Behavioural Finance Models and Behavioural Biases in Stock Price Forecasting

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ABSTRACT

Stock market is affected by news and information. If the stock market is not efficient, the reaction of stock price to news and information will place the stock market in overreaction and under-reaction states. Many models have been already presented by using different tools and techniques to forecast the stock market behaviour. In this study, the reaction of stock price in the stock market was modelled by the behavioural finance approach. The population of this study included the companies listed on the Tehran Stock Exchange. In order to forecast the stock price, the final price data of the end December, March, June, and September 2006-2015 and the stock prices of 2014 and 2015 were analyzed as the sample. In this study, Bayes' rule was used to estimate the probability of the model change. Through this rule, the probability of an event can be calculated by conditioning the occurrence or lack of occurrence of another event. The results of model estimation showed that there is the probability of being placed in high-fluctuated regimes (overreaction) and low- fluctuated (under-reaction of stock price despite the shocks entered to the stock market. In modelling with the 4-month final prices, it was proved that the real stock price had no difference from the market price.

1 Introduction

Behavioral science is among the applied knowledge which entered the sciences in form of a specialized field called psychology. The fundamental infrastructure of this knowledge is human and intrinsic, behavioral, and characteristic complexities which must be understood in a scientific framework called psychology. Behavioral finance refers to the study of the effect of psychology on the behavior of market. Behavioral finance attempts to show the use of decision-making processes of psychology in recognizing and forecasting the financial markets. Most previous studies on asset validation focused on the behavioral reaction of investors. Such studies proved that the changes in the behavioral reaction of investors can cause the changes in pricing and efficiency of assets and the behavioral reaction of investors were introduced as a significant factor in the process of market-pricing (Khademi-e Grashi and Ghazizadeh, [18]). Behavioral finance is studying the interpretation of individuals from information to make conscious investment decisions. In other words, behavioral finance studies the effect of psychological processes in decision-making. In addition, behavioral finance can

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be considered as a paradigm studying the financial markets by using the studied models. Such models ignore the two main and limiting hypotheses of traditional –maximization paradigm of expected desirability and complete rationality. Behavioral finance has two main bases; one is the limitation in arbitrage stating that rational investors cannot easily use the arbitrage opportunities because it requires the acceptance of some risks. Secondly, it is the psychology for studying the behavior and judgment of investors and the errors committed by the individuals (Raei and Fallahpour, [25]). The findings indicated that investors do not always behave rationally as shown by the common models. Based on psychological theories, humans have a tendency to keep special events as images in their minds and such mental images are sometimes more effective than the events on their behaviors. With the arrival of other sciences such as the sciences related to human as the most significant factor in decisions especially the investments including psychology, psychiatry, and sociology, a new horizon was created to the financial science opening new doors to a modern school called behavioral finance for progress in the financial fields.

Behavioral finance models neglect the assumptions of investors' complete rationality. Behavioral economists refer to the results of cognitive psychologists' test studying the variety of behavioral biases to gain information about the irrational behaviors of investors (Darabi et al, [6]). Due to the role of stock price changes in investors' decisions, studying the difficult aspects and research background made the researchers to investigate the overreaction and under-reaction phenomena to the new information and present some models by using the data related to the stock price. In this study, two behavioral finance models were used to investigate the very complicated and non-linear behavior of stock price and then forecast it.

2 Literature Review

The philosophy of the neoclassical economics school is based on the rational behavior of individuals as well as enterprises in the economy. At the same time, if a phenomenon is incompatible with this principle, it is referred to as bias. In the Western economics literature and the analysis of financial behavior, the existential nature of human beings is defined as a rational being that decides under fully transparent conditions. But Herbert Simon, the leading figure in financial behavior, identified economic man as an unreal existence in economic theories. That is, an investor may make a decision that is not economically justified. Users and investors use their professional judgment to make economic decisions (Hellmann, [12]). Due to cognitive limitations and the average and low levels of financial literacy, many decisions violate financial principles. Families typically spend their money and rarely save for their retirement. Investors benefit from past returns and often trade. Even senior executives who typically have high education will make decisions that are influenced by personal background and high self-esteem. Many other behaviors can be explained by the principles recognized by cognitive science (Frydman and Camerer, [8]). The school or the view of behavioral finance, which emanates from a combination of psychology and finance, states that psychology plays a role in financial decision-making. Since cognitive errors and distortions affect investment theories, behavioral finance is a study of how people analyze and interpret information for making informed investment decisions. In other words, behavioral finance seeks to influence the psychological processes in decision making. Today, the idea of a completely rational behavior of investors who always seeks to maximize their

