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INVESTIGATING STUDENTS' BEHAVIORAL BIASES IN REGARD TO FINANCIAL DECISION-MAKING

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Abstract: The purpose of this paper is to examine the factors influencing the appearance of biases in the behavior of university students. The studied biases are herding behavior, overconfidence, mental accounting, loss-aversion, anchoring and introspection. Three main assumptions were formulated, one regarding the relationship between the biases and financial knowledge, another related to the impact of gender, and the third one presuming a possible explanatory power of the Cognitive Reflection Test results in relation with the heuristics. The findings present evidence regarding the significant influencing power of financial knowledge on the behavior of university students from Cluj-Napoca, suggesting that this aspect could be a possible solution in order to diminish the negative effects of some of the behavioral biases examined. Besides the importance of financial knowledge, the results emphasis the explanatory power of gender when considering the errors of herding, overconfidence, mental accounting and loss-aversion, showing that men tend to be more influenced by these errors. The third assumption proved to be false, indicating that the performance of students at the Cognitive Reflection Test does not have a great impact on the presence of the examined biases.

JEL classification: G00, G40, G41

Keywords: Herding behavior; Overconfidence; Mental accounting; Loss-aversion; Anchoring; Introspection; Financial knowledge

1. Introduction

The effects of different psychological elements on financial behavior of individuals is examined by a relatively new field of study, called Behavioral Finance (Shefrin, 2006).

The emerging science of Behavioral Finance arose as a solution to unexplainable issues between traditional finance theories and real-world finance problems (Branch, 2014). Deviations from rational choices and the urge to find a solution to them, were

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key factors in developing this science. It is believed that the irrational human behavior should be corrected, but in order to do so, an understanding of it and its limitations is needed (Frankfurter et al., 2004). A main difference between the traditional and behavioral approaches, is that behaviorists accept and use elements and ideas of another science, namely psychology, to explain the behavior of investors (De Bondt, 2004). Knowing the investor means knowing the market. Human behavior is reflected in everything we experience on the market. Individuals tend to make systematic errors when making decisions, causing deviations from rationality. The main issue in behavioral finance is to examine why these errors occur (Krishnamurti, 2009).

According to Traditional Finance, investors tend to be fully rational with an unlimited capability to process information. Besides these assumptions, a general market equilibrium is also presumed (Evstigneev et al., 2013). In a world with perfectly rational investors and efficient markets, behavioral finance introduced realism (Kliger, 2014). Almost every financial theory has as a root the assumption that investors are rational. They want to maximize utility and would keep this in mind whenever they act. In fact, with time, the opposite of this assumption has been proved. Individuals are not always rational. They do not always make rational choices, due to the presence of behavioral biases. Wealth can surely be maximized when individuals take rational decisions, but that is not how human nature works (Krishnamurti, 2009). It is said that these behavioral biases, patterns, are unavoidable elements of human behavior, they are somehow "written" in our actions and are difficult to change and overcome (Menkhoff and Nikiforow, 2009).

In order to see why the appearance of behavioral finance was inevitable, we have to understand what traditional finance is based on, what are its main objectives. Traditionalists assumed that our mind works as a computer and has a general problem-solving capacity. It can be thought how to make optimal decisions. Besides this assumption, they also considered emotions to be impedimental when referring to optimal decisions. Feelings, emotions were considered the exact opposite of rationality. Last, but not least, in their opinion, humans have a strain of selfishness in them, always acting to achieve personal gains (Olsen, 2008). Behavioral finance developed another perspective, with the help of psychology, and succeeded in explaining some behavioral patterns that make it impossible for individuals to act rationally. This way, they explained what was until then "unexplainable".

When talking about, and analyzing financial markets, human behavior is an unmissable factor (Van der Sar, 2004). In order to get answers for different anomalies, we have to understand how individuals process information and how they use it in order to make financial decisions (Garcia, 2011). Knowing ourselves, understanding our behavior, could result in the creation of our own individual system of decision-making, enabling us to overcome our behavioral errors and act in an efficient way (Montier, 2010). Behavioral finance does not abandon traditional approaches, on the contrary, it makes possible for them to "survive". With the help of this new science, traditional ways can be reconsidered and placed in a more proper position, in order for them to be applied more constructively (Shiller, 2006). Some elements of standard finance are kept, while others could be replaced with the purpose of providing a behavioral framework for investors (Statman, 2008).

This paper focuses on examining a few of these behavioral patterns, that will be detailed below, namely, herding behavior, overconfidence, introspection bias, anchoring, mental accounting and loss aversion. A survey was conducted on 85 university

students from Cluj-Napoca, taking into consideration whether they have or not, any financial education. The presence of these biases was tested, considering the gender, education level and employment status of the individuals. The initial assumption of the demographic data being significant when talking about cognitive errors, was questioned and in some cases the opposite was proven. In order to test the significance of these factors, a binary regression was run, the whole process being detailed in the methodology section of this paper.

2. Literature review

As briefly mentioned above, traditional theories of finance assume optimal decision-making, rational individuals and efficient markets (van der Sar, 2004). The assumption that people are rational and their expectations are of the same nature, can be further detailed. This rationality supposes that we are able to use all the information available to us and select what is relevant and what can be neglected. This way we could be able to formulate rational expectations and make also rational decisions (Garcia, 2011).

Each and every decision of individuals, according to this traditional view, is in correlation with any other, all having the purpose of maximizing utility. Another assumption of traditionalists states that all available information about the future cash-flows are reflected by the price. This means that every single time a new information gets to the investor, they rethink and reevaluate their expectations, causing this way changes in price (van der Sar, 2004). Investors, in a world ruled by traditional theories, are clever, completely rational, having the only goal to create wealth and market equilibrium (Evstigneev et al., 2013). When information is processed, they apply statistical elements, and apply them always in a correct way. With these theories and rules, a “homo economicus” was created, a rational, convenient, over-simplified version of individuals and human nature, who always acts to achieve greater wealth (Frankfurter et al., 2004).

