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EFFECTS OF COGNITIVE BIASES ON THE RATIONALITY OF INVESTMENT DECISIONS

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CONTENTS

1 INTRODUCTION

The idea of the thesis is to describe different cognitive biases that are associated with investor behavior and the harmfulness of these biases on the rationality of investment decisions. The focus of the thesis is not on professional investors, but on everyday people and their thought processes, as they are making investment decisions. In investing, there are winners and losers, and the thesis will introduce some of the most common biases that affect rational decision-making, and evidently result in more or less irrational investment decisions.

Before discussing different forms of irrational investment behavior, it is important to understand rational decision-making and the different factors that need to be taken into account while making rational investment decisions. The thesis will first define some of the key factors that are necessary for rational investment decisions to take place. This includes understanding the possibilities and risks that are associated with making different investment decisions. Due to the fact that the thesis focuses on describing the thought processes of amateur investors as well as the possible flaws that may occur in their decision-making, the thesis will only introduce the simplest asset pricing models that help in making rational investment decisions.

After determining the different factors, which is necessary to understand to make rational investment decisions, the thesis will discuss the different fallacies and cognitive biases that negatively affect the rationality of investment decisions. These biases have a tendency of causing an illusion of validity (Fisher & Statman, 2000, 72); they make people believe that their thought process is rational when, in fact, it is not. Several studies of these biases and their negative effects on investment decisions have been done previously, examples and conclusions of which will be discussed later on in the thesis.

The thesis will ultimately attempt to answer the question “Why do cognitive biases occur in investing?”. Additional questions that the thesis will try to answer are “What kinds of cognitive biases do investors face?” and “What can investors do to avoid cognitive biases?” The purpose of the thesis is to provide information especially to amateur investors about the possible cognitive biases that might occur in their

investment decisions without them noticing. By exposing some of the most common flaws of investor behavior the thesis attempts to help investors recognize and eliminate the irrationalities in their decision-making processes.

The second chapter of this thesis will introduce the concept of rationality, describe investment risk and how it differs in different financial markets, as well as define and describe the efficient market hypothesis. The third chapter will define and elaborate different kinds of heuristics and cognitive biases that constantly affect rational decision-making and cause a spiral of irrational behavior. The fourth chapter will further explain different cognitive biases and their occurrence investing, as well as how investors can be susceptible to many cognitive biases at once in certain kinds of situations. The fifth chapter draws conclusions based on the first four chapters, as well as provides suggestions for future research on the subject.

2 RATIONAL INVESTMENT DECISIONS

This chapter will introduce the terms that need to be taken into account when making investment decisions. The chapter will first introduce the term of rationality because in order to make rational investment decisions it is important to grasp on what it means to act rationally. Next, the chapter will define and explain the meaning and significance of investment risk because it is necessary to understand that different securities have different amounts of risk associated with them. Further on, the chapter will introduce a term called the efficient market hypothesis. It is vital for an investor to understand, and it will also help in comprehending the causes of the different cognitive biases that will be introduced and explained in the third chapter of this thesis.

2.1 Rationality

People have found defining rationality a difficult task, as it has been under a lot of debate. However, it has been generally agreed that acting rationally and making rational decisions should obey some rules of consistency and coherence. (Tversky & Kahneman, 1981) Human beings, however, act according to what is known as bounded rationality in the presence of uncertainty and imperfect competition. When rationality is bounded, it is lacking omniscience. (Simon, 1979) This means that the existence of asymmetrical information, unequal opportunity and uncertainty of outcomes result in irrational behavior at least to some extent, as people do not know "everything about everything".

Even experienced researchers can make irrational decisions if they act according to their intuition (Tversky & Kahneman, 1974). This implies that acting according to one's intuition is bound to be an act of irrational behavior. The third chapter of the thesis will introduce what are known as heuristics and cognitive biases that have been proven to underlie irrational behavior and bounded rationality.

2.2 Investment Risk

Investors have the possibility of investing on four different kinds of markets: the money market, the securities market, the foreign exchange market and the derivatives

market. The money market deals with short-term securities and the transfer of funds with a maximum term to maturity of one year. The other three markets belong to the capital market, which deals with long-term securities and the transfer of funds of securities with a term to maturity of over one year. (Pilbeam, 2010, 33, 35.) All of the markets have different kinds and varying amounts of risk associated with them.

