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RESEARCH ARTICLE

BEHAVIORAL BIASES AND RATIONAL DECISION MAKING PROCESS: STRUCTURAL EQUATION MODELING APPROACH, MOROCCAN STOCK MARKET

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ABSTRACT

Awarded by two Nobel Prize winners in economics, behavioral finance proponents claim considerable consequences of behavioral biases on the investment policies of stock market players. By administering a questionnaire, the main purpose of the study is to empirically prove the relationship between the biases in our study (Overconfidence, Herding, loss aversion, disposition effect, anchoring, over-reaction to information and under-reaction to information) and their behavioral impact on the rationality of the decision-making process. Structural Equation Modeling (SEM), adopting the Partial Least Squares (PLS) approach, using Smart PLS 3.0 software, was conducted on the empirical data collected from a panel of financial professionals in the Moroccan stock market. Our results confirm the assumptions made beforehand and testify that these behavioral biases have a significant negative influence on the rationality of decision making process of the Moroccan portfolio managers.

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INTRODUCTION

The multiplicity of anomalies in the financial markets, the bursting of speculative bubbles and the volatility of transactions remain a major challenge for the proponents of the theory of financial market efficiency. The latter relies heavily on its corollary which is reflected in the assumption of rationality of agents stating that investors would be in full possession of various strategies and follow specific procedural logic to achieve the