Traditional view on finance states that for an individual to make good decisions, he/she has to be capable to forecast some variables, to have financial knowledge and to have the ability of processing relevant information (Garcia, 2011). What traditional models do not take in consideration, among other behavioral aspects, is the bad practice of individuals, analyzing every situation and event separately and not trying to find a correlation between them. They do not take in consideration the possibility of a united out-turn. Separate accounts are created in our mind for every event, taking no notice of possible links (van der Sar, 2004).

When the basics of traditional finance were developed, the economy was in an elementary phase, compared to its current state. More plain and uncomplicated rules were enough to explain financial decision-making (Garcia, 2011). Rational investors/individuals are able to make use and evaluate every piece of information that they possess, in order to maximize utility, and they are risk-averse (Matsumoto et al., 2013).

Regarding risk, traditional finance says that every possible outcome and consequence of an event should be examined and carefully analyzed, including risk in a systematic way. The most popular model used for this purpose is the one proposed by Von Neumann and Morgenstern in 1947, called “expected utility model of choice under risk” (van der Sar, 2004).

Various theories of traditional finance exist, having as base some assumptions that do not match with the available scientific evidence. In the opinion of traditionalists, human brain is similar to a computer. It focuses on problem-solving in a most efficient way possible. According to them, risk is perceived as a combination of variance and returns, and rational investors manage to use this information in a way that benefits them the most, without letting their emotions to dictate. In real life, as research shows, this is not attainable (Olsen, 2008). Capital Asset Pricing Model is also a pier of traditional finance, having as a base the assumption that prices are efficient (Shefrin, 2001).

What traditional finance presumed, did not always occur in reality. The theories did not create an accurate picture of how individuals make their decisions. The unexplainable issues led to the creation and manifestation of behavioral finance. (van der Sar, 2004)

Behavioral finance offers an understanding of how individuals process available information and shows how this information is implemented in their decision-making process. What earlier was mentioned, regarding the aim of individuals to use all available information in order to maximize utility, is now questioned and repelled by behavioral studies (Garcia, 2011).

Around the 1980's a behavioral revolution in the field of finance occurred. Existing anomalies, deviations from standard approaches needed an explanation (Shiller, 2006). These studies examine how, and why, the behavior of individuals deviates from rational expectations. They focus not only on the outcome of events and decisions, but also on the process that led to a particular outcome. When analyzing the process of decision-making, behaviorists do it with the help of different psychological elements and aspects (van der Sar, 2004). They acknowledge that people do not always act rationally. They are influenced by a lot of different aspects, all having an impact on how they make their decisions (Ritter, 2003).

What was in the past assumed, when markets and the economy were way more uncomplicated, is now too simple. In order to understand current decisions and events, a multidimensional view is required (Branch, 2014). Behavioral finance studies examine the real behavior of individuals, corporations. They do not assume particular outcomes, rather keep a close watch on what is happening in reality (De Bondt, 2004).

What this new field of study has shown, is the fact that emotions and cognitive errors have a great impact on the decisions of investors. It presents and examines the biases that control us when we make these decisions (Matsumoto et al., 2013). What traditionalists denied and avoided, is the importance of emotions and feelings. They have a significant impact on how people act, regardless if we neglect them or not. Emotions are inevitable components of human nature and their adequate understanding could lead to better decisions.

Knowing ourselves is the first step in overcoming our boundaries (Olsen, 2008). When trying to explain why a particular event occurred or why a decision was not made rationally, behavioral theories and assumptions step in (van der Sar, 2004). Key assumptions of behavioral finance state that people are loss averse; they can be influenced by how problems are framed; in possession of more information, regardless if it is relevant or not, they become overconfident; and they constantly try to ease decision-making (Shefrin, 2001). Regarding the phenomena of framing, we can state that people are influenced by the way a problem or an event is presented to them and react according to this (Ritter, 2003). The framing of information can have a significant impact on the preferences of individuals, while these are pliable and context-specific (Di et al., 2013).

While previously, in case of traditional views, the relevance of more information was emphasized, behavioral studies suggest that more information does not necessarily lead to a better, more rational decision. It is proven by behavioral research, that plus information, even if irrelevant, causes individuals to be overconfident when analyzing a problem or making decisions. When there is too much information available, the studies show, people become confused and perform worse when making financial decisions (Garcia, 2011). What they also try to examine is the amount of irrationality that can be tolerated and if it is possible for rational investors to reestablish the equilibrium on the market (van der Sar, 2004). Until now, they managed to prove that, when the number of irrational investors and decisions becomes considerable, the remaining rational ones are not able to correct them and set back the efficiency and equilibrium (Branch, 2014).

According to the ideas that behavioral finance examines and bolsters up, risk cannot be perceived in a simple way. It is multi-dimensional and a number of influencing factors should be taken into consideration in order to estimate it. Even if risk can be computed in a rational way, emotions will always have an influence on how we perceive it and will not let us act reasonably. In contrast with what was until now assumed, people are not always risk-averse (Shefrin, 2006). Risk cannot be explained only with mathematical formulas. It is more complex than that, involving the attitude of the investor (Statman, 2008).

Behaviorists state that in real life, the CAPM model is not always accurate (Shefrin, 2001). A “behavioral asset pricing model”, BAPM, was developed, where the expected return is a function of many variables, including “social responsibility factor”, “status factor”, etc. (Statman, 2008).

