

Cognitive Bias and their Implications on the Financial Market

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Abstract— Behavioral Finance is a science that encompasses the knowledge of finance, economics and cognitive psychology in order to understand the investment decision making process. The main objective of this paper is to demonstrate that the emergence of behavioral finance contributes to a better understanding about the decision making process. Behavioral finance presents evidence that this process can be triggered by cognitive illusions, heuristics and cognitive biases, resulting in misleading investment decision-making, which is not based on rationality. In general, the goal of learning about the cognitive biases and the decision-making process is being able to recognize situations in which these particular errors can manifest themselves. This way, it can help investors to avoid mistakes in the process of asset allocation and, consequently, improve future performance. It provides a better theoretical foundation of the investor's behavior, one can better understand the dynamics of financial markets and avoid actions of euphoria and panic that can produce serious economic consequences, as evidenced by recurring financial crises in history.

Index Term— Behavioral Finance, Cognitive Illusions, Heuristics, Cognitive Biases, Financial Market.

I. INTRODUCTION

The environment of financial decision making is frequently characterized by its complexity and uncertainty. This context makes investors prioritize their intuition over rationality postulated by modern finance theories. These theories are based on assumptions that the investor is rational, risk-averse and uses the utility curve to maximize his well-being Markowitz (1952) [1], Fama (1970) [2], Sharpe (1963) [3]. Traditional and modern finance are concerned about finding rational solutions for decision problems caused by investor's behavior through the development of assumptions and tools Baker and Nofsinger (2002) [4]. Behavioral finance, in turn, refers to a new science that encompasses finance concepts and cognitive psychology, with the primary objective to understand and predict systematic financial market implications of the psychological process of decision making Olsen (1998) [5]. Behavioral finance is what Thaler (1998) [6], calls an open-minded-finance, because it studies the possibility that some agents in the economy behave sometimes

less than completely based on rationality. According to MostafaSadeghnia; Abdolhamidhooshmand and Habibniko (2013) [7] behavioral finance can be summarized as follows: a. the combination of classical and finance economics and psychology and decision sciences; b. attempts to explain the causes of exceptions in the financial literature; c. examines how investors commit systematic or mental errors in their judgments.

Considering this, the main objective of this paper is to demonstrate that the process of investment decision making can be triggered by cognitive illusions, heuristics and cognitive biases, resulting in the financial markets, in bad decision-making, not based on rationality.

II. CRITICISM OF THE TRADITIONAL FINANCE THEORY

One of the first models of decision making formulated at the beginning of the 19th century was the principle of the *Homo Economicus*. According to this principle, decision makers are: (1) fully informed about all the possible options for their decisions and all the possible outcomes of their decision options, (2) infinitely sensitive to subtle differences between decision options and, (3) fully rational as to their choice of options Edwards (1954) [8].

Such thinking influenced the assumptions of modern finance that financial markets are efficient, economic agents, which are rational and obey the axioms of expected utility theory to make decisions. According to Fama (1965) [9] an efficient market is the market where there are large numbers of rational profit maximizers actively competing, with each trying to predict future market values of individual securities, and where important current information is almost freely available to all participants. Rationality in this context means that investors use all available information in a logical and systematic manner to make optimal choices, given the alternatives available and the objectives to be achieved.

According to Shiller (2003) [10], the Efficient Market Hypothesis (EMH) as a theoretical framework dominated academic circles during the '70s, encouraging the publication of several papers on asset pricing models based on rational expectations. Among them, An Intertemporal Capital Asset Pricing Model (1973) [11], by Robert Merton, Asset Prices in an Exchange Economy (1978) [12], by Robert Lucas, The Theory Consumption Betas (1979) [13], by Douglas Breeden and the book A Random Walk Down Wall Street (1973) [14], by Burton Malkiel. Efficient Market Hypothesis advocates the efficiency of the financial market in terms of the overwhelming information, news, or communication involved. According to Fama (1970) [2], efficient markets are markets where 'there are large numbers of rational profit maximizers

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actively competing, with each trying to predict future market values of individual securities, and where important current information is almost freely available to all participants’.