2.2.1 Money Market

The money market is a part of the fixed-income market. Short-term debt securities are traded on the money market. A large portion of these securities is traded in great quantities, so they are not available to individual investors. Small investors, however, have the possibility of investing in money market funds that purchase various money market securities on behalf of these investors. Examples of these securities are Treasury bills, certificates of deposit and commercial papers. (Bodie, Kane, & Marcus, 2014, 29–30.)

Treasury bills (T-bills) are more marketable than any other money market instrument. T-bills are offered to the public by the government with the purpose to raise money. T-bills have a maturity value that is paid back to the investors at their maturity date. The profit made by investors comes from the fact that the government sells T-bills to the public at a discount from the maturity value. T-bills are known to be easily converted to cash and sold at low transaction cost, as well as having little price risk. What additionally makes them attractive to investors is the fact that profits from T-bills are not subject to tax deductions. (Bodie et al., 2014, 29.)

Certificates of deposit (CDs) can basically be defined as bank deposits that have a certain fixed date when the deposit is returned to the depositor or investor. A deposit cannot be withdrawn from the bank on demand. The bank pays the depositor the principle sum plus interest only at the end of the fixed term. However, CDs that are issued with a greater face value than 100 000 dollars can be negotiated to be sold to another investor if the holder of the CD needs to convert the CD into cash before its date of maturity. Short-term CDs are typically highly marketable, but the market becomes remarkably smaller when the maturity of CDs is over three months. (Bodie et al., 2014, 30.) The risks that are associated with CDs can be considered fairly

minimal taking into account that CDs with a face value of over 100 000 dollars can be possibly sold on.

Commercial papers are unsecured short-term debt notes issued by large, significant companies that are known to the general public. It is very common that commercial papers grant investors with a line of credit that they can use to pay off the commercial paper if necessary. Commercial papers have a maturity of up to 270 days, although they typically have a maturity of under one or two months. Small investors can only invest in commercial papers via money market mutual funds because commercial papers are commonly issued in multiples of 100 000 dollars. Investing in these securities is typically considered to be relatively safe, as a maturity of only one month allows the condition of a firm to be monitored and predicted over such a short period of time. However, assets-backed commercial papers issued by financial firms such as banks were some years ago used to raise capital for these financial institutions to invest in other kinds of securities, such as subprime mortgages. The issuing of these kinds of commercial papers caused a chain of events that ultimately led to the financial crisis of 2008. (Bodie et al., 2014, 30–31.)

It is important to understand that money market securities, despite having low risk, are not risk-free. T-bills have the lowest risk as well as the lowest yield of all money market securities, and the risk associated with them is fairly minimal. However, the other money market instruments have a higher yield than T-bills to compensate for the higher risk that investors have to bear when holding these riskier securities. (Bodie et al., 2014, 32.)

2.2.2 Securities Market

The amount of risk that is associated with making an investment on the securities market depends on the kind of financial securities that are being invested in. A financial security can be defined as a legal claim to a future cash flow. A financial security has an issuer who gives the legal ownership of the financial security to an investor in exchange for the amount of cash that the financial security is worth. The issuer of the financial security agrees to make future cash payments to the investor as

a compensation for the risk the investor is bearing for owning the financial security. (Pilbeam, 2010, 28-29.)

The risk on a financial security can basically be defined as the probability that the actual return of the security will be lower than its expected return. In the securities market, investors can choose to invest in either stocks or bonds; that is, in equity or debt securities. The former of the securities have more risk associated to them as the latter because the rate of interest that bond holders receive is usually fixed, whereas the expected rate of return on stocks is more uncertain. (Pilbeam, 2010, 156.)

Debt securities are traded in the bond market. These securities differ from money market securities in the sense that these debt securities have a term to maturity of over one year, whereas money market securities only deal with securities with a maturity of up to one year. Securities that are included in the bond market are, for example, Treasury notes and bonds, corporate bonds and mortgage securities. (Bodie et al., 2014, 34.)

Treasury notes and bonds are long-term debt securities issued by the government. They differ from each other in their maturity times; T-notes have a term to maturity of up to 10 years, whereas the maturity of T-bonds ranges from 10-30 years. In the US, both securities can be issued at a face value of 100 dollars, but typically both securities are issued in increments of 1000 dollars. Both securities make coupon payments, which are basically payments of interest that are paid semiannually to the holders of these securities. The least risky Treasury bonds are called inflation-protected Treasury bonds, which are linked to an index of the cost of living. This kind of a Treasury bond is employed in many countries around the world, and the point of it is to provide the citizens of a country an effective way to reduce the risk caused by inflation. (Bodie et al., 2014, 34–35.)