While traditional theories could not explain some anomalies in the behavior of investors, behavioral studies showed that with the help of other sciences we can be able to understand why and how individuals process information and how does that influence the decision-making process (Garcia, 2011).

Behavioral approaches are criticized for their ad hoc nature. After an event occurred, they say it is not hard to name the bias that influenced investors behavior. Predicting which one will be influential in a future event, on the other hand, is not that simple (Ritter, 2003) Another aspect that raised questions about behavioral approaches is the lack of a model that could replace the traditional one (Branch, 2014).

Despite the fact that many studies in the field of behavioral finance were conducted, solutions for different anomalies proposed, behavioral finance should not and cannot be separated from traditional finance. It was not developed to disagree or run against traditional approaches. It appeared in order to complete and upgrade it (van der Sar, 2004).

2.1. Heuristics and biases

When individuals face difficult problems, controversary thoughts, they instinctively try to simplify the situation, by searching for shortcuts, timesaving methods. These are the so-called heuristics and biases. In these cases, people do not act rationally. They trust the information that is plainer and understandable, trying to connect what they hear/see to something that they already know. Coming from our human nature, we tend to assign more relevance to information that confirms our views and acquired knowledge, and ignore those that contradict them (Garcia, 2011). In these

situations, that require a great amount of thinking and analyzing, heuristics, or the so-called “rules of thumb”, step in to simplify the process (Ritter, 2003). When these controversial thoughts are present, the easing of the decision making can also lead to changes in what we believe is true. The phenomena describing these confusions, is called cognitive dissonance (Garcia, 2011).

Long time ago, when the only purpose of humans was to survive, the instinct of acting quickly was developed. This instinct of finding a quick solution did not disappear with time. Even if today we do not face the same dangers and we have time to think rationally and more detailed, we tend not to do so (Evstigneev et al., 2013). If we could understand how we act, what are our limitations, we could be able to understand also the forces that influence our behavior (Statman, 2014).

Among the behavioral errors and psychological elements that influence our decisions and cause deviations from rationality, we can enumerate herding behavior, mental accounting, loss-aversion, overconfidence, anchoring and introspection bias (Algalith, 2012).

As mentioned above, this paper focuses on examining the presence of the enumerated biases. Alongside with other influencing factors, namely, financial knowledge, the above-mentioned cognitive errors will be tested and analyzed.

Herding behavior

As the results of many experiments show, individuals, even if they are almost sure of something, or possess relevant information and evidence, tend to act irrationally, changing, or completely neglecting their views, just to adapt to the opinion of the crowd. An experiment that clearly reflects this idea was conducted, where individuals had to estimate the length of different lines. When their answers did not match with what others estimated, the majority of the subjects changed their numbers to adapt (Garcia, 2011). Even if useful information is in our possession, the majority of us follows the crowd, in order to avoid the feeling of missing out (Menkhoff and Nikiforow, 2009).

Another behavioral bias, closely related to herding, is excessive, unexplainable loyalty. This phenomenon is often present in groups. A further and more severe form of herding is the phenomenon of groupthink (Morck, 2008). Individuals often tend to neglect their own forecasts, in order to fit into a group (Olsen, 2008).

Herding behavior, groupthink and also the exaggerated loyalty, even if it is hard to understand in this modern era, contributed to the well-being and survival of people throughout history (Morck, 2008).

Mental accounting

When we do not try to find links between the information that we use in order to make decisions and we assign different “parts” of our mind to each of them, another behavioral bias is present, the one, called mental accounting. When this cognitive error dominates, we neglect the fact that problems analyzed together could lead to more optimal decisions (Ritter, 2003).

In case of the acquisition of goods, services, for example, we tend to associate their value with the purchase price, even if it is not appropriate anymore. Until the point that we sell the good, or cannot use it anymore, we assign a mental account for it, where the initial information is stuck (Statman, 2008).

Loss-aversion

Deriving from our human nature, we are terrified of losses. Loss scares individuals, it is perceived way differently than gains, even if it is the same amount (Krishnamurti, 2009). People value losses more than gains. Approximately two and a half times is higher the influence of losses. While, as evidence shows, we are more sensitive to losses, the theory of investors being risk-averse and this driving their actions and attitude, could be questioned. Loss-aversion has greater impact on how we perceive risk (Shefrin, 2001). Due to human nature, reduction of our wealth, well-being, influences more our decisions than the increase of it. Renouncing to something can be far harder to process than acquiring (Benartzi and Thaler, 1993).

Overconfidence

Instinctively, when facing difficult situations, our brain is engaged in finding quick solutions, rather than analyzing the details. One of the heuristics that contributes to finding these shortcuts is overconfidence (Alsabban and Alarfaj, 2020).

When possessing more information, the unambiguous assumption is that it will help us make better decisions and have a clearer view about a particular subject. In real life, often the exact opposite happens. We become more confident with each additional information and in the meantime less precise and accurate. We fall into the trap of the “illusion of knowledge” (Hall et al., 2007). Most people are willing to pay for additional information, even if it is not relevant, with the purpose of boosting their confidence level (Eliaz and Schotter, 2010).

Often, positive past events, gains, inevitably influence us to be overconfident. We stop relying on facts and do not engage our mind in analyzing the situation (Alsabban and Alarfaj, 2020). We tend to follow what we trust to be true and assume that we for sure know it better. This often happens is case of individuals that are experts in a field. This cognitive error makes people feel too optimistic when they should not and they do not use the available information in an efficient way. They tend to reject any help and trust only the ideas of their own. These investors/individuals assign too much importance and correctness to the information they possess (Garcia, 2011). Trusting what we are familiar with and thinking our abilities are superior to others, are the piers of this bias (Ritter, 2003). Those investors that tend to be more confident, usually are less risk-averse (Shefrin, 2001).