The 1980s were dedicated to an important academic debate about the consistency of the models of efficient markets, mainly on the excess volatility.

The assumption about the efficiency of markets has a long history in research on finance. However, according to Shiller (2003) [15], from the beginning there has always been a tension on the hypothesis, a feeling that there was something wrong with it. One of the main criticisms of the traditional paradigm which views decision-making as a fully rational process of finding an optimal choice given the information available was stated by Herbert Simon (1955) [15], in his article A Behavioral Model of Rational Choice. In the article Simon (1955) [15], states: ‘Our rationality is bounded, and our acting is constrained’. According to Simon (1955) [15], the dream of rationality as embodied in the *Homo economicus* of economics and psychology required a decision maker to be a supremely skilful actor, whose behaviour could reveal something of the requirements the environment placed on him but nothing about his own cognitive make-up..

Simon (1955) [15], proposed that human rationality is limited by both internal (mental) and external restrictions (environment) and that these limits rather than being seen as separate must fit together like the blades of scissors. According to him, these two blades – the two sources of bounds on our rationality – must fit together closely for rationality to cut. While the external bounds may be more or less immutable from the actors standpoint, the internal bounds comprising the capacities of the cognitive system can be shaped, for instance by evolution or development, to take advantage of the structure of the external environment.

Thus, according to Simon (1955), the mind can take advantage of this connection to make good decisions for the use of mental mechanisms whose internal structures using the structures of external information available in the environment. From this perspective, according to him, "We can see the bounded rationality with a positive outcome of the two types of bounds fitting together". Simon points out: The human behavior is intendedly rational, but only limitedly so. (Simon, 1955, p. 24).

Subsequently, many studies have been conducted questioning the traditional paradigm of unlimited rationality and demonstrating abnormalities in financial markets. Among the most cited are: the study of Paul Slovic (1972) [16], called On the Individual Perception of Risk; Amos Tversky and Daniel Kahneman in (1974) [17], On Heuristic Rules (heuristics driven bias) and Mental Structures (decision frames) in (1979) [18], On the Impossibility of Informational Efficient Markets by Sanford Grossman and Joseph Stiglitz (1985) [19], Judgment under uncertainty: heuristics and biases by Tversky and Kahneman (1974) [20], and Does the Stock Market overreact? by Werner De Bondt and Richard Thaler (1985) [21]. The discovery of these studies and other abnormalities in the financial market led to the publication of a special issue of the Journal of Financial Economics in June 1978.

In the mid-1985, there was sufficient evidence on the validity of the hypothesis on market efficiency. The various

studies cited confirmed that the main assumptions of rational behavior were not entirely correct. Furthermore, it would be necessary to understand other models of human behavior to grasp the process of decision making of investors, as it was being studied in the social sciences Shiller (2003) [22].

III. THE EMERGENCE OF BEHAVIORAL FINANCE

According to Baker (2010) [23], Behavioral Finance emerged in 1980s as a response to emerged failures of the core economic models that explain anomalies in financial markets. This approach is based on the concept of explaining behavior through biases of belief information and non-standard preferences to make an argument for irrational behavior among agents that can explain persistent mispricing of assets and other anomalies. Shefrin (2002) [24], affirm that Behavioral finance flourished when the advances made in psychology called the attention of economists. Among the major studies, those by Paul Slovic (1969) [25], stand out: Analyzing the Expert Judge: A Descriptive Study of a Stockbroker's Decision Processes on brokers, published in the Journal of Applied Psychology in 1969; plus the Psychological Study of Human Judgment: Implications for Investment Decision Making, published in The Journal of Finance in 1972.

However, it was the articles of Amos Tversky and Daniel Kahneman which most impressed researchers in the area of finance. The first Judgment under Uncertainty: Heuristics and Biases, published in the Science Journal in (1974) [17], and Prospect Theory: An Analysis of Decision under Risk, published in Econometrica in (1979) [26]. In the article Judgment under Uncertainty: Heuristics and biases (1974) [17], Kahneman and Tversky describe three heuristics used to access probabilities and predict values. In the article Prospect Theory: An Analysis of Decision under Risk, Tversky and Kahneman (1979) [26], presented a critique of expected utility theory as a descriptive model of decision making in risky situations and developed an alternative model called Prospect Theory.