Corporate bonds are issued by private companies with the purpose of raising capital for their operations. Similar to Treasury bonds and notes, corporate bonds make semiannual coupon payments to investors during their term to maturity, and the face value is return to the bondholders at maturity. However, the risk related to corporate bonds is significantly higher than the risk associated with T-bonds and notes.

Corporate bonds have the risk of the bond issuer going bankrupt, which can result in bondholders losing their entire investment. Corporate bonds can also have different options attached to them, which will be described later on in this chapter. (Bodie et al., 2014, 39.)

The value of a bond can be estimated by using bond-valuation models. A simple model that is commonly used is presented in the following formula:

$$Bond\ Price = C * \frac{\left[1 - \left[\frac{1}{(1+i)^n}\right]\right]}{i} + \frac{M}{(1+i)^n} \quad , \qquad (1)$$

where

C = coupon payment

i = yield to maturity

n = term to maturity

M = face value of bond

The coupon payment is the interest payment that the bondholder receives, for example, annually until the bond matures. Yield to maturity is the percentage of interest that the bondholder receives, for example, annually until the maturity date of the bond. Term to maturity is the number of, for example, years until the bond matures. The face value of a bond is the amount of money that the bondholder has invested in the bond when buying it.

The rapid expansion of mortgage-backed securities has led to the majority of people having the opportunity of investing in a mortgage loan portfolio. Resultingly, mortgage loans are a significant part of the fixed-income market today. These kinds of securities can be defined as a right to own a pool of mortgages or an obligation that is secured by a mortgage pool. As mentioned earlier in this chapter, subprime mortgages,

which are loans offered to financially weaker borrowers with higher risk, were a major component in the happening of the financial crisis in 2008, during which banks, hedge funds and other investors, as well as people who were holders of subprime mortgage securities ended up making huge financial losses. After the financial crisis, people are likely to be more careful regarding the securitization, that is, turning for example a mortgage loan into a security because of the potential risks of such practice, the worst possible outcome of which was demonstrated in the financial crisis. (Bodie et al., 2014, 39–40.)

Common stocks, also known as equity securities, of most large companies are usually traded freely on at least one stock exchange. Owning shares of a stock means that the shareholder owns a part of the company, the shares of which they hold. Every shareholder has the right to participate in annual meetings and vote on issues related to the governance of the company. Sometimes, however, a company can issue two kinds of common stock, of which the first one entitles the shareholder a vote, while the other does not. This might result in the nonvoting stock having a cheaper price than the voting stock. Shareholders also elect the board of directors for the company, and the board chooses managers to run the company. The board oversees the management of the firm in order to make sure that the management is acting in such a way that is in the best interest of the shareholders. (Bodie et al., 2014, 41–42.)

The investment risks that are associated with investing in common stock have to do with residual claim and limited liability. Residual claim means that shareholders will be paid last if the assets of the company are liquidated. The risk in this is in the fact that the company may not necessarily have enough assets to pay back all of the money that the it owes, and so, as the shareholders are last in line, shareholders might not be able to get their money back. Limited liability means that the most a shareholder can lose if the company goes bankrupt is their original investment, but they are not personally responsible for the firm’s obligations. (Bodie et al., 2014, 42)

2.2.3 Derivatives Market

The derivatives market has experienced significant growth in recent years. The values of derivatives are based on the values of other financial securities, such as stocks,

bonds or market index values. Examples of derivatives, or derivative securities, are options and futures contracts. (Bodie et al., 2014, 51)

There are two kinds of options, call options and put options. A call option gives an investor the possibility to purchase, for example, shares of stock for a certain predetermined price on or before the expiration date of the option. The idea of the option is that the investor could purchase a certain number of shares of stock for a price that is lower than the market value of the stock. (Bodie et al., 2014, 51) For example, if an investor has an option to purchase shares of stock of a company for 150 US dollars it would be profitable for the investor to use the call option if the market value of the stock decreases to under 150 US dollars.

A put option gives an investor the right to sell, for example, shares of stock for a predetermined price on or before the expiration date of the option. The point of a put option is similar to a call option in the sense that it is rational for an investor to use the put option if the market value of the security that the option is attached to increases above the predetermined price of the option. (Bodie et al., 2014, 51) For example, if the predetermined price of the put option is 150 US dollars it is rational for the investor to use the option if the market value of the stock increases above 150 US dollars.

