Cognitive Biases and Decision Making
An Analysisof Investors in the Brazilian Stock Market

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Abstract

The light of the traditional financial theory, the understanding of decision-making has as principle the notion that both the market and its participants are agents constantly operating in a fully rational manner, in order to maximize profit. In this perspective, decisions are made objectively, not biased. This is the result of an adequate processing of all new information available, free from any interference of emotional or cognitive nature. In addition, financial markets should be frictionless, and from this standpoint, prices reflect the exact value of its assets in a way that the influence of irrational participants is corrected by rational traders.

Even tough, the recognition of unreality regarding these assumptions has allowed the development of a new theoretical framework called behavioral finance. This fresh look at decision-making recognizes the limitations and cognitive circumstances of the decision-making agent, i.e., its limited rationality. To this end, the objective of this study was to analyze how cognitive biases influence the investors' decision-making for the Brazilian case. Among the biases mapped by the subject literature, four were selected to conduct this study: Belief bias, Overconfidence bias, Regret bias and the "Snakebite" Effect bias. This is a quantitative study with a descriptive and explanatory nature, which used the structural equation modeling technique. The sample was collected virtually, using an adapted survey of the study published by Chin (2012), which obtained 149 valid responses. The empirical results show that overconfidence, regret and "snakebite" effect comprise a significant relation with decision making. The belief variable presented factors close to zero, showing modest influence on the dependent variable studied.

Keywords: Belief, Overconfidence, Regret, "Snakebite" effect, Behavioral Finance.

1. Introduction

In general, the traditional theories of finance are attached to the assumptions of neoclassical economics whose guiding principle is the idea that investors act rationally and constantly make use of all available information in the decision making process for an investment, considering also that the market is stable and that stock prices always follow a predictable trend. The rational investor is defined as the one who makes acceptable choices, consistent with the Savage´s notion of Subjective Expected Utility. The Subjective expected utility is a decision method in risk situations that combines two subjective concepts: i) the personal utility function; ii) a personal probability distribution based on the Bayesian probability theory (BARBERIS, Thaler, 2003). In order to fulfill the purposes taken as truth by the

traditional financial theory, it would be up to the investor the ability to process correctly all new information about an event, pondering chances to integrate and consider each piece of information in such a way to envisage the future consequences of his actions. Such assumptions are, according to Baltussen (2009), far from the reality.

The increasing fluctuations and volatility of the markets observed in recent years have been insufficiently explained by the traditional economic and financial theory. Thus, behavioral finance has increasingly attracted the interest of academic researchers who seek to understand the factors behind the behavior of economic agents and the market itself.

Barberis and Thaler (2003) argue that deviations from rational behavior are intrinsic to human nature and must be incorporated into the economic analysis as a natural extension of traditional models. In this perspective, the field of Behavioral Finance has become promising in the financial industry, and it distinguishes itself by incorporating concepts from other areas of knowledge such as psychology and sociology to explain the financial decisions made by individuals (BALTUSSEM, 2009).

A few studies, forinstance, the one published by Chin (2012) which analyzed the Malaysian stock market, seeking to determine how psychological factors affect the investor´s decision-making have become increasingly frequent and made important contributions to the field of behavioral finance. In this perspective, this study looked at how the cognitive biases may affect the investor´s decision-making in the Brazilian stock market. To this end, four cognitive biases were examined: i) belief, ii) overconfidence, iii) regret and iv) "snake bite" effect, in order to further understand its effects on decision making.

The study is divided into five sections, which starts with this Introduction. The following section presents the major contributions of literature by means of a review of previous studies. The third section addresses the methodological aspects adopted in this research. The fourth section clarifies the results from the analysis of data collected through the questionnaire used for the study. In the fifth section, the conclusions and suggestions for future research are presented.

2. Theoretical-Empirical Framework

The study of behavioral finance has as predecessor, studies carried out by Kahneman and Tversky (1979) on human behavior and decision-makingin risk situations. Focused on understanding the investor's attitudes in the daily routine of the financial market, Kahneman and Tversky (1979) conducted experiments that sought to analyze how individuals were led to make decisions based on the benefit (gains or losses) and the risk involved in such decision.

Kahneman and Tversky (1979) observed that people generally feel much more the pain of loss than the pleasure andjoy of equivalent investment gains. This indicates a loss aversion behavior that challenged the economic and traditional financialprinciples, more specifically, the utility theory, which assumes that the investor assesses the risk of an investment based on the change that will be provided in his level of wealth. By integrating part of modern finance, the utility theory supports the perfect investment rationality, contested by behavioral finance, which assesses the risk of an investment making use of a reference, whichevaluates gains and losses (halfed; TORRES, 2001).

Besides loss aversion, another finding presented in behavioral finance studies is called disposition effect, explained by the Prospect Theory of Kahneman and Tversky (1984). This effect is a behavioral shift, the tendency investors have to sell securities whose value is increasing and at the same time keep in their portfolio securities that are devaluing. From these

studies, several heuristic processes began to be investigated. Alves (2009) and Costa (2009), highlight some: representation, overconfidence, historical or anchoring patterns, erroneous bet, erroneous weighting, mental accounting, tendency to exaggeration and availability, herd effect and confirmation bias. Such processes show that emotions have great influence on decision-making and people have lost a lot of money in the stock market for disregarding the effects of psychological factors (CHIN, 2012).

