

Víctor Alberto Peña*
Alina Gómez-Mejía**

Effect of the anchoring and adjustment heuristic and optimism bias in stock market forecasts

Recibido: 21 de agosto de 2019

Concepto de evaluación: 30 de octubre de 2019

Aprobado: 12 de diciembre de 2019

Artículo de investigación

© 2019 Universidad Católica de Colombia.

Facultad de Ciencias
Económicas y Administrativas.

Todos los derechos reservados

ABSTRACT

Stock market forecasting is an important and challenging process that influences investment decisions. This paper presents an experimental design that aims to measure the influence of the anchoring and adjustment heuristic and optimism bias in these forecasts.

The study was conducted using information from the S&P MILA Pacific Alliance Select financial index; this was presented to 670 students from the cities of Concepción (Chile), Cali (Colombia), and Lima (Peru). Data was collected and presented through an instrument that asked participants to make a forecast judgment of the said financial index, based on the presented graphics, representing a year, a month, a week, and the last closing value of the index. Thus, it was possible to measure the influence of the anchor and adjustment heuristic in order to establish whether the presence of an initial value affected the financial forecast. Similarly, the study sought to determine whether the judgment issued was biased toward an optimistic or pessimistic position, thereby proving the presence of an error or expectation bias, known as optimism bias.

The results were analyzed using the least squares method, and the data panel confirmed that the anchoring and adjustment heuristic influences the forecast of the financial index used in the study. Similarly, the presence of optimism bias in the cognitive process of forecasting in finance was inferred.

Keywords: Anchor and adjustment heuristic, behavioral finance, financial forecast, judgment, optimism bias.

JEL Classification: C2, G15, G40, G41

Cómo citar este artículo / To reference this article / Para citar este artículo:

Peña, V., A. & Gómez-Mejía, A. (2019). Effect of the anchoring and adjustment heuristic and optimism bias in stock market forecasts. *Revista Finanzas y Política Económica*, 11(2), 389-409. doi:<http://dx.doi.org/10.14718/revfinanzpolitecon.2019.11.2.10>

Efecto de la heurística de anclaje y ajuste y el sesgo de optimismo en los pronósticos del mercado de valores

RESUMEN

La previsión del mercado de valores es un proceso importante y desafiante que influye en las decisiones de inversión. Este artículo presenta un diseño

* Master's degree in Economics and Management. Professor in Department of Accounting and Finance, Pontificia Universidad Javeriana de Cali, Colombia. Address: Calle 18 # 118-250 Cali, Colombia. Email: vpena@javerianacali.edu.co.

 <https://orcid.org/0000-0003-4846-1335>

** Ph.D. in Management Sciences. Professor in Department of Accounting and Finance, Pontificia Universidad Javeriana de Cali, Colombia. Address: Calle 18 # 118-250 Cali, Colombia. Email: aligomez@javerianacali.edu.co.

 <https://orcid.org/0000-0001-7259-9911>

experimental que tiene como objetivo medir la influencia de la heurística de anclaje y ajuste y el sesgo de optimismo en los pronósticos del mercado de valores.

El estudio se realizó utilizando información del índice financiero S&P MILA Pacific Alliance Select. Este fue presentado a 670 estudiantes de las ciudades de Concepción (Chile), Cali (Colombia) y Lima (Perú). Los datos fueron recopilados y presentados a través de un instrumento que pedía a los participantes que hicieran un juicio de pronóstico del dicho índice financiero con base en los gráficos presentados, representando un año, un mes, una semana y el último valor de cierre del índice. De esta manera, era posible medir la influencia de la heurística de anclaje y ajuste para establecer si la presencia de un valor inicial afectaba el pronóstico financiero. Además, el estudio buscó determinar si el juicio emitido estaba sesgado hacia una posición optimista o pesimista, demostrando así la presencia de un error o sesgo de expectativa, conocido como sesgo de optimismo.

Los resultados se analizaron usando el método de mínimos cuadrados, y el panel de datos confirmó que la heurística de anclaje y ajuste influye en el pronóstico del índice financiero utilizado en el estudio. Del mismo modo, se infirió la presencia de sesgo de optimismo en el proceso cognitivo del pronóstico financiero.

Palabras clave: finanzas conductuales, heurística de anclaje y ajuste, juicio, pronóstico financiero, sesgo de optimismo.

Efeito da heurística da ancoragem e do ajustamento e o viés de otimismo nas previsões do mercado de valores

RESUMO

A previsão do mercado de valores é um processo importante e desafiador que influencia nas decisões de investimento. Este artigo apresenta um desenho experimental que tem como objetivo medir a influência da heurística da ancoragem e do ajustamento, bem como o viés de otimismo nas previsões do mercado de valores. Este estudo foi realizado com base na informação do índice financeiro S&P MILA Pacific Alliance Select, o qual foi apresentado a 670 estudantes de Concepción (Chile), Cali (Colômbia) e Lima (Peru). Os dados foram reunidos e apresentados por meio de um instrumento que pedia aos participantes que emitissem um parecer de previsão desse índice financeiro a partir dos gráficos apresentados, que representavam um ano, um mês, uma semana e o último valor do fechamento do índice. Desse modo, era possível medir a influência da heurística da ancoragem e do ajustamento para estabelecer se a presença de um valor inicial afetava a previsão financeira. Além disso, o estudo pretendeu determinar se o parecer emitido continha um viés otimista ou pessimista, o que demonstrou a presença de um erro ou viés de expectativa, conhecido como “viés de otimismo”. Os resultados foram analisados com o método de mínimos quadrados, e o painel de dados confirmou que a heurística da ancoragem e do ajustamento influencia na previsão do índice financeiro utilizado no estudo. Assim, inferiu-se a presença de viés de otimismo no processo cognitivo da previsão financeira.

Palavras-chave: finanças comportamentais, heurística da ancoragem e do ajustamento, julgamento, prognóstico financeiro, viés de otimismo.

INTRODUCTION

Decision-making in an environment as volatile as financial markets implies that investors need to choose from thousands of data in order to discover the most appropriate one to evaluate and execute their decision to buy, sell, or postpone an operation concerning a financial asset. This decision is carried out through a cognitive process that consists of complex mental operations executed with a precise purpose: to select an action among several eligible options (Cadet & Chasseigne, 2009). This process is affected by the presence of heuristics and cognitive biases (Tversky & Kahneman, 1974). In particular, the financial decision process has been studied from different perspectives that try to describe and analyze it, given that it can have an impact on financial decisions in world economy. This happens because, despite the existing country borders, in economic terms, financial markets constitute a great independent network. Although this aspect contributes to economic growth, bad financial decisions that generate a crisis in a remote country could have global repercussions due to the current integration of world economic cycles (Ductor & Leiva-Leon, 2016). Consequently, understanding how an investor carries out financial decision processes will help to better understand market behavior.

In finance, two theoretical corpora have been developed, which sometimes complement each other and, at other times, they contradict each other. The first is based on the efficient markets hypothesis, which assumes that the price of a financial asset reflects all the available information and financial decisions are made rationally (Fama, 1997). This theory includes important economic concepts, such as the random path of asset prices (Working, 1934; Cowles & Jones, 1937; Kendall & Hill, 1953), expected utility profit (Von Neumann & Morgenstern 1944), the concept of market efficiency and market levels (Fama, 1970), and rational expectations (Lucas, 1978). This corpus of studies focuses on decision as a result.

The second corpus is known as behavioral finance, where financial decisions are studied as

a cognitive process. Behavioral finance combines concepts of economics and psychology to study financial decisions. One of its basic principles is the inability of investors to process all the available information due to cognitive limitations (March, 1978). The theoretical construction of behavioral finance involves different concepts, such as the model of rational choice behavior (Simon, 1955), bounded rationality (Simon, 1972; Kahneman, 2003), the psychological study of human judgment (Slovic, 1972), the influence of heuristics and cognitive biases on judgment (A. Tversky & Kahneman, 1974), prospect theory (Kahneman & Tversky, 1979), cumulative prospective theory (Tversky & Kahneman, 1992), market anomalies (Kahneman, Knetsch & Thaler, 1991), and behavioral portfolio theory (Shefrin & Statman, 2000).

From the perspective of behavioral finance, the act of financial forecasting is a permanent operation of the investor, who, using historical information on a financial asset, tries to establish the direction of future trends for that asset; thus, a judgment is constituted. Judgments are the result of cognitively processing the information obtained from the environment and establishing how we interpret things; this process can be affected by heuristics and cognitive biases that result in errors of judgment. This paper is based on the behavioral finance theory, which is used to analyze how financial forecasting is affected in the presence of two cognitive problems, namely the anchoring and adjustment heuristic and the optimism bias.

The anchoring and adjustment heuristic has a special effect on finances due to the fact that investors continually need to make probability judgments, such as establishing forecasts of the future value of an asset or deciding whether to acquire or sell a financial instrument that has a reference value in real time. If an investor is influenced by the anchoring and adjustment heuristic, he will tend to anchor to the reference value assigned by the market to the desired financial instrument. When new information about the asset arises, a rational investor looks for a way to objectively analyze it, studying the fundamental values and

then proceeding to forecast or to make a purchase or sale decision. Those influenced by this heuristic will remain anchored to the initial value and may be affected by cognitive biases (Pompian, 2012). Studies that analyze the influence of the anchoring and adjustment heuristic have come less from the field of finance than from other disciplines, and are oriented toward results in the capital markets of developed countries (Shin & Park, 2018). Far more scarce are works that link the anchoring and adjustment heuristic and optimism bias as influences on a financial decision.