A futures contract calls that an investor will buy a security from another investor at a specified price at a specified date in the future. The contract can benefit either one of the investors, depending on what happens to the market price of the security in between the date of making the futures contract and the date on which the security is delivered. The buyer benefits from the contract if the specified price is lower than market price of the security when the trade is made, and the seller makes a profit on the contract if the specified price is higher than the market price of the security when the trade is made. (Bodie et al., 2014, 53) For example, if the specified price of the futures contract is 50 US dollars the buyer benefits from the trade at the specified date if the market price of the security is higher than 50 US dollars when the trade is made, and the seller benefits from the contract if the market price is lower than 50 US dollars when the trade is made. This implies that the risk in futures contracts is in the uncertainty, whether the market price of the security will increase or decrease in between the date of making the contract and the date of making the trade.

2.2.4 Market Indexes and Indicators

Stock market indexes are basically large portfolios of significant companies, the purpose of which is to describe the performance of the national stock market as a whole. Some of the most significant stock market indexes world-wide are the Dow Jones Industrial Average in the US, the Nikkei Average of Tokyo in Japan and the Financial Times index of London in Great Britain. Each of the above-mentioned market indexes measure the performance of the stock market in their own country. (Bodie et al., 2014, 44)

Bond market indicators have the same logic as stock market indexes, as there are several indicators that attempt to describe the performance of different kinds of bonds. The three groups of bond market indexes that are most well-known are Merrill Lynch, Barclays and Salomon Smith Barney (which is now a part of Citigroup). Bond market indexes are, however, traded somewhat infrequently, which means that it is difficult to compute accurate rates of return on many bonds. (Bodie et al., 2014, 50) In other words, the risk that is associated with investing in bond market indexes comes from the fact that the computed rates of return on many bonds do not provide very accurate results. This implies that some bond prices have to be estimated in practice by using bond-valuation models.

2.3 Efficient Market Hypothesis

The efficient market hypothesis (EMH) states that capital markets that are well-organized are efficient markets. The EMH argues that although inefficiencies might exist in well-organized capital markets they occur only seldom and are rather insignificant. (Ross, Westerfield, & Jordan, 2008, 391) Another way to describe the EMH was proposed by Fama (1970) who defined the EMH as the hypothesis that security prices fully reflect all available information. The idea behind both definitions is that capital markets will ultimately organize themselves in such a manner that investors will find it hard to make abnormal returns.

The efficient markets theory was first proposed in 1900 by the French mathematician Louis Bachelier in his PhD thesis “The Theory of Speculation”, in which he discussed

the price changes of stocks and commodities and how the prices seemed equivalent in different situations (Bachelier, 1900). However, Bachelier's theory was similar to the random walk theory proposed by Jules Regnault in his book from 1863, "Calculation of the Chance and Philosophy of the Stock Market" (Regnault, 1863), which poses a question, whether Bachelier based his theory on the work of Regnault.

The most significant contribution to the EMH, however, was made by Eugene Fama (1970), who stated that it is impossible for investors to buy underpriced securities or sell overpriced securities. Fama used three different kinds of tests to underpin the validity of the EMH: weak form tests, semi-strong form tests and strong form tests. The three kinds of tests took different factors into account, and all of them showed results that supported the EMH.

Many investors use most of their time trying to find mispriced stocks; that is, stocks the price of which is lower or higher than it should be. These investors analyze different companies thoroughly in order to find stocks the price of which does not correlate correctly with how well the company is doing. The number of investors operating this way is significant, which results in competition between these kinds of investors. The competition among these investors means that the number of mispriced stocks on the market decreases all the time. In other words, the price of stocks on the market approaches their actual and correct price, and this implies that the markets are becoming correctly priced. As the definition of an efficient market is that investors pay the exact price that the stocks are worth and the companies receive the exact amount of capital that their stocks are worth, the competition among investors who search for mispriced stocks will ultimately result in the markets becoming efficient. (Ross et al., 2008, 391)

3 COGNITIVE BIASES IN INVESTING

For the sake of simplicity, investors are assumed to always act and behave rationally while making investment decisions. However, the development of behavioral finance has enabled the identification of various fallacies, known as cognitive biases, that can harm the rational behavior of investors. Studies have shown that investors are continuously susceptible to these cognitive biases that have negative effects on the rationality of their investment decisions. Investors, in fact, often act according to one or more cognitive biases without them even recognizing the irrationalities in their investment behavior.