The lines below show the biases analyzed in this study as well as their theoretical assumptions.

Overconfidence: According to Simões (2013), investors who are overconfident, usually with relatively unmixed portfolios,invest persistently in the stock market,this pattern might leadconsequently to bad financial decisions. Tversky and Kahneman (1974) explain that overconfidence results from the fact that people use their initial estimates as an anchor, which causes a bias in their confidence intervals estimates. The adjustments for the initial anchors are inadequateand result in very small confidence intervals. According to Fonseca and Yu (2003), individuals become more confident in their predictions and relatively less susceptible to change of opinion, as their professional experiences increases. However, the increase in experience does not contribute proportionally to the increase in correct predictions. Thus, the authors found that greater confidence in predictions, combined with lower scores show that more experienced professionals display in most cases higher levels of overconfidence.

Pimenta, Borsato and Ribeiro (2012) sought to determine whether overconfidence and sociodemographic characteristics influence the decisions of investors, analysts and investment professionals. Results show that overconfidence, as well as other variables, has a significant impact on decision-making.

Belief Bias: The belief bias analyzed in this papercan be studied in a number of ways. Costa (2009) analyzed the profile of investors in the capital market and identified an original thought, in which individuals tend to hold an illusory validation of their thoughts eliminating some memories and selecting only those that support their beliefs. In the present paper, the variable belief is addressed under the aspect that individuals are steadfast in their ideas (beliefs) and are unlikely to change their thoughts and opinions (Kahneman, Tversky, 1979).

Tizziani et al. (2010) tested the disposition effect from the analysis of the portfolios of all Brazilian equity funds in investments from November 2003 to March 2008, results indicated that funds are subject to the disposition effect ,despite the analysis of the number of transactions .When trading volumes are analyzed the study does not identify the effect, showing greater tendency toward losses instead of gains, a result that differs from the US stock market analyzed in the study by Odean (1998).

Regret: With regard to regret effect , Rogers et al. (2007) emphasize that the "fear of regret causes people to make irrational decisions, creating cognitive frames that make them blind to historical data and especially to statistical probabilities". According to Shefrin (2009) regret is the psychological pain associated with the fact that after taking a particular decision, it becomes clear that a different choice would have produced a better result. The author carried out a study on behavioral finance literature, identifying strengths and weaknesses; his conclusion is that neoclassical economists need to incorporate more psychology in their models while behavioral economists need to incorporate more rigor in their studies, making the future of both lines a convergence between them.

By reviewing past results of investment selections, Odean, Strahilevitz, and Barber (2005) found that securities sold (with perceived gain), are bought twice more compared to the securities in which the individual had losses.

Snakebite: Kartasova et al. (2014) conducted a study to determine the influence of the "snakebite" effect on the risk aversion of investors and consequently the rate of return on investments. According to the authors, the "snakebite" effect arises when the individual suffering huge losses, is afraid to take on new risks and avoid investing in riskier securities. Results reveal the influence of this bias in subsequent investors´ decisions,leading toa profitblockade, which affectsconsequently theinvestment return rate. A few previousstudies analyzed the security-buying behavior, which had been sold in the past; as a result, Chin (2012) stresses the need for investigating the "snakebite" effect as one of the psychological biases that may influence decision-making.

In order to determine how cognitive factors affect the investors' decision-making, this paper was based onthe study of psychological biases and investor behavior(Chin 2012), which analyzes the psychological factors: belief, self-confidence, regret, and "snakebite" effect on the Malaysian stock market. Correlation analysis revealed that all variables have a significant impact on decision making ,endorsing that psychological biases inhibit investors to make rational decisions.

3.Methodological Procedures

The objective of this study is to verify how psychological biases affect the investors' decision-making on the Brazilian stock market, examining specifically four cognitive factors: belief, overconfidence, regret and the "snakebite" effect. Thus, this paper iscategorized as a descriptive and explanatory cross-sectional study. The survey method was used for data collection, addressing a convenience non-probability sample (GIL, 2008).

3.1 Population and Sample

Data from the São Paulo Stock Exchange present a substantial increase in the number of individuals who invest in the Brazilian stock market. In 2002, there were 85,249 registered CPFs to operate in this market; 82.37% were males and 17.63% females. The latest published report (January 2015) has 567,902 entries, namely 75.69% are men and 24.31% women, anincrease of 566% in the number of entries in just over 10 years, displaying heightened interest in the stock market where the influences of heuristic processes studied by behavioral finance are present.

For the present study, data collection was carried out through an online questionnaire adapted from Chin's study (2012), sent to potential respondents, economics students from the Pontifical Catholic University of Parana. Since the questionnaire was intended for people, who invest or have already invested in the stock market. The sample has the characteristics ofa non-probabilistic and conveniencesampling.

