrentam grandes desafios que comprovam a importância e a necessidade de ter um fundo de emergência que lhes permita equilibrar as suas finanças pessoais. Este fundo deverá corresponder a, pelo menos, 5 a 6 vezes o rendimento mensal da família de modo acautelar o impacto financeiro de uma diminuição de rendimentos provocada, por exemplo, por uma situação de desemprego ou de doença." – O Jornal Económico https://jornaleconomico.pt/noticias/conheca-a-importancia-da-poupanca-em-contexto-de-crise-835872

Tinha conhecimento da informação que consta nesta notícia?

- Sim
- Não

Após ler esta notícia, indique para quanto tempo acha relevante ter um fundo de emergência que cubra uma diminuição de rendimento mensal da família provocado, por exemplo, por uma situação de desemprego ou doença.

- Até 1 mês
- 2 a 3 meses
- 3 a 4 meses
- 5 a 6 meses
- Mais de 6 meses

4. Information Nudge - Market participation

Grupo de controlo (sem nudge):

Estaria disposto a investir parte do seu património no mercado de ações [investimento direto em ações e/ou fundos de investimento em ações]?

- Sim
- Não

Se sim, indique a percentagem do seu património que estaria disposto a investir no mercado de ações [investimento direto em ações e/ou fundos de investimento em ações]:

- Entre 0% e 25%
- Entre 26% e 50%
- Entre 51% e 75%
- Mais de 76%
- Entre 76% e 85%
- Entre 86% e 100%

Grupo de teste (com nudge)

Leia com atenção a seguinte informação

"Há quatro classes de ativos pelos quais os investidores podem optar: depósitos, obrigações, ações e imobiliário. Dentro destes, as ações foram consideradas a melhor classe de ativos para investir a longo prazo num estudo realizado em 21 países, incluindo Portugal." - O observador https://observador.pt/especiais/acoes-sao-a-melhor-classe-de-ativos-para-investir-a-longo-prazo/

Tinha conhecimento da informação que consta nesta notícia?

- Sim
- Não

Após ler esta notícia, estaria disposto a investir parte do seu património no mercado de ações?

- Sim
- Não

Se sim, indique a percentagem do seu património que estaria disposto a investir no mercado de ações:

- Entre 0% e 25%

- Entre 26% e 50%
- Entre 51% e 75%
- Mais de 76%
- Entre 76% e 85%
- Entre 86% e 100%

Parte 3: Literacia Financeira percecionada, Experiência Financeira, Perfil de Risco

As seguintes perguntas são relacionadas com a temática em estudo, por favor responda com atenção.

8. Como avalia os seus conhecimentos financeiros quando comparados com a média da população portuguesa?
    - Bastante inferior à média
    - Inferior à média
    - Igual à média
    - Superior à média
    - Bastante superior à média

9. Alguma vez investiu em mercados financeiros (ou seja, ações, obrigações de empresas, obrigações do tesouro, unidades de participação em fundos de investimento, futuros, opções, CFD/contracts for differences, outros produtos derivados, produtos financeiros complexos, entre outros)?

    - Sim
    - Não

10. Atualmente tem investimentos nos mercados financeiros (ou seja, ações, obrigações de empresas, obrigações do tesouro, unidades de participação em fundos de investimento, futuros, opções, CFD/contracts for differences, outros produtos derivados, produtos financeiros complexos, entre outros)?

    - Sim
    - Não

11. Indique o perfil de investidor com que mais se identifica:

- Conservador ou Prudente (Procura garantia de capital investido e rendimentos mínimos ou baixos)
- Equilibrado ou Moderado (Disposto a assumir um pequeno nível de risco para potenciais retornos a médio e longo prazo)
- Dinâmico (Disposto a assumir algumas perdas no capital investido e que procura retornos relativamente mais elevados)
- Agressivo (Disposto a correr riscos significativos - perda total ou até superior ao capital investido - para maximizar os retornos a longo prazo)

Parte 4: Comportamento de Poupança e Participação de Mercado

As seguintes perguntas estão relacionadas com o seu comportamento de poupança, por favor responda com atenção.

12. Tem como hábito poupar parte do seu rendimento?

- Sim
- Não
- Não sei
- Não respondo

13. Qual a percentagem do seu rendimento que costuma aplicar a poupança?

- Nenhum
- Até 10%
- Entre 10% e 20%
- Entre 20% e 40%
- Entre 40% e 50%
- Mais de 50%

14. Tem um fundo de emergência que cubra uma diminuição de rendimento mensal da família provocado, por exemplo, por uma situação de desemprego ou doença?

