

**U**NIVERSITAT  
**J**AUME • **I**

## **Exploring the Influence of Personality on Bias Propensity: A Pilot Experiment**

**Author:** Patricia Muñoz Galera

**Mail:** [al396225@uji.es](mailto:al396225@uji.es)

**Degree:** Grado de Economía.

**Group:** A

**Academic year:** 2022-2023

**Tutor:** María Aurora García Gallego

**ABSTRACT**

This dissertation explores the influence of individuals' psychological characteristics on their economically irrational decision-making through a pilot experiment. The research aims at addressing the question by designing an experiment. Firstly, the study provides a contextualization of behavioral economics and highlights the key features of economic behavior. Additionally, it examines the impact of personal traits on investors and delves into the major cognitive biases that will be analyzed in the experiment. Subsequently, a pilot experiment is conducted, followed by an extensive analysis of the results obtained and the limitations encountered during the implementation. The findings shed light on the relationship between psychological characteristics and irrational economic decision-making, contributing to a deeper understanding of this field. The experiment serves as a valuable stepping stone for future research in this area.

**JEL classification:** A13; C01; C25; C93

**Keywords:** behavioral economics, pilot experiment, cognitive biases, psychological characteristics.

**INDEX:**

<b>1. Introduction.....</b>	<b>4</b>
<b>2. Behavioral economics.....</b>	<b>5</b>
2.1. Objectives of behavioral economics.....	6
2.2. What topics does it specifically address?.....	6
<b>3. Behavioral finance.....</b>	<b>7</b>
<b>4. Influence of investors' personal characteristics on their economic decisions.</b>	<b>11</b>
<b>5. Cognitive biases.....</b>	<b>12</b>
5.1. The law of small numbers bias.....	12
5.2. The uncertainty judgments.....	13
5.3. The prospect theory.....	14
5.4. Common use of the accessibility heuristic.....	16
5.5. The problems of dominance and invariance.....	16
5.6. The overconfidence bias.....	17
5.7. The conjunction fallacy.....	17
<b>6. Pilot experiment.....</b>	<b>18</b>
6.1. Questionnaires.....	18
6.2. Econometric analysis.....	23
6.3. Results obtained from model estimations.....	30
<b>7. Limitations and extensions.....</b>	<b>31</b>
<b>8. Conclusion.....</b>	<b>32</b>
<b>9. Bibliography.....</b>	<b>34</b>
<b>APPENDIX: TEST NEO-FFI.....</b>	<b>35</b>

**INDEX OF TABLES**

Table 1. Possible descriptions for each dimension.....	20
Table 2. Research results obtained.....	25
Table 3. Univariate statistics.....	28
Table 4. Correlation matrix.....	28
Table 5. Results of model estimations.....	30

**INDEX OF FIGURES**

Figure 1. The Müller-Lyer illusion.....	14
Figure 2. Hypothetical valuation function.....	16

## 1. Introduction

People's behavior can be differentiated according to the personal and cognitive characteristics of each individual. These differences vary according to the cultural, social, economic and family environment and are also influenced by the media.

Therefore, the aim of this work is to observe the differences in people's investment behavior taking into account their psychocognitive characteristics.

My motivation comes from a recent conversation I had with a stranger about investments in which I observed that at his age he is very much influenced by supposed expert investors who have made him believe that if he works hard he is going to be a millionaire. The analysis and prejudice that I inexpertly made through what he was telling me has awakened my interest to make a deeper, critical and thoughtful analysis. My interest is focused on whether there are psychological characteristics that influence human beings when making investment decisions. From my point of view and before conducting the experiment, I believe that people who tend to fall into biases tend to share similar psychological characteristics that influence their investment behavior.

This project aims at developing a pilot experiment to demonstrate whether there is a relationship between the different psychological profiles of people and the ease with which they make non-rational decisions that lead them to commit biases related to investment decisions. The dissertation is open to possible corrections and extensions by other researchers. Psychological research has shown that people may have cognitive characteristics that affect their judgment and decision making, and that these psychological traits may change depending on the individual characteristics of each person. In this work we intend to investigate personality dimensions, such as the level of neuroticism or the tendency to impulsivity, that directly influence individuals' non-rational decision making.

Before proceeding to a future larger study, the pilot experiment will be conducted with a small sample of participants to assess the validity and reliability of the techniques used. The most important result obtained in this pilot experiment is that men fall into the overconfidence bias more frequently than women. The findings of this study may have important ramifications for our understanding of how psychological traits affect cognitive biases and, consequently, people's financial decision making.

First, an introduction to behavioral economics (Chapter 2) and especially behavioral finance (Chapter 3) is given. The influences of the personal characteristics of investors in making their economic decisions will also be explained (Chapter 4). The cognitive biases on which the subsequent test will be based will be explained (Chapter 5). On the other hand, the methodology of the pilot experiment and the main results obtained are explained (Chapter 6). Finally, the limitations and extensions that have been encountered in carrying out this study are developed (Chapter 7).

## 2. Behavioral economics

Behavioral economics is a branch of economics that involves aspects of psychology and sociology. This is the study of how psychological and social factors influence the economic decision-making of individuals.

Most of the decisions made by individuals do not respond to the assumption of rationality. Below are some examples of non-rational behaviors:

- A flood of information, if there is too much information, individuals tend to choose randomly or not at all due to information overload.
- Heuristics are quick decision-making rules that are used to simplify people's usual choices and usually work well, but sometimes create biases.
- Inertia users prefer to maintain their resting state tendency to continue making decisions based on habits or routines, instead of evaluating new options or available information.
- Legacy, people tend to stick with the same suppliers and/or brands for fear of error.
- Myopia, some humans have a short-term vision, so they prioritize the present moment rather than valuing their future needs.
- Framework, the way in which information is transmitted influences consumers in different ways.
- Risk aversion, worrying about making a loss may prevent you from seeing a potential gain.

Adam Smith or Jeremy Bentham, who are considered classical economists, already in their time thought about the relationship between economics and psychological behavior, but later lost relevance with the advent of homo economicus and neoclassical economics. Homo economicus is the term used for the theoretical representation of a human being who behaves rationally in the face of economic stimuli. Homo economicus does not consider that decisions are affected by other factors, regardless

of whether they are social or emotional, and understands that the sum of individual interests coincides with the social interest.

During the twentieth century, the participation of psychology in economic studies was taken up again, developing behavioral economics. Amos Tversky and Daniel Kahneman in 1979 wrote the most relevant paper for the development of this branch trying to explain those strange behaviors that had occurred during the previous years.

According to Richard Thaler, all individuals have cognitive limitations that prevent them from rationally processing large amounts of information. Moreover, Thaler argues that individuals make decisions emotionally and are subject to biases in handling probabilities. The American economist affirms that subjects are often willing to sacrifice their own self-interest to satisfy the preferences of society. We can therefore summarize that the contribution of the 2017 Nobel Prize in Economics is based on the research and analysis of how human attitudes, among which bounded rationality, social preferences and lack of self-control stand out, affect individual decision making.

### 2.1. Objectives of behavioral economics

The objective of this field of economics is to study and understand how psychological behavior affects and how emotions influence economic decision making and the consequences of these decisions. Individuals not only rely on rationalization and the information available to them to make decisions but are also influenced by unstudied decisions, the welfare of other individuals, acts based on external agents, and these factors also cause irrational behaviors. Therefore, through economics, psychology and sociology, we try to understand human behavior in the economic context, with special attention to irrational behavior. All decisions made by individuals that are not based on rationalization can therefore lead to biases that lead to errors.

The main objectives of behavioral economics are based on discovering how human beings behave when making decisions. The research explains human behavior as seen from social preferences, heuristics and norms from which new models of behavior are constructed.