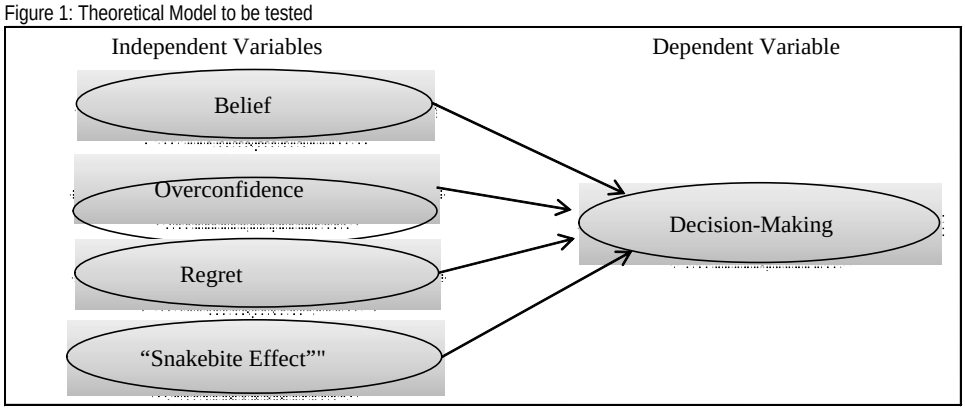
The questionnaire was conducted from December 2014 to January 2015. In Total 201 Questionnaires were answered, 52 were excluded for being incomplete, leaving 149 to be included in the study. Those who had never invested in the stock market and considered outliers, were excluded from analysis, the final count was 72 valid responses.

3.2 Hypotheses and Assumptions

The research framework for this study shown in Figure 1, is modeled on the study published by Chin (2012) which analyzed the behavior of Malaysian stock market investors. The study consists of four independent variables (IV), namely belief, overconfidence, regret and "snakebite" effect. The investor's decision-making constitutes the Dependent Variable (DV). Considering these variables, four hypotheses were defined for testing:

H1: There is a statistically significant relation between the investor´s belief and decision-making;
H2: There is a statistically significant relation between the investor´s overconfidence and decision- making;
H3: There is a statistically significant relation between the investor´s decision-making and regret;
H4: There is a statistically significant relation between the investor´s decision-making and the "snake-bite effect";

Figure 1: Theoretical Model to be tested



Source: Chin (2012).

3.3 Data Analysis Method

Among the techniques of existing analyzes, for the present study was used a multivariate analysis technique called structural equation modeling (SEM), from a situation of multivariate nonmorality, using least squares: structural equation modeling based on partial least squares adjustment estimation models (partial least square - PLS).

According to Hair et al. (2014) PLS-SEM (Structural equation modeling), makes use of available data to estimate the relations of the model , in order to minimize the error terms (the residual variance) of endogenous constructs, in other words, PLS / SEM estimates coefficients that maximize the R^2 of endogenous constructs. In this case, the correlations among the constructs and their measured variables or items are calculated and then linear regression are held between constructs (structural models) (Ringle et al., 2014).

According to Byrne (2001), when working with SEM, it is advisable to make distinction between latent exogenous and endogenous variables. Exogenous variable is one, which acts as a predictor (cause) to other constructs or variables (Hair et al., 2005), it is a synonym of independent variable, since it entails change in the amount of other latent variables in the

model.As the endogenous variable is a synonym of dependent variable, affected by an exogenous variable in the model, directly or indirectly (Byrne, 2001).

For the analysis, it was used the software SmartPLS version 3.0. Tenenhaus et al. (2004) emphasize that the PLS for structural equation modeling is suitable in cases of small samples, with no need for variable normalization.

4 Presentation and Analysis of Results

A total of 72 valid questionnaires were obtained, 63 men (87.5% of the sample) and 9 women (12.5% of the sample). As noted previously, the male population in the stock market is much larger compared to thenumber of female investors, thus, the sample matches the proportion of the population.

The predominant age group of the sample ranges from 30-39 years old and the second group with the highest number of respondents ranges from 40 to 49 years old, the two groups represent 63.9% of the sample.

Regarding the other demographic data (presented in Table 1), the sample can be characterized as predominantly married people (62.5%), without children (41.67%), employed or self-employed (84.72%), with a varied household income and relatively low experience in the stock market (56.94% have up to 6 years of experience).

In the matter of risk,most respondentsare considered prone to this possibility (58.33%).

Table 1: Descriptive analysis of the sample.

Item		Freq.	(%)
Gender	Male	63	87,50
	Female	9	12,50
	Total	72	100,00
Age Group	20 to 29 years	15	20,80
	30 to 39 years	25	34,70
	40 to 49 years	21	29,20
	50 to 59 years	8	11,10
	Above 60 years	3	4,20
	Total	72	100,00
Marital Status	Single	22	30,56
	Married/Stable Union	45	62,50
	Divorced	3	4,17
	Widow(er)	2	2,78
	Total	72	100,00
Number of Children	No Children	30	41,67
	1 Child	19	26,39
	2 Children	19	26,39
	3 Children	4	5,56
	Total	72	100
Main Occupation	Student	3	4,17
	Employed	41	56,94
	Self-Employed	20	27,78
	Retired	4	5,56
	Unemployed	4	5,56
	Total	72	100

Item		Freq.	(%)
Household Income	Up to 2.172,00	2	2,78
	from 2.172,00 to 4.344,00	11	15,28
	from 4.344,01 to 6.516,00	9	12,50
	from 6.516,01 to 8.688,00	6	8,33
	from 8.688,01 to10.860,00	10	13,89
	from 10.860,01 to 13.032,00	10	13,89
	from 13.032,01 to 15.204,00	6	8,33
	above 15.204,00	18	25,00
	Total	72	100
Experience	0 to 3 years	26	36,11
	4 a 6 years	15	20,83
	7 a 9 years	12	16,67
	10 a 12 years	10	13,89
	13 a 15 years	1	1,39
	16 years and above	8	11,11
	Total	72	100,00

Item		Freq.	(%)
Risk	Prone to Risk	42	58,33
	Risk Averse	16	22,22
	Indifferent to the risk	14	19,44
	Total	72	100,00

Source: The Authors

Table 2 shows all questions used in the research instrument and its dispersion parameters and centrality as mean, standard deviation, asymmetry and kurtosis, including minimum and maximum values, noting that the five-point Likert scale was used.