Later on in 1985, two other articles were published, which became essential for the emergence of behavioral finance. The first by Werner De Bondt and Richard Thaler (1985) [21], titled Does the Stock Market overreact? In this article the authors apply the heuristic of representativeness by Tversky and Kahneman (1974) [17], in market pricing, discovering that investors exaggerate both to good and bad news. However, they argue that the hype leads investors who lost in the past to underestimate prices and past winners to overestimate them.

In the article by Hersh Shefrin and Meir Statman (1985). [28], called The Disposition to Sell Winners too Early and Ride Losers too Long: Theory and Evidence, the authors apply Kahneman and Tversky's notion of framing to holding losses, calling the phenomenon disposition effect. They argued that investors are predisposed to hold losing stocks for too long and sell winning stocks too early.

After 1987, some scholars in Finance and Psychology such as: De Bondt, Thaler, Tversky, Kahneman, Shefrin, Statman, Shiller, among others, began to review the assumptions advocated by traditional finance and study phenomena related to volatility, abnormalities, exaggeration, loss aversion,

cognitive biases and heuristics, thereby strengthening the emergence of the field of behavioral finance.

According to Macedo (2003, p.59) [31], "Behavioral finance mixed concepts of economics, finance and cognitive psychology in an attempt to build a more detailed model of human behavior in financial markets. Thaler (1998) [32], defines behavioral finance as the study of how humans interpret and act on the information to make investment decisions.

For Fuller (2000) [33], Behavioral Finance is a relatively new field in economics that is evidenced among professional investors and can be characterized as an integration of classical economics and finance with the psychology and science of decision making, an attempt to explain what causes some abnormalities that are observed in finance literature.

In brief, Behavioral Finance is a new understanding of the financial markets that emerged in part as a response to the difficulties encountered by traditional paradigms. It requires that some financial phenomena are better understood using models in which agents are not fully rational. The studies conducted by Behavioral Finance have focused on understanding the cognitive illusions and their implications on the behavior of decision makers. As such, cognitive illusions can influence the financial market, as it will be shown below.

3.2 Heuristics

According to studies by Amos Tversky and Daniel Kahnemann (1974) [27], heuristics are mental shortcuts which lighten the cognitive load to make decisions, but can lead to biases in the process of decision making. The heuristics according to them are the means by which agents find excellent solutions, taking into account the costs of making fully rational decisions, since the presence of limitations on the exercise of full and unlimited rationality is plain human nature. The cognitive biases are systematic judgment errors, or rather, are mental errors caused by the simplification of information processing strategy, which often causes a distortion in the way individuals perceive reality. "However, the use of heuristic rules can be based on incorrect assumptions leading agents to commit systematic errors in decision making, People rely on a limited number of heuristic principles which reduce the complex tasks of assessing probabilities and predicting values to simpler judgmental operations. In general, these heuristics are quite useful, but sometimes they lead to severe and systematic errors". (Kahneman and Tversky, 1974, p. 1124) [27].

These authors describe three heuristics that are used in the process of decision making under uncertainty: (a) the representativeness heuristic, which is usually employed when individuals are asked to judge the likelihood of an object or event A, belonging to a class or process B, (b) the availability heuristic for examples or scenarios, which is often used when people are asked to calculate the frequency of a class or the plausibility of a particular development, and (c) adjustment or anchoring, which is usually applied to numerical prediction when a relevant value is available (Kahneman & Tversky,

1974, p. 1131) [27]. The following heuristics are presented in detail.

3.2.1. Representativeness Heuristic

Kahneman and Tversky (1974) [27], suggest that the representativeness heuristic is used when subjects judge the probability of an uncertain event in accordance with: (a) how similar or representative of the population to which it originates it is, and (b) the degree to which it reflects the salient features of the process by which it is generated (such as random).