This chapter will introduce some of the most common cognitive biases that affect rational decision-making, the recognition and understanding of which can help investors in preventing the susceptibility to not only the cognitive biases but also the heuristics which lead to them. The chapter will first introduce some of the most common heuristics that affect rational investment behavior. The chapter will then go on to describe the concept of prospect theory that describes the fallacious attitudes of investors on investment risk, as well as some of the most significant cognitive biases that affect investors' decision-making.

3.1 Heuristics

People have a tendency of assessing probabilities of outcomes of uncertain situations by relying on various non-scientific principles or rules of thumb. These principles are not based on facts or statistics, but rather on individual beliefs and assumptions (Tversky & Kahneman, 1974). In other words, people think that an uncertain situation most probably has a certain kind of outcome because they base their assessment on their own assumptions that, in fact, have no scientific or statistical proof or basis. These beliefs and assumptions that people use to evaluate and decide upon the outcomes or results of uncertain situations are called heuristics.

Tversky and Kahneman (1974) presented three heuristics that people use to make decisions and judgements in uncertain situations. The first of these is representativeness, which people often use when they are asked to assess, for example,

the probability of A belonging to a certain group B. Representativeness is basically used to assess the probability of situations concerning the relationship between different factors, such as A and B. The problem with representativeness is that it does not take all the factors that are relevant to assessing probability into account.

The second heuristic, according to Tversky and Kahneman (1974), is called availability of instances or scenarios which basically means that people have a tendency to evaluate, for example, the risk of a middle-aged person having a heart attack based on the amount of heart attacks of their own acquaintances. Another example provided by Tversky and Kahneman (1974) was that people might assess the probability of a business failing based on the risks and difficulties that can possibly be associated with the business. The problem with this approach is that the availability of instances or scenarios is affected by many other factors than just the frequency of instances or scenarios and the probability of these events occurring.

The third heuristic proposed by Tversky and Kahneman (1974) is called adjustment and anchoring. People tend to use this heuristic to assess the probability of a future result by basing their assessment on an initial value that they adjust to come up with their assessment on the future result. Kahneman and Tversky argue that people have a tendency to underestimate the probability of failure when assessing the probability of a complex system. For example, Bar-Hillel (1973 via Tversky & Kahneman, 1974) completed a study where subjects were asked to choose between three different types of gambles: simple events, conjunctive events and disjunctive events. An example of a simple event was to draw a red marble from a bag where 50 percent of the marbles were red, and 50 percent were white. A conjunctive event was to, for example, draw a red marble seven consecutive times from a bag where 90 percent of the marbles were red, and 10 percent were white. A disjunctive event was to, for example, draw a red marble at least once in seven successive tries from a bag where 10 percent of the marbles were red, and 90 percent were white. The study revealed that subjects were more likely to bet on a conjunctive event than a simple event, although the probability of the conjunctive event was 0.48, and the probability of the simple event was 0.50. Subjects were also more likely to bet on a simple event than a disjunctive event, although the probability of the disjunctive event was 0.52. This implies that people are prone to overestimate the probability of conjunctive events and underestimate the

probability of disjunctive events. The findings can be explained to be the cause of the anchoring bias, which will be described more in depth later on in this chapter.

According to Tversky and Kahneman (1974), the three heuristics presented above are "highly economical and usually effective, but they lead to systematic and predictable errors". They argued that better decisions could be made in uncertain situations by understanding these heuristics as well as the biases to which these heuristics lead.

3.2 Prospect Theory

Prospect theory was created by Daniel Kahneman and Amos Tversky in 1979. They argued that the expected utility theory that was used in the analysis of decision making under risk was incomplete. Kahneman and Tversky presented examples in their paper "Prospect theory: An analysis of decision under risk" that proved that people do not obey the axioms of the expected utility theory in all circumstances. For instance, one of the examples presented by Kahneman and Tversky was, whether a person would choose to take 450 of the Israeli currency or take a gamble, in which the person would have a 50% chance to win 1000 and a 50% chance to win nothing. It would be rational for the person to choose to take a gamble because the expected value of the gamble is:

$$E(X) = 0.5 * 1000 + 0.5 * 0 = 500 > 450$$

In other words, the expected value of the gamble is greater than that of taking 450. However, according to Kahneman and Tversky, people are more likely to choose to take 450. Rationality would suggest taking the gamble, but people have a tendency to fear losing 450 (which they do not actually lose) more than believing in the gamble, the expected value of which is 50 greater than 450. This is irrational. (Kahneman & Tversky, 1979.)