The questionnaire used was an adaptation ofa study published by Chin (2012). In order to verify the internal consistency of the instrument, Cronbach's alpha coefficient was processed with all variables. The result of alpha coefficient was equal to CA = 0.735, ensuring the reliability of internal instrument, since the acceptable coefficient must be greater than AC> 0.06 (Hair et al.; 2005).

Table 2: Descriptive Statistics of Research Variables

Q	Questions	N	Mín.	Máx.	Mean	S.D.	Assimet.	Kurt.	C
Belief 1	I follow "hot" tips, posted on some forums and / or social networking groups	72	1	4	2,319	1,161	0,176	- 1,447	BELIEF
Belief 2	When I hear good ads from a particular company, I buy their stocks. Meanwhile, if I hear bad news, I sell the stocks quickly.	72	1	4	2,056	1,112	0,583	- 1,065	
Belief 3	I follow trends to buy / sell popular stocks	72	1	4	1,625	0,846	1,099	0,144	
Belief 4	I trust past performance reports provided by companies	72	1	4	3,153	1,146	-0,942	- 0,702	
Belief 5	I trust the opinions and assumptions of newspapers	72	1	4	2,625	1,156	-0,117	- 1,442	
OVERCONFIDENCE 1	I think I always buy stocks at the lowest price and sell for a higher price	72	2	5	3,528	0,978	-0,219	- 0,943	OVERCONFIDENCE
OVERCONFIDENCE 2	I believe that my stocks will go up	72	2	5	3,958	0,740	-0,791	1,107	
OVERCONFIDENCE 3	I can identify good stocks with my knowledge and skills	72	2	5	3,833	0,787	-0,228	- 0,357	
OVERCONFIDENCE 4	I can predict the future movement of the stock price after doing some analysis	72	2	5	3,458	0,855	-0,215	- 0,621	
REGRET 1	I should have bought stocks earlier at a lower price because now their price have risen	72	1	5	3,000	1,322	-0,151	- 1,181	REGRET
REGRET 2	I should have sold the stocks earlier for a higher price for that now they decreased in value compared to my purchase price	72	1	5	3,250	1,308	-0,325	- 1,067	
REGRET 3	I should have kept my stocks longer because now they have increased compared to my selling price	72	1	5	2,653	1,153	0,211	- 0,798	
REGRET 4	I should listen to the advice of the more experienced people and my friends before buying / selling stocks	72	1	5	2,931	1,142	-0,269	- 0,983	

SNAKEBITE EFFECT 1	I do not want to take a high risk, while high risks bring high returns	72	1	5	3,208	1,198	-0,365	- 0,939	"SNAKEBITE EFFECT "
SNAKEBITE EFFECT 2	I try to avoid buying stocks which I have had losses	72	1	5	2,861	1,303	0,147	- 1,153	
SNAKE-BITE EFFECT 3	When the price drops temporarily, I sell the stocks to avoid making more losses	72	1	5	2,208	1,113	0,520	- 0,822	
SNAKE-BITE EFFECT 4	I worry about the influence of financial crisis	72	1	5	4,236	0,896	-1,578	3,333	
DECISION1	I consider all the pros and cons before making a decision	72	2	5	4,083	0,801	-0,492	- 0,373	DECISION MAKING
DECISION2	I keep calm when I have to make a decision very quickly	72	2	5	4,111	0,832	-0,969	0,823	
DECISION3	I take a decision only after considering all the implications	72	2	5	3,931	0,845	-0,587	- 0,037	
DECISION4	I choose a safe option if there is any	72	2	5	3,875	0,871	-0,409	- 0,453	

Source: The Authors

By examining questions related to the variable belief, it was found that most responses were directed to "disagree", however, the question "I trust past performance reports provided by companies," showed a mean of 3,153 with a standard deviation of 1.156, indicating that investors tend to reduce the complex tasks of forming expectations and probabilities by making simple judgments. This interpretation is also suggested by Chin (2012), showing that heuristic judgments are useful, but sometimes might lead to cognitive illusions or systematic errors as shown by Tversky and Kahneman (1974).

The variables targeted at measuring the overconfidence construct had mean values above 3, indicating the presence of overconfidence bias in the responses. This bias, according to Fonseca and Yu (2003), is typical of individuals who have a higher level of experience; however, it does not mean that such individuals have greater successes in their predictions.