benefits is not enough to justify the behavior and reaction of markets, therefore, behavioral finance can be considered as a paradigm in which financial markets are studied using models that abandon two main hypotheses and limitations of the traditional paradigm, namely the maximization of expected utility and total rationality. In behavioral finance, it is claimed that sometimes it is necessary to find the answer to the empirical riddles in the financial field in order to accept the possibility that some of the economic factors are not always rational (Birnberg, [3]).

Cognitive psychology explores the way investors think. Financial behavior suggests that people's thinking is influenced by their preferences and cognitive biases. The main difference between the two beliefs is that people's thinking is influenced by their cognitive preferences and biases. The main difference between the two is that the behavioral patterns of preferences should be reflected and taken into account, but biases should be eliminated or controlled by patterns (Jagongo and Mutswenje, [16]). Theories in the field of psychology of motivation includes theory of goal setting, adaptive theory, organizational justice theory, theory of expectation, theory of discretion, individual and environment compatibility theory, and the theory of desire. Also, theories in the field of social psychology include role theory, social analogy theory and social recognition theory. Informational effects are motivational effects focused on motivating individuals, which is a function of the comparison between the probable or actual consequences of the decision and the mental retardation of individuals. Information effects focus on the influence of management accounting information on the selection and application of subjective initiatives for the search and processing of management accounting information (Brinberg et al, [4]). Behavioral finance approximately dates back to the early 70s. This combined branch of financial sciences using psychology and sometimes sociology to better analyze the financial markets' affairs often studies the decision making process of investors and their reactions to different conditions of financial markets. This branch often focuses on the effect of personality, culture, and judgments of investors on investment decisions. This intellectual school referred to psychology and decision-making science by observing the inability of the current models which were based on complete rationality. The advocates of this school accepted the limited rationality that was presented by Simon as pre-assumption and attempted to fertilize the financial models by psychology. Behavioral finance believes in trace of psychology biases in the market and investors and attempts to forecast the process and direction of prices by studying the sociology, psychology, and ethnology of decision-making patterns and behavioral models (Badri and Sadeghi, [1]). Behavioral finance is a branch of behavioral science studying the financial affairs from a wider social-scientific approach such as paying attention to psychology and sociology as well as removing the rational framework. Accordingly, a lot of focus on prices and interest was changed to human psychology dealing with modern financial management with a more open attitude and using more real assumptions to explain the behavior of financial markets (Rahnemay-e Roudposhti and Zandieh, [24]). The school or attitude of behavioral finance that was created from the combination of psychology and finance states that psychology plays a role in financial decision-making. Since the cognitive errors and deviations affect the investment ideas, thus they affect the financial options too (Eslami-e Bidgoli and Kordlouy, [7]). Khademi and Ghazizadeh [18] studied the effective factors in decision making of shareholders on the Tehran stock exchange. Their study results showed that political factors, market psychological factors, economic factors, and financial factors respectively have the maximum effect on the decision making of shareholders on the Tehran stock exchange at the company level. Keshavarz Hadad and Rezaei [17] studied the group behav-

ior among the institutional investors during 2006-2008. The obtained results confirmed the group behavior among the institutional investors and showed its level higher than the developed countries. In addition, the group behavior was raised in behavioral finance of this claim that it is sometimes necessary to accept the probability that sometimes some economic factors do not behave rationally in order to find an answer to the empirical questions in the finance (Birnberg et al, [4]). According to Robert Olsen, behavioral finance attempts to show the application of psychological decision-making processes in recognizing and forecasting the financial markets. Investment in the stock is an important part of the country's economy, so the issue of forecasting is particularly important in developing countries such as ours; in order to manage the stock market for sustainable development properly .The Stock price of crash risk, which is defined as an undesirable event, is a contagious phenomenon at the market level. In this sense, the decline in stock prices is not limited to a single stock, but all of the stock in the market so identifying the factors influencing this phenomenon as well as its proper prediction can be a great help to Decision makers and investors (Malekian et al, [20]).