The influence of moderate optimism on decisions has been revalidated as positive by researchers, allowing a better confrontation of uncertainty and an active alignment closer to the objectives sought (Armor & Taylor, 2002). On the other hand, an excess of optimism is understood as an unrealistic or irrational optimism that can be maintained in spite of evidence that conditions are not favorable. This negatively influences the decision, due to which knowledge is overlooked when facing a problem and unnecessary risks are taken.

This research seeks to study how the anchoring and adjustment heuristic and optimism bias influence the process of developing a financial forecast on a Latin American financial index in individuals from Chile, Colombia, and Peru, and raises the following research question:

How the anchoring and adjustment heuristic and optimism bias influence the forecast of the S&P MILA Pacific Alliance Select financial index in Colombia, Chile, and Peru?

Regarding the anchoring and adjustment heuristic, the last available value corresponding to the closing value of the S&P MILA Pacific Alliance Select financial index is used to evaluate whether the information provided in the instrument influences the forecast made by 670 participants from Colombia, Chile, and Peru. This experiment has the characteristic of being exploratory and experimental and is based on the field of behavioral finance.

To analyze the anchor effect, linear regressions were used to explain the relationships between study variables. Also, the study seeks to

determine whether there is evidence of expectation bias, particularly excess of optimism, in participant responses, comparing the forecast against the realized value of the financial index within the designated time horizons. Optimism was analyzed through linear regressions and a data panel using the fixed effects model. This procedure was carried out by adapting the methodology proposed by Giordani and Söderlind (2006) and Kinari (2016).

The objectives of this research are to measure the influence of the anchoring and adjustment heuristic and optimism bias in the forecast of the S&P MILA Pacific Alliance Select financial index in Chile, Colombia, and Peru. Additionally, it seeks to confirm the influence of the anchor and adjustment heuristic when making a financial forecasting judgment of the financial index, as well as the presence of expectation bias by determining excess of optimism in the preparation of a forecast judgment of the financial index.

THEORETICAL FRAMEWORK

Theoretical foundations of behavioral finance

The theoretical development of behavioral finance began with concepts provided by Herbert Simon (1955; 1957), which, contrary to the rational approach, propose that humans are affected by bounded rationality. This concept establishes that an agent, when facing the decision-making process, is influenced by non-rational aspects, such as human emotions, and shows the cognitive limitation of humans to process all the information when making a decision. Other limitations studied were bounded willpower, which leads the investor to focus on short-term results when, perhaps, the optimum is in the long term, as well as bounded selfishness, which shows how sometimes human beings limit their profit in favor of others (Mullainathan & Thaler, 2000). These limitations on human behavior affect the behavior of investors who, at the moment of

making a financial investment decision, must evaluate multiple variables; this is where errors arise, which may lead to a decision not being made in an optimal way (Daniel, Hirshleifer & Teoh, 2002).

Behavioral finance is a consolidated field of knowledge that studies the behavior of investors when they make their financial decisions (Ricciardi & Simon, 2000). It is empirical and consists of observing people and the way they make decisions, resorting to multiple logical methods. This behavioral view seriously questions whether markets are efficient (Shiller, 2003), and the supposed efficiency of financial markets is refuted due to the appearance of anomalies, such as financial bubbles, which would not occur in a market where decisions are made rationally (Schwert, 2003).

The conceptual contributions of researchers who have developed the field of behavioral finance are very numerous; in particular, those works that serve as theoretical foundations stand out. One of these is prospect theory proposed by Kahneman and Tversky (1979), who made controlled experiments in laboratory where they observed how participants differently perceived gains and losses, and especially the importance of the reference point to formulate and execute investment decisions.

They examined the behavior of participants concerning aversion to losses, observing propensity to avoid risk when the experiment was presented within a profit framework and the assumption of risk when it was presented within a framework of loss (Kahneman & Tversky, 1979). They concluded that, although the two alternatives are equal in terms of reward, the reference point affects decisions because losses are perceived more intensely than gains. This form of information analysis is known as a framing effect, which is an example of cognitive bias (Tversky & Kahneman, 1981).

A second concept corresponds to the limits of arbitration, which was developed by Barberis and Thaler (2003). Arbitration is an outstanding strategy from the perspective of an efficient market and it is an investment opportunity constantly pursued by investors, since it takes advantage of the price differential of the same asset in two markets.

In behavioral finance, there are considered to be different limits to this strategy: the most important is ignoring the notion that prices reflect all available information. On the contrary, deviations from the fundamental value of an asset are given by operators that are not completely rational. Another limitations are high cost, high risk, and difficulties to find updated information, finding thus price gaps that allow a successful arbitration, which will discourage investors from applying the strategy.

A third concept is heuristics and cognitive biases. These constitute a large area of behavioral finance in terms of research production. They arise as a response to understanding the irrationality of judgments and financial decisions that, through a process of empirical evidence, show why the market does not behave efficiently. Its origins are explained using decision theory: normative models are based on a set of rules and standard axioms derived from economy (expected profit theory) and mathematics (probability theory), which seek to forecast the result of the decisions taken. When the outcome of the forecast deviates from reality, this is because errors (Newell & Bröder, 2008) or “cognitive biases” have been generated. The term “cognitive biases” was established by Tversky and Kahneman (1974), who explained that this is a systematic error that arises when faced with situations of judgment and decision and is due to the cognitive limitations of people. Errors are a consequence of the use of heuristics. This concept was developed by Kahneman and Tversky in their article “Judgment under uncertainty: Heuristics and biases” (Tversky & Kahneman, 1974).

According to these authors, a heuristic is defined as a mental shortcut and is the result of making a decision without having all the information available; it is constituted as a tool of our mind, which simplifies the problem faced (Kahneman, 2003; Caputo, 2014). For some researchers, heuristics become an effective tool to process information (Gigerenzer & Gaissmaier, 2011; Forbes, Hudson, Skerratt & Soufian, 2015), while for others, they become a potential variable that generates cognitive biases, which lead to error due to the simplification

of processes (Tversky & Kahneman 1974; Hilary & Hsu, 2011; Hirshleifer, 2015). The conclusions of these researchers show how heuristics and biases influence the way financial decisions are made with the possibility of rendering the decision inefficient (Hysenbelli, Rubaltelli & Rumiati, 2013).

In finance, decisions are taken by rational and irrational investors, who make different value judgments when assigning what should be the price of an asset and how arbitration should take place, which explains the exchanges of richness between the types of investors (Hirshleifer, 2015). Although the undervaluation of the price of an asset is not always due to erroneous valuations derived from cognitive biases—since they are also due to temporary imbalances of supply and demand (Ritter, 2003)—, biases are inherent in human nature and may affect financial decisions.

There are numerous studies on heuristics and cognitive biases, although not all are related to finances. Some studies have a strong influence on judgments and financial decisions affecting transactions and market prices, such as the anchoring and adjustment heuristic (Kahneman, Slovic, & Tversky, 1982), cognitive dissonance (Festinger, 1957), framing effect (Kahneman & Tversky, 1979; Levin, Schneider & Gaeth, 1998; Ben-David & Hirshleifer, 2012), aversion to loss (Kahneman & Tversky, 1979; Odean, 1998), mental accounting (Thaler, 1980), overreaction in decision making (De Bondt & Thaler, 1985), overconfidence bias (Griffin & Tversky, 1992; Barber & Odean, 2001), status quo (Samuelson & Zeckhauser 1988), and optimism bias (Chambers & Windschitl, 2004; Sharot, 2011).

A common feature to these works is that they present a problem of reasoning in their respective normative answers to participants. Distances between the normative answer and participant answers were denominated biases. Biases are understood as the consequence of the use of heuristics in the cognitive process of participants (Wilke & Mata, 2012) and are divided into two broad categories (cognitive and emotional), each category with a large number of biases that generate errors in judgments. Cognitive biases are caused by an error

in information processing; however, it is possible to correct this bad reasoning over time. Emotional biases are more difficult to correct; given that they are rooted in the psychology of the investor, the judgments issued are not based on the processing of mental calculations, but intuition (Pompian, 2012).

Although behavioral finance, compared to other consolidated fields of knowledge, has not been around for long, its evolution has been vertiginous, owing its interdisciplinary characteristics to contributions from various fields, such as sociology, economics, and psychology. In particular, the contributions made in this last field have allowed a better understanding of how the process of establishing a judgment or a financial decision, as well as the cognitive process behind it takes place.

Decision as a cognitive process

Behavioral finance is a set of theories and concepts that show how investors perform the process of making a judgment or financial decision. Thus, the elaboration of judgments is seen as a cognitive process that allows the individual to understand and recognize things that surround him (Ricciard, 2008). Locke (1796) states that a trial is defined as a mental activity that faces a world of uncertainty, where ideas are built to agree or disagree with a proposition, which may be true or false, but without any evidence to support it (as cited in Pachur & Bröder, 2013).