### 2.2. What topics does it specifically address?

Key topics include the following:

- Incentives and motivations

The ultimatum game (Güth et al.1982), in which participant "A" is offered an amount of money that can be shared with participant "B". On the other hand, participant "B" is given the opportunity to accept the offer or reject it, in the event that his decision is to reject the proposal, no participant will receive anything. And when the decision is made, the game is over. It is thanks to this game that it has been shown that people are more generous than expected and that this depends on the aversion to inequity. The results obtained were that the most frequent offer corresponded to half of the money to be distributed. The arguments that emerged to explain the anomalies that were found were diverse, but the common nexus of all was the common respect for social norms. Being altruistic is considered socially correct, while not donating a portion of money to the other person is frowned upon by society. Cialdini and Trost defined social norms (Cialdini and Trost, 1998), "social norms are forms of behavior that are embodied in the members of a community, which guide their actions without the need to make use of the force of law", therefore individuals tend to accept moral principles related to altruism and the equitable distribution of wealth. In conclusion, social motivations, such as altruism, influence individuals when making decisions.

- Social influences

Two types of social influences that affect human decisions can be differentiated, they can be informative or normative. In the case of informative behaviors, the individual pays more attention to what other people do and acts by repeating the same behavior, usually due to lack of information.

- Heuristics, risk and bias

Several studies by behavioral economists have shown that individuals do not respond adequately to situations involving probability and risk, nor do we interpret situations of a random nature. This is because human beings have two systems for processing thoughts, one is intuitive and automatic, which is very useful for solving everyday problems, and the other is reflective and rational.

### **3. Behavioral finance**

Finance is very important in the economy of countries, companies and households. Economic resources are scarce, and individuals must scale the needs they have in order to use resources in the most efficient way. Therefore, it is essential to have a financial education that allows them to avoid making high-risk decisions. Throughout history there have been no educational programs that included financial education or

provided financial concepts and this is one of the main reasons why society thinks that finance is complex. According to the OECD (2005) financial education is the process by which consumers and investors improve their understanding of financial products, concepts and risks and develop skills to become more aware of financial risks and opportunities, take informed action and adopt actions to improve their financial well-being. According to OECD (2016) low levels of financial literacy are reflected in:

- a) Excessive indebtedness.
- b) Lack of savings for retirement.
- c) Lack of provision for education and health.
- d) Use of informal savings mechanisms, usually insecure and with low yields.

Authors such as Gnan, Sllgoner and Weber (2007) suggest that financial education contributes to the overall welfare of the economy. The results of the evaluations carried out in programs aimed at assessing the economic and financial education of adults have a positive impact on their financial knowledge and behavior. In contrast, the results in the case of young people are not so clear, as there is no consensus on whether financial education improves their financial behaviors.

Therefore, on this basis, we will analyze the behavior of individuals when making decisions. Authors such as Cooper and Kaplan (1988) point out that the difference between the fact that some individuals successfully modify their behavior while others fail is due to the cost to individuals and society of inefficient financial decisions.

Behavioral economics takes into account the cognitive capacities and emotions of individuals to understand the decisions they make. It thus differs from more traditional economic models that hold that behavior is determined exclusively by individual cost-benefit calculations. Behavioral economics argues that decisions made by human beings can be incongruent in the long run. Two theories stand out:

- a) Cognitive theory argues that individual behaviors can be affected and modified by variations in the way people think. So the information perceived by individuals is important because it generates reflective cognitive processes.(Thaler & Sunstein, 2008; Vlaev & Darzi, 2012; Dolan et.al., 2012).
- b) Context theory argues that behaviors can be modified as a result of changes in the environment in which decisions are being made. As Van Dijk (2001) points out, "context theory explains how participants are able to adapt (the production and reception/interpretation) of discourse to the communicative-interpersonal-social situation."



Individuals who find themselves in a situation of financial opportunity in a context of weakness tend to make financially inefficient decisions. This is due to the difficulty in accessing products and the little financial education they have received. It may also be related to the complexity of modifying traditional behaviors in society.

Behavioral economics has identified causal mechanisms by which individuals make decisions. It is important to consider peer pressure, which refers to the influence exerted by the behavior of other individuals on the decisions a person makes. This influence can be both positive and negative and can affect both a person's behavior and attitudes. In the context of economic decision making, peer pressure can be particularly important in situations where there is uncertainty about what is the right choice or when the choice has social implications. For example, social pressure may influence the choice of a grade, the purchase of a product, or the decision to invest in a particular financial market. Often, people may be willing to accept an option that is not the best for them personally, simply because they believe it is what is expected of them or what the group prefers. So we can say that people care about each other's decisions as long as they transmit information about the quality of a product. Moreover, the way of transmitting and perceiving this information has been changing over time and nowadays it is not necessary to interact personally. In this way, social learning can be achieved thanks to blogs, reviews, online forums... It is crucial to understand the different forms of social communication and their effect in order to develop efficient and effective financial inclusion strategies.

The literature highlights that the way people perceive whether or not they are in control influences financial decisions. Kahneman and Tversky put forward prospect theory as a possible explanation of framing effects. First we must explain the concept of framing, which is based on the idea that the way information is presented, either positively or negatively, can influence how people perceive and process information, and can affect decision making. Framing can also influence how people perceive the risks and rewards of a given financial action. Second, the theory developed by Kahneman and Tversky in 1970 proposes that people make decisions based on how they perceive the available options and how they value the outcomes associated with those options, i.e., people not only consider the final outcome of a decision, but also how they got there and how they felt in the process. This theory is based on two fundamental concepts: expected value and loss aversion. Expected value refers to the probability of obtaining a given outcome multiplied by the value of that outcome. Loss aversion refers to the

fact that people value losses more than gains in the same magnitude. These two authors argued that people make decisions irrationally due to certain cognitive biases, and these biases can lead people to make decisions that are not optimal from a rational point of view. According to prospect theory, the decision-making process consists of three main phases: the evaluation of available options, the evaluation of possible outcomes, and the choice of an option. In the first phase, the person considers the different options available to make a decision and compares them in terms of their relevant characteristics and attributes. For this purpose, the options are coded and a benchmark is established, those results above this point will be considered gains, and results below this point will be perceived as losses. It is estimated that the effect of the framing will depend on personal characteristics such as level of financial education, gender and age.

Although behavioral theories attempt to explain the reasons why people act the way they do, each model presents a different route into the realm of financial behavior. Despite this, most projects have focused on the demographic and socioeconomic characteristics of individuals. The variables that affect an individual's decision making are age, gender, number of years of education received, level of income and level of debt. By way of illustration, we could mention that different studies have obtained the same result on how higher education, higher salary income and lower debt obligations have a positive effect on more efficient financial decisions (Hawley and Fujii, 1993). Regarding gender, there is controversy since some studies point out that the female gender tends to have a greater tendency to acquire financial products and services, and other studies argue that this should not be generalized because there are other characteristics that should be taken into account over and above the simple fact of being a woman or not. In addition, there are environmental factors that affect investment decisions, one of which is the peer influence highlighted above.

#### *The BB&K Five-Way Model.*

Another major factor affecting human behavior is the perception of risk. There is a key model that allows us to provide a more complete framework of how financial markets work and how investors make investment decisions. The model is the well-known BB&K, an investor profiling model developed by Dennis Bailard, Douglas Biehl and Kevin Kaiser in 1986. The five investor personalities recognized by this model are as follows:

1. Adventurer: these investors are willing to take on as much risk as possible to obtain the highest possible return. They may hold a portfolio mainly of stocks

and other high-risk investment instruments. They have their own ideas about investing.