- Não
- Sim, para 1 mês
- Sim, para 2 a 3 meses
- Sim, para 3 a 4 meses
- Sim, para 5 a 6 meses
- Sim, para mais de 6 meses
- Não sei
- Não respondo

15. A sua carteira atual de valores mobiliários (ou seja, ações, obrigações de empresas, obrigações do tesouro, unidades de participação em fundos de investimento, futuros, opções, CFD/contracts for differences, outros produtos derivados, produtos financeiros complexos, entre outros) representa aproximadamente que percentagem do seu património total?

- Não tenho valores mobiliários = 0
- Entre 0% e 25%=1
- Entre 26% e 50%=2
- Entre 51% e 75%=3
- Entre 76% e 85% =4
- Entre 86% e 100% =4

Parte 8: Big Five

As seguintes questões servem para avaliar a sua literacia financeira, por favor responda atentamente.

16. Suponha que coloca $100 numa conta poupança e a taxa de juro era de 2% por ano. Após 5 anos, quanto acha que teria na conta se deixasse o dinheiro para crescer? (considerando que não são cobradas comissões nem impostos)

- Mais de $102
- Exactamente $102
- Menos de $102
- Não sei
- Prefiro não dizer.

17. Considere que a taxa de juro da sua conta poupança era de 1% ao ano e que a inflação era de 2% ao ano. Após 1 ano, quanto é que poderia comprar com o dinheiro nesta conta?

- Mais do que hoje
- Exactamente o mesmo
- Menos do que hoje
- Não sei
- Prefiro não dizer.

18. Se as taxas de juro subirem, o que acontecerá aos preços das obrigações?

Vão aumentar
Vão diminuir
Ficarão na mesma
Não há relação entre os preços das obrigações e a taxa de juro
Não sei
Prefiro não dizer.

19. Uma hipoteca de 15 anos requer normalmente pagamentos mensais mais elevados do que uma hipoteca de 30 anos, mas os juros totais pagos ao longo da vida do empréstimo serão menores.

- Verdadeiro
- Falso
- Não sei
- Prefiro não dizer

20. Investir em ações de uma só empresa geralmente oferece um retorno mais seguro do que investir o mesmo numa carteira diversificada de ações

- Verdadeiro
- Falso
- Igual
- Não sei
- Prefiro não dizer

21. Indique quantas das questões anteriores pensa que acertou

- 1
- 2

- 3
- 4
- 5

Parte 9: Preferência de nudge

22. Numa escala de likert de 1 a 5, indique a importância que atribui a cada um dos elementos como relevantes para potencialmente influenciar positivamente as suas decisões financeiras: (1-Sem importância, 2- pouca importância, 3- neutro, 4- alguma importância, 5- muita importância)

- Receber informações sobre produtos financeiros adequados ao seu perfil de risco
- Ter informação detalhada sobre especificidades de cada produto de investimento (rendibilidade, risco, custos associados, complexidade...)
- Ter informação detalhada sobre as formas de poupança mais adequadas
- Definir uma percentagem do seu salário a ser alocado a um investimento compatível com o seu perfil de risco
- Definir um montante a aplicar periodicamente para a poupança pré-definido

"Agradecemos a sua participação neste questionário e o tempo despendido.
A sua resposta foi registada."

Appendix 2. VIF Tables

Table 23 Variance inflation factor (VIF) – financial literacy

	VIF	1/VIF
2.age	1.545	0.647
3.age	2.593	0.386
4.age	4.232	0.236
5.age	4.458	0.224
1.gender	1.411	0.709
1.marital status	3.071	0.326
2.education level	4.617	0.217
3.education level	4.688	0.213
2.education area	1.299	0.770
3.education area	1.726	0.580
2.net income	1.731	0.578
3.net income	2.708	0.369
2.perceived fl	6.591	0.152
3.perceived fl	9.973	0.100
4.perceived fl	8.836	0.113
5.perceived fl	3.764	0.266
1.financial experience	2.611	0.383
2.risk profile	1.471	0.680
3.risk profile	1.457	0.686
4.risk profile	1.168	0.856
2.confidence level	1.699	0.589
3.confidence level	1.614	0.620
Mean VIF	3.273	.