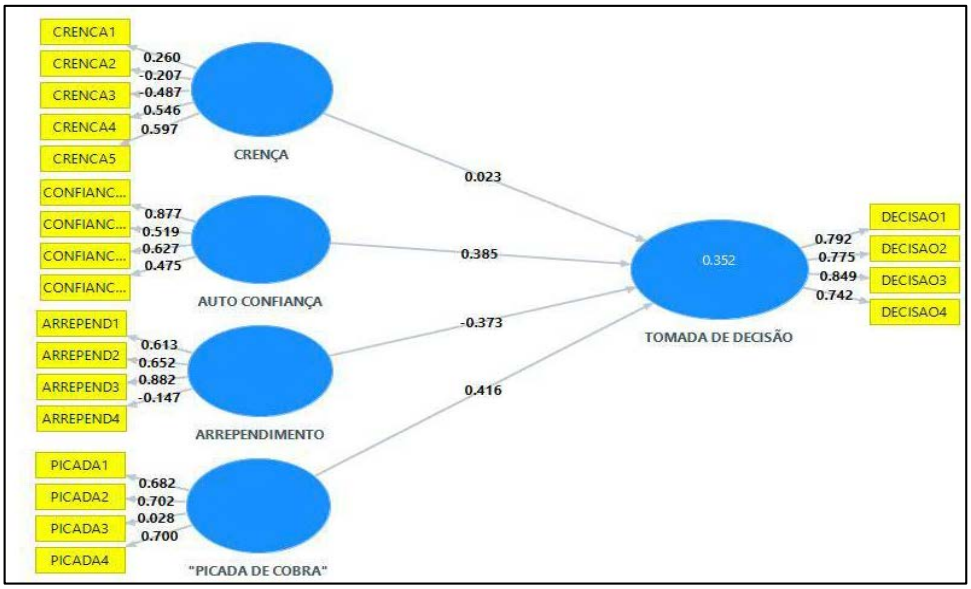
The analysis of the variables used to measure regret indicated some balance between the responses; the results suggest that not all respondents are subject to such bias, where people regret of having taken a decision finding that no alternative would bring better results (Shefrin, 2009).

For the "snake bite effect", the question "I worry about the influence of the financial crisis" showed the highest mean (4.083) it suggests that investors are more concerned with the existence of crises, highlighting the " snakebite effect "when compared with new results.

4.1 Assessment of the Exploratory Measurement Model

Based on the structural model initially proposed, the processing of data withSmartPLS software version 3.0 was performed, as seen in Figure 2.

Figure 2: Estimation of Exploratory Structural Model



Source: The Authors

In order to check the quality of Structural Equation Model (SEM) proposed from the variables used for each construct, firstly the analysis of convergent validities, obtained fromthe observations of Average Variances Extracted (AVEs) must be carried out, shown in Table 32.

Table 3: Quality Adjustment Values of the Initial Estimated Model

	AVE	Composite Reliability	R Square	Cronbach's Alpha
"Snakebite" Effect	0,362	0,636	-	0,326
Regret Effect	0,400	0,625	-	0,715
Overconfidence	0,415	0,727	-	0,598
Belief	0,200	0,112	-	0,694
Decision-making	0,625	0,869	0,352	0,799

Note: Only the dependent variable has the R^2 value.
Source: The Authors

The values of the AVEs should be above 0.50 (AVE> 0.50) according to the criteria proposed by Fornell and Larcker(Henseler et al., 2009). Table 3 shows that only one construct (decision making) presented AVE value greater than 0.50. In this case, variables of the constructs with AVE lower than 0.50 must be eliminated. The variables to be eliminated should

be those with the lowest factorial loads shown in Figure 2,thus, variables: Belief 2, Belief 3, Overconfidence 4, Regret 1, Regret 4, and Snakebite effect 3, were excluded from subsequent analysis.

After the elimination of variables, new coefficients were obtained, shown in Table 43. The value of AVEs was greater than 0.50 for the Regret, Belief, and Decision-Making constructs. For the constructs "Snakebite effect" and Overconfidence the AVEs values were close to 0.50 (0.485 and 0.489, respectively) however, due to the reduced number of variables, it was decided to keep the model so that the constructs were not eliminated.

Table 4: Quality Values after Adjustment of the Model

	AVE	Composite Reliability	R Square	Cronbach's Alpha
"Snake-bite" Effect	0,485	0,738	-	0,502
Regret Effect	0,711	0,828	-	0,639
Overconfidence	0,489	0,731	-	0,565
Belief	0,537	0,766	-	0,584
Decision-making	0,626	0,870	0,313	0,799

Source: The Authors

When the convergent validity is guaranteed, the internal consistency values (Cronbach's Alpha) and composite reliability (Composite Reliability) must be observed. These two coefficients were used to assess whether the sample is free of biases, or, if the set of answers are reliable (Ringle; SILVA; Bido, 2014).

The composite reliability values suggested in the literature must be above 0.70 (Hair Jr. et al., 2014) and for the internal consistency it is recommended values greater than 0.60 (Hair Jr. et al., 2005). Table 4 presents a composite adequate reliability since all constructs are above 0.70, on the other hand, the Cronbach's alpha showed low values for the three constructs (AC <0.60).

Given the small number of variables, the model is maintained due to the satisfactory composite reliability (CC> 0.70). According to Ringle, Silva and Bido (2014) "DC is more appropriate to the PLS-PM, because it prioritizes variables according to their reliabilities, while the AC is very sensitive to the number of variables in each construct."

The third step to validate the structural equation modeling (SEM) is the assessment of discriminant validity (DV), presented as an indicator that the constructs (also called latent variables) are independent of each other (HAIR Jr. et al ., 2014).

For the DV assessment, the criterion of Fornell and Larcker (1981) was followed, the AVEs square roots (values of the main diagonal in bold) of each construct must be compared with the correlations (other values of rows and columns) between the constructs in order to reach a properresult. The AVEs square roots should be higher than the correlations between the constructs. The results of these correlations are provided by PLS software and shown in Table 5.