2. **Celebrity:** that group is made up of people who do not have their own investment ideas but do not want to be excluded. They want to invest even though they have no idea. They are inexperienced, they prefer the security and stability in their investment wallet and they are the ones who get too carried away by fashion.
3. **Individualist:** is made up of a group of people who have their own ideas about investment, are self-confident and do not want to take risks.
4. **Guardian:** that profile is associated with careful people who worry about their money and are not interested in excitement. They prefer the security and stability in their investment wallet.
5. **Straight arrow:** which is considered in this profile as a very well-balanced person, who is exposed to medium amount of risk. They are between confidence and anxiety, and also between caution and extremely impetuosity.

This model is important because it recognizes that investors have different levels of risk aversion and preferences that can be influenced by psychological and emotional factors.

#### **4. Influence of investors' personal characteristics on their economic decisions.**

This is the question around which all academic work revolves. There are two schools of thought on which all existing work is based. On the one hand, a group of academics has used different demographic characteristics as variables affecting investment management decisions, including gender, age, ethnicity, wealth and income. In addition, these researchers demonstrate the existence of a positive relationship between risk tolerance and demographic characteristics such as economic education and income level. In addition, there are authors who show that women tend to be more risk-averse than men. Similarly, it has been noted that people prefer to take less financial risk as they get older; this may be justified because older investors have less time to recover from potential losses. Even so, studies on risk aversion and age are inconclusive. On the other hand, the other group of academics is based on psychology, so that the different psychological characteristics of each individual will be used to explain the different decisions they make.

The pilot experiment to be carried out in this work is classified in the second group of economists since it will try to demonstrate whether the psychological characteristics of individuals influence the economic decisions they make, making them more biased or not. In other words, we will try to find out if there are psychological characteristics that directly influence individuals, causing them not to make rational decisions.

## **5. Cognitive biases**

A bias is that error of perception that leads individuals to make economic decisions in an erroneous way, due to the fact that different scenarios have not been studied, analyzed and foreseen, so that shortcuts influenced by emotions or experience have been taken. Biases are the fundamental variable in behavioral economics. Biases cause individuals to make non-rational decisions, and they exist because they help our brains process information faster. This concept can be defined as non-conscious drivers that influence the way we perceive things and make decisions in both business and life. The biases that different individuals incur when making investment-related decisions are described below. Investors may fall into one bias or more than one. The concept of cognitive bias was introduced by Israeli psychologists Kahneman and Tversky in 1972. There is a high probability that people are influenced by biases because the brain executes millions of mental processes every second. Kahneman and Tversky developed their own view of bounded rationality. The examples they used to explain the existence of biases are given below.

### **5.1. The law of small numbers bias**

This bias was discovered by psychologists Daniel Kahneman and Amos Tversky when they realized that most researchers made mistakes when choosing the size of the research sample, since these were not large enough to avoid extreme results. This cognitive bias consists of the tendency to believe that a sampling distribution is distributed in the same way as a population distribution, regardless of the sample, i.e., that a relatively small number of observations will correctly reflect the behavior of the general population.

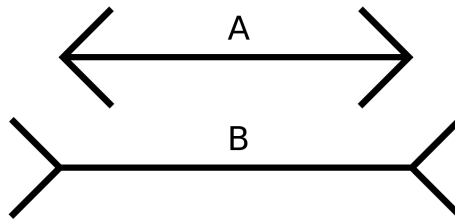
An example is the 'heads or tails' game, which has been researched and developed in game theory work. After the same option (tails) has come up several times, people tend to think that in the next roll it will come up tails, but actually the probability of repeating the same option is the same, because the coin is the same and on both sides it still has

the two options, heads or tails. Therefore, regardless of the number of times an option has come up, the probability of getting the same option again is exactly the same. The fact that it has come up repeatedly does not mean that it cannot continue to come up. Therefore, a small sample cannot reflect what will be the behavior of the set of observations.

## 5.2. The uncertainty judgments

Kahneman and Tversky conducted cognitive psychology experiments known as uncertainty judgments. Uncertainty judgments focused on how people make decisions when faced with indecisive situations. In addition, these experiments involve presenting participants with a set of information about a future event and then asking participants to make a prediction about the outcome of the event. The event may be, for example, a horse race, the outcome of a soccer match or an election. These two authors found that people tended to overestimate the certainty of their predictions, even when given contradictory information. Furthermore, these well-known psychologists found that people often base their predictions on irrelevant information or information that they should not rely on, such as their own intuition or personal biases.

The Müller-Lyer illusion is an optical illusion that is based on two lines of equal size that have arrows pointing in different directions at their ends, and appear to have different dimensions. One of the lines has the arrows pointing outward and the other pointing inward. The arrow with the lines pointing outward appears longer than the other line with the arrows pointing inward. This illusion shows how visual perception can be misled by contextual information, which can lead to erroneous judgments in situations of uncertainty. Kahneman and Tversky argued that our judgments and decisions can be influenced by a variety of factors, including the Müller-Lyer illusion that despite knowing that the two lines are the same size the visual context of the arrows influences the perception of the dimensions of the line. These types of illusions can be considered as a manifestation of the representativeness heuristic. In conclusion, the Müller-Lyer illusion is an example of how contextual information can influence human perception, and in turn how human perception can be subject to cognitive biases and errors when making decisions in uncertain contexts.

**Figure 1.** *The Müller-Lyer illusion*

Uncertainty judgments provide valuable insight into how the human mind processes and uses information under uncertainty and how we can work to minimize the effects of cognitive biases.

### 5.3. The prospect theory

The theory developed by Kahneman and Tversky, which consists of how people make decisions in situations of uncertainty, has risky choice as a key concept. Risky choice refers to the decision between two or more options involving different levels of risk. This point of view of risky choice was initiated by Bernoulli and to exemplify it we will consider that a person could choose between winning 4000€ with total security or playing a bet in which there is a 50% probability of winning 10000€ and a 50% probability of not winning anything. The expected value is obtained by performing the following calculation  $(0.50 \times 10000) + (0.50 \times 0) = 5000€$ .

With this experiment Kahneman and Tversky discovered that people do not always make rational decisions when faced with risky choices. Instead of choosing the option that offers the highest expected value, which is the sum of the value of each possible outcome multiplied by its probability, people may make decisions based on biases or heuristics that can lead to suboptimal outcomes. People prefer a safe gain rather than seek risk and lose everything. Bernoulli explained this through subjective value or utility which is represented by a concave function. This means that the difference in utility between 200 and 100 is greater than that between 1200 and 1100. This means that the subjective value added to the 800€ of the example is more than 80% of the profit on 1000€. In conclusion, the risk is rejected because by taking the risk one would only earn 85% in the case with an 80% probability of winning the 1000€. It is not a profitable option, the expected value would be only €50 more.

Prospect theory is a hypothesis developed by Kahneman and Tversky in 1979. This theory describes how people make decisions on occasions where they must decide between alternatives that involve risk. It is suggested that an aversion to loss will cause an individual to tend to choose between the option that causes the least perceived loss.

An example is shown below:

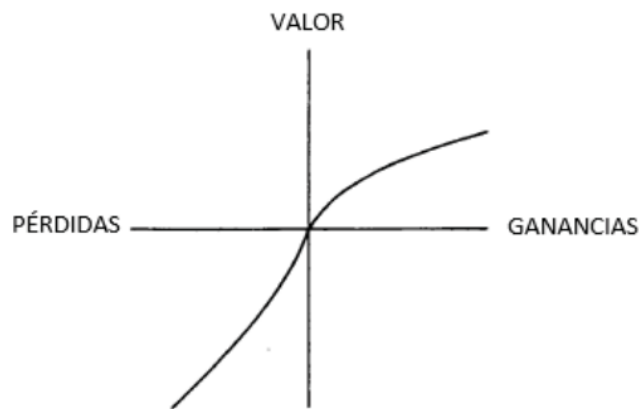
Which option would you choose?