Difference of investors' expectations is a key problem in capital market studies considered as a risk factor influencing the asset price and as a consequence, it will affect the capital cost of corporate. Furthermore, it has been predicted that difference of investors' expectations along with short-term sale limitations can lead to the increased stock price at the time of assessment by optimistic people. Previous researches have not addressed how the accounting information disclosure, especially earnings announcements may affect difference of investors' expectations. Some empirical findings indicate that difference of investors' expectations is resulted from earnings announcements. However, several studies found out that accounting numbers disclosure had a reverse effect: creating difference information interpretation and heterogeneous reaction of investors. Recently, the view has been supported by some studies. He demonstrated that earnings announcements might cause difference of investors' expectations through dispersing the other expectations (Golami Jamkarani and Mokhtari, [10]).

The emerging discrepancy between the efficient market hypothesis and reality encouraged a deeper insight focused on psychology, as an important factor in financial theory. Behavioral finance was formulated - a new branch of theory, combining the knowledge of psychology, sociology and other social sciences due to the integrating various scientific knowledge behavioral finance better explains market anomalies and financial behavior of individuals. An efficient market theory hypothesis maintains that investors, while competing for big profits, establish fair prices. In order to better understand an individual financial behavior, the behavioral theory of psychology, sociology and anthropology is applied. An efficient market is associated with the theory of rational expectations, including the assessment of all information about property. However, if there are many irrational investors and their financial behavior does not correlate, and their transactions invalidate each other and have an impact on prices, the question arises on a far too poor assessment of the irrational investors' impact on the market. If investors are irrational, their financial decisions determine prices, although do not change the value of financial assets. As a result, rational investors can sell overvalued or buy undervalued assets, thus gaining profit, until the asset price converges with its value. Behavioral finance study the effects of social, cognitive, and emotional factors on the economic decisions of individuals and institutions and the consequences for benefit and the resource allocation. Behavioral finance does not take the characteristics of the decision-maker as fixed; the focus is on the non-equilibrium processes, actions of diverse agents with bounded rationality who may learn from experience and interactions. The

behavioral finance investigates the subtle facets and interactions in the human brain, faced with the uncertainty of making economic decisions. The most common human traits (fear, anger, greed, self-lessness) place considerable emphasis on our decisions about money. Intellect (grasping a situation), reason (long-term consequences of the action taken) and emotion (considering a course of action) are all interrelated; they are the springs behind human decision. Human behavior is generally reactive, not proactive; therefore, it is difficult to make predictions on the basis of narrow rules. Behavioral finances can relatively easily explain why an individual has made a decision, but have difficulty in quantifying what effects that decision will have on the individual. In addition to the above presentation of behavior errors occurring on the capital market, we may make a graphic description of their mechanism as being similar to that of a pendulum continuously oscillating between optimistic investors (who have security prices rise unfoundedly) and pessimistic investors (who have security prices fall unnecessarily). Optimistic investors, like confident ones, are more willing to make risky investments. They make irrational transactions, and their irrational reactions can lead to abnormal in returns and trading volume (Opera and Tanasescu, [23]).

Researchers suggest that mood markedly affects judgment and decision-making, subsequently altering investor behavior. The mood or psychological state of investors when making decisions can affect their preferences, risk assessments and rational cogitations and, ultimately, their investment decisions. Therefore, financial decisions should vary with investor mood. However, compared to the extensive empirical evidence that mood affects financial markets, its effects on equilibrium asset prices are relatively unsubstantiated. Although some studies in the past decade have modeled investor psychology, most have focused on psychological bias (e.g. narrow-framing, overconfidence, representativeness heuristic, over- and under reaction, ambiguity aversion and familiarity) or on concern about future feelings (e.g. loss- and disappointment-aversion) rather than on mood variations.Thus, the influence of shifting investor mood on equilibrium asset prices and returns remain an open challenge (Hui-chu, [14]).

3 Behavioural Biases

At this section, three general groups of the resources causing bias in thinking and decision-making processes are studied. Bias refers to the deviation from correct and optimal decision-making. These three groups are:

A. Innovative groups

B. Self-deception

C. Social interactions

A. Innovative groups: Since the capacity of information processing is limited in human, people use innovative methods which lead to relatively good decision-making. Such a simplification that is performed in decision-making processes is called innovative simplification (Hirshleifer, [13]). In fact, innovative methods