Judgments and decisions are the results of cognitive processing and there are important differences between them. As described, a judgment is an idea about the phenomenon that is being analyzed and does not imply action. On the contrary, a decision is made to follow a course of action and, although a trial can be used to carry it out because it allows the reduction of uncertainty, a decision can also be executed while discarding the judgment that was previously elaborated (Einhorn & Hogarth, 1981). The mental activity that allows elaborating a judgment or making a decision is denominated by Krch (2011, p. 627) as a “cognitive

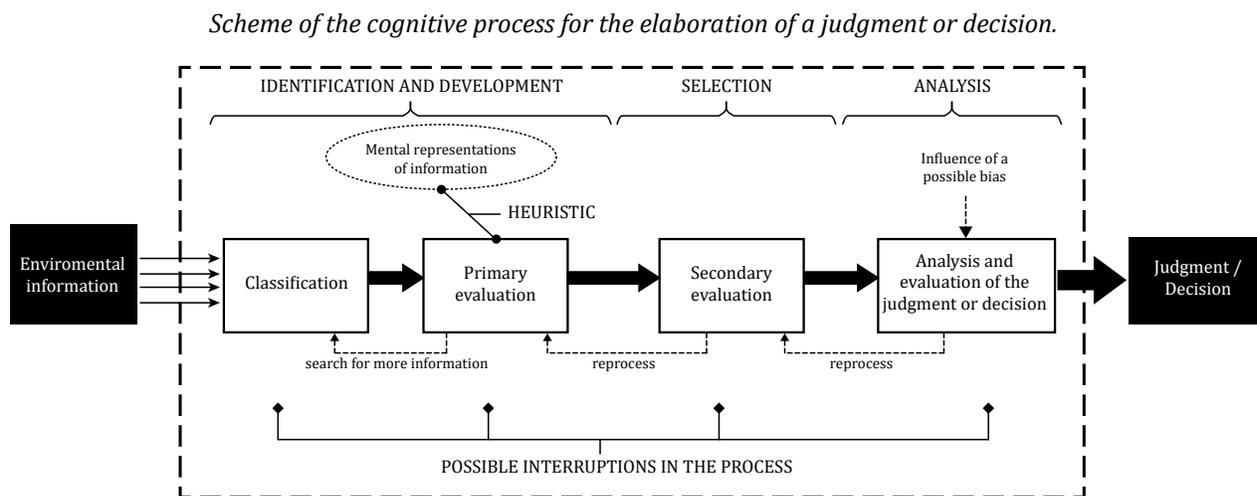
process,” defined as “mental representations of information that can include attention, perception, reasoning, storage and manipulation of memories. It is approached as a sequence of ordered stages in which sensory input is transformed, processed, stored, recovered and used.” The cognitive process allows the investor to elaborate a judgment, such as establishing a financial forecast, which is the presentation of an idea subject to a condition of uncertainty.

Figure 1 shows a diagram adapted from the general model of the strategic decision-making process proposed by Mintzberg, Raisinghani and Theoret (1976), which illustrates how the cognitive process is carried out when a person makes a judgment or a decision. It could be summarized in three parts: the first is where an individual gets information about the environment, the second represents where the complex cognitive process takes place, and the third part is where the judgment or decision is issued by the individual.

A linear path runs through all three parts of the cognitive process; nevertheless, the path will hardly be linear. There is a possible interruption in each phase due to multiple causes, such as the lack of sufficient information or the impossibility of

advancing to a next phase, which leads to a reprocessing between the phases of this procedure. When people face a problem, such as the need to make a judgment or decision, first, they obtain external information from the environment. Once the information has been collected, the cognitive process will begin with the stage called “identification and development,” which is composed of two phases. The first one, called “classification,” prioritizes the information obtained by level of importance. The data considered most relevant will be used in the next phase called “primary evaluation,” which is where the preparation of the trial or decision begins. Its source of information has been defined during the previous stage and, here, the type of judgment the individual is going to build, analyze, and select, or how the decision will be made, is addressed. The process to make judgments or decisions is carried out by recovering mental representations stored in memory, which constitute an additional source of information and are used when it is impossible to have all the information available to deal with the problem. In case of insufficient available data, an option is to look for more information. This mechanism of the mind, which allows the elaboration of a judgment or a decision, is called a heuristic and its

Figure 1.



Source: Authors' elaboration by adapting the general model of the strategic decision process of Mintzberg, Raisinghani and Theoret (1976)

probable effect is the manifestation of a cognitive bias in later phases, which leads to errors and will be contained in the final judgment or decision.

The primary evaluation phase can generate several judgments or different types of decisions. In the “selection” stage, where the “secondary evaluation” phase takes place, different trials or elections from the previous phase are compared in order to select the trial or decision that is the most appropriate at the discretion of the individual. If there is an option that has a better perspective than others, but is not considered adequate, the primary evaluation will be reinitiated.

The following stage is that of “analysis,” which is the end of the cognitive process. Once the judgment or decision has been selected, this option is submitted to an “analysis and evaluation” phase to establish whether it should be returned to a previous phase, or, on the contrary, it should be considered true given that the final option fulfills the final criterion. It is in this final phase that the bias can manifest itself, generating an error in the final judgment or decision. Thus, we arrive at the third and final part, where the elaborated judgment or the course of action decided is made known. A better understanding of this complex cognitive process makes it possible to know how decisions are made and judgments are elaborated, which are fundamental events of life that are frequently carried out in uncertain situations in both individual and collective aspects. Confronting uncertainty requires a great effort of the mind to choose the option that, among a set of possible actions, leads to the best result given one’s preferences (Aguiar, 2004).

Behavioral finance studies judgment and decision-making based on decision theory, which considers that a decision or judgment is a mental construction resulting from a cognitive process. In the analysis of a decision, subjective variables are taken into account, allowing for a more realistic analysis of human behavior, which results in the determination that sometimes individuals and groups systematically violate the principles of economic rationality (Ricciardi, 2008; Hastie & Dawes, 2010). Considering the human component of decisions

that are executed in a financial market, it should be recognized that human limitations affect the behavior of those markets given that the cognitive process is subject to potential problems.

Cognitive process problems

The cognitive process is composed of a complex combination of phases that allows making judgments and decisions. Nevertheless, even if this process is carried out conscientiously, it will never be free of problems, such as heuristics and cognitive biases, since these are inherent elements of human nature; each one distributed in multiple categories and with the potential to affect financial decisions, implying a reason to study the nature of those problems. In this section, we explain the concepts of anchoring and adjustment heuristic and optimism bias. These two concepts represent problems in the cognitive process that affect decisions and financial forecasts.

The heuristics

The great advantage of heuristics is to minimize response time to make judgments in conditions of uncertainty, since they allow decisions to be made thanks to mental shortcuts used by the brain. While these are considered efficient because of simple mental calculations required when executing them, they tend to generate systematic and predictable errors (biases). The heuristics that most influence the cognitive process are anchoring and adjustment, representativeness, and availability, described by Tversky and Kahneman (1974).

Anchoring and adjustment heuristic

This heuristic occurs when trying to predict the future value of a phenomenon. If, before making a forecast, we have a reference value of the phenomenon as a source of data, such as a historical average or a present value, that number will influence the predicted value. Tversky and Kahneman (1974)

concluded that this way of expressing a judgment under conditions of uncertainty is affected by large and predictable forecast errors, and they called this the anchoring and adjustment heuristic.

This heuristic is defined as a strategy to estimate uncertain quantities. First, a starting value called an anchor is shown. Then, based on the information provided, we seek to find a value for the event, which is where the adjustment is carried out, evaluating whether it is too high or too low and gradually adjusting the estimate by “moving it” mentally from the anchor (Kahneman, 2011). Studies on this heuristic conclude that the adjustment process is insufficient because the estimates for the value of the event are conditioned by the value of the anchor and do not allow an adequate adjustment (Slovic & Lichtenstein, 1971; Tversky & Kahneman, 1973, 1974 ; Thaler & Sunstein, 2008; Englich & Soder, 2009).

The evidence shows that adjustment is inefficient because it is interrupted. Once the number in the process of adjustment reaches a range of values considered acceptable, this range is usually close to the anchor (Epley & Gilovich, 2006). Besides, it is characterized by being a quick way to make judgments and constitutes a potential generator of biased responses (Chapman & Johnson, 2002).

Research that seeks to demonstrate the influence of anchoring and adjustment is varied and was conducted in different contexts. Works include experiments with questions of general culture (Epley & Gilovich, 2001; McElroy & Dowd, 2007; Blankenship, Wegener, Petty, Detweiler-Bedell & Macy, 2008), probability of political events (Plous, 1989; Chapman & Johnson, 1999), marketing decisions, (Wansink, Kent & Hoch, 1998; Ariely, Loewenstein & Prelec, 2003; Mussweiler, Strack & Pfeiffer, 2000), and negotiation (Galinsky & Mussweiler, 2001).

In economics and finance, Northcraft and Neale (1987) experimented with real estate agents, who individually had to analyze a property. From a list price assigned by the researchers, the participant agents had to estimate the appraised value of the property, possible sale value and purchase

price, and the lowest acceptable offer. The agents were divided into two groups; although the allocation of list prices was different—one higher than the other—, both groups responded to the initial anchor by placing their forecasts close to the start value, which showed the strong influence of this heuristic on the forecast judgment.

In the financial field, a research by Campbell and Sharpe (2009) examined the forecasts of the monthly publications of various macroeconomic projections to verify whether they were anchored to previous results. The evidence of the influence of the anchoring and adjustment heuristic was significant. The forecasts were “anchored” to previous values that professionals were forecasting, which could affect the stock market as a source of information for investors. The researchers concluded that the bond market was strongly impacted by these macroeconomic reports.