optimal decision. An abundant literature has emerged to undermine the postulate of the thesis of efficiency, in this case, investors make errors of judgment, suffer interpersonal influences, inefficiencies and shepherd phenomena contagion, which are obviously justified by the economic fundamentals (H. SIMON 1947, GROSSMAN and STIGLITZ 1980, ORLEAN 2001). However, it is only after the advent of behavioral finance that this questioning began to take hold (KAHNEMAN, SMITH 2002, SHILLER 2003, STRACCA, 2004) notably in front of a full-fledged discipline of finance with his own academic journal (Journal of behavioral finance, 2003).

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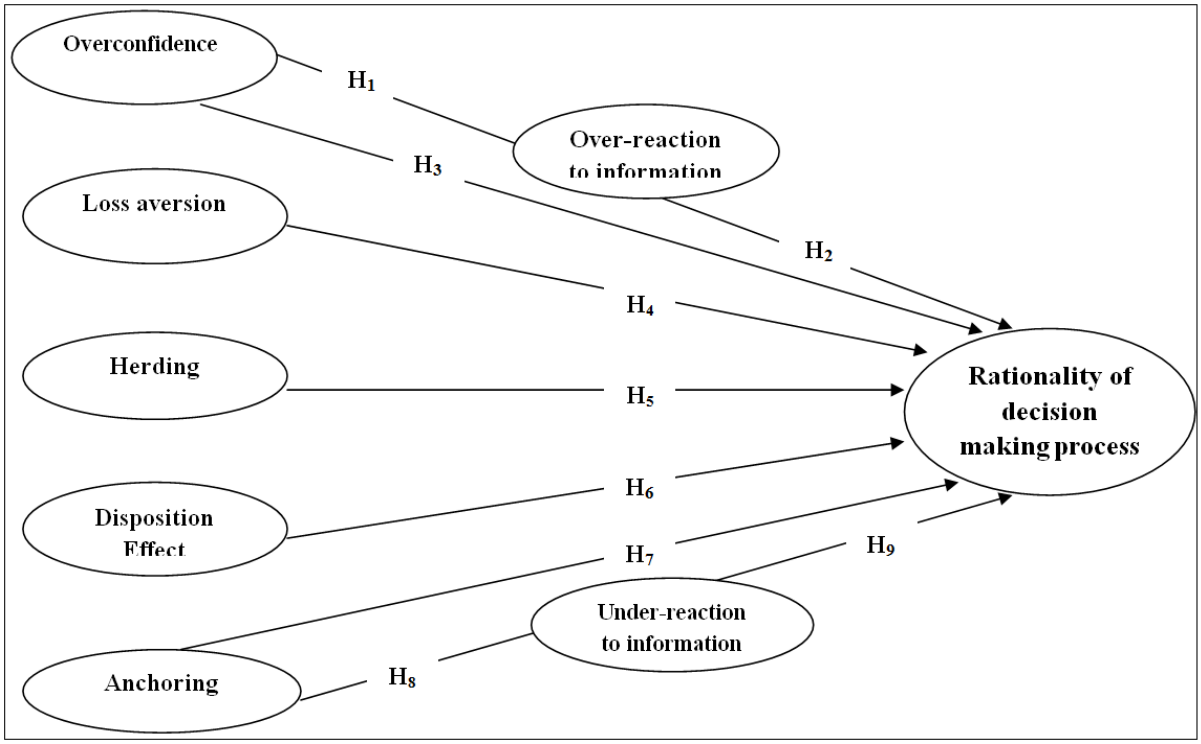
Behavioral finance has emerged from the psychological and financial integration, proclaiming that psychology plays an important role in the financial decision proposing to reconsider the axioms of rational decision. Two of its fervent followers were awarded the Nobel Prize in Economics: (SMITH and KANHEMAN, 2002) and (THALER, 2017). They believe that investors are subject to behavioral biases and distortions lead to lack of self-control, being too confident about their abilities, distorting information, overreacting or following the crowd without thinking. In this article, we seek to better understand the human behaviors that govern the dynamics of the Moroccan stock market by elucidating the impact of behavioral biases (Overconfidence, herding, anchoring, disposition effect, loss aversion, over and under reaction to information) on the rationality of the investment decisions of a panel of financial professionals with the help of a questionnaire developed and administered to a sample of portfolio managers.