- 1) A. Obtain 4000€.  
B. Have a 50% chance of winning 10000€ and a 50% chance of winning nothing.
- 2) A. Lose 4000€.  
B. Have a 50% chance of losing 10000€ and a 50% chance of losing nothing.

The analyses carried out by the two psychologists showed that people's responses are different when it comes to profit or loss. In the first example, the majority of the population would choose the less risky option, since it is about making money. In the second example, individuals are more likely to choose the riskier option, because they prefer to opt for the possibility of not losing anything. That is, individuals value a certain gain more than an uncertain potential gain, but they value a certain loss less than an uncertain potential loss. We call risk aversion the fact that there is a steeper slope in the curve for losses than for gains. These two authors define that the value function presented has a number of characteristics:

- It is described on the losses and gains to which the individual is eligible, and not on the final wealth.
- Profits and losses are calculated on the basis of a reference point called the status quo, for which the following conditions must be met  $v(0) = 0$ .
- The function is strictly concave for gains ( $v''(x) < 0$ , to  $x > 0$ ), the function is strictly concave for gains
- The function is strictly convex for losses ( $v''(x) > 0$ , to  $x < 0$ ), so that this part tends to be more risk-prone.
- Thus, the slope of the function is steeper for the loss bracket than for the gain bracket. This is explained by loss aversion, since an individual is more impacted by a risk that entails losses than by an equivalent risk that generates gains.

**Figure 2.** *Hypothetical valuation function*



*Source: Kahneman y Tversky (1979)*

In conclusion, prospect theory states that individuals make decisions based on the way they perceive the available alternatives rather than on the final outcomes alone. In addition, people are more likely to avoid risk for gains and take risk for losses.

#### 5.4. Common use of the accessibility heuristic.

The accessibility heuristic is a problem-solving and decision-making strategy used to assess the probability that an option is true. This accessibility is influenced by factors such as frequency of exposure, emotional intensity, ease of visualization and availability in memory. This heuristic can lead to errors in judgment and cognitive biases. One of the examples most commonly used by Kahneman and Tversky to demonstrate this heuristic is the one presented below:

"A personality test is conducted on 30 engineers and 70 lawyers, all successful people in their various professions. You should note that one description has been chosen out of the 100 available and state what is the probability that the following description corresponds to an engineer:

Peter is a 40-year-old man. He is married and has 2 children. He possesses great ability and motivation that promises to be successful in his work. His friends hold him in high regard." Most of the examinees answered that the probability was 50%, but the probability could not be greater than 30%.

#### 5.5. The problems of dominance and invariance.

The two principles that have become known thanks to the work of Von Neuman and Morgenstein are dominance and invariance.



The dominance principle requires that if option A is as good as B in all but one respect in which A is better than B, option A should be chosen over B. The invariance principle assumes that two options of the same choice problem are equivalent when presented together should demonstrate the same preference when presented separately. In the experiments conducted by Kahneman and Tversky, the logical principle of invariance was not respected.

#### 5.6. The overconfidence bias

This bias consists of overestimating the success of one's own decisions. More specifically, it can be demonstrated by means of an equation that relates the overconfidence of subjective estimates (E) compared to the actual results obtained or observed (O).

$$C = \sum_{i=1}^n (E_i - O_i)$$

The subjective confidence of success in one's own decisions (C) is obtained through the difference between what has been estimated (E) and what has been observed (O). In the case where the estimate is higher than the observed, the overconfidence bias will be generated. In the opposite case, where the observed is higher than the estimated, the opposite will be generated, i.e., the underconfidence bias. An experiment was carried out by Macbeth & Cortada in 2005 comparing the values obtained by 78 subjects, but no statistically significant differences were found. On the other hand, when they separated the group into two subgroups, differentiating between those with good results and those with worse results, they obtained results that showed that the subjects with low performance overestimated their results, while those with higher performance underestimated their results. In spite of this, this bias is still under investigation in order to better demonstrate it.

#### 5.7. The conjunction fallacy

The conjunction fallacy appears when a set of circumstances that are supposedly related to each other and that are more likely to occur than if only one occurs are erroneously accepted. To demonstrate this, the following problem is used, where a description of a person is posed and then one must choose which option is more probable. "Linda is 31 years old, single and intelligent. She is concerned about discrimination and social justice issues. Indicate which alternative you think is more likely:

- 1) Linda is currently a bank employee.
- 2) Linda is a bank employee and a feminist.”

The results obtained were that more than 85% of the people who were asked this problem answered option 2. With this decision people fell into the conjunction fallacy because they did not take into account that possessing two attributes together is less probable than possessing only one of them. In many cases human beings are unable to calculate probabilities formally and must resort to their intuitive judgment, but it must be taken into account that this judgment can lead to errors that should be known.

## **6. Pilot experiment**

An experiment is designed aiming at relating different personality characteristics of individuals with some biases in which they may fall into when making economic decisions. Here we develop just a pilot version of it. The experiment consists of subjects answering to two questionnaires, the first of them is a NEO-FFI test, with which the degree of neuroticism, openness to experience, extroversion, friendliness and conscientiousness of the individuals will be found out; the second, is based on 9 questions through which the economic decisions made by the respondents is detected as well as whether they are non-rational decisions and, as a result, fall into any of the biases investigated.

With the data obtained, seven different models will be created, one for each bias being investigated. The seven models will be defined in the following order: small numbers law bias, uncertainty judgments, prospect theory, common use of the accessibility heuristic, the problems of dominance and invariance, overconfidence bias, and the conjunction fallacy.

### **6.1. Questionnaires**

The order chosen to answer the questionnaires is first the personality test in order to evaluate the personality of the individual and to concentrate on answering questions about him/herself, so that later, when carrying out the questions of the biases, more real and reasoned answers can be obtained.

The NEO-FFI test is described below<sup>1</sup>. The BB&K five-way model is a personality theory that classifies people into five dimensions. These five dimensions can be used

---

<sup>1</sup> The NEO-FFI test questions are shown in the appendix.

to classify people using various personality tests that are based on this model. Some of these tests are the Big Five Inventory (BFI), the HEXACO Personality Inventory, the 16PF (16 Factor Personality Questionnaire) and finally the NEO Personality Inventory Revised and Reduced (NEO-FFI) test, which is the one that will be used in this experiment.

In this experiment through the NEO Personality Inventory Revised (NEO-FFI) version of the test we assess the personality of individuals and how it can influence their investment decisions. In addition, we will investigate whether these dimensions are the cause of falling into different biases. This test consists of 60 questions assessing five personality factors. Each question is answered on a five-point scale, ranging from "strongly disagree" to "strongly agree". The five dimensions of the test are as follows:

1.- *Openness to experience, (open)*, is a quality that can be measured in terms of how receptive and creative a person is to new experiences. Those who score high in this category tend to be imaginative, curious, and value originality and variety. A person scoring high in this area, for example, might be more interested in making investments in emerging markets or new technologies.

2.- *Conscientiousness, (conci)*, this extension is based on a person's tendency to be orderly, reliable and responsible. The type of individuals found in this section tend to be more cautious, prefer safe and stable investments, value planning and goal achievement.

3.- *Extroversion, (extro)*, this dimension considers an individual's propensity to seek out and enjoy social stimulation and interactions. It reveals the degree to which a person is assertive, sociable, more willing to take risks and actively seeks investment opportunities, for example, through social networks or networking events.