According to these authors the reasons why individuals use the representativeness heuristic is when they fail to understand the concept of basic estimates, the prevalence of an event or a feature within its population of events or characteristics. Another reason is the insensitivity to the sample size, because it is believed erroneously that small samples of events, people, etc. are similar in all respects to the entire population from which the sample is extracted. People tend to underestimate the likelihood that the characteristics of a small sample of a population inadequately represent those of the entire population. "We also tend to use the representativeness heuristic when we are very aware of anecdotal evidence based on a very small sample of the population" (Kahneman and Tversky, 1974, p. 1124) [27].

They claim: "This approach to the judgment of probability leads to serious errors, because similarity, or representativeness, is not influenced by several factors that should affect judgments of probability If people evaluate probability by representativeness, therefore, prior probabilities will be neglected" (Kahneman and Tversky, 1974, p. 1124) [27].

3.2.2 Availability Heuristic

According to Kahneman and Tversky (1974) [27], individuals use the availability heuristic when making judgments on the basis of how easily they can use the memory of what they perceive as relevant circumstances of a phenomenon. The availability heuristic occurs because people have a strong tendency to focus their attention on a particular fact rather than the entire situation, only because this particular fact is more present in their minds Brabazon, (2000) [34], Tversky and Kahneman, (1974) [27], "Availability is a useful clue for assessing frequency or probability, because of instances of large classes (Kahneman and Tversky, 1974, p. 1127) [27]. However, the use of the availability heuristic can lead to the occurrence of some cognitive biases, as shown below:

- Biases due to the recoverability of examples: judging the size of a trial class by the ease of recovery due to the occurrence of a greater number of examples.
- Imagination biases - judging the possibility of occurrence of events that are not stored in the memory by generating responses based on certain rules.

According to Tversky and Kahneman, (1974) [27], another cognitive bias that can occur as a result of the availability heuristic is illusory correlation. Because it causes people to seek correlations between information that they are more

familiar with or which is more present in their minds. This may contribute to exaggerated highs or lows of the stock price or in the market Brabazon (2000) [35]. The illusory correlation is the tendency to view events or specific attributes and specific categories as belonging together, because we have a pre-disposition to do so. For events, we can see spurious relations of cause and effect. In the case of attributes, personal losses may be used to form and use stereotypes Fuller (2000) [36].

3.2.3 Anchoring and Adjustment

Anchoring and adjustment are tools, used by the brain to solve complex problems for the initial selection of a quantifiable estimate that will be slowly adjusted to the correct answers as new information is being received. However, according to Kahneman and Tversky (1974, p. 1128) [17], "Such adjustments are typically insufficient". The tendency to anchor (anchoring and adjustment) can cause investors to use a certain mental anchor mark to buy or sell a stock. This anchor could be a price, achieved at a determined time before a sale or purchase or a forecast of an analyst. Once the anchor is formed, investors tend to give little value to new information, even if it changes the profile of the company.

According Kahneman and Tversky (1974) [17], the use of the availability and adjustment heuristic leads to the occurrence of the following cognitive biases:

- insufficient adjustment bias - the bias is caused by insufficient adjustments to the final anchor in relation to what was established by the initial anchor.
- bias in the evaluation of conjunctive and disjunctive events - this bias is displayed by individuals when they tend to overestimate the probability of conjunctive events and underestimate the probability of disjunctive events.
- anchoring bias in assessment of subjective probability distributions - this bias is due to subjective assessments of quantitative values.

3.3 Cognitive illusions caused by mental structures

As previously mentioned, the process of decision making is also influenced by mental structures, i.e., by how the choices are presented. The following section presents some cognitive illusions caused by mental structures:

3.3.1 Frame Dependence

According to Shefrin (2002, p.21.) [29], "Frame is the form used to describe a decision problem". Framing is a heuristic in which people tend to draw conclusions based on the structure in which a situation was presented. According to Ritter (2003, p. 33) [28], it is the notion that the way of how a concept is presented matters". The concept of frame dependence means that the way people behave depends on how their decision problems were structured.