The example presented above is, however, not adequate enough to explain prospect theory because different amounts of risk have varying effects on people's investment decisions. Kahneman and Tversky presented several further examples demonstrating people's attitudes towards varied amounts of risk regarding investment decisions, which will be discussed further in chapter 4 of this paper.

The disposition effect is a cognitive bias that describes how investors are prone to sell securities from which they have profited and to keep securities on which they have made a loss (Weber & Camerer, 1998). Furthermore, Kahneman and Tversky (Kahneman & Tversky, 1979, 26.) demonstrated that "a person who has not made peace with his losses is likely to accept gambles that would be unacceptable to him otherwise." In other words, the disposition effect is closely related with the findings of Tversky and Kahneman (Kahneman & Tversky, 1979) that will be discussed more in depth in the fourth chapter of this thesis.

3.3 Overconfidence

Overconfidence is one of the most common cognitive biases affecting the rationality of people's investment decisions. Overconfidence has been proven to cause people to overestimate their own knowledge and ability to control the outcome of situations and underestimate the risks associated with those situations. (Nofsinger, 2005, 10.)

Investing requires the collecting and analyzing of information, as well as making decisions based on the collected information. However, this is not easy and so people have a tendency to misinterpret the accuracy of the information and overestimate their ability to analyze the collected information correctly. This kind of overconfident behavior can lead to irrational investment decisions, excessive risk-taking and eventually a negative return on investment (ROI). (Nofsinger, 2005, 11.)

The negative effects resulting from overconfidence often start occurring after an investor has received positive results from their investments. After receiving a positive return on their investment, the investor starts believing more in their own opinion and judgement, and less on the impact of luck. Ultimately, this often results in the investor becoming overconfident, which means that the investor becomes prone to the different fallacies that may result from overconfidence. (Nofsinger, 2005, 18.)

There may, however, be a way to avoid overconfidence at least in certain situations. Fisher and Statman (2000) argued that overconfidence could be avoided by adjusting estimates of uncertain situations in such a way that the confidence intervals of the made estimates would reflect the level of knowledge of the decision-maker as

accurately as possible. In other words, the less the decision-maker knows about the subject of estimation, the less accurate of an estimate they should make. The estimate should be narrowed down to such a frame that the decision-maker would be confident that the correct answer would not be outside of the frame.

3.4 Anchoring

Investors are prone to fixate on certain prices of stocks, which are called reference points. Fixating on these reference points is in the core of the anchoring bias because people base their judgement, whether they experience a win or a loss on their investment, on the specific reference points. These points are, however, merely created by investors, as they are not based on any scientific evidence, but rather on what prices the investors have seen the stocks reaching. (Baker & Nofsinger, 2002) For example, an investor may have seen the price of a stock fluctuating between 25 US dollars and 35 US dollars. In this case, the investor starts treating 25 US dollars and 35 US dollars as benchmarks as they are making judgements on how successful their investment has been.

The anchoring bias was originally introduced by Tversky and Kahneman (1974) who explained that people have a tendency of estimating a certain value based on an initial value that has been presented to them. In other words, the estimates people make end up being relatively close to the initial value, or anchor, that has been presented to them before making the estimate. Tversky and Kahneman (1974) defined this exact occurrence as the anchoring bias.

Jacowitz and Kahneman (1995) later described that numerical estimates made by people end up being close to an anchor, which is the initial value, that they have been caused to consider before making the estimate. They called this the anchoring effect.

4 STUDIES AND DISCUSSION

The third chapter of this thesis introduced the concept of prospect theory by describing the irrationalities that emerge in the decision-making processes of investors when deciding upon choosing between a gamble or a certain gain. The expected value of choosing the gamble proved to be higher than the certain profit, but the majority of people would irrationally avoid the gamble and take the certain gain. Why is this? Kahneman and Tversky (1979) explained that the irrational behavior occurs due to a reference point that people consider when making a decision. The reference point can be, for example, the status quo or the amount of total assets of the person making the decision. The reference point is an important factor regarding the outcome of the decision, as it alters the investment behavior of the person making the decision according to the relevant reference point, which implies that the person making the decision becomes risk-averse or risk-taking depending on the reference point in question. (Kahneman & Tversky, 1979)

Tversky and Kahneman (1992) indicated that, according to prospect theory, making a decision includes two phases: First, the decision-maker uses a concept called framing to gather all the necessary materials and information that are necessary to be able to make a decision on the matter. Following the first phase, the decision-maker uses what is known as valuation to give value to the various options regarding the decision, and makes a decision based on the determined valuation.