Overconfidence is a bias that could be individual or even a common phenomenon within a group of individuals (Garcia, 2011). It has three different levels, namely “illusion of control”, “better-than -average effect” and “miscalibration” (Menkhoff and Nikiforow, 2009).

Anchoring

When investors are indecisive, when they face unpredictability, they decide based on previous, not necessarily useful information, in order to reach to a solution. This destructive habit is called anchoring. It is an initiative to reduce the effort of finding answers and analyzing situations (Matsumoto et al., 2013). As research shows, a possible reason behind under-reaction on the markets, is anchoring. Individuals tend to be too conservative and this is reflected in the decision they make (van der Sar, 2004).

Introspection bias

When talking about and examining the behavior of others, people can observe the presence of biases instantaneously. When they should identify these biases in their own decision-making process, they are in denial (Garcia, 2011). This is the so-called introspection bias. The results of experiments show, that when it comes to success, individuals attribute it to their own abilities. In contrast, when failures are considered, external factors are said to dominate (Alsabban and Alarfaj, 2020).

2.2. Conclusion on heuristics and biases

The aim of behavioral studies is to observe what are the causes of deviations from the rational assumptions, what patterns of behavior influence the investors and how these can be "remedied" (Frankfurter et al., 2004). While these biases can lead us to shortcuts and sometimes are useful when we face difficult problems, they usually influence our decisions in a negative way. Behaviorists suggest that knowing ourselves is a key factor in overcoming bad habits. Maybe it is not part of our human nature to act rationally, but we can minimize the impact of these ruinous habits in order to maximize utility (Krishnamurti, 2009). Even if the biases are identified, these contagious habits are very hard to overcome. These errors require great effort and devotion to be defeated (Menkhoff and Nikiforow, 2009). It is believed that these behavioral biases and psychological aspects contributed to the conformation of different market disasters or crisis (Di et al., 2013). What surely cannot be stated is that all anomalies and mistakes are caused by these bad habits, but they are surely present and influence human behavior (Ritter, 2003). A term exists for the action of reducing the impact of these biases, eliminating or controlling them when decisions are made, called "debiasing" (Shefrin, 2006).

3. Methodology

The usage of questionnaires, interviews, in order to collect information is the simple definition of survey methodology. It requires great attention and planning, from the point we start formulating the questions until the end of the evaluation and presentation of collected data. This method assumes that all subjects process the questions in the same way. If changes, deviations, in answers exist, that is attributed to the difference in opinion or views. What conducting a survey requires from the subject, is to understand the questions and provided answers; to be able to recall information and do it accurately; and most importantly the willingness to do it. Without the willingness of the subject to take the survey, both understanding and ability requirements are useless (DeMarris and Lapan, 2003).

3.1. Planning and purpose

The purpose of this paper is to monitor the presence of six different behavioral biases in the decision-making process of university students from Cluj-Napoca. Both undergraduate and master's degree students were taken into consideration. The majority of articles and papers I have read before constructing my survey, mainly focused on the presence of one or two biases and their analysis. Experiments were

conducted to test excessive loyalty, herding behavior, overconfidence, etc., mostly in case of the behavior of active investors. Some questions from these articles were combined and reformulated in order to inspect the presence of the six chosen cognitive errors in the behavior of university students. The questions will be further detailed in this chapter.

While the field of behavioral finance is relatively new and still in the developing phase, lot of unanswered questions still exist. The reason why I have chosen to include more biases in my study, is to see which one dominates in case of my population, which ones need more attention and effort to overcome. University students were selected, because being a student myself, I consider that our way of thinking has more in common and I can understand better what influences them. This helped me when selecting and reformulating the questions. I took in consideration what I found to be interesting and what I would be willing to spend 10-15 minutes of my time with.

Another reason why students were chosen is that they are still in an early phase of their life-cycle. If behavioral biases are present and dominate their actions, they are easier to overcome and work on, in this earlier phase. They could be able to build habits that offer help in eliminating or at least minimizing the impact of these errors. This is why financial knowledge of individuals is also included in the research. To see whether this has a positive effect on the behavior of students. Positive effect meaning that they are less influenced by these errors when making decisions. If financial knowledge diminishes the impact of these contagious habits, its usage could provide a possible solution.

3.2. Questions included

The questions included in the survey can be divided into three groups. The first group contains those that examine the presence of herding behavior, introspection bias, mental accounting, loss aversion, overconfidence and anchoring. The questions from the second group are related to financial literacy. They serve the purpose of testing if the subjects have any kind of financial knowledge. Last, but not least, the remaining questions compose together the Cognitive Reflection Test (CRT) (Toplak et al., 2011).

Besides these three groups, general questions, demographic data, are also included. These are the gender of the subject, its current level of university education and employment status. I wanted to examine the significance of these demographic data on each of the biases.

The questions from the three above mentioned groups (not including the ones regarding general information about the subject), are mixed up, in order for the individuals not to detect any correlation. The subjects were informed, that they are required to provide quick answers, without hesitating and thinking too much. They were told that the survey examines financial decision-making. Despite the fact that they did not understand why and how some questions examine their behavior in this field, the general feedback was great. They found it interesting and enjoyable.

3.3. Survey data analysis

My research focuses, as above mentioned, on how students from Cluj-Napoca make financial decisions, what biases are present and dominate their decision-making process.

The key research questions include:

- What is the relation between demographic data and the examined biases? Do these demographic data have any significance when examining these cognitive errors?
- Does financial literacy have any impact on the level of influence of the biases?
- Is it true that those individuals that manage to answer correctly to all three questions of Cognitive Reflection Test are less likely to be influenced by these errors?

The three main ideas of which validity is tested in this research paper are formulated below:

H1. Financial literacy is a significant factor influencing the presence of behavioral biases.