4.- *Amability, (amabi)*, refers to a person's capacity for empathy, cooperation, and caring. Those who score high on this dimension often value interpersonal relationships, collaboration, and are understanding, kind, and considerate. This dimension can affect how a person values relationships in the workplace and is important in determining how he or she manages relationships with colleagues and other industry participants.

5.- *Neuroticism, (neuro)*, determines a person's propensity to feel unpleasant emotions such as anxiety, sadness, and anger. Those who score high in this area often have unstable emotions and are easily stressed or worried. It is significant because it illustrates how this can affect how a person handles risk and uncertainty when making investment decisions.

Each dimension is measured by 6 subscales, allowing a more detailed assessment of each dimension. The scores obtained are compared with those of the normative sample and presented on a T-score scale, where score 50 represents the population mean. These dimensions do not completely determine an investor's behavior, but they offer an idea of how an individual's personality may influence his or her investment decisions and how he or she may interact with other agents in the financial market. The five dimensions described by this test are shown in the following table in each of the rows, following the order of the acronym (NEOAC). In addition, in each of the columns the different possibilities that an individual has with respect to each dimension and the score obtained are shown. Therefore, once the scores for each of the questions in the questionnaire have been obtained, the profile can be drawn up. For the questionnaire, profiles will not be defined, but simply the degree that each individual presents in the different dimensions will be taken into account.

**Table 1**

<i>Possible Descriptions for Each Dimension</i>		
Confident, resilient and generally relaxed, even in stressful situations.	Generally calm and able to cope with stressful situations. But, sometimes I experience feelings of guilt, anger or sadness.	Sensitive, emotional and prone to experience unpleasant sensations.
Introverted, reserved and serious. Prefers to be alone or in the company of very close friends.	Moderate in activity and enthusiasm. Appreciates the company of others, but also enjoys solitude	Extraverted, open, active and energetic. I Like to be surrounded by people.
Down to earth, practical, traditional and committed to existing methods.	Practical yet eager to try new ways of doing things. Seeks a balance between the new and the old.	Open to new experiences. Has a wide range of interests and is very imaginative.
Realistic, skeptical, proud and competitive. Tends to express anger with little regard.	Generally pleasant, warm and calm. But sometimes I can be stubborn and competitive.	Compassionate, sensitive and willing to cooperate and avoid conflict.
He is not well organized and sometimes shows little care in his work. Prefers not to make plans.	Formal and moderately well organized. Generally has clear objectives, but is also capable of putting aside his work.	Responsible and organized. He has solid principles and does not stop until he achieves his goals.

Next, a survey is carried out in which economic decisions must be made and which will allow to find out which individuals make non-rational decisions and as a consequence fall into the different biases mentioned. This part consists of 9 questions. Each of them is designed to find out whether an individual tends to commit a bias or whether he or she is rational enough not to do so. Seven situations are presented in which the individual has to answer what decision they would make if they were in that situation. These questions are validated as they have been extracted from different papers by researchers, mainly Kahneman and Tversky but also others such as Müller-Lyer. The following are the questions that will help to measure the biases.

*Question 1:* Let's say that in five consecutive lottery draws the number 7 ball has been drawn. Options: 25%, 70%, 10% and 50%. What is the probability that the number 7 ball will be drawn in the next drawing?

Although the probability that the number 7 ball will fall in any draw is always 10%, this question exemplifies the bias of the law of small numbers because people tend to believe that the number 7 ball has a higher probability. Having already been drawn several times in a row, it will come up in the next draw. This is the result of people's propensity to find patterns and correlations in the data, even when those patterns and correlations are completely arbitrary.

*Question 2:* Consider a disease for which a new medical therapy has a success rate of 80 percent. Which of the following is the probability of cure if the treatment is applied? 80, 70, 70, 50, or 20 percent.

Despite having an 80 percent success rate, the probability that a particular patient will be cured is not necessarily 80 percent, demonstrating the bias of uncertainty judgments. This is due to the fact that a number of variables, such as a patient's age and general health, can affect how effectively they will receive a treatment. However, many people give in to the bias of uncertainty judgments and think that the probability of a cure is always 80%, which can lead them to make the wrong decisions.

*Question 3:* Imagine you have to choose between two outcomes in a game: the first is a guaranteed \$100 win, the second is a 50% chance of winning \$200, and the final outcome is a 50% chance of winning nothing.

Risky choice bias is demonstrated in this situation because the first safer option has a guaranteed return while the second riskier option has an uncertain return. The safe option has a higher expected value, but many people still prefer to take risks.

*Question 4:* If you have \$1,000 and must choose between losing \$500 or having a 50% chance of losing nothing and a 50% chance of losing \$1,000, you must choose option 2.

According to the prospect theory bias, people base their decisions less on actual outcomes and more on how those outcomes are perceived and their chances of success or failure. Even though both options have a potential loss of €500, many people choose option two because they believe they will ultimately benefit from it. Whatever the case, both options have the same expectation of value when viewed rationally.

*Question 5:* In this case the following situation is proposed to individuals:

"A personality test is given to 30 engineers and 70 lawyers, all successful people in their various professions. One description is chosen at random from the 100 available.

Peter is a 40-year-old man, married with two children. He possesses great problem-solving skills and motivation that make him successful in his work. He is held in high esteem by his friends. Could you say what is the probability that the above description corresponds to an engineer?". The choices are 50%, 70% and 30%.

*Question 6:* The following situation is presented in which a country is predicting an epidemic that will kill 600 people, but the government is planning different health programs to combat the disease. The options from which the individuals surveyed can choose are as follows:

- A) 200 people may be saved.
- B) There is a  $\frac{1}{3}$  chance that 600 people will be saved and  $\frac{2}{3}$  chance that no one will be saved.

In this case we are talking about profits, so most people will not risk the death of the entire population, since they prefer to insure their lives, i.e. they reject the risk.

*Question 7:* This question is a continuation of the previous one. In this case, two new programs are presented to prevent the epidemic. The choices you now have are:

- A) Choose the first program but 400 people will die.
- B) Adopt the second program in which no one will die with  $\frac{1}{3}$  probability and with  $\frac{2}{3}$  probability 600 people will die.

In this case it is expected that most of the surveyed population will choose the second option. This is because when talking about losses individuals prefer to look for risk.

*Question 8:* In which of the following do you think you can do better than the average person?

- a) Exceptionally superior.
- b) Slightly better than average.
- c) Close to average.

This question will allow us to show whether respondents have the overconfidence bias, which is the tendency of most people to overestimate their own abilities compared to those of others. The appropriate response would be "about average for important skills," as it is more likely to provide a more accurate assessment.

*Question 9:* Which of the following is most likely given that Linda has consistently received high ratings and is concerned about the political climate in her country?

- a) Linda works as a nurse.
- b) Linda is a feminist nurse.

The conjunction fallacy refers to the tendency to think that the probability of two events occurring simultaneously is greater than the probability of only one of them occurring. Because it appears to be more accurate and complete, most people tend to choose option B.

## 6.2. Econometric analysis

Through this experiment we are trying to find out if there is any kind of relationship between the personality of people and the fact of falling into biases. Thus, for each of the biases raised in the questions of the second questionnaire, a model will be created in which the personality dimensions studied through the NEO-FFI test and gender are included as independent variables.

The regression models that have been carried out with each of the biases are logit models. This type of regression model is used to analyze the relationship between a binary variable, i.e. the variable takes two possible values, and a set of independent variables. The logit model is based on a logistic function, which is a mathematical function that transforms a continuous variable into a value between 0 and 1. In the case studied through the logit regression model, the aim is to find out the coefficients that represent the effect that each of the independent variables has on the probability that the dependent variable takes the value 1, i.e. that the bias does occur.