The disposition effect is a cognitive bias that makes people risk-averse when their investment has increased in value and risk-taking when the value of their investment has decreased. In other words, people tend to sell, for example, their shares of stock when they would make a profit from selling the shares, and hold on to their shares if selling the shares would make them suffer a loss. (Weber & Camerer, 1998) This implies that people are not consistent regarding their attitudes towards risk. Furthermore, Tversky and Kahneman (1981) stated that people have a tendency to evaluate the risk of an uncertain choice differently when the options regarding the choice are presented as gains or losses. This is a cognitive bias called the framing effect.

Jacowitz and Kahneman (1995) further demonstrated that the way a choice is presented to people has a significant effect on the decisions they end up making. The study showed that the median estimates people made when they were asked to guess, for example, the height of Mount Everest or the population of Chicago, were greatly varying on every question because people were given different initial values, or anchors, before they were asked to make the estimates. The study emphasized the validity of the anchoring effect because the estimates people made were clearly affected by the initial value that was presented to them. The study also showed that the anchors subjects were given beforehand seemed to have an effect on the level of confidence that they had regarding making the estimate; subjects seemed to believe that the anchors presented to them had value regarding their decision-making. However, the amount of knowledge that subjects had before they were presented with an initial value had no distinguishable effects in people's susceptibility to the anchoring effect.

Barberis and Thaler (2003) stated that the decision-making of investors appears to be affected by the familiarity and ambiguity of different possible investment decisions. For example, people seem to be more willing to invest in the stock market of their own country than in a foreign market index even though investing in the index would be less risky. This is due to the perception of investors that investing in the foreign index would be more ambiguous or less familiar than investing in the national stock market. Odean (1999) described that selling investments is greatly related with the anchoring effect. In other words, people have a tendency to base their decision to sell their investments more on what has happened in the past than what is predicted to happen in the future. This implies that investors are prone to base their prediction of the future on the past, which is irrational. Odean (1999) further stated that investors consider their investments profitable or not profitable based on a certain reference point or break-even point; if the selling price of an investment is higher than its reference point, which could be, for example, the initial buying price of the investment, the investor considers it a gain, and if the selling price of the investment is lower than the reference point, the investor considers it a loss. However, Odean (1999) explained that a person who has, for example, bought a house for an initial price of 100 000 US dollars does not consider oneself breaking even if the house is sold for 100 000 US dollars when the value of the house is estimated to be 200 000 US dollars at the time of selling. In

other words, investors do not consider different reference points accurate in certain situations when the status quo is changing rapidly.

5 CONCLUSIONS

People act according to bounded rationality because people do not know everything. Uncertainty is present in every investment decision because the future is unknown. As people, we are not fond of uncertainty, but on the contrary we despise it and we want to get rid of it. This means that we get the urge to fill the lack of certainty with an ersatz that gives us a feeling of security, as if we would know what the outcome of an uncertain situation will be. This kind of thinking leads us to stray from the path of rationality into the realm of irrationality and heuristics.

Heuristics provide us an illusion of certainty; they make us feel that we are in control of the future, and that we know what the outcome of an uncertain situation will be when this is truly not the case. Although heuristics can be used to come up with relatively accurate estimates of uncertain situations, they are not consistent, and they will ultimately provide us erroneous results. However, people do not understand this, as the seemingly accurate estimates give people a sense of validity and legitimacy about using heuristics. This leads to people using heuristics always when faced with uncertainty, and eventually it becomes a habit. This habit of using heuristics leads to people having cognitive biases when assessing uncertainty.

Cognitive biases cause systematic irrational behavior in people when they are faced with uncertainty and risk. These biases differ from each other but the principle in each one is the same: people base their estimates of uncertain situations on non-scientific principles, and so they are bound to not make the best possible choices when evaluating options of uncertain choices; The disposition effect causes investors to sell investments too early and hold on to investments for too long, the anchoring bias causes people to predict the future based on the past and overconfidence makes people neglect facts and make decisions only based on their own intuition and know-how.