Table 24 Variance inflation factor (VIF) – market participation

	VIF	1/VIF
2.age	1.621	0.617
3.age	2.666	0.375
4.age	4.354	0.230
5.age	4.557	0.219
1.gender	1.473	0.679
1.marital status	3.149	0.318
2.education level	5.216	0.192
3.education level	5.372	0.186
2.education area	1.321	0.757
3.education area	1.833	0.546
2.net income	1.767	0.566
3.net income	2.810	0.356
2.perceived fl	6.850	0.146
3.perceived fl	10.673	0.094
4.perceived fl	9.803	0.102
5.perceived fl	4.126	0.242
1.financial experience	2.679	0.373
2.risk profile	1.485	0.673
3.risk profile	1.463	0.683
4.risk profile	1.177	0.850
1.fl total	2.389	0.419
2.fl total	3.327	0.301
3.fl total	4.478	0.223
4.fl total	5.635	0.177
5.fl total	5.066	0.197
2.confidence level	2.381	0.420
3.confidence level	1.760	0.568
Mean VIF	3.626	.

Table 25 Variance inflation factor (VIF) – save_dummy

	VIF	1/VIF
2.age	1.621	0.617
3.age	2.666	0.375
4.age	4.354	0.230
5.age	4.557	0.219
1.gender	1.473	0.679
1.marital status	3.149	0.318
2.education level	5.216	0.192
3.education level	5.372	0.186
2.education area	1.321	0.757
3.education area	1.833	0.546
2.net income	1.767	0.566
3.net income	2.810	0.356
2.perceived fl	6.850	0.146
3.perceived fl	10.673	0.094
4.perceived fl	9.803	0.102

5.perceived fl	4.126	0.242
1.financial experience	2.679	0.373
2.risk profile	1.485	0.673
3.risk profile	1.463	0.683
4.risk profile	1.177	0.850
1.fl total	2.389	0.419
2.fl total	3.327	0.301
3.fl total	4.478	0.223
4.fl total	5.635	0.177
5.fl total	5.066	0.197
2.confidence level	2.381	0.420
3.confidence level	1.760	0.568
Mean VIF	3.626	.

Table 26 Variance inflation factor (VIF) – save_percentage

	VIF	1/VIF
2.age	1.621	0.617
3.age	2.666	0.375
4.age	4.354	0.230
5.age	4.557	0.219
1.gender	1.473	0.679
1.marital status	3.149	0.318
2.education level	5.216	0.192
3.education level	5.372	0.186
2.education area	1.321	0.757
3.education area	1.833	0.546
2.net income	1.767	0.566
3.net income	2.810	0.356
2.perceived fl	6.850	0.146
3.perceived fl	10.673	0.094
4.perceived fl	9.803	0.102
5.perceived fl	4.126	0.242
1.financial experience	2.679	0.373
2.risk profile	1.485	0.673
3.risk profile	1.463	0.683
4.risk profile	1.177	0.850
1.fl total	2.389	0.419
2.fl total	3.327	0.301
3.fl total	4.478	0.223
4.fl total	5.635	0.177
5.fl total	5.066	0.197
2.confidence level	2.381	0.420
3.confidence level	1.760	0.568
Mean VIF	3.626	.

Table 27 Variance inflation factor (VIF) – emergency_fund

	VIF	1/VIF
2.age	1.621	0.617
3.age	2.666	0.375

4.age	4.354	0.230
5.age	4.557	0.219
1.gender	1.473	0.679
1.marital status	3.149	0.318
2.education level	5.216	0.192
3.education level	5.372	0.186
2.education area	1.321	0.757
3.education area	1.833	0.546
2.net income	1.767	0.566
3.net income	2.810	0.356
2.perceived fl	6.850	0.146
3.perceived fl	10.673	0.094
4.perceived fl	9.803	0.102
5.perceived fl	4.126	0.242
1.financial experience	2.679	0.373
2.risk profile	1.485	0.673
3.risk profile	1.463	0.683
4.risk profile	1.177	0.850
1.fl total	2.389	0.419
2.fl total	3.327	0.301
3.fl total	4.478	0.223
4.fl total	5.635	0.177
5.fl total	5.066	0.197
2.confidence level	2.381	0.420
3.confidence level	1.760	0.568
Mean VIF	3.626	.