Di et al. (2013) found that, the lack of knowledge in a topic, the absence of experience in a field, leads to the habit of procrastination and the urge to find quick, understandable solutions without properly examining in details the given issue. Following these assertions, the first assumption that I made is the one formulated as Hypothesis 1.

H2. Women tend to be less overconfident than men.

As Ritter (2013) concludes in his article, women are less likely to let themselves to be influenced by overconfidence bias. They do not overvalue their abilities and the knowledge that they have, in such a great degree as men. This hypothesis is also tested in our research to examine whether this is true or not in case of university students in Cluj-Napoca.

H3. Those individuals that manage to answer correctly to the CRT questions, are less likely to fall victims of behavioral biases.

In the first part of data analysis, the presence of the six biases will be detailed. Which are the ones that have the greatest influence on the whole sample. In the second part of the analysis, binary probit regressions will be run to see how the presence of the heuristics are explained by the available personal characeristics/ demographic data of the subjects (Menkhoff and Nikiforow, 2009).

For this purpose, and also in the first part the counting to be easier, dummy variables were created for each bias and also for demographic data. If the answer of the subject indicates the presence of the bias, the value taken is 1, otherwise it is 0. In case of gender, the value is 1, if the individual is a man. Also 1 is the value taken in case of undergraduate and employed individuals.

A dummy variable for CRT was also created, it takes the value 1 if the individual managed to answer all 3 questions of the test correctly.

In case of financial literacy, the three big questions of testing it, were included, and surprisingly none of the subjects managed to answer correctly to all of them. This is why I chose to create a dummy that takes the value 1 if the individual answered correctly for at least two questions, and 0 otherwise. The individuals that answered correctly for at least two, were considered having a bit of financial knowledge.

A binary choice model, in our case, binary probit regression, is used in case of categorical variables. The probit model uses the normal distribution of the errors of forecasted probabilities.

I had a dataset of 85 individuals, more precisely, university students, and I gathered data on their financial decision-making, how different behavioral biases affect the way they perceive different problems. These behavioral biases were used as dependent variables, one by one, and demographic data alongside with CRT results and financial literacy were used as explanatory ones.

The regressions were realized starting with considering the coefficient of each explanatory variable and also the constant to be equal with 0. This means that initially I did not assume any predictive power of the variables. In the probit model, the main variable of interest, from which the probabilities are derived, is z-stat. Z-stat is written as the combination of the coefficients and the values of the explanatory variables. Initially it equaled 0. From z-stat I got to the probability of default, by plugging in the z-stat in the standard normal distribution formula. The probability of default I got this way equaled 0.50. In order to optimize the coefficients, to arrive to an optimal value of the parameters, so they would maximize potential explanatory power, the log-likelihood function needed to be maximized. In order to do this, I used the following formula:

$$\log L = \sum_{i=1}^{n} (y_i \log \hat{y}_i + (1 - y_i) \log \hat{y}_i) \quad (1)$$

where: y_i -dependent variable

$\hat{y}_i$ -estimated y_i (estimated probability)

Following this step, the total log-likelihood was calculated, over the 85 students. Then I specified my optimization task in order to reach the best values of my coefficients.

After calculating the coefficients, in order to determinate the standard errors, I had to use a weight matrix. In binary models, this weight matrix is needed to arrive at the covariance matrix results. The covariance matrix was then used to determine the standard errors.

The weighted matrix is a diagonal one, meaning that all values besides the diagonal, are equal to 0. The formula used to calculate the values on the diagonal is the following:

$$W = diag\left(\frac{\varphi^2(\bar{b}\ X)}{\hat{y}_i(1-\hat{y}_i)}\right) \quad (2)$$

where: $\varphi^2(\bar{b}\ X)$ -standard normal distribution function of Z-stat

$\hat{y}_i$ -estimated probability

After having the weight matrix, I was able to create the covariance matrix. This started with the calculation of the transposed matrix of the explanatory variable values and the multiplication of the weight matrix with the explanatory variable values. After calculating these two, the product of them was determined. Last but not least, the inverse of their product or the so-called covariance matrix was created. The formula of the above described process is shown below:

$$V(\hat{b}) = (X^T W X)^{-1} \qquad (3)$$

The values appearing on the diagonal of the covariance matrix were used further, in order to determine standard error. I calculated it as the square root of those particular values. Further, z-stat was determined. It is the ratio between the coefficient and standard error. For the p-value the standard normal distribution of the absolute value of z-stat was used, in the following way:

2*(1-standard normal distribution of the absolute value of z-stat)

After getting the results, I analyzed the magnitude of the coefficients, and their statistical significance.

4. Results

The key questions I wanted to answer with conducting a survey on students, were mentioned above, in the “Methodology” chapter. Many of my general assumptions were cast-off after processing the survey data, because sometimes the exact opposite of them has been proved.

A few general assumptions that I made after reading about the experiments of others, about surveys that were conducted, were that men tend to be more overconfident than women, individuals that have better results at the cognitive reflection test are less influenced by the biases, etc. The results in this chapter will reveal whether these assumptions were proved to be true or not in case of the students that took my survey.

As mentioned before, this study is based on a survey, that addressed university students from Cluj-Napoca. 85 individuals completed it and the below presented table shows their personal characteristics.