Conceptual model and research hypothesis

In order to elucidate the influence of behavioral biases on the rationality of the decision-making process, our study presents the following conceptual model highlighting the endogenous and exogenous variables of our model.



Source : Made by the authors

Figure 1. Conceptual Research Model

Our theoretical construct is formalized in the form of the following research hypotheses that will be tested empirically by our model.

H_1: Overconfidence has a significant positive effect on over-reaction to information.
H_2: Over-reaction to information is negatively correlated with the rationality of decision-making process.
H_2': Over-reaction to information has a mediating effect between overconfidence and rationality of decision-making process.
H_3: Overconfidence negatively affects the rationality of decision-making process.
H_4: Loss aversion has a significant negative effect on rationality of decision-making process.
H_5: Herding is negatively associated with the rationality of decision-making process.
H_6: The disposition effect negatively influences the rationality of decision-making process.
H_7: Anchoring is negatively correlated with the rationality of decision-making process.
H_8: Anchoring has a significant positive effect on the under-reaction to information.
H_9: Under-reaction to information is negatively associated with the rationality of decision-making process.
H_9': Under-reaction to information has a mediating effect between the anchoring and the rationality of decision-making process.

MATERIALS AND METHODS

The main objective of our research is to elucidate how the rationality of decision-making process and the behavioral biases of our study are related. Based on a Structural Equation Model (SEM), adopting a Partial Least Squares (PLS) impact of these biases on the rationality of financial decisions of portfolio managers operating in Casablanca Stock Exchange. Thanks to the interviews carried out in the exploratory qualitative phase, we have been able to develop a questionnaire which represents the most common instrument empirically exploited for the study of biases (DEBONDT, 1998, BENARTZI, KAHNEMAN and THALER, 1999, BIAIS, 2005, GLASER and WEBER, 2007). This questionnaire associates items for each latent variable and evaluates each proposal according to the LIKERT scale in 7 scoring points ranging from "Strongly disagree" to "Totally agree". These items were inspired to a large extent by the opinions collected during the semi-directive interviews as well as by the theoretical review and empirical literature. A convenience sampling was used with a panel of financial professionals responsible for a portfolio of securities domiciled on the Casablanca Stock Exchange, these portfolio managers operate in brokerage firms, management and insurance companies as well as investment banks. We mainly focused on investigating portfolio managers and traders because according to (MANGOT, 2005) these two profiles bear the psychological bias of the profession, especially since many researchers have already looked into these two profiles, (HEISLER 1994, ODEAN 1999). Before administering our questionnaire, we launched a pilot survey with market finance and behavioral approach professionals to test its feasibility. After this test, we came out with several remarks and corrections taken into consideration in the final questionnaire of our research. 90 questionnaires were administered electronically to our sample, after two months of systematic reminders, 74 questionnaires were returned completed and only 68 turned out to be exploitable. To explore the correlations between the different latent variables and check the validity of the items, an exploratory factor analysis (EFA) was conducted with SPSS 21.0. This was followed by a confirmatory analysis (CFA) to ensure the reliability of the scales of measurement and the quality of conceptual adjustment of the constructs in our model.

Table 1. Analysis of convergent validity

Variables	Items	Factor loading	Composite reliability	Average Mean Extracted	Cronbach Alpha
Rationality of decision making process	RAT1	0,848	0,832	0,561	0,725
	RAT2	0,698			
	RAT3	0,544			
	RAT5	0,860			
Overconfidence	OVER1	0,706	0,911	0,675	0,878
	OVER2	0,785			
	OVER5	0,833			
	OVER6	0,852			
	OVER7	0,916			
Anchoring	ANCR1	0,867	0,92	0,744	0,886
	ANCR2	0,893			
	ANCR4	0,742			
	ANCR5	0,937			
Loss Aversion	AVER1	0,946	0,946	0,816	0,924
	AVER2	0,907			
	AVER3	0,859			
	AVER4	0,899			
Disposition Effect	DISP1	0,927	0,939	0,947	0,856
	DISP2	0,904			
	DISP3	0,944			
Herding	HERD1	0,944	0,951	0,796	0,934
	HERD2	0,711			
	HERD4	0,949			
	HERD6	0,914			
	HERD7	0,921			
Over-reaction to information	OVERR1	0,829	0,836	8,719	0,61
	OVERR2	0,867			
Under-reaction to information	UNDER1	0,892	0,905	0,826	0,791
	UNDER2	0,926			

Source : Results of SmartPLS$_3$

The hypothesis test was carried out using Structural Equation Modeling to bring out the causal relationships between the different latent variables of our model. Confirmatory analysis and structural equation modeling were conducted using Smart PLS 3.0.

RESULTS

Based on the SEM literature, convergent validity can be confirmed by examining CRONBACH's alpha, composite reliability, and average extracted variance. The results in Table N°1 indicate that the items in each variable are statistically significant in the measure of their respective constructs with a factor loading of at least 0.7, the composite reliability of each variable is at its lowest 0.832 exceeding the acceptance threshold of 0.7 (HAIR, 1998). The average variance extracted from each variable is greater than 0.5. These results show that the measurement model has an adequate convergent validity.