By observing the values emphasized in bold, it can be stated that the criterion has been validated because the correlations were lower than the square root value of the AVEs for each construct. In this context, if values were lower than the correlations, such constructs should be grouped as recommended by Perez et al. (2012).

Table 5: Correlations Between the constructs in the Adjusted Model and Square Roots in the Main Diagonal (in bold).

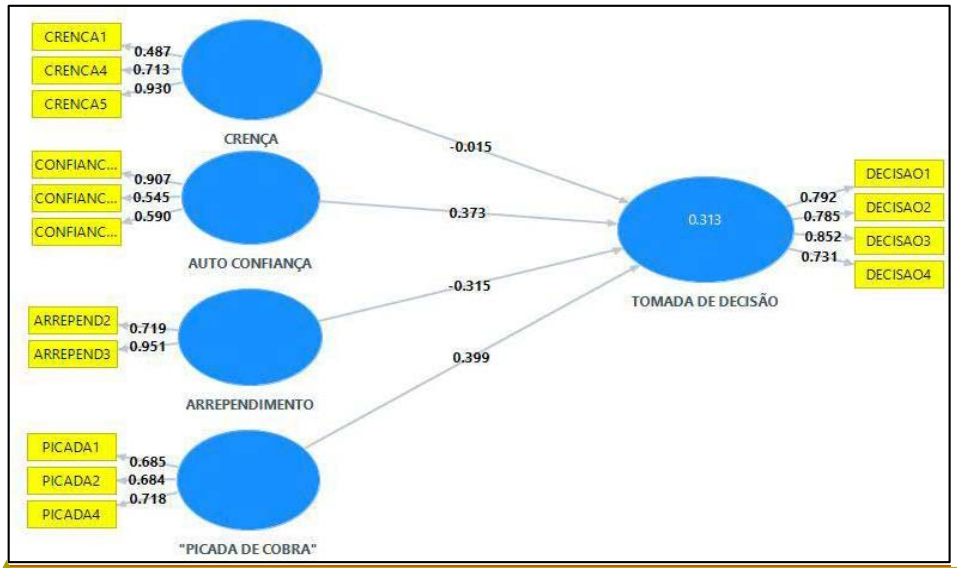
	"Snakebite" Effect	Regret Effect	Overconfidence	Belief	Decision-making
"Snakebite" Effect	0,696				
Regret	0,321	0,843			
Overconfidence	-0,006	-0,001	0,699		
Belief	0,458	0,331	0,111	0,733	
Decision-making	0,289	-0,192	0,370	0,105	0,791

Source: The Authors

4.2 Validation of the proposed confirmatory Structural Model

When the discriminant validity was checked, the settings of the measurement model were completed and the structural model analysis initiated. In this second stage, the first analysis was the evaluation of the coefficient of determination (R^2) that indicates the percentage of variance of the dependent variable which is explained by the independent variables (or constructs), as shown in Table 4.

Figure 3: Adjusted Confirmatory Structural Model



Source: The Authors

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The R^2 (R Squared) is displayed only for the dependent variables; in this case" decision making", the result was 0.313. According to Ringle, Silva and Bido (2014) with regards to the area of social and behavioral sciences, Cohen (1988) suggests that R^2 values close to 2% are classified as small effect size, R^2 values close to 13% and R^2 as medium effect, and values close to 26% large effect size.

Figure 3 shows the confirmatory model after adjustments.

Figure 3 illustrates the coefficients of the regression associated with each of the observed variables (belief, overconfidence, regret, and"snakebite" effect), and how they affect the dependent variable (decision-making). The regression coefficients indicate how each independent variable affects the dependent variable. The coefficient associated with the variable belief was quite close to zero (-0.015), this suggests, according to Perez et al. (2012), that belief has little or no contribution to the decision-making variation. This result differs from that found by Chin (2012), which identified that the variable belief showed a statistically significant correlation with the variable decision-making. After identifying the influence of variables through the significance of the regression coefficients, relations should be significant using a level of 5%, i.e., p-value <0.05. If the p-value> 0.05 the null hypothesis (H0) should be accepted and the inclusion of variables must be reconsidered.

To verify the significance and validation of the structural model the random sampling algorithm PLS software called bootstrapping was used. For processing the instrument,a 500 case parameter was adopted with the objective of generating 500 simulations to obtain the results making use of t-student distribution.

The value of t-student statistic varies according to the sample size analyzed, ,for small samples t-student critical values should be checked, as for the samples above 120 degrees of freedom (sample number minus 1) the value of statistics t-student to be considered significant, must be greater than 1.96.

Table 6 presents the results of Student t test for each of the structural relations. As noted previously in this study, the relation between belief and decision-making did not show significance in the model. Thus, the first hypothesis (H1) that "there is a statistically significant relation between the investor´s beliefs and decision making" was refuted. This shows that in Brazil, investors are not influenced by opinions or judgments transmitted through newspapers, they do not rely on past performance reports provided by companies. Brazilian investors are more critical of the "hot" tips, good and bad ads, and the movement of other investors when buying and selling stocks. One possible explanation for this finding may lie in the fact that in Brazil, a certain crisis of confidence, political legitimacy and financial institutions can be detected. Regarding the financial market, the manipulation of information that occurred in the case OGX and the main company in the Brazilian stock market, Petrobras, might shed light on the relation between belief and decision-making observed in this study.