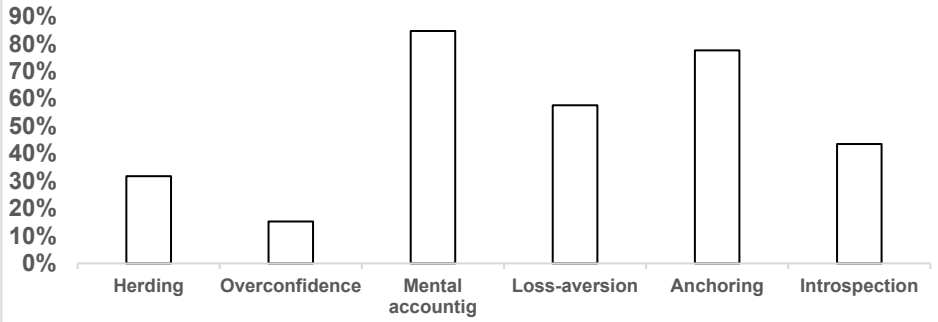
Table 1: Demographic data of the subjects

Gender	Male: 46	Female: 39
Education Level	Undergrad.: 62	Master's: 23
Employment Status	Employed: 37	Unemployed: 48

As we can see in Table 1, 46 men and 39 women took the questionnaire, which means that approximately 54,12% of the individuals were of male gender. In case of education level, the difference is higher. Only 27% of them are at master’s level of education currently. Regarding employment status, we can say that more than half of the individuals are unemployed. This was the brief presentation of the personal data of the subjects.

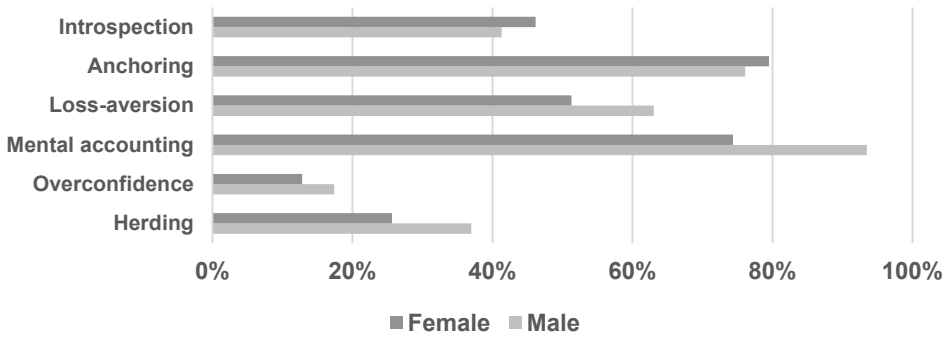
Further on, Figure 1 shows the presence of the biases based on the answers of the individuals, regardless of their demographic data.

Figure 1. The presence of the behavioral biases taking into consideration the whole sample



According to the above presented figure, the bias that has the greatest influence on the behavior of the subjects is mental accounting. 85% of the individuals are victims of this heuristic. They create special accounts in their mind for every situation, information, and show a resistance to analyzing everything as a whole and observing possible links. Anchoring, the urge to rely on past results/events and refusing to change or rethink new information, is the second in our list. Approximately 78% of the students are influenced by this error. Anchoring is then followed by loss-aversion, introspection and herding. Surprisingly, only 15% of the subjects fell victims of overconfidence, this bias achieving this way the less influential status.

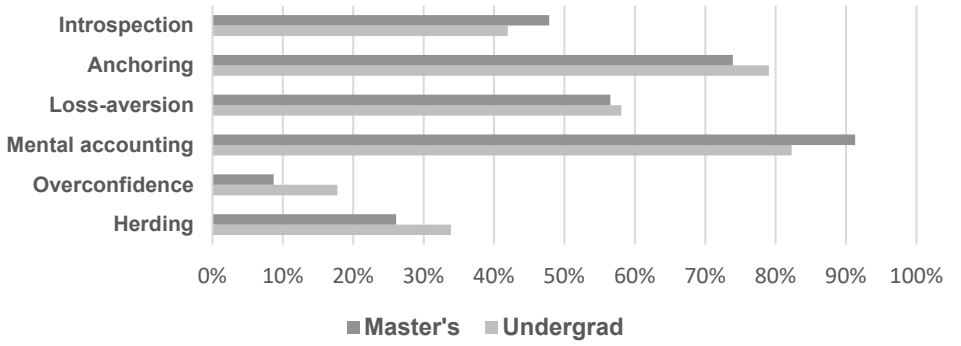
Figure 2. Presence of biases regarding the gender of the subjects



Matsumoto et al. (2013), concluded that men and women present in the same amount the “symptoms” of anchoring bias. In case of our sample, Figure 2 shows, that the percentages in which anchoring is present in the decision-making process of men and women is almost the same. Regarding overconfidence, we

already concluded that it is the least influential bias among the six examined ones. The other aspect of interest when taking into consideration overconfidence, is whether men are more overconfident than women or not. Even if the difference is not that high, we can clearly observe that more men tend to overestimate their abilities and accumulated knowledge than women. What Ritter (2003) concluded in his article regarding investors and overconfidence, proved to be true in case of students too.

Figure 3. Presence of biases regarding the education level of the subjects



First thing that can be observed after analyzing the above presented chart, is that education level does not cause great fluctuations in the presence of behavioral biases when considering the decision-making process of individuals. A higher amount of difference can be noticed in case of overconfidence, undergraduate students are more likely to be overconfident.