Discriminant validity is defined as the degree to which a set of elements can differentiate a construct from other constructs. (SOSIK, 2009) also advise to verify the discriminant validity by ensuring that the shared variance between latent constructs (measured by correlations between constructs) is less than the variance shared by a construct with its items (measured by the square root the average variance extracted). (FORNELL and LARECKER, 1981) suggested a criterion for examining discriminant validity which is shown in the table below. As shown in Table N°2, the diagonal elements are the square roots of the average variance extracted and the numbers below represent the correlation between the variables. Discriminant validity can be assumed if the diagonal elements are higher than other non-diagonal elements in their respective rows and columns. Indeed, the results in the correlation matrix shown in Table N°2 ensure that the discriminant validity is confirmed. This means that the shared variance between the elements of each construct is greater than the variance shared with other constructs (COMPEAU, 1999). To evaluate the predictive relevance of the model, R^2 and cross-validated redundancy were used. The R^2 value indicates the amount of variance of the endogenous variable explained by the exogenous variables. The results in table N°3 show that 93.1% of rationality of decision-making process is explained by the exogenous variables of our model. The under-reaction to information and the over-reaction to information are explained at 79.4% and 19.5% respectively. According to the guidelines suggested by (COHEN, 1988) a predictive relevance (R^2) above 26% is considered substantial, which is the case of rationality and under-reaction to information; R^2 between 19% and 33% is considered low but acceptable according to (FALK and MILLER 1992), which is the case of the endogenous variable over-reaction to information. Following the suggestion of (FORNELL and CHA, 1994) the predictive power of a model can be pronounced only if the values of the crossed validated redundancy (obtained thanks to the "Blindfolding" method on SmartPLS 3.0) are greater than 0 if not, the predictive power cannot be confirmed. From the results in Table N°3, the values of cross validated redundancy of our endogenous variables are 0.487; 0.625 and 0.110. These results support the claim that the model has an adequate predictive quality. Unlike LISREL-SEM, PLS-SEM only has one measure of goodness of fit that has been defined as the overall adjustment measure by (TENENHAUS, 2005). This measure is the geometric mean of the mean variances extracted and the average of the R^2 for the endogenous variables as indicated in the following formula.

$$GoF = \sqrt{Mean\ R^2 x\ Mean\ AVE}$$

In our case, the value of the goodness of fit of our model is 0.68, which reveals a high quality of adjustment according to

Table 2. Correlations and discriminant analysis (Fornell and Larcker criterion)

Constructs	1-ANCR	2-AVER	3-DISP	4-OVER	5-HERD	6-RAT	7-UNDER	8-OVERR
1- Anchoring	0,934							
2- Loss Aversion	0,863	0,904						
3- Disposition effect	-0,873	-0,876	0,925					
4- Overconfidence	-0,780	-0,873	0,839	0,872				
5- Herding	-0,925	-0,957	0,887	0,821	0,933			
6- Rationality of decision making process	0,799	0,749	-0,853	-0,905	-0,921	0,903		
7- Under-reaction to information	-0,891	-0,906	0,825	0,809	0,892	-0,816	0,909	
8- Over-reaction to information	-0,627	-0,531	0,381	0,407	0,508	-0,489	0,381	0,848

Source : Results of $SmartPLS_3$

Table 3. Predictive relevance of the model

Endogenous variables	R^2 of latent endogenous variables	Cross validated redundancy
Rationality of decision making process	0,931	0,487
Under-reaction to information	0,794	0,625
Over-reaction to information	0,195	0,110

Source : Results of SmartPLS 3.0

Table 4. Results of hypotheses testing

N° Hyp.	Hypotheses	Coefficient	Standard error	T Valeur	P Valeur	Status
H1	Overconfidence → Over-reaction to information	0,407	0,143	2,851	0,005	Accepted
H2	Over-reaction to information → Rationality of decision making process	-0194	0,060	3,219	0,001	Accepted
H3	Overconfidence → Rationality of decision making process	-0,291	0,080	2,660	0,008	Accepted
H4	Loss Aversion → Rationality of decision making process	0,445	0,115	2,964	0,003	Rejected
H5	Herding → Rationality of decision making process	-0,710	0,148	4,783	0,000	Accepted
H6	Disposition effect → Rationality of decision making process	-0,323	0,113	2,864	0,004	Accepted
H7	Anchoring → Rationality of decision making process	-0,808	0,146	5,550	0,000	Accepted
H8	Anchoring → Under-reaction to information	-0,891	0,018	49,152	0,000	Rejected
H9	Under-reaction to information → Rationality of decision making process	0,042	0,127	0,326	0,744	Rejected

Significance level: P<0, 05
Source: Results of Smart PLS 3.0

Table 5. Mediation effect of over-reaction to information (Total mediation)