In summary, for each of the biases a binary dependent variable has been created, and as independent variables we have gender, and those related to personality, which are neuroticism, extroversion, openness to experience, agreeableness and conscientiousness. The dependent variables are:

$$\begin{aligned}
 y_1 &= \textit{smallnumber} \\
 y_2 &= \textit{uncertjudg} \\
 y_3 &= \textit{prospecttheory} \\
 y_4 &= \textit{accessheuristic} \\
 y_5 &= \textit{dominainaria} \\
 y_6 &= \textit{overconfidence} \\
 y_7 &= \textit{conjunctionfallacy}
 \end{aligned}$$

Through these estimations we hope to find out if the probability of falling into the bias is related to the different personality dimensions. To test this prediction, the seven models on which the bias study is based have been carried out.

$$\begin{aligned}
 P(y_k = 1|X) &= \Lambda(\alpha_0 + \alpha_1 \textit{gender}_i + \alpha_2 \textit{neuro}_i + \alpha_3 \textit{extra}_i + \alpha_4 \textit{open}_i + \alpha_5 \textit{amabi}_i + \alpha_6 \textit{conci}_i) \\
 i &= 1, 2, \dots, N \quad k = 1, 2, \dots, N
 \end{aligned}$$

This equation will be the base equation to be estimated for each different model by substituting the dependent variable in each case by the corresponding one depending on the bias being studied. As the explained variable is a binary variable, discrete choice models must be used since the variable is not continuous. This model helps us to understand why they fall into the bias or not. In this case the endogenous variable is binary and can only take two values, 1 or 0.



The main features of the equation: Lambda ( $\Lambda$ ) is used to represent the logistic cumulative distribution function, which is a mathematical function that describes the cumulative probability that a random variable follows a logistic distribution. Furthermore, one of the basic properties of this function represented by lambda is that when the independent variable tends to infinity, the function tends to one, meaning that the cumulative probability approaches 1 as x increases in value. For the case in which the function tends to 0, the opposite would occur.

The data on which this research is based have been obtained through the dissemination of the questionnaire among different social groups. Eighty-one observations were obtained, 24 of them belonging to men and 57 to women. Through the experiment we have been able to obtain the percentage of respondents who have fallen into each of the biases. These percentages vary greatly and are shown in table 2.

**Table 2.** *Percentage of People Affected by Biases.*

<b>BIASES</b>	<b>TOTAL</b>	<b>WOMAN</b>	<b>MAN</b>
BIAS OF THE LAW OF SMALL NUMBERS	58%	61.14%	50%
UNCERTAINTY JUDGMENTS	23.5%	24.56%	20.83%
PROSPECTIVE THEORY	54.32%	54.38%	54.16%
COMMON USE OF ACCESSIBILITY HEURISTICS	53.1%	56.14%	45.83%
PROBLEM OF DOMINANCE AND INVARIANCE	58%	54.38%	50%
OVERCONFIDENCE BIAS	58%	49.12%	79.16%
THE CONJUNCTION FALLACY	69.1%	73.68%	58.33%

The values obtained in the columns that differentiate gender can be interpreted as follows: in the case of the first bias, the percentage of men who commit the bias with respect to the total number of male respondents is 50%. In the case of women, 61.40% of the total number of women commit this bias. And the total refers to the percentage with respect to the population as a whole. Table 2 shows the total values obtained in each of the questions carried out after the personality test. From the results obtained we could determine that most of the individuals tend to consider non-rational answers that connect them with a certain bias.

It should be noted that the bias related to uncertainty judgments has not been proven, since when carrying out the optical illusion proposed by Müller-Lyer, most of the respondents were able to differentiate that they are arrows of equal size and therefore did not fall into this bias. This fact may be due to the fact that the group surveyed can make decisions based on information so that they are not influenced by this type of optical illusion. Another consequence may be the existence of significant differences about how this group of people process visual information compared to other individuals who do fall into the bias, so this fact could be interesting for research in areas such as neuroscience and cognitive psychology.

In the first place, as for the biases that are tested, we obtain the bias of the law of small numbers, in this case the predictions of Kahneman and Tversky are justified by the experiment, since 58% of the population considers that the fact that the number 7 is repeated 5 times increases the probability that this number will continue to appear. Therefore, it is shown that individuals believe that a small number of observations (5 observations) will correctly reflect the behavior of the game, i.e., that the 7 ball will continue to come up repeatedly with a higher probability than the rest, despite the fact that the probability has not changed on any occasion.

The prospective theory is solidly proven, since the number of individuals who make a safe or risky decision in the first instance and change their decision in the second is 54.32%. In this case, the theory of Kahneman and Tversky is proven, in which they state that people do not make decisions rationally when they find themselves in risky situations. As explained above, individuals do not value losses and gains in the same way, which is why in the experiment the majority decided to change their answers to the second question, since it was posed from a negative point of view, i.e., from the point of view of losses. On the premise that they did not value the expected value of the alternatives, and sometimes they choose options with a lower expected value. Therefore, it has been shown that individuals make decisions based on how they perceive the questions and the different alternatives and not only on the final result.

In the third of the biases, most of the population tends to select an incorrect answer as to the probability that the description relates to an engineer, even though the probability is the same in all cases.

In the case of invariance problems in this experiment it is found that people tend to choose different options even though both alternatives mean the same thing but are

stated differently. Therefore, as predicted by Kahneman and Tversky, individuals do not respect the logical principle of invariance.

The overconfidence bias is justified by 58% of the individuals surveyed, since they have overestimated their skills and abilities above the rest of the population. This may be due to previous experience that makes them think they are experts in a particular subject, also due to personality or social pressure as there are people who tend to overconfidence such as people with high self-esteem or very extroverted.

In the last case, which corresponds to the conjunction fallacy bias, we can observe that 69.1% of the respondents have fallen into this bias and therefore have considered that it is more likely that Maria is a doctor and a feminist, while the correct answer is that it is less likely that two attributes have to be fulfilled than only one. The reasons that may cause the sample to fall into the conjunction fallacy are the following, firstly the representativeness heuristic, since respondents instead of relying on the probability of an event occurring base their decisions on how similar two events are and how representative they are of the category they believe they are representing. In conclusion, most of the biases raised in the pilot experiment have been verified. In addition, there are several possibilities that explain the consequences of why individuals have committed the bias.

As mentioned above, there are seven models that are the result of an analysis of data obtained from the experiment. All of them are econometric logit models, each of which will have gender and the five personality dimensions of the NEO-FFI test as independent variables. The descriptive statistics are shown below.

**Table 3.***Univariate Statistics*

Variable	Number of observations	Media	Min.	Max.	Desv. estándar
$x_1 = neuro$	81	48.6673	32.0512	67.5	7.0693
$x_2 = extro$	81	49.8050	32.8767	61.5714	6.5147
$x_3 = apert$	81	46.4529	36.6666	66.6197	5.3709
$x_4 = amabi$	81	39.6195	25	57.3214	6.2028
$x_5 = concie$	81	41.9098	30.2739	52.1917	5.7965

The table 4 represents the Spearman correlation matrix between the variables of the econometric model under investigation. The Spearman correlation test evaluates the monotonic relationship between variables, which means that it can capture both linear and nonlinear relationships.