Figure 4. Presence of biases regarding the employment status of the subjects

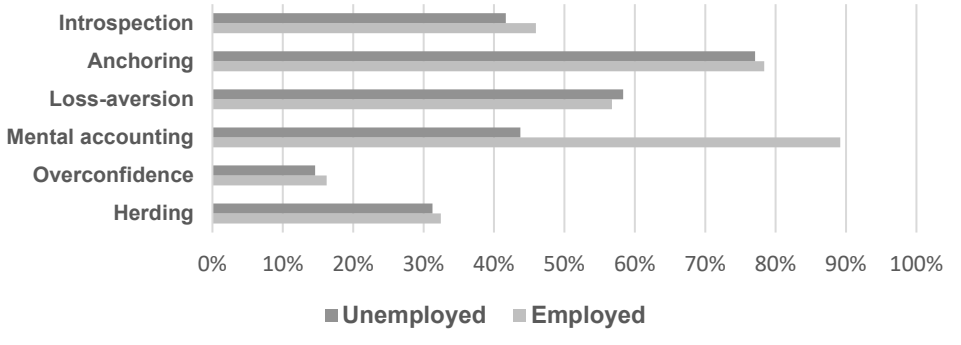


Figure 4 presents the degree in which the analyzed behavioral biases influence the decision-making process of employed and unemployed individuals. The highest and most outstanding discrepancy occurs in case of mental accounting. Approximately half of the unemployed individuals are influenced by this bias, while in case of employed students, this percentage reaches 89%. This may occur due to the complexity of tasks individuals face when working and studying in parallel, so they need to find a way in order to simplify problems. Creating a separate account for all of their tasks may seem a good solution but it balks them from having a holistic picture of their duties. In case of all other biases, the differences between employed and unemployed individuals is pretty much non-existent.

As mentioned in the methodology section, a binary regression was run in order to test the significance of demographic data on the examined heuristics. Not only personal information, but also the results from CRT and financial literacy questions were included as explanatory variables. The results of the regressions are shown in the tables below.

Table 2 contains the results of the binary probit regression having herding behavior as dependent variable. Gender, education level, employment status, the CRT results and Financial literacy being the explanatory elements. The table indicates which explanatory variables are significant and the magnitude of each. The sign of the coefficient suggests a positive or negative relationship between the dependent variable and independent ones.

Table 2: Variables explaining herding behavior

Herding behavior	*Coefficient*	*Z-stat*
Gender	0.340056***	3.089205
Education level	-0.737007	-0.186039
Employment status	0.533737	1.377620
CRT	-0.765670	-0.193547
Financial literacy	-2.362320***	-4.071249

Note: ***, **, * denote statistical significance at the 1%, 5%, and 10% level

When analyzing the results of the above-presented table, we can clearly observe that two explanatory variables are significant when examining the presence of herding behavior. These variables are gender and financial literacy. Both of these explanatory variables have a significance level at 1%. The sign of each coefficient shows whether the variable is positively related to the dependent one or not. As we can observe, gender has a positive relationship with herding behavior, meaning that it is more likely for a male student to fall into the mental trap of herding behavior. In case of financial literacy, as explanatory variable of herding behavior, a negative relationship can be noticed. This buttress up the findings of Sekita (2022), stating that financial literacy has a great impact on the presence of behavioral biases in the decision-making process of individuals. It proves to be true, that in case of herding, the more financial knowledge a student has, the less likely it is for him/her to present the “symptoms” of herding behavior when making financial decisions.

Table 3: Variables explaining overconfidence

Overconfidence	*Coefficient*	*Z-stat*
Gender	0.351707**	3.069360
Education level	-1.025717	-0.249729
Employment status	0.550321	1.305144
CRT	-0.987288	-0.240742
Financial literacy	-3.369879***	-5.302230

Note: ***, **, * denote statistical significance at the 1%, 5%, and 10% level

Going further to the analysis of overconfidence bias, looking at the table, we can state that education level, employment status and the results from the CRT do not show any significance. Until now, the assumption that those individuals who perform better at the CRT are less likely to be influenced by the biases, did not prove to be significant. The sign of the coefficient indicates a negative relationship, but it did not turn out to be significant. On the other hand, gender and financial knowledge are both influential elements regarding examined bias. As Garcia (2011) explained, overconfidence has a non-negligible impact on how individuals process information and what they consider significant. As we can observe, gender influences the presence of overconfidence in a noteworthy manner. What Ritter concluded, proved to be true in case of students. He said, as previously mentioned, that men tend to be more overconfident than women when making financial decisions. The positive coefficient, significant at 5%, indicates that it is more likely for a male student to be influenced by overconfidence than a female one. Just as in case of herding, financial literacy has a significant impact on the presence of overconfidence bias. Those individuals that managed to answer to at least two of the three financial literacy questions correctly, are less likely to be overconfident when making decisions. This can be due to the fact that they possess more information regarding financial aspects which makes them evaluate finance related problems more rationally.

Table 4: Variables explaining mental accounting

Mental accounting	*Coefficient*	*Z-stat*
Gender	0.233525**	2.010799
Education level	-1.355775	-0.200247
Employment status	0.796644**	2.007164
CRT	-1.210282	-0.178866
Financial literacy	-3.033730***	-4.883931

Note: ***, **, * denote statistical significance at the 1%, 5%, and 10% level

The three variables that have a significant impact on the appearance of mental accounting bias in case of university students, are gender, employment status and financial literacy. So far, gender and financial literacy turned out to have a significant explanatory power when talking about behavioral biases influencing

financial decision-making. Employment status is the third aspect that has a significant impact when mental accounting is analyzed. As we can see, from the sign of the coefficient, this explanatory variable has a positive relationship with the examined bias. This positive relationship indicates that it is more likely for an individual who is employed to create separate accounts for different tasks in his/her mind in order to ease the decision-making process. Even if this seems to be a great solution when problems are complicated, it does not allow the individual to observe possible links and correlations. CRT as explanatory variable turned out to be insignificant, just as in case of herding and overconfidence, proving the assumption of Toplak (2011) false in case of university students from Cluj-Napoca. The assumption that those individuals that perform better on CRT are less likely to be influenced by behavioral biases, so far turned out to be insignificant, meaning that it is not a great predictor of heuristics.