3.3.2 Prospect Theory

The prospect theory by Daniel Kahnemann and Amos Tversky (1979) [26], promotes evidence of frame dependence. The

Prospect Theory makes a critique of expected utility theory as a descriptive model of decision making under risk, and develops an alternative model. Thus, for Kahneman and Tversky (1979) [26], prospect theory is an alternative theory of choice, in which the value is assigned to gains and losses rather than final goods, in which probabilities are replaced by decision weights. The value function of prospect theory is normally concave for gains and commonly convex for losses and is generally steeper for losses than for gains. The weights in the decisions are generally lower than the corresponding probabilities, except in intervals of low probabilities, as shown in Figure 2. Therefore, the great weight given to low probabilities may contribute to the attractiveness in the fields of insurance and gambling Kahneman and Tversky (1979, p. 263) [26].

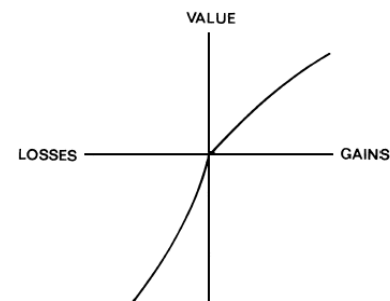


Fig. 1. Hypothetical Value Function of Prospect Theory. [26]

Source:

In summary, the prospect theory demonstrates that individuals tend to choose the options that demonstrate risk aversion when faced with a choice that involves potential gains. Specifically, we tend to choose options that offer a small but certain gain, rather than a larger but uncertain gain, unless the gain is much more uncertain or only modestly lower than the right one. On the other hand, one tends to choose the options that demonstrate risk seeking when faced with choices involving potential losses, meaning one tends to select options that offer a great but uncertain loss instead of a certain but minor loss, unless the uncertain loss is tremendously larger or only slightly smaller than the right one.

According to Plous (1993) [29], contrary to the expected utility theory, prospect theory believes that the choice preferences in a decision making process will depend on how a problem is structured. If the reference point is defined by an outcome perceived as a gain, then the resulting function value is concave and decision makers tend to be risk averse. On the other hand, if the reference point is defined by a result perceived as a loss, function value is convex and decision-makers are predisposed to risk.

3.3.3 Disposition effect

The disposition effect is based on studies conducted by the prospect theory by Shefrin and Statman (1985) [30]. It is considered a psychological effect related to a predisposition of individuals to determine the initial value (purchase price) of investments from its point of reference, in order to assess whether the sale of the investments will generate gains or losses. However, the disposition effect also posits that

investors tend to hold stock portfolios with low performances for a long time and sell very rapidly the ones with positive performances Shefrin and Statman (1985) [30].

3.3.4 Mental accounting

Kivetz (1999) [31], believes that mental accounting refers to the set of cognitive operations used by individuals to organize, evaluate and monitor financial activities. According to Ritter (2003) [28], people sometimes separate decisions which in principle should be combined. For example, many people have a household budget for food and another one for entertainment. At home, for example, with the household budget, one does not eat lobster or shrimp because it would be more expensive than fish. However, in a restaurant, one orders lobster or shrimp, even if it turns out to be more expensive than a simple fish dish. If one does not assess the problem separately, one could realize that it would be cheaper to eat shrimp or lobster at home than in a restaurant.

Kivetz (1999. p. 249) [31], states that: "evidence suggests that the principles of mental accounting often regulate the purchase and consumption of luxuries and that reasons may play an important part in this process. In particular, buying and consuming luxury goods tends to call for reasons and justification and can evoke intra-personal conflict that might be resolved with the aid of mental accounting. Moreover, reasons can serve as important building blocks in the formation and grouping of mental accounts".

3.3.5 Regret bias

Regret is the emotion, the feeling experienced by people for not taking the right decision. According to Shefrin (2002) [24], it is more than the pain of a loss; the pain is associated with feeling, responsible for the loss. Regret can easily affect the decisions that people make. According to him, someone who feels intense regret, does not have a strong preference for variety, always thinks ahead, and may follow the same route to work every day in order to minimize a possible future regret.