**Table 4***Correlation Matrix*

	Gender	Neuro	Extro	Apert	Amabi	Concie
Gender	1					
Neuro	0.3381**	1				
Extro	0.1505	0.0800	1			
Apert	-0.0475	-0.3506**	0.1936***	1		
Amabi	0.1785	-0.1151	0.0436	0.1458	1	
Concie	0.0359	-0.2603	-0.0283	-0.0780	-0.1554	1

**Note: The symbols \*, \*\*, \*\*\* indicate 10%, 5% and 1% significance levels, respectively.**

Therefore, this matrix reflects the correlation of all variables, i.e., it expresses to what extent two variables are related. There is a positive correlation between gender and the neurotic dimension, i.e., men are more neurotic than women. We also found a

correlation between gender and the overconfidence bias, men are more overconfident than women; this aspect has been verified in other official experiments on a worldwide scale. On the other hand, we observed a negative correlation between two dependent variables: openness to the outside and neuroticism, which is explained in such a way that people who are more open to the outside tend to be less neurotic. In addition, there is also another notable correlation between conscientiousness and neuroticism; people who have a higher degree of conscientiousness tend to be less neurotic. Similarly, we have been able to verify that there is a correlation between the independent variable of conjunction fallacy and the dependent variable conscientiousness and that this relationship is negative, i.e. people who have fallen into the fallacy bias are less conscientious.

In relation to the explanatory variables, different correlations are observed, the first of which is between the accessibility heuristic bias and uncertainty judgments, in this case people who have committed the accessibility heuristic bias are also falling into the uncertainty judgment bias. Similarly, those who have fallen into the overconfidence bias are also falling into the heuristics bias, and those who have committed the conjunction fallacy have also fallen into the dominance and invariance bias.

The Mann-Whitney test is a nonparametric statistical test used to compare the distribution of two independent samples. This test is used to assess whether there are significant differences between the medians of two independent groups. And this test establishes whether there is sufficient evidence to claim that the two samples come from different populations or whether the differences are simply the result of chance. The null hypothesis of the Mann-Whitney test states that there are no systematic differences between the two underlying populations. The alternative hypothesis is that there are significant differences between them.

Carrying out this test for the variable gender and neuro, we have obtained a p\_value of 0.0025, so the null hypothesis is rejected and we conclude that there are significant differences between the two samples.

The same test was used with the gender variables and the rest of the independent variables, but in none of these cases was it possible to reject the null hypothesis. In conclusion, the Mann-Whitney test has shown that there are significant differences between gender and neuro in this experiment. Men are more neurotic than women.

## 6.3. Results obtained from model estimations

The estimations of each of the models proposed were carried out using the STATA program. The results obtained are shown in the following table. The models correspond respectively to each of the dependent variables defined above.

**Table 5***Econometric Models*

	<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>	<b>Model 4</b>	<b>Model 5</b>	<b>Model 6</b>	<b>Model 7</b>
<b>Gender</b>	-0.4452 (0.5761)	-0.3441 (0.6958)	-0.2808 (0.5782)	-0.2176 (0.5822)	-0.2904 (0.5727)	1.9792 (0.6980)**	-0.6611 (0.6294)
<b>Neuroticism</b>	-0.0129 (0.0413)	0.0026 (0.0490)	0.0490 (0.0422)	-0.0160 (0.0418)	0.0439 (0.0417)	-0.0809 (0.0455)*	0.0297 (0.0469)
<b>Extroversion</b>	0.0068 (0.0368)	0.0621 (0.0478)	0.0183 (0.0364)	0.0471 (0.0375)	-0.0151 (0.0361)	0.0566 (0.0390)	-0.0026 (0.0404)
<b>Openness to experience</b>	-0.0279 (0.0477)	0.0274 (0.0579)	0.0116 (0.0478)	0.0419 (0.0501)	0.0117 (0.0476)	-0.0516 (0.0503)	0.0308 (0.0551)
<b>Amability</b>	0.0187 (0.0408)	0.0076 (0.0477)	0.0048 (0.0405)	-0.0707 (0.0434)	-0.0335 (0.0410)	-0.0484 (0.0433)	-0.0916 (0.0484)*
<b>Conscientiousness</b>	-0.0655 (0.0450)	-0.0347 (0.0529)	-0.0540 (0.0444)	-0.0124 (0.0445)	-0.0311 (0.0439)	-0.0437 (0.0472)	-0.1121 (0.0517)**
<b>Constant</b>	4.0586 (5.1571)	-4.4905 (6.1448)	-1.4997 (5.1264)	0.0049 (5.2099)	-0.9124 (5.1123)	7.0788 (5.5446)	6.7223 (5.8770)
<b>Note: The symbols *, **, *** indicate 10%, 5% and 1% significance levels, respectively.</b>							

In these seven models we have observed that there are different variables that are significant. In order to be able to interpret the coefficients more easily, they can be converted to their exponential form, thanks to the odds ratio. This ratio is interpreted as the odds ratio between two compared groups.

Among them, the gender variable in model number 6 stands out, which corresponds to the overconfidence bias. It is shown that the probability of men falling into the bias is significantly different from that of women, men are more overconfident than women, based on a significance level of 5%. In the same model, at a 1% significance level, for each unit increase in the neuroticism variable the probability of being overconfident decreases. In other words, the probability of falling into the overconfidence bias decreases slightly as the degree of neuroticism of individuals increases.

As for the conjunction fallacy bias, which corresponds to model number 7, the Conscientiousness variable is significant at 5%. Therefore, it is shown that there is a relationship between the degree of conscientiousness of the respondents and the probability of falling into the conjunction fallacy bias. For each unit increase in the variable awareness, the probability of a person falling into the conjunction fallacy bias decreases. Another case is that of the amability variable, which is explained at a significance level of 1%. This implies that for each unit increase of the independent variable we are analyzing, the probabilities of occurrence of the conjunction fallacy bias decrease. That is, an increase in the degree of agreeableness is related to a slight decrease in the odds of experiencing the conjunction fallacy bias.

## **7. Limitations and extensions**

This experiment is a pilot test to find out if the non-rational decisions that individuals make and that make them fall into biases are related to their personality. Through the econometric analysis of the different models presented, it has not been possible to determine a coherent and strong answer to the main research question. That is to say, it has not been possible to demonstrate that the personality of individuals influences and conditions their economic decisions, leading them to fall into a bias. This may have been caused by different factors.

The first and most important factor is that in the methodology of experimental economics, experiments in which there is an economic incentive are considered more valid, since payments are a strict rule of the methodology. According to (Daniel Read, 2005) there are three factors through which economic incentives have effects. First is cognitive effort: the more money at stake, the more importance will be given to the experiment. Second is the motivational focus, this factor has the notion that the agent's goal can be altered by money. Finally, there is the emotional trigger factor, which consists of a series of psychological aspects of the human being that are activated when money is at stake. Therefore, in this pilot experiment in which no financial incentives were offered, respondents may not have shown the necessary interest to participate and thus obtain meaningful results.

Another explanation could be the fact that there are other types of variables such as, for example, the level of education attained, or the time dedicated to investments that can directly influence whether or not these biases are committed. These are variables that have not been included in the research and therefore have not been studied and included in the models, but which could be included in new extensions of this study.

On the other hand, being a pilot experiment, the sample is small because only 81 individuals are being investigated, this may have caused a lack of representativeness and a greater probability of selection bias, since a small sample may not be sufficiently representative of the total population, which means that the results obtained may not be applicable to the population as a whole. In addition, in a small sample the results are more likely to be more variable and therefore less accurate. In conclusion, a small sample could limit the significance of the results of the experiment and thus the usefulness of the findings. Thus, in this experiment the expected results may not have been obtained as a consequence of the small sample.

In summary, the objective of this pilot experiment has been to relate the different dimensions of the personality of individuals with their ability not to fall into biases, but the results obtained are not as expected. There are different causes that may explain this situation, so the possibility remains open for other researchers to extend and correct the experiment in a different situation.

## **8. Conclusion**

This final degree dissertation focuses on examining the possible connection between personality traits and judgments that give rise to biases. This pilot experience arises from the interest of verifying whether there are people with similar personalities behaving in an identical way when making economic decisions. Therefore, the theory of Kahneman and Tversky has helped and guided this work.