Table 5: Variables explaining loss-aversion

Loss-aversion	*Coefficient*	*Z-stat*
Gender	0.349524**	2.934902
Education level	-0.534417	-0.120155
Employment status	0.228338	0.546351
CRT	-0.597408	-0.134545
Financial literacy	-1.001627	-1.596309

Note: ***, **, * denote statistical significance at the 1%, 5%, and 10% level

Surprisingly, in case of loss-aversion, which, as Menkhoff and Nikiforow (2009) said, is one of the most common behavioral biases influencing the decision-making process of individuals, the only category that turned out to have a significant impact, is gender. What we could observe so far regarding the influence of gender on the presence of behavioral biases, is true in case of loss-aversion too. When considering male students, the likelihood of being loss-averse is higher. The significance level of the coefficient, indicates a relatively strong explanatory power. The insignificance of the other dependent variables, when considering loss-aversion, may be due to the fact that fear from the unknown and from loss is a key aspect of human nature, instinctively influencing all of our decisions, regardless how educated we are, etc. As Evstigneev et al. (2013) said, fear from danger, fear from losses is an instinct that appeared and developed when the only purpose of humans was to survive. This is written so deeply in our behavior and human nature that regardless of how educated we are it always influences our decision-making.

Table 6: Variables explaining anchoring

Anchoring	*Coefficient*	*Z-stat*
Gender	0.041948	0.125433
Education level	0.065897	0.169640
Employment status	0.115097	0.313516
CRT	-0.831392**	-2.236171
Financial literacy	-0.206071	-0.580430

Note: ***, **, * denote statistical significance at the 1%, 5%, and 10% level

Going further, another purpose of this paper is to analyze the presence and influencing factors of anchoring bias. When making decisions, regardless of the field in which we operate, we tend to rely on information that we first received and adjust the new data to this initial knowledge. It is a habit that first seems to ease complicated decision-making processes. Matsumoto et al. (2013) concluded that in case of investors, gender is not an influential factor when considering the presence of anchoring bias. Men and women tend to rely on this mental shortcut in approximately in the same amount. According to the findings of my study, this turned out to be true in case of students too. As it appears, gender is not a great predictor of anchoring bias. On the other hand, first so far, CRT turns out to have a significant impact on the presence of the analyzed heuristic. The minus sign indicates that the better a student performed at the CRT, the less likely it is for him/her to rely on past information, on an anchoring point, and manages to analyze problems and new data more rationally.

Table 7: Variables explaining introspection

Introspection	*Coefficient*	*Z-stat*
Gender	-0.156000	-0.5902
Education level	-0.095864	-0.283234
Employment status	0.114028	0.356030
CRT	-0.016086	-0.051866
Financial literacy	-0.016086	-0.051866

Note: ***, **, * denote statistical significance at the 1%, 5%, and 10% level

Introspection bias is the mental shortcut present when we attribute success to our own abilities, and failures to external influencing factors. We fail to recognize our own faults, but tend to observe them instantaneously when analyzing others. As the above presented table shows, we cannot conclude that any of the explanatory categories have a significant impact on the appearance of this heuristic. Nor gender or financial literacy, the two variables that so far turned out to have a pretty great explanatory power, are significant predictors of introspection bias. Deriving from these results, we can conclude in case of this bias, that its appearance does not follow any pattern taking into consideration the gender, education level etc. of the subjects.

5. Conclusion

Being a relatively new approach, behavioral finance has many unanswered questions, many unexplored areas that provide great opportunities for researchers. It appeared as a response to unexplainable anomalies, errors which occurred in the usage of traditional finance models and assumptions. It provided and continues to provide answers and solutions to these problems, by examining human behavior with the help of psychology and other social sciences. Behaviorists observed that traditional assumptions do not stand a chance in this fast-evolving world. They distinguished many forms and types of behavioral biases, six of them were analyzed in this paper.

After creating a survey that was distributed to university students from Cluj-Napoca, answers were gathered and analyzed. The results of this are shown in this study. After analyzing these results, we can conclude, first of all, that behavioral biases do have a great impact on individuals, in case of these university students, mental accounting having the greatest influence. Some personal factors do have an impact on the presence of these biases, but there is not a single personal data used as explanatory variable, that could be considered significant for all the examined cognitive errors.

One of the purposes of this paper was to see, whether financial knowledge has an impact on the presence of these biases or not. It turned out that the first hypothesis, mentioned in the "Methodology" section regarding the influence of financial literacy proved to be true. Even if, according to my analysis, it is not a great predictor of all biases, it has a significant impact on the presence of herding behavior, overconfidence and mental accounting. This way, the findings of Di et al. (2013) proved to be true in case of my sample, stating that financial knowledge could help in overcoming mental errors. What Hall et al. (2007) concluded, was cast-off in case of university students, proving that the more knowledge they have in the field of finance the less likely it is for them to follow the crowd, to create separate accounts in their mind for different problems and to overestimate their own abilities.

Regarding the next initial assumption, stating that those individuals that perform better at CRT are less likely to fall into the trap of introspection, herding, mental accounting etc., did not proved to be true when considering my subjects. Even if they managed to answer all three questions of the test correctly, it did not protect them from the negative effects of heuristics and biases.

In addition to the findings of Ritter (2003), regarding the presence of overconfidence bias in case of men and women, which turned out to be true in my analysis too, men tend to also be more influenced by the urge to follow the crowd, to separate their decisions and tasks into different accounts and to be more loss-averse. Gender, this way, turns out to be a great predictor not just in case of overconfidence but in case of other biases too.

This paper can provide an introspection for any individual working with students, showing which are the influencing factors when considering the decision-making process of the young individuals they work with. Identifying these errors in an early phase and creating "remedies" for them could result in a more rational, less pliable generation. As we could see, providing financial knowledge and information to students is one of the solutions that could lead to a positive outturn.

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