Another group of research focused on the analysis of financial instruments of stock exchanges in various parts of the world, seeking to establish the degree of influence of this heuristic in the United States (Amir & Ganzach, 1998; Westerhoff, 2003; Cen, Hilary & Wei, 2013; Lucey & O’Connor, 2016), Australia (Marsden, Veeraraghavan & Ye, 2008), South Korea (Shin & Park, 2018), Finland and Sweden (Kaustia, Alho & Puttonen, 2008), and Taiwan (Liao, Chou & Chiu, 2013). Although these works rely on different methodologies and were carried out in different sectors of the financial market, their results converge to establish that there is an influence of anchoring and adjustment in forecasts and financial decisions.

Cognitive biases

Cognitive biases are brain processing errors that can arise when making a judgment or a decision, which lead an individual to commit mistakes. They are associated with heuristics since they are a potential consequence of the mental shortcut performed by an individual to solve a problem or situation. This section describes how optimism bias could affect investors’ forecasts and decisions.

Optimism bias

Optimism is defined as a tendency to see and judge things in their most favorable aspect, despite lacking evidence to support that tendency. It is a personality feature present in the majority of the population. In the case of investors, optimism is reflected by underestimating the uncertainty of economic conditions and considering that their investment decisions will be above the average of other investors.

Kahneman and Riepe (1998) evoke concepts from decision theory to describe this bias. When a decision is made, there must be a choice between different options whose final result is not known with certainty. While probabilities are assigned to these decision options and to the decision, the beliefs and preferences of the individual are mixed in, which can generate errors of judgment, such as optimism bias. Optimism bias is a very common psychological aspect in investors, where they overestimate their knowledge about the market, underestimate the risks, and exaggerate their ability to control events. This bias is emotional in nature and can affect investment decisions since they are based on intuition (Pompian, 2012).

Optimism bias has been studied from multiple disciplines. From the field of neuroscience, it is defined as the difference between a person's expectations and the results that follow. In this field, experiments have been carried out that confirm it as one of the most persistent biases in humans, present in about 80% of the population (Sharot, 2011). In every decision-making process, the importance of anticipating what will happen in the future is highlighted. A human characteristic is that the anticipation of an event does not engender an impartial response from the brain; on the contrary, results show that human beings expect positive events in the future, even when there is no evidence to support such expectations (Sharot, Riccardi, Raio & Phelps, 2007; Staněk, 2017). In addition, there is a tendency to overestimate the probability of positive events and underestimate the probability of negative events (Shepperd, Carroll, Grace & Terry, 2002).

From a biological point of view, it has been demonstrated that an individual with a moderate tendency toward optimism bias shows statistically higher probabilities of living longer, with better physical and mental health conditions, and with better results than persons with an unbiased forecast. Nevertheless, those with an exaggerated tendency toward this bias show a propensity for unrealistic optimism, which generates a harmful influence in decision-making (Sharot, 2011).

Regarding the biological field, moderate optimism is an evolutive advantage. Lovallo and Kahneman (2003) consider optimism to be beneficial in the field of business, which generates much more enthusiasm than a realistic or a pessimistic market analysis and allows people to better face difficult situations. Errors of judgment in an investment decision are due to an exaggerated optimism disconnected from reality. Studies about human cognition show that investors focus more on an internal view of their situation, represented by an intuitive and emotional thinking process, which leads to overestimating cognitive abilities and disregarding external views that could improve the accuracy of the forecast. When an investment process has good results, this imbalance of focus between internal and external views causes the investor to reinforce this inadequate way of making decisions, while in the face of a bad result, the investor will attribute responsibility only to external factors (Langer, 1975).

The possession of a small dose of optimism is good for business, as confirmed by Puri and Robinson (2007), who believe that optimism is a critical component of economic decision-making. Using data from the Survey of Consumer Finances—a survey sponsored by the Federal Reserve Board and the United States Treasury Department—, two types of investors were profiled: the moderate optimist and the extreme optimist. It was concluded that the decision-making process of moderate optimists is prudent and optimism helps to balance current and future decisions, allowing greater self-control, which results in reasonable financial behavior.

On the contrary, extreme optimists showed imprudent financial habits and behavior.

Predicting the future value of financial assets or market conditions is a permanent activity in economy. Empirical evidence in psychology shows the influence of the optimism bias. When trying to make predictions, people tend to assign a higher probability to results that they want to obtain and not to the realistic evidence derived from a logical analysis (Armor & Taylor, 2002). The inaccuracies of forecasts are affected by the optimism bias and another bias called planning fallacy. This occurs when decision-making is excessively or unrealistically optimistic (Weinstein, 1980), leading to establishing insufficient completion times for projects (Buehler, Griffin & Ross, 1994) or to overestimating benefits and underestimating costs (Lovallo & Kahneman, 2003).

Studies on the imprecision of forecasting are not limited to studying short time periods allocated to carry out projects. In finance, precision in the forecast of investors is achieved by getting a balance between a moderate optimism and realism; otherwise, there will be an excessive optimism bias or unrealistic optimism (Weinstein, 1980; Jefferson, Bortolotti & Kuzmanovic, 2017), which causes that investors make an error of judgment, considering the personal risk to be less than the risk faced by others, when estimating the probability of success or failure of their objective (Helweg-Larsen & Shepperd, 2001).

The simultaneous manifestations of other biases contribute to increasing the excess of optimism in investors. Biases, such as the illusion of control, refer to the belief of human beings that they are able to control or influence events that are not controllable (Thompson, Armstrong & Thomas, 1998; Montier, 2013), creating an exaggerated sense of control about uncertainty and underestimating the role of unexpected events (Rau, 2011). In stock market investors, the illusion of control and optimism leads to carrying out transactions beyond limits established as prudent, maintaining undervalued investment portfolios, and making unnecessary acquisitions of risky assets (Pompian,

2012). A second bias that maximizes optimism is the illusion of knowledge, which corresponds to the tendency of people to believe that the more information collected, the more accurate the forecasts. The importance of information lies in how it is used and not in how much of it is accumulated (Montier, 2013).

In general terms, the optimism bias is an emotional bias that is described as a judgment problem. An excess in this bias generates extreme or unrealistic optimism and affects investors' decision-making, especially given the presence of other biases, such as the illusion of control and knowledge, which can lead investors to consider unattainable profitability objectives or make them believe that their skills are superior to their average colleagues. Elaborating a forecast is based on a complex cognitive process that includes several stages, such as obtaining environmental information, classification, primary evaluation—this is where heuristics arise and an outline of the judgment or decision is formulated—, and, finally, secondary evaluation, where better options are selected and an analysis of the judgment or final decision is carried out—it is in these latter stages where biases appear. Behavioral finance is a field of multidisciplinary knowledge that has demonstrated that these cognitive processes have important problems, such as heuristics and biases, which can potentially influence judgments and the final decision and may be harmful because they cause errors. In this paper, two of the most representative problems of financial decisions have been chosen: the anchoring and adjustment heuristic and optimism bias; in the analysis of the results, this study seeks to verify the level of influence of these problems in financial forecast.

RESEARCH METHODOLOGY

Data were obtained through an instrument applied to undergraduate students with previous knowledge of statistics and finance. This allowed participating students in universities in Chile, Colombia, and Peru to be familiar with the type of questions included in the instrument. Using the instrument,

students had to make a forecast judgment by indicating the future value of a financial index—specifically, the S&P MILA Pacific Alliance Select index—which measures the performance of the 67 largest and most liquid companies in Chile, Colombia, Peru, and Mexico (S&P Global, 2019).

The universities that participated in the experiment were: Pontificia Universidad Javeriana, Colombia; Universidad de Concepción, Universidad del Desarrollo, and Universidad Católica de la Santísima Concepción, Chile; and Universidad de Lima, Peru. 690 undergraduate students participated and, after filtering the database, 670 valid answers were found.

Table 1.

Number of students from participating universities

Participating universities	Country	Applied instruments
Pontificia Universidad Javeriana, Cali	Colombia	336
Universidad de Lima	Peru	247
Universidad de Concepción	Chile	43
Universidad del Desarrollo	Chile	23
Universidad Católica de la Santísima Concepción	Chile	21
Total		670

Source: Authors' elaboration.

Description of the experiment

The experiment sought to measure the influence of the anchoring and adjustment heuristic and optimism bias when elaborating a financial forecast. To this end, an instrument was created that presented information on the S&P MILA Pacific Alliance Select financial index, taking as a reference point the current value of the index. The participants were asked to answer three questions: first, they had to

predict the future value one day later, then a week later, and, finally, a month later.

Before applying the instrument, a plan was designed to carry out the experiment among 670 students in five universities in three different countries. At each site, a tutor was assigned to conduct the experiment among a group of individuals. It was established that twenty dates would be needed to perform this experiment; this is why twenty scenarios of the original instrument were created, and in each scenario, the closing value of the index and three graphs representing its most recent value were updated.

The procedure for the experiment was applied with the same parameters on each occasion: first, the tutor explained the objectives and showed how predictions should be input into the instrument. Before starting, each participant read an informed consent where the academic purposes of the activity were specified and they could decide whether to accept or decline participation. Participants were provided with graphic information and they had to use these criteria to prepare a forecast of the future values of the S&P MILA Pacific Alliance Select index, with three different time horizons: first, the value projected for the next day, for the next week and, finally, for the next month.