The pilot experiment developed consists of two questionnaires, the first of which is the NEO-FFI test that defines the degree to which each person possesses five personality characteristics. The second consists of nine questions through which it has been possible to determine whether individuals are biased or not. In addition, thanks to STATA, the regressions of each of the models were calculated and the significant variables were obtained. In this project, relationships between gender and some personality traits have been shown with biases at the 5% or 10% significance level. On one hand, the final conclusion is that men are more overconfident than women, and as the degree of neuroticism increases the probability of falling into the overconfidence bias decreases. On the other hand, the conjunction fallacy is influenced by the fact that as the degree of conscientiousness increases, the probability of committing this bias decreases, and the same happens with agreeableness.



The work has identified important limitations, even though the results of the pilot experiment did not show a significant relationship between the variables examined. The results may have been affected by the lack of control that the participants had at the time they answered the questionnaires.

Therefore, further study in a controlled environment would be necessary in order to produce more conclusive results. In particular, it would be recommendable for the repetition of the experiment with a better control of the participants and taking into account more factors that could affect a biased judgment.

Despite the limitations discovered, this research adds to our understanding of the connection between personality and biased judgment. To broaden our understanding of human decisions and their impact in various contexts, it also emphasizes the importance of additional research in behavioral economics.

## 9. Bibliography

Akhtar, Thyagaraj, K. S., and Das, N. (2014). Developing an Empirical Framework for Investment Strategy Based on BB&K Five-Way Model. *IPE Journal of Management*, 4(2), pp. 47.

Bailard, T. E.; Biehl, D. L. and Kaiser, R. W. (1986). *Personal Money Management*, Chicago, Ill. Science Research Associates.

Bernoulli, D. (1954). Exposition of a new theory on the measurement of risk. *Econometrica*, 22, pp. 23-36 (Original publication 1738).

Cortada de Kohan, N., Macbeth, G. (2006). Los sesgos cognitivos en la toma de decisiones. *Revista de Psicología*, 2(3), pp. 52-68.

Costa, and McCrae, R. R. (1999). Inventario de personalidad Neo revisado (NEO PI-R); Inventario Neo reducido de cinco factores (NEO-FFI). *Tea*.

Del Barrio, V. (1992). Evaluación de las características de la personalidad. En: Fernández-Ballesteros, R. (ed.). *Introducción a la evaluación psicológica II*, Madrid: Pirámide.

Fajfar, P. (2013). Normas sociales, solidaridad y coordinación en el juego de ultimátum. *Doctoral dissertation*, Facultad de Ciencias Económicas. Universidad de Buenos Aires.

Filbeck, G., Hatfield, P., and Horvarth, P. (2005). Risk Aversion and Personality Type. *The Journal of Behavioral Finance*, 6, pp. 170-181.

Kahneman, D. and Tversky, A. (1973). The psychology of prediction. *Psychological Review*, 80 (4), pp. 237-251.

Kahneman, D. and Tversky, A. (2000). *Choices, Values and Frames*. N.Y. Russell Sage Foundation Cambridge University Press.

Keuthen, Tung, E. S., Tung, M. G., Curley, E. E., and Flessner, C. A. (2016). NEO-FFI Personality Clusters in Trichotillomania. *Psychiatry Research*, 239, pp. 196–203. <https://doi.org/10.1016/j.psychres.2016.03.011>

Read, D. (2005). Monetary incentives, what are they good for? *Journal of Economic Methodology*, 12 (2), pp. 265–276.

Simon, Herbert A. (1955). A Behavioral Model of Rational Choice. *The Quarterly Journal of Economics*, 69 (1), pp. 99–118.

Tomer, John F. (2007). What is Behavioral Economics?. *The Journal of Socio-Economics*, 36 (3), pp. 463–79.

Tversky, A. and Kahneman, D. (1971). Belief in the law of small numbers. *Psychological Bulletin*, 76 (2), pp. 105-110.

Tversky, A. and Kahnman, D. (1983). Extensional versus Intuitive reasoning. *The Conjunction Fallacy in Probability Judgment Psychological Review*, 90 (4), pp. 293-315.

Zapata, A., Cabrera, E., Hernández, J.; and, Martínez, J., (2016). Educación financiera entre jóvenes universitarios: Una visión general. *Revista Administración y Finanzas*, 2-6, pp. 1-8.

#### **APPENDIX: TEST NEO-FFI**

The questions contained in the NEO Personality Inventory Revised Reduced (NEO-FFI) test are listed below. After posting the results thanks to the template, this test allows the researcher to create a description of the personality of the individual under investigation.

1. I often feel inferior to others.
2. I am a cheerful and lively person.
3. Sometimes, when I read poetry or contemplate a work of art, I feel a deep emotion or excitement.
4. I tend to think the best of people.
5. I never seem to be able to get organized.
6. I rarely feel afraid or anxious.
7. I really enjoy talking to people.
8. Poetry has little or no effect on me.
9. I sometimes bully or flatter people into doing what I want.
10. I have clear goals and strive to achieve them in an orderly fashion.
11. Sometimes frightening thoughts come to my mind.
12. I enjoy parties where there are lots of people.
13. I have a wide variety of intellectual interests.
14. Sometimes I get people to do what I want by trickery.
15. I work hard to achieve my goals.
16. Sometimes it seems to me that I am worth absolutely nothing.
17. I do not consider myself particularly cheerful.
18. I am curious about the forms I find in art and in nature.
19. If someone starts a fight with me, I'm willing to fight back.
20. I have a lot of self-discipline.
21. Sometimes things seem too bleak and hopeless to me.
22. I like to have a lot of people around.
23. I find philosophical discussions boring.
24. When I have been offended, what I try to do is to forgive and forget.
25. Before taking an action, I always consider its consequences.
26. When I am under heavy stress, I sometimes feel that I am going to collapse.
27. I am not as lively and animated as other people.
28. I have a lot of fantasy.
29. My first reaction is to trust people.
30. I try to do my tasks carefully, so that they don't have to be done again.
31. I often feel tense and restless.
32. I am a very active person.
33. I like to concentrate on a reverie or fantasy and, letting it grow and develop, explore all its possibilities.
34. Some people think of me as cold and calculating.
35. I strive for perfection in everything I do.

36. At times I have felt bitter and resentful.
37. In meetings, I usually prefer to let others do the talking.
38. I have little interest in thinking about the nature of the universe or the human condition.
39. I have great faith in human nature.
40. I am efficient and effective in my work.
41. I am fairly stable emotionally.
42. I shy away from crowds.
43. Sometimes I lose interest when people talk about very abstract and theoretical issues.
44. I try to be humble.
45. I am a productive person, who always finishes his work.
46. I am rarely sad or depressed.
47. Sometimes I am overflowing with happiness.
48. I experience a wide variety of emotions or feelings.
49. I believe that most of the people I deal with are honest and trustworthy.
50. Sometimes I act first and then think.
51. Sometimes I do things impulsively and then regret it.
52. I like to be where the action is.
53. I often try new foods or foods from other countries.
54. I can be sarcastic and biting if necessary.
55. There are so many little things to be born that sometimes what I do is not attend to any of them.
56. It's hard for me to lose my temper.
57. I don't really like chatting with people.
58. I rarely experience strong emotions.
59. Beggars do not inspire me sympathy.
60. Many times I do not prepare in advance what I have to be born.

All these questions must be answered with A,B,C,D,E, with A being totally disagree; B, disagree; C, neutral; D, agree; and, E, totally agree. The score obtained by each individual will be classified in a scoring system that will determine, according to the answers given, a description of how the individual questioned thinks, feels and relates.