The variable overconfidence presented a coefficient of 0.373 in relation to decision-making, showing a statistically significant contribution to this variation. This result shows that people feel very confident in the moment of decision-making, considering that stocks are bought at a low price and soldwith profit. Investors believe their portfolio will rise, and that they will be able to identify good stocks with their knowledge and skills, allowing the prediction of market movement after some analysis. Thus, the second hypothesis (H2) that "there is a statistically significant relation between the investor´s overconfidence and decision making" was corroborated.

For the variable regret, the coefficient obtained was -0.315, showing the presence of an inverted relation between regret and decision-making. This result suggests that the higher the regret effect, the lower the investor's decision-making will be , since regret is the pain of knowing that after taking a decision, another alternative would have brought better results (Shefrin, 2009). Having the coefficient of the variable regret presented a statistically significant contribution (p = 0.024), the third hypothesis (H3) "there is a statistically significant relation between regret and the investor´s decision- making" was corroborated.

Finally, the "snakebite" effect introduced a standardized coefficient of 0.399, making this the variable that most influenced decision-making. The 0.01 significance level validates the fourth hypothesis (H4) that "there is a statistically significant relation between the “snakebite“effect and the investor's decision-making”; the results presented by Kartasova et al. (2014) are also confirmed.

Table 6 shows the results of the final model with the hypotheses tested.

Table 6: Final Results of the Confirmatory Proposed Model.

Structural Relationship	Standardized coefficient	t test	P-value	Hypotheses	Hypothesis Status
Belief → Decision Making	-0,015	0,096	0,924	H1	Refuted
Overconfidence → Decision Making	0,373	4,259	0,000*	H2	Corroborated
Regret → Decision Making	-0,315	2,265	0,024*	H3	Corroborated
“Snake-bite “Effect → Decision Making	0,399	3,351	0,001*	H4	Corroborated

* Significant values at 5% (p <0.05).
Source: Research Data.

The results presented in Table 6 indicate that three of the four variables have statistically significant relation on the investors' decision-making, confirming, in part, the hypotheses as occurred with Chin's work (2012).

5. Conclusion

The focus of this research was to investigate how cognitive biases affect the investors' decision-making in the Brazilian stock market, examining specifically four biases: belief, overconfidence, regret and the "snakebite" effect, based on the psychological biases and investor behavior study (Chin 2012), which waspplied in the Malaysian stock market. To perform the quantitative approach research, the multivariate analysis technique called structural equation modeling (SEM) using SmartPLS software was selected.

The results show that the variables overconfidence, regret and "snakebite" effect, had statistically significant relations with the variable decision making, confirming the results presented by Chin (2012), stating that cognitive biases inhibit investors to make rational decisions. However, statistically significant relations between belief and decision-making were observed, showing little or no influence on the decision-making. Such results may be related to the fact that the stock market is still very incipient in the country, people who invest have few contacts with other investors, individuals who work in this market are more critical about the information for decision making. This result also shows that the investor relies much more on his

instincts and judgments compared to the information available in the market, which may reflect a certain distrust towards the institutions providing information, companies or regulatory agencies. Recent scandals involving the companies Petrobras and OGX Group can demonstrate disbelief about the quality of information available to the market.

Overall, investors display a high level of overconfidence believing they can buy stocks at a low price and make profit. They also believe their knowledge and skill might enable good predictions after some analysis (FONSECA; YU, 2003). Regret and "snakebite" effect also proved important in the built model, showing the direct influence of such aspects in decision-making.

These results indicated how cognitive biases influence investors in decision-making and serve as insights for future research on new forms and strategies ofcontrol and monitoring of investment behavior in order to assess the movement of the stock market. In Brazil, it is observed that such biases are intrinsic to the individual, with less influence resulting from the information available that may result from disbelief about the quality of information provided by companies.

Among the limitations of this study, the number of respondents in the sample is considered low in relation to the estimated population, which makes impossible the generalization of results. Another limitation was the questionnaires filled out over the Internet, without a proper contextualization of the study, may have generated some unreliable answers, decreasing the reliability of the model.

This study points the way to future research, suggesting the study of replication with a larger sample of respondents in order to achieve better model coefficients to ensure its reliability. It is also suggested the inclusion of other constructs that may influence the variable decision-making, with the objective of achieving a higher level of model explanation.

References

ALVES, W. H. L. Finanças comportamentais: uma análise das exigências de prêmio pelos alunos de economia da UFPB. Universidade Federal da Paraíba. **Dissertação Mestrado**, 2009.

BALTUSSEN, G. **Behavioral finance: an introduction**. SSRN Working Paper.2009.

BARBERIS, N. A.; THALER R. H.**A survey of behavioral finance**.In Handbook of the Economics of Finance. G. Constantinides, M. Harris and R.Stulz (Eds), North-Holland, Amsterdam. 2003.

BYRNE, B. M. **Structural equation modeling with AMOS** – Basic concepts, applications and programming.New Jersey: Lawrence Erlbaum Associates Publishers, 2001.

CASTRO JUNIOR, F. H. F.; FAMÁ, R. As novas Finanças e a Teoria Comportamental no Contexto da Tomada de Decisão sobre Investimentos. **Caderno de PesquisasemAdministração**, v. 9, n. 2, p. 25–35, 2002.