Methods of analysis

The applied experiment allowed obtaining different information from participants. Table 2 shows a summary of the variables obtained and their description. With this information collected, an econometric study was conducted to verify the influence of the anchoring and adjustment heuristic and optimism bias when making a financial forecast, in particular that of the S&P MILA Pacific Alliance Select index.

The method used to analyze the influence of the anchoring and adjustment heuristic was the ordinary least squares method (OLS). Equation 1 represents the model:

Table 2.

Study variables to analyze the anchoring and adjustment heuristic and optimism bias

Name var.	Type of variable	Description
index	quantitative	Current value of the S&P MILA Pacific Alliance Select index
forecast	quantitative	Value of the forecasting judgment by the participant
real	quantitative	Future value of the financial index
age	quantitative	Participant's age
sex	dichotomic	Sex of the participant
country	quantitative	Origin of the participant
term	quantitative	Forecast judgment time

Source: Authors' elaboration.

$$Y_i = \alpha + \beta X_i + \varepsilon_i \quad [1]$$

where Y_i corresponds to the dependent variable forecast. This variable was obtained when participants, after analyzing the information provided, predicted the future value of the financial index with time horizons of one day, one week, and one month. X_i contains information on the independent variables, such as the variable index, represented in the instrument as the most recent value of the financial index. As the experiment was conducted in different locations, during different days, the value of this variable was always updated to the last closing value. Other independent variables were country, age, and sex, which represent the participant's country of origin, age, and sex. α represented the average value of the forecast; β measures the impact of each of the variables.

The procedure for the optimism bias analysis was carried out by adopting the procedures of Giordani and Söderlind (2006) and Kinari (2016). Optimism is defined as an error in expectation, obtained from the difference between the forecast of the participant and the real value of the index. If this difference is on average positive, it would indicate that the participant had optimistic beliefs. In the experiment performed, the index forecasts were made in time horizons separated by a day, a week and a month, which allowed organizing a data panel using a fixed effects model represented in equation 2.

$$Y_{i,t} = \alpha + \beta X_{i,t} + u_{i,t} \quad [2]$$

where $Y_{i,t}$ corresponds to the dependent variable forecast of participant i in period t . The independent variable $X_{i,t}$ corresponds to the real value of the S&P MILA Pacific Alliance Select index in period t . Since the experiment used real index information, once the experiment was finished, one month had to pass to obtain the actual index values and thus complete the information in the data panel. The value of α in equation 2 is assumed to be the average individual effect of the participants of the experiment, which is interpreted as a state of mind that can displace the forecasts above or below the value of the index. The certainty to define α optimism or pessimism will be given as long as the value of β equals one. $u_{i,t}$ corresponds to the random component.

RESULTS

This section presents the results of the quantitative analysis of the database constructed with data obtained from the experiment. The data analysis procedure was performed using the STATA software.

Results of the anchoring and adjustment heuristic

Table 3 summarizes the results of the model obtained with the regression corrected for heteroscedasticity

and with an R-squared result of 0.3517 and a value of the Akaike information criterion (AIC) of 24314, noting a strong relationship between the dependent variable forecast and the independent variable index. The coefficient of the index is very close to one, which means that, leaving the rest constant, an increase of one point in the value of the index increases the value of the forecast by one point, which is statistically significant at 1%. This conclusion allows us to determine that there is evidence that, in the elaboration of a forecasting judgment, the presentation of an initial value before the elaboration of the judgment influences, through an anchor effect, the value of the financial forecast.

Additionally, the results were analyzed by country. As a comparison criterion between countries, Colombia was assigned as a reference country, which allowed the analysis of Peru and Chile. In the case of Peru, its coefficient is 13.04 with a level of statistical significance of 1%, which can be interpreted as follows: if the participant is from Peru and not from Colombia, this increases the value of the forecast by 13.04 points; in the Chilean case, it increases the forecast by 26.39 points, also with a level of significance of 1%. The variable age, significant at 5% and with a coefficient of 2.60, implies that an increase of one year in age increases the value of the forecast by 2.60 points, leaving the rest constant. The sex variable was not significant, but its inclusion improved the R-squared value. To be certain that the variables of the model were appropriate,

the Ramsey test was applied, whose null hypothesis is that the model does not have important variables that have been omitted. Given that its result is $Prob > F = 0.0606$, we did not reject the null hypothesis and the variables described are maintained.

A negative value of the intercept does not make economic sense, due to which it is not interpreted; however, it was not removed from the model, because without this variable, the R-squared was negative. The final equation, which relates the dependent variable forecast with the independent variables index (anchor), country and age, is:

$$forecast = -51.13 + 0.9965 index + 13.04 Perú + 22.30 Chile + 2.60 age \quad [3]$$

Before obtaining this model, other estimations were made that considered several independent variables, but did not achieve a goodness of fit better than the presented model, for all the R-squared and AIC used.

Results related to optimism bias

Since records were organized with preset time intervals at a day, a week and a month, we opted for the use of an econometric data panel model. Table 4 summarizes the tests performed, their hypotheses, and the results used to choose the final model.

First, the Breusch and Pagan LM test was applied to determine whether it would be appropriate to use a random effects model or a regression

Table 3.

Results of the anchor and adjustment heuristic

Dep. var.	Indep. var.	Coef.	Std.	Sig		
forecast	index	0.997	0.03	***	Prob > F	0.0000
	age	2.603	1.16	**	R-squared	0.3517
	sex	-4.059	5.13		AIC	24314
	Perú	13.042	5.15	***	Ramsey Prob > F	0.0606
	Chile	22.310	7.71	***		
	_cons	-51.138	143.33			

Source: Authors' calculations.

Table 4.

<i>Justification of the model</i>			
Models	Test	Hypothesis	Result
OLS vs random effects	Breusch and Pagan LM	H0: Variance of u_i equals 0.	Prob > $\chi^2 = 0.0000$
OLS vs fixed effects	Fixed effects regression	H0: Coefficients of the dummies equals 0.	Prob > F = 0.0000
Random effects vs. fixed effects	Hausman	H0: There are no differences between estimators.	Prob > $\chi^2 = 0.0000$
First-order serial correlation	Wooldridge test	H0: There is no first-order autocorrelation.	Prob > F = 0.9650

Source: Authors' calculations.

Table 5.

<i>Results of the fixed effects model</i>					
Depend var.	Forecast				
Indep. var.	Coef.	Std. err.	Significance		
real	0.09733	0.026	***	Prob > F	0.0002
_cons	4179.496	120.941	***	H0: $\beta = 0$	

Source: Authors' calculations.

by OLS. The result allowed rejecting the null hypothesis of variance equal to zero of the random components, thus defining that the random effect model is more appropriate.

Next, a fixed effect regression model was applied to verify the null hypothesis that the coefficients of the dummy variables are equal to zero. The result allows rejecting this hypothesis and defining that the individual effects are different from zero, which establishes that the fixed effect model would be more appropriate than OLS.

To define whether the random effects model or the fixed effects model should be used, the Hausman test was run. The result allowed rejection of the null hypothesis that the coefficients of both models do not differ substantially, thus establishing the use of the fixed effects model.

Finally, a first-order serial autocorrelation test was performed, using the Wooldridge Test, to determine whether the error of a period is correlated with the next period. Since it cannot reject the null hypothesis that defines no problems of first-order serial autocorrelation order, we proceeded to use the fixed-effect model. Table 5 shows the results of the fixed effect model corrected for

heteroscedasticity between the dependent variable forecast and the real value of the financial index.

The equation of the model is:

$$\text{forecast} = 4179.496 + 0.09733 \text{ real} \quad [4]$$

where the result of the test (F) establishes that β is different from zero, with a statistical significance level of 1%. Table 6 shows the result of verifying whether β is equal to 1, which would allow an interpretation of the value of α .

Table 6.

<i>Beta checking</i>			
Test	Real = 1	Prob > F	0.0000
F(1, 669) = 1213.23		H0: $\beta = 1$	

Source: Authors' calculations.

A linear hypothesis test was carried out after the estimation to determine whether β is equal to one. By rejecting the null hypothesis, we consider β to be different from one and, for this reason, it cannot be established that α , a positive value, is optimistic. However, an alternative planned by Kinari (2016) to analyze optimism consists of comparing

the sizes of α to see whether they are incremental over time; thus, an analysis was made using OLS, separating the historical records into ranges of one day, one week, and one month. This information is provided in Table 7.

The result of separating three periods and analyzing them individually allows observing that the values of α , corresponding to the individual effect and referenced as the mood of the participant, become incremental as the time horizon for the forecasting judgment becomes larger, as does uncertainty. This result suggests that optimism increases as the time horizon is prolonged; however, it is not possible to determine its influence on the forecasting process due to an inability to define whether it corresponds to a moderate optimism or an excess of optimism.

DISCUSSION

This article has described the cognitive process behind the development of a forecast and based its research objective on establishing whether the anchoring and adjustment heuristic and optimism bias exert any influence on the forecast of the future value of a financial index.