H2'	hypotheses	Coefficient	Standard error	T Valeur	P Valeur	Status
Indirect effect with mediator	Overconfidence → Over-reaction to information	0,407	0,143	2,851	0,005	Accepted
	Over-reaction to information → Rationality of decision making process	-0194	0,060	3,219	0,001	Accepted
	Overconfidence → Rationality of decision making process	-0,079	0,039	2,031	0,043	Accepted
Direct effect with mediator	Overconfidence → Rationality of decision making process	-0,291	0,080	2,660	0,008	Accepted

Significance level: P<0,05 Source : Results of Smart PLS 3.0

the basic values suggested by (WETSELS, 2009). These results attest to an adequate level of overall validity of our PLS model. After that the validity and reliability of our construct has been established, the next step is to test the hypotheses of the study by running a PLS Algorithm and a Bootstrapping Algorithm in SmartPLS 3.0. The results are shown in Table N°4. As illustrated in Table N°4, we accepted 6 hypotheses and rejected 3 using the significance level of 0.05 as a reference. The results show that almost all the behavioral biases: heuristics, herding or cognitive biases that are part of the prospect theory have a significant negative effect on the rationality of the decision-making process of the portfolio managers, except loss aversion which derogates from this conclusion (Hypothesis rejected). For stock anomalies, over-reaction to information has a negative influence on rationality (β = -0.194, value T = 3.219, P value = 0.01), while we have rejected the hypothesis related to the under-reaction to the information (β = -0.042, value T = 0.326, value P = 0.744). To test the mediation effect of over-reaction to information between overconfidence and decision-making rationality, the PLS Bootstrapping algorithm was conducted to estimate the direct and indirect effect between these variables. The results obtained in Table N°5 confirm that overconfidence directly and indirectly significantly affects the rationality of decision-making process with (β = -0.291, value T = 2.660 P value = 0.008) and (β = -0.079, T value = 2.031, P value = 0.043) respectively. These results thus illustrate the total mediation of over-reaction to information. There is no need to test the hypothesis H_9' which mediates under-reaction to information since the indirect hypothesis between anchoring and rationality of the decision-making process have been rejected, hence the effect mediator of the under-reaction to information is rejected.

DISCUSSION, LIMITS AND CONCLUSIONS

Referring to the results of our Structural Equation Modeling, we were able to confirm most of the hypotheses developed during our exploratory theoretical conceptual introspection. All the more so, according to the tests of hypothesis and path

coefficients, it turned out that the behavioral biases being part of our study excepting loss aversion and under-reaction to the information (hypothesis rejected) have a significant negative impact on rationality of decision-making process of the portfolio managers operating in the Casablanca Stock Exchange. Our results go hand in hand with the theoretical assumptions of (TVERSKY and KANHEMAN, 1974) and the results of (GERVAIS and ODEAN, 2001) which attest that investors have a certain number of strategic simplifications that skew their acuity of information processing thereby prejudicing the rationality of their financial decisions. Therefore, is it a question of evoking the irrationality of the investors operating in the Casablanca Stock Exchange and undermining at the same time the thesis of the efficiency of the financial markets or would it be more judicious to speak of limited rationality conferred with an argument belonging to (SIMON, 1982, 1991), who suggested that the tendency of psychological anticipation is the foundation of limited rational behavior. Our study could have gained in relevance if we had gone through more in detail in the financial decision-making process of the portfolio managers, in order to focus on the exact phase where the behavioral biases act, in addition to this, studying the interrelation between the biases could have been interesting by assuming their interdependence. This issue could be the subject of future research given the burgeoning expansion of behavioral finance among academics and practitioners alike, and the extent to which human behavior is affecting the dynamics of financial markets. The results of this study may be useful for individual investors, financial brokers, financial managers and other financial decision-makers to improve their cognitive thinking process and make more rational decisions.

Conflict of interest statement: Authors certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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