CHIN, A. L. L. Psychological Biases and Investor Behaviour: Survey Evidence from Malaysian Stock Market. **International Journal on Social Science Economics & Art**.v.2, n. 2, 2012.

COHEN, J. **Statistical power analysis for the behavioral sciences**.2ª edição. New York: Psychology Press, 1988.

COSTA, F. N. Comportamentos dos investidores: do *homo economicus* ao *homo pragmaticus*. Texto para discussão. **IE/UNICAMP**. n.165, ago. 2009.

FONSECA, C. F.; YU, A. S. O. Todos acima da média: excesso de confiança em profissionais de finanças. **Revista de Administração**, v. 38, n.2, p. 101-111. 2003.

FORNELL, C.; LARCKER, D. F. Evaluating structural equation models with unobservable variables and measurement error.**Journal of Marketing Research**. v.18, n.1, p. 39-50, 1981.

GIL, A. C. **Métodos e técnicas de pesquisa social**. 6. ed. São Paulo: Atlas, 2008.

HALFELD, M.; TORRES, F. F. L. Finanças Comportamentais: aplicações no contexto brasileiro. **Revista de Administração de Empresas**, v. 41, n. 2, p. 64-71, 2001.

HAIR, J. F.; HULT, T. M.; RINGLE, C. M.; SARSTEDT, M. A. A primer on partial least squares structural equation modeling (PLS-SEM). Los Angeles: **SAGE**, 2014.

HAIR Jr, J. F.; BABIN, B.; MONEY, A. H.; SAMOUEL, P. **Fundamentos de métodos de pesquisa em administração**. Porto Alegre: Bookman, 2005.

HENSELER, J.; RINGLE, C. M.; SINKOVICS, R. R. The use of partial least squares path modeling in international marketing. Advances in International Marketing.**Advances in International Marketing**. v. 20, p. 277-319, 2009.

KAHNEMAN, D., TVERSKY, A. Choices, Values, and Frames.**American Psychological Association, Inc,** v. 39 (4), pp. 341-350, 1984.

KAHNEMAN, D., TVERSKY, A. Prospect Theory: an analysis of decision under risk. **Econometrica**, v. 47, n. 2, p. 263-291, Mar. 1979.

KARTASOVA, J.; GASPARENIENE, L.; REMEIKIENE, R. Influence of "snake-bite" effect on investment return rate: Lithuanian example. **Mediterranean Journal of Social Sciences**. v. 5, n. 27. Dez. 2014.

KIMURA, H.; BASSO, L. F. C.; KRAUTER, E. Paradoxos em Finanças: Teoria Moderna Versus Finanças Comportamentais. **RAE-Revista de Administração de Empresas**, v. 46, n. 1, jan-mar, 2006.

ODEAN, T. Are investors reluctant to realize their losses? **Journal of Finance**. v. 53, p. 1775–1798. 1998.

ODEAN, T.; STRAHILEVITZ, M.; BARBER. B. Once Burned, Twice Shy : How Naive Learning and Counterfactuals Affect the Repurchase of Stocks Previously Sold. **Working Paper**, 2005.

PEREZ, G.; ZILBER, M. A.; CESAR, A. M. R. V. C.; LEX, S.; MEDEIROS Jr, A. Tecnologia de informação para apoio ao ensino superior: O uso da ferramenta Moodle por professores de ciências contábeis. **Revista de Contabilidade e Organizações**. v.6, n. 16, p. 143-164. 2012.

PIMENTA, D. P.; BORSATO, J. M. L. S.; RIBEIRO, K. C.S.Um estudo sobre a influência das características sociodemográficas e do excesso de confiança nas decisões dos investidores, analistas e profissionais de investimento à luz das Finanças Comportamentais. **REGE** , v. 19, n. 2, p. 263-280, São Paulo, abr./jun. 2012.

RINGLE, C. M.; SILVA, D.; BIDO, D. Modelagem de Equações Estruturais com utilização do SMARTPLS. **Revista Brasileira de Marketing – ReMark**, Edição Especial, vol. 13, n. 2. Mai., 2014.

ROGERS, P.; SECURATO, J. R.; ROBEIRO, K. C. S. Finanças comportamentais no Brasil: um estudo comparativo. **Revista de Economia e Administração.** v. 6, n.1, p. 49-68, jan./mar. 2007.

SHEFRIN, H."Behavioralizing finance."**Foundation and Trend in Finance**, p. 1-184, 2009.

SIMÕES, T. P. B. Efeito disposição nos investidores portugueses. **Universidade Técnica de Lisboa**. Instituto Superior de Economia e Gestão. Dissertação de Mestrado. 2013.

TENENHAUS, M.; VINZI, V. E.; CHATELIN, Y. M.; LAURO, C. PLS Path Modeling. **Computational Statistics & Data Analysis**. v. 48, p. 159-205, 2004.

TIZZIANI, E.; KLOTZLE, M. C.; NESS Jr., W. L.; MOTTA, L. F. O efeito disposição na indústria brasileira de fundos de investimento em ações. **Revista Brasileira de Finanças**. v. 8, n. 4, p.383–416, Rio de Janeiro, 2010.

TVERSKY, A., KAHNEMAN, D. Judgement under Uncertainty :heuristic an biases. **Science**, Vol.183, p. 1124-1134, 1974.