Regarding the anchoring and adjustment heuristic, our results indicate that presenting a starting value as the closing price does have an influence on the forecast of the future value of the index, because that initial value operates as an

anchor, due to which the forecast has an insufficient adjustment and its value remains close to the starting value. This may cause an inefficient forecast and confirms that this type of heuristic has a strong influence on financial activities, such as establishing a future value. This is an important aspect, because when investors are aware that this heuristic might arise, they could consider analyzing the situation better to make more adequate financial forecasts. Other studies have reached similar conclusions, analyzing how the anchoring and adjustment heuristic affects various activities that occur in the field of finance, such as the current value of the P/E ratio and the future forecast of the dividend yield (Fisher & Statman, 2000); the 52-week high price as an explanation for the profits from momentum investing (George & Hwang, 2004); the closing price and 1-day price forecast (Duclos, 2014); the positive relation with the current value of the 52-week high and post-earnings announcement drift (Shin & Park, 2018); and the closing price and the valuation of ex-dividend shares (Chang, Lin, Luo & Ren, 2019).

Regarding the influence of optimism bias on forecasts, our results are inconclusive, although we managed to adapt the methodology of studying optimism bias used by Giordani and Söderlind (2006) and Kinari (2016) to analyze the data obtained in the experiment and organize them into a data panel structure. We achieved to infer that there is a presence of optimism bias in the process of forecasting the index to one day, one week, and one month,

Table 7.

Comparison of α in three time periods

Dep. var.	Indep. var.	Coef.	Std.	Sig		
1 day forecast	real 1 day	0.697	0.056	***	Prob > F	0.0000
	_cons	1409.3	259.49	***	R-squared	0.1619
1 week forecast	real 1 week	0.649	0.100	***	Prob > F	0.0000
	_cons	1622.2	463.86	***	R-squared	0.0993
1 month forecast	real 1 month	0.427	0.029	***	Prob > F	0.0000
	_cons	2613.9	135.69	***	R-squared	0.2566

Source: Authors' calculations.

but without reaching an accurate measurement of the degree of influence.

One of the limitations found in this work was the inability to explain precisely the differences in the anchoring and adjustment heuristic by country, which would have been helpful to know in which participating countries this type of heuristics affected the most. We consider that it was due to an unequal number of participants per country, with many more participants from Colombia than from Peru and Chile. As for optimism, the paper described moderate optimism as positive and extreme optimism as harmful. It was not possible to ensure with total certainty the degree of influence on the financial forecast and type of optimism involved. A better instrument to capture this type of information would be important to define how much this bias harms or benefits the financial forecast.

CONCLUSIONS

The theoretical framework presented a review of the scientific literature on behavioral finance; it also described how the cognitive process is carried out when preparing a forecast, including problems that affect it in its different stages, such as heuristics and biases. This review allowed recognizing the importance and influence of the anchor and

adjustment heuristic, proving its influence in the experiment performed. With regard to optimism bias, the paper described various investigations, ranging from a deep-rooted biological explanation of the human psyche to its connection to finance, since this bias generates important effects on investors and decisions, both positively and negatively, always depending on the intensity of optimism. The main contribution of this work consists of a better understanding of how a problem of the cognitive process, such as the anchoring and adjustment heuristic, affects the forecast in financial markets, as well as highlighting the importance of optimism bias in this type of process.

Future research should include Mexico in order to get an overview of all the countries of the Latin American Integrated Market (MILA). It is also recommended to have a balanced number of participants per country in order to achieve a more homogeneous sample as well as a country characterization. In addition to the anchoring and adjustment heuristic, it would be interesting to include other types of biases that affect financial decisions, such as the herd effect, status quo bias, and overconfidence bias. In the case of optimism bias, it is necessary to improve the instrument to achieve a more efficient measurement of this bias when making a financial forecast.

REFERENCES

1. Aguiar, F. (2004). Teoría de la decisión e incertidumbre: modelos normativos y descriptivos. *Empiria: Revista de Metodología de Ciencias Sociales*, (8), 139-160. <https://doi.org/10.5944/empiria.8.2004.982>
2. Amir, E., & Ganzach, Y. (1998). Overreaction and underreaction in analysts' forecasts. *Journal of Economic Behavior & Organization*, 37(3), 333-347. <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1024.5590&rep=rep1&type=pdf>
3. Ariely, D., Loewenstein, G., & Prelec, D. (2003). «Coherent Arbitrariness»: Stable Demand Curves Without Stable Preferences. *The Quarterly Journal of Economics*, 118(1), 73-106. <https://doi.org/10.1162/00335530360535153>
4. Armor, D. A., & Taylor, S. E. (2002). When predictions fail: The dilemma of unrealistic optimism. In Gilovich, T., Griffin, D. W., & Kahneman, D. (eds.). *Heuristics and biases: The psychology of intuitive judgment*. (pp. 334-347). New York: Cambridge University Press. <https://doi.org/10.1017/CBO9780511808098.021>

5. Barber, B. M., & Odean, T. (2001). Boys will be boys: Gender, overconfidence, and common stock investment. *Quarterly Journal of Economics*, 116(1), 261-292. <http://dx.doi.org/10.2139/ssrn.139415>
6. Barberis, N., & Thaler, R. (2003). A survey of behavioral finance. *Handbook of the Economic of Finance*, 1052-1121. http://houdekpetr.cz!/data/public_html/papers/economics_psychology/Barberis%20Thaler%202003.pdf
7. Ben-David, I., & Hirshleifer, D. (2012). Are investors really reluctant to realize their losses? Trading responses to past returns and the disposition effect. *Review of Financial Studies*. 25(8), 2485-2532. <https://doi.org/10.1093/rfs/hhs077>
8. Blankenship, K. L., Wegener, D. T., Petty, R. E., Detweiler-Bedell, B., & Macy, C. L. (2008). Elaboration and consequences of anchored estimates: An attitudinal perspective on numerical anchoring. *Journal of Experimental Social Psychology*, 44(6), 1465-1476. <https://doi.org/10.1016/j.jesp.2008.07.005>
9. Buehler, R., Griffin, D., & Ross, M. (1994). Exploring the «planning fallacy»: Why people underestimate their task completion times. *Journal of Personality and Social Psychology*, 67(3), 366-381. <https://doi.org/10.1037/0022-3514.67.3.366>
10. Cadet, B., & Chasseigne, G. (2009). *Psychologie du jugement et de la décision: Des modèles aux applications*. (A. Editore, Ed.) (1st ed). Paris: De Boeck Universite.
11. Campbell, S. D., & Sharpe, S. A. (2009). Anchoring bias in consensus forecasts and its effect on market prices. *Journal of Financial and Quantitative Analysis*, 44(2), 369-390. <https://doi.org/10.1017/S0022109009090127>
12. Caputo, A. (2014). Relevant information, personality traits and anchoring effect. *International Journal of Management and Decision Making*, 13(1), 62-76. <https://doi.org/10.1504/ijmdm.2014.058470>
13. Cen, L., Hilary, G., & Wei, K. C. J. (2013). The role of anchoring bias in the equity market: Evidence from analysts' earnings forecasts and stock returns. *Journal of Financial and Quantitative Analysis*, 48(1), 47-76. <https://doi.org/10.1017/S002210901200060>
14. Chambers, J. R., & Windschitl, P. D. (2004). Biases in Social Comparative Judgments: The Role of Nonmotivated Factors in Above-Average and Comparative-Optimism Effects. *Psychological Bulletin*, 130(5), 813-838. <https://doi.org/10.1037/0033-2909.130.5.813>
15. Chang, E. C., Lin, T. C., Luo, Y., & Ren, J. (2019). Ex-day returns of stock distributions: An anchoring explanation. *Management Science*. <https://doi.org/10.1287/mnsc.2017.2843>
16. Chapman, G. B., & Johnson, E. J. (1999). Anchoring, activation, and the construction of values. *Organizational Behavior and Human Decision Processes*, 79(2), 115-153. <https://doi.org/10.1006/obhd.1999.2841>
17. Chapman, G. B., & Johnson, E. J. (2002). Incorporating the Irrelevant: Anchors in Judgments of Belief and Value. In Gilovich, T., Griffin, D. W., & Kahneman, D. (eds.). *Heuristics and Biases: The Psychology of Intuitive Judgment* (pp. 120-138). New York: Cambridge University Press. <https://doi.org/10.1017/CBO9780511808098.008>
18. Cowles, A., & Jones, H. E. (1937). Some A Posteriori Probabilities in Stock Market Action. *Econometrica*, 5(3), 280-294. <https://doi.org/10.2307/1905515>
19. Daniel, K., Hirshleifer, D., & Teoh, S. H. (2002). Investor psychology in capital markets: evidence and policy implication. *Journal of Monetary Economics*, 49(1), 139-209. [https://doi.org/10.1016/S0304-3932\(01\)0001-5](https://doi.org/10.1016/S0304-3932(01)0001-5)