The problem with cognitive biases seems to be that people do not even realize that they are behaving irrationally and according to various cognitive biases. This implies that the problem could only be solved if people could avoid behaving according to the cognitive biases in the first place, and so the solution to the problem should be found by observing the cause of the cognitive biases: heuristics. Cognitive biases appear to

be further developed forms of different heuristics, which implies that the process that ultimately leads to cognitive biases can be reverse engineered in order to find the root cause of cognitive biases. As stated previously, heuristics lead to cognitive biases, but why do heuristics exist? They exist because people are not perfectly rational beings; nobody knows everything about everything, and so people use their intuition to make the feeling of uncertainty disappear. Uncertainty, in this case, means the uncomfortable feeling of not knowing something regarding a decision, choice or prediction. However, using one's intuition is irrational, and this is where the problems begin; people start using heuristics because their intuition tells them that it is a smart move to make. Then people see that heuristics provide them fairly accurate results regarding their decision, choice or prediction, and they start believing that using heuristics is rational. However, heuristics are neither consistent nor do they provide the best possible results, and so it is, in fact, irrational to use them. Nevertheless, people use them because they believe that it is rational. Once people lean on heuristics for long enough, using them becomes a habit, and eventually these heuristics become cognitive biases, which means that people behave irrationally on a consistent basis, and so they are continuously not making the best possible choices, which implies that at least some results are bound to be adverse.

Investing has a lot to do with acting rationally and perceiving different amounts of risk. However, the existence of cognitive biases can provide investors more or less confusing results. This is, because investors believe that they are making rational decisions day in day out when they are, in fact, behaving irrationally regarding every single investment decision that they are making, and they do not even realize it. Because of this, investors end up pondering the negative results that they are getting from their investments, and they will most likely not figure out the root cause of their negative results by themselves. Investors should therefore be informed that the belief that they have regarding the rationality of heuristics is a fallacy.

Further research should focus on finding out ways to make people feel comfortable while dealing with uncertainty because uncertainty is what seems to drive people to behave irrationally. People cannot, at least for now, know everything about everything, and so irrational behavior cannot be eliminated. Because of this, research should focus on getting rid of the irrational coping mechanisms that people use to deal with

uncertainty so that people would attempt to make as rational decisions as they can in uncertain situations with the inevitably limited amount of information that they have.

REFERENCES

Bachelier, L. (1900). Théorie de la spéculation. Paper presented at the *Annales Scientifiques De L'École Normale Supérieure, , 17* 21-86.

Baker, H. K. & Nofsinger, J. R. (2002). Psychological biases of investors. *Financial Services Review, 11*(2), 97-117.

Barberis, N. & Thaler, R. (2003). A survey of behavioral finance. *Handbook of the Economics of Finance, 1*, 1053-1128.

Bar-Hillel, M. (1973). On the subjective probability of compound events. *Organizational Behavior and Human Performance, 9*(3), 396-406.

Bodie, Z, Kane, A. & Marcus, A. J. (2014). *Investments* (10th global ed ed.). New York: McGraw Hill Education.

Fama, E. F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. *The Journal of Finance, 25*(2), 383-417. doi:10.2307/2325486

Fisher, K. L. & Statman, M. (2000). Cognitive biases in market forecasts. *Journal of Portfolio Management, 27*(1), 72-81.

Jacowitz, K. E. & Kahneman, D. (1995). Measures of anchoring in estimation tasks. *Personality and Social Psychology Bulletin, 21*(11), 1161-1166.

Kahneman, D. & Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. *Econometrica, 47*(2), 263-291. doi:10.2307/1914185

Nofsinger, J. R. (2005). *The psychology of investing* (2. ed.). Upper Saddle River (N.J.): Pearson Prentice Hall.

Odean, T. (1999). Do investors trade too much? *American Economic Review, 89*(5), 1279-1298.

Pilbeam, K. (2010). *Finance and financial markets* (3rd ed ed.). Basingstoke: Palgrave Macmillan.

Regnault, J. (1863). *Calcul des chances et philosophie de la bourse* Mallet-Bachelier.

Ross, S. A, Westerfield, R. & Jordan, B. D. (2008). *Fundamentals of corporate finance* Tata McGraw-Hill Education.

Simon, H. A. (1979). Rational decision making in business organizations. *The American Economic Review, 69*(4), 493-513.

Tversky, A. & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science, 185*(4157), 1124-1131.

Tversky, A. & Kahneman, D. (1981). The framing of decisions and the psychology of choice. *Science, 211*(4481), 453-458.

Tversky, A. & Kahneman, D. (1992). Advances in prospect theory: Cumulative representation of uncertainty. *Journal of Risk and Uncertainty, 5*(4), 297-323.

Weber, M. & Camerer, C. F. (1998). The disposition effect in securities trading: An experimental analysis. *Journal of Economic Behavior & Organization, 33*(2), 167-184.