In the January 1998 issue of Money magazine, Harry Markowitz was asked what motivated his personal choice on asset allocation. He said that it was not exactly the quest for a risk/return trade-off, his intention was to minimize future regret. According to Shiller (1997) [32], regret theory can apparently help explain the fact that investors often give in to the urge to sell stocks that have lost value and accelerate the sale of shares that have gained value.

For Shefrin and Statman (1985) [30], the regret bias can be interpreted as the reason why investors avoid selling stocks that have dropped in price, in order to not finalize the mistake they committed and to not feel the pain of regret. They sell the stocks that have risen so they do not feel regret for failing to do so, before the stocks drop afterwards.

3.3.6 Conservatism bias

The conservatism bias means that investors are too slow, too conservative to update their beliefs in response to recent evidence. This means that they can initially underreact to new

information on a company. As a consequence, prices will fully reflect the new information only gradually. For Montier (2002) [33], this is a tendency to cling stubbornly to a vision or foresight. Once the position has been established, most people find it very difficult to change this view. Change occurs only in a very slow manner, this trend creates the effect of underreaction to events. According to Shiller (1992) [34], conservatism is a combination of overconfidence with anchoring and anchoring-adjustment leading investors and analysts to adapt slowly to the arrival of new information.

3.3.7 Overoptimism

Optimism according to Montier (2002) [33], is the mood or attitude associated with a positive outlook towards the future. According to Lovallo and Kahneman (2003) [35], optimism generates more enthusiasm than realism, making a proper assessment of reality on the part of investors more difficult. Such bias can cause investors to be less resilient when faced with difficult situations and challenging objectives.

Montier (2002) [33], believes that excessive optimism stems from a number of cognitive biases such as illusion of control - when individuals feel they have more control of the situation than they really have. Self-attribution bias occurs when the positive results of certain situations are assigned to their own skills and poor results are attributed to bad luck.

Margaret Matlin and David Stang (1978) [36], conducted hundreds of studies showing that human beings are extremely optimistic. They even discovered that some aspects of human cognition such as language, memory and thought are selectively positive. For example, people use more positive words than negative ones when they write or speak. In memories, they recall positive experiences faster than negative ones, plus most people assess themselves positively in a particular way, more positively than others do.

3.3.8 Sunk Cost Fallacy

A cost is *sunk* when it cannot be recovered. According to Friedman et. al. (2007) [37], once a cost is sunk, it has no effect on the (balances/paybacks) incremental of future decisions and consequently plays no role in rational choice.

The sunk cost fallacy is considered a maladaptive behavior that is manifested by the strong tendency to continue a project once a money, effort, or time investment has been made. The effect is considered this way, because only marginal costs and benefits, not past costs, should be taken into account in the process of rational decision. This tendency can lead to sub-optimal economic decisions because such decisions should be based solely on future costs and benefits and not past costs that have already taken place. The sunk cost fallacy has been demonstrated in various professional fields such as sports Staw and Hoang (1995) [38], and capital markets McCarthy, Schoorman and Cooper (1993) [39].

IV. CONCLUSION

In general, the goal of learning about cognitive judgment biases and the process of decision making is being able to recognize situations in which these particular errors can

manifest themselves. This can help the investor to avoid mistakes in the process of asset allocation and, as a consequence, improve future performance.

The knowledge about cognitive illusions that can affect the decision process allows investors to avoid mistakes in the financial decisions. Thus, knowing and letting the investors know about cognitive illusions to which they are subject is crucial for the improvement of investment allocation. It is believed that only through the systematization of information on investor behavior and the process of decision making, it will be possible to construct appropriate tools to support decision-making, which can contribute to economic efficiency in the markets.

Insofar as greater theoretical support to empirical studies on investor behavior is being proportioned, one can better understand the dynamics of financial markets and prevent the movements of euphoria and panic, which can produce serious economic consequences, as demonstrated by recurrent financial crises in market history. A better understanding of this topic is fundamental for investors to make decisions more efficient- and effectively.

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