20. De Bondt, W. F. M., & Thaler, R. (1985). Does the Stock Market Overreact? *Journal of Finance*, 40(3), 793-805. <https://doi.org/10.1111/j.1540-6261.1985.tb05004.x>
21. Duclos, R. (2014). The psychology of investment behavior: (De)biasing financial decision-making one graph at a time. *Journal of Consumer Psychology*, 25(2), 317-325. <https://doi.org/10.1016/j.jcps.2014.11.005>
22. Ductor, L., & Leiva-Leon, D. (2016). Dynamics of global business cycle interdependence. *Journal of International Economics*, 102, 110-127. <https://doi.org/10.1016/j.jinteco.2016.07.003>
23. Einhorn, H. J., & Hogarth, R. M. (1981). Behavioral Decision Theory: Processed of Judgment and Choice. *Annual Review of Psychology*, 32, 53-88. <https://doi.org/10.1146/annurev.ps.32.020181.000413>
24. English, B., & Soder, K. (2009). Moody experts—How mood and expertise influence judgmental anchoring. *Judgment and Decision Making*, 4(1), 41-50. <https://psycnet.apa.org/record/2009-02933-004>
25. Epley, N., & Gilovich, T. (2001). Putting adjustment back in the anchoring and adjustment heuristic: Differential Processing of Self-Generated and Experimenter-Provided Anchors. *Psychological Science*, 12(5), 391-396. <https://doi.org/10.1111/1467-9280.00372>
26. Epley, N., & Gilovich, T. (2006). The Anchoring-and- Adjustment Heuristic Why the Adjustments. *Psychological Science*, 17(4), 311-318. <https://doi.org/10.1111/j.1467-9280.2006.01704.x>
27. Fama, E. (1997). Market Efficiency, Long-Term Returns, and Behavioral Finance. *Journal of Financial Economics*, 49(3), 283-306. <https://pdfs.semanticscholar.org/0187/0cadeddf6c98ece3b878ce168c86636a5c4b.pdf>
28. Fama, E. F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. *The Journal of Finance*, 25(2), 383. <https://doi.org/10.2307/2325486>
29. Festinger, L. (1957). *A Theory of Cognitive Dissonance*. Stanford University Press.
30. Fisher, K. L., & Statman, M. (2000). Cognitive Biases in Market Forecasts. *The Journal of Portfolio Management*, 27(1), 72-81. <https://doi.org/10.3905/jpm.2000.319785>
31. Forbes, W., Hudson, R., Skerratt, L., & Soufian, M. (2015). Which heuristics can aid financial-decision-making? *International Review of Financial Analysis*, 42, 199-210.
32. Galinsky, A. D., & Mussweiler, T. (2001). First offers as anchors: The role of perspective-taking and negotiator focus. *Journal of Personality and Social Psychology*, 81(4), 657-669. <https://doi.org/10.1037/0022-3514.81.4.657>
33. George, T. J., & Hwang, C. Y. (2004). The 52-week high and momentum investing. *Journal of Finance*, 59(5), 2145-2176. <https://doi.org/10.1111/j.1540-6261.2004.00695.x>
34. Gigerenzer, G., & Gaissmaier, W. (2011). Heuristic decision making. *Annual Review of Psychology*, 62(1), 451-482. <https://doi.org/10.1146/annurev-psych-120709-145346>
35. Giordani, P., & Söderlind, P. (2006). Is there evidence of pessimism and doubt in subjective distributions? Implications for the equity premium puzzle. *Journal of Economic Dynamics and Control*, 30(6), 1027-1043. <https://doi.org/10.1016/j.jedc.2005.05.001>
36. Griffin, D., & Tversky, A. (1992). The weighing of evidence and the determinants of confidence. *Cognitive Psychology*, 24, 411-435. [https://doi.org/10.1016/0010-0285\(92\)90013-R](https://doi.org/10.1016/0010-0285(92)90013-R)
37. Hastie, R., & Dawes, R. M. (2010). *Rational Choice in an Uncertain World: The Psychology of Judgment and Decision Making*. SAGE Publications.

38. Helweg-Larsen, M., & Shepperd, J. A. (2001). Do Moderators of the Optimistic Bias Affect Personal or Target Risk Estimates? A Review of the Literature. *Personality and Social Psychology Review*, 5(1), 74-95. https://doi.org/10.1207/S15327957PSPR0501_5
39. Hilary, G., & Hsu, C. (2011). Endogenous overconfidence in managerial forecasts. *Journal of Accounting and Economics*, 51(3), 300-313. <https://doi.org/10.1016/j.jacceco.2011.01.002>
40. Hirshleifer, D. (2015). Behavioral Finance. *Annual Review of Financial Economics*, 7(1), 133-159. <https://doi.org/10.1146/annurev-financial-092214-043752>
41. Hysenbelli, D., Rubaltelli, E., & Rumiati, R. (2013). Others' opinions count, but not all of them: anchoring to ingroup versus outgroup members' behavior in charitable giving. *Judgment and Decision Making*, 8(6), 678-690. <http://journal.sjdm.org/12/121219/jdm121219.pdf>
42. Jefferson, A., Bortolotti, L., & Kuzmanovic, B. (2017). What is unrealistic optimism? *Consciousness and Cognition*, 50, 3-11. <https://doi.org/10.1016/j.concog.2016.10.005>
43. Kahneman, D. (2003). Maps of Bounded Rationality: Psychology for Behavioral Economics. *American Economic Review*, 93(5), 1449-1475. <https://doi.org/10.1257/000282803322655392>
44. Kahneman, D. (2011). *Thinking, Fast and Slow*. New York: Farrar, Straus and Giroux.
45. Kahneman, D., Knetsch, J. L., & Thaler, R. H. (1991). Anomalies: The endowment effect, loss aversion, and status quo bias. *The Journal of Economic Perspectives*, 5(1), 193-206. <http://pubs.aeaweb.org/doi/10.1257/jep.5.1.193>.
46. Kahneman, D., & Riepe, M. W. (1998). Aspects of Investor Psychology. *The Journal of Portfolio Management*, 24(4), 52-65. <https://doi.org/10.3905/jpm.1998.409643>
47. Kahneman, D., Slovic, P., & Tversky, A. (1982). *Judgement Under Uncertainty: Heuristics and Biases*. Cambridge University Press.
48. Kahneman, D., & Tversky, A. (1973). On the psychology of prediction. *Psychological Review*, 80(4), 237-251. <https://doi.org/10.1037/h0034747>
49. Kahneman, D., & Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. *Econometrica*, 47(2), 263. <https://doi.org/10.2307/1914185>
50. Kaustia, M., Alho, E., & Puttonen, V. (2008). How Much Does Expertise Reduce Behavioral Biases? The Case of Anchoring Effects in Stock Return Estimates. *Financial Management*, 37(3), 391-412. <https://doi.org/10.1111/j.1755-053X.2008.00018.x>
51. Kendall, M. G., & Hill, A. B. (1953). The analysis of economic time-series-Part I: Prices. *Journal of the Royal Statistical Society Series A*, 116(1), 11. <https://doi.org/10.2307/2980947>
52. Kinari, Y. (2016). Properties of expectation biases: Optimism and overconfidence. *Journal of Behavioral and Experimental Finance*, 10(1), 32-49. <https://doi.org/10.1016/j.jbef.2016.02.003>
53. Krch, D. (2011). Cognitive Processing. In J. S. Kreutzer, J. DeLuca, & B. Caplan (eds.). *Encyclopedia of Clinical Neuropsychology*. (p. 627). New York, NY: Springer New York.
54. Langer, E. J. (1975). The illusion of control. *Journal of Personality and Social Psychology*, 32(2), 311-328. <https://doi.org/10.1037/0022-3514.32.2.311>
55. Levin, I. P., Schneider, S. L., & Gaeth, G. J. (1998). All Frames Are Not Created Equal: A Typology and Critical Analysis of Framing Effects. *Organizational Behavior and Human Decision Processes*, 76(2), 149-188. <https://doi.org/10.1006/obhd.1998.2804>

56. Liao, L.-C., Chou, R. Y., & Chiu, B. (2013). Anchoring effect on foreign institutional investors' momentum trading behavior: Evidence from the Taiwan stock market. *The North American Journal of Economics and Finance*, 26, 72-91. <https://doi.org/10.1016/j.najef.2013.07.001>
57. Locke, J. (1796). An Essay Concerning Human Understanding. *The Philosophical Review*. 3(5), 601-605. <https://openpublishing.psu.edu/locke/bib/ch0e.html>
58. Lovallo, D., & Kahneman, D. (2003). Delusions of Success: How Optimism Undermines Executives' Decisions. *Harvard Business Review*. 81(7), 56-63, 117. <https://www.ncbi.nlm.nih.gov/pubmed/12858711>
59. Lucas, R. E. J. (1978). Asset Prices in an Exchange Economy. *Econometrica*, 46(6), 1429-1445. <http://www.its.caltech.edu/~pbs/expfinance/Readings/Lucas1978.pdf>
60. Lucey, M. E., & O'Connor, F. A. (2016). Mind the gap: Psychological barriers in gold and silver prices. *Finance Research Letters*, 17, 135-140. <https://doi.org/10.1016/j.frl.2016.03.009>
61. March, J. G. (1978). Bounded Rationality, Ambiguity, and the Engineering of Choice. *The Bell Journal of Economics*, 9(2), 587. <https://www.jstor.org/stable/3003600>
62. Marsden, A., Veeraraghavan, M., & Ye, M. (2008). Heuristics of Representativeness, Anchoring and Adjustment, and Leniency: Impact on Earnings' Forecasts by Australian Analysts. *Quarterly Journal of Finance & Accounting*, 47(2), 83-102. <https://doi.org/https://doi.org/10.2139/ssrn.996514>
63. McElroy, T., & Dowd, K. (2007). Susceptibility to anchoring effects: How openness-to-experience influences responses to anchoring cues. *Judgment and Decision Making*, 2(1), 48-53. <http://journal.sjdm.org/jdm06143.pdf>
64. Mintzberg, H., Raisinghani, D., & Theoret, A. (1976). The Structure of «Unstructured» Decision Processes. *Administrative Science Quarterly*, 21(2), 246. <https://doi.org/10.2307/2392045>
65. Montier, J. (2013). *Behavioural Investing: A Practitioner's Guide to Applying Behavioural Finance*. Chichester, England: John Wiley & Sons.
66. Mullainathan, S., & Thaler, R. (2000). *Behavioral Economics. the National Bureau of Economic Research* (Vol. 3). Cambridge, MA. <https://doi.org/10.3386/w7948>
67. Mussweiler, T., Strack, F., & Pfeiffer, T. (2000). Overcoming the Inevitable Anchoring Effect: Considering the Opposite Compensates for Selective Accessibility. *Personality and Social Psychology Bulletin*, 26(9), 1142-1150. <https://doi.org/10.1177/01461672002611010>
68. Newell, B. R., & Bröder, A. (2008). Cognitive processes, models and metaphors in decision research. *Judgment and Decision Making*, 3(3), 195-204. <http://journal.sjdm.org/bn1.pdf>
69. Northcraft, G. B., & Neale, M. A. (1987). Experts, amateurs, and real estate: An anchoring-and-adjustment perspective on property pricing decisions. *Organizational Behavior and Human Decision Processes*, 39(1), 84-97. [https://doi.org/10.1016/0749-5978\(87\)90046-X](https://doi.org/10.1016/0749-5978(87)90046-X)
70. Odean, T. (1998). Are Investors Reluctant to Realize Their Losses? *The Journal of Finance*, 53(5), 1775-1798. <https://doi.org/10.1111/0022-1082.00072>
71. Pachur, T., & Bröder, A. (2013). Judgment: a cognitive processing perspective. *Wiley Interdisciplinary Reviews: Cognitive Science*, 4(6), 665-681. <https://doi.org/10.1002/wcs.1259>
72. Plous, S. (1989). Thinking the Unthinkable: The Effects of Anchoring on Likelihood Estimates of Nuclear War. *Journal of Applied Social Psychology*, 19(1), 67-91. <https://doi.org/10.1111/j.1559-1816.1989.tb01221.x>
73. Pompian, M. M. (2012). *Behavioral Finance and Wealth Management : How to Build Optimal Portfolios That Account for Investor Biases* (2.nd ed.). Chichester, England: John Wiley & Sons.

74. Puri, M., & Robinson, D. (2007). Optimism and economic choice. *Journal of Financial Economics*, 86(1), 71-99. <https://doi.org/10.1016/j.jfineco.2006.09.003>
75. Rau, R. (2011). Market Inefficiency. In Baker, H. K., & Nofsinger, J. R. (eds.). *Behavioral Finance: Investors, Corporations, and Markets* (pp. 331-349). Hoboken, New Jersey: John Wiley & Sons.
76. Ricciardi, V. (2008). The Psychology of Risk: The Behavioral Finance Perspective. In Fabozzi, F. J. (ed.). *The Handbook of Finance. Vol. 2. Investment Management and Financial Management*. (pp. 85-111). London: John Wiley & Sons.
77. Ricciardi, V., & Simon, H. K. (2000). What is Behavioral Finance? *Business, Education & Technology Journal*, 2(2), 1-9. <https://ssrn.com/abstract=256754>
78. Ritter, J. R. (2003). Behavioral finance. *Pacific-Basin Finance Journal*, 11(4), 429-437. [https://doi.org/10.1016/S0927-538X\(03\)00048-9](https://doi.org/10.1016/S0927-538X(03)00048-9)
79. S&P Global. (2019). *S&P MILA Indices Methodology*. https://us.spindices.com/documents/methodologies/methodology-sp-mila-indices.pdf?force_download=true
80. Samuelson, W., & Zeckhauser, R. (1988). Status quo bias in decision making. *Journal of Risk and Uncertainty*, 1(1), 7-59. <https://doi.org/10.1007/BF00055564>
81. Schwert, G. W. (2003). Anomalies and Market Efficiency. *Handbook of the Economics of Finance*, 1, 939-974. <http://schwert.ssb.rochester.edu/hbfech15.pdf>
82. Sharot, T. (2011). The optimism bias. *Current Biology*, 21(23), R941-R945. <https://doi.org/10.1016/j.cub.2011.10.030>
83. Sharot, T., Ricciardi, A. M., Raio, C. M., & Phelps, E. A. (2007). Neural mechanisms mediating optimism bias. *Nature*, 450(November), 102-105. <https://www.ncbi.nlm.nih.gov/pubmed/17960136>
84. Shefrin, H., & Statman, M. (2000). Behavioral Portfolio Theory. *The Journal of Financial and Quantitative Analysis*, 35(2), 127. <https://doi.org/10.2307/2676187>
85. Shepperd, J. A., Carroll, P., Grace, J., & Terry, M. (2002). Exploring the Causes of Comparative Optimism. *Psychologica Belgica*, 42, 65-98. <https://psycnet.apa.org/record/2002-06881-007>
86. Shiller, R. J. (2003). From Efficient Markets Theory to Behavioral Finance The 1980s and Excess Volatility. *Journal of Economic Perspectives*, 17(1), 83-104. <https://doi.org/10.1257/089533003321164967>
87. Shin, H., & Park, S. (2018). Do foreign investors mitigate anchoring bias in stock market? Evidence based on post-earnings announcement drift. *Pacific-Basin Finance Journal*, 48(December 2016), 224-240. <https://doi.org/10.1016/j.pacfin.2018.02.008>
88. Simon, H. A. (1955). A Behavioral Model of Rational Choice. *The Quarterly Journal of Economics*, 69(1), 99. <https://doi.org/10.2307/1884852>
89. Simon, H. A. (1957). *Models of man; social and rational. Operations Research* (Vol. 5). Oxford, England: Wiley.
90. Simon, H. A. (1972). Theories of Bounded Rationality. In *Decision and Organization: A volume in honor of Jacob Marschak* (pp. 161-176). North-Holland Publishing Company.
91. Slovic, P., & Lichtenstein, S. (1971). Comparison of Bayesian and regression approaches to the study of information processing in judgment. *Organizational Behavior and Human Performance*, 6(6), 649-744. [https://doi.org/10.1016/0030-5073\(71\)90033-X](https://doi.org/10.1016/0030-5073(71)90033-X)
92. Slovic, Paul. (1972). Psychological Study of Human Judgment: Implications for Investment Decision Making. *Journal of Finance*, 27(4), 779-799. <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1540-6261.1972.tb01311.x>

93. Staněk, R. (2017). Home bias in sport betting : Evidence from Czech betting market. *Judgment and Decision Making*, 12(2), 168-172. <http://journal.sjdm.org/16/16824/jdm16824.html7>
94. Thaler, R. (1980). Toward a positive theory of consumer choice. *Journal of Economic Behavior and Organization*, 1(1), 39-60. [https://doi.org/10.1016/0167-2681\(80\)90051-7](https://doi.org/10.1016/0167-2681(80)90051-7)
95. Thaler, R., & Sunstein, C. (2008). *Nudge: Improving Decisions about Health, Wealth, and Happiness* (revised). Penguin UK.
96. Thompson, S. C., Armstrong, W., & Thomas, C. (1998). Illusions of Control, Underestimations, and Accuracy: A Control Heuristic Explanation. *Psychological Bulletin*, 123(2), 143-161. <https://doi.org/10.1037/0033-2909.123.2.143>
97. Tversky, A., & Kahneman, D. (1974). Judgment under Uncertainty: Heuristics and Biases. *Science*, 185(4157), 1124-1131. <https://doi.org/10.1126/science.185.4157.1124>
98. Tversky, A., & Kahneman, D. (1981). The framing of decisions and the psychology of choice. *Science*, 211(4481), 453-458. <https://doi.org/10.1126/science.7455683>
99. Tversky, A., & Kahneman, D. (1992). Advances in Prospect Theory: Cumulative Representation of Uncertainty. *Journal of Risk & Uncertainty*, 5(4), 297-323. <https://link.springer.com/article/10.1007/BF00122574>
100. Von Neumann, J., & Morgenstern, O. (1944). *Theory of Games and Economic Behavior*. Princeton University Press.
101. Wansink, B., Kent, R. J., & Hoch, S. J. (1998). An Anchoring and Adjustment Model of Purchase Quantity Decisions. *Journal of Marketing Research*, 35(1), 71. <https://doi.org/10.2307/3151931>
102. Weinstein, N. D. (1980). Unrealistic optimism about future life events. *Journal of Personality and Social Psychology*, 39(5), 806-820. <https://doi.org/10.1037/0022-3514.39.5.806>
103. Westerhoff, F. (2003). Anchoring and Psychological Barriers in Foreign Exchange Markets. *Journal of Behavioral Finance*, 4(2), 65-70. https://doi.org/10.1207/S15427579JPFM0402_03
104. Wilke, A., & Mata, R. (2012). Cognitive Bias. In *Encyclopedia of human behavior* (pp. 531-535). London: Academic Press.
105. Working, H. (1934). A Random-Difference Series for Use in the Analysis of Time Series. *Journal of the American Statistical Association*, 29(185), 11-24. <https://www.tandfonline.com/doi/abs/10.1080/01621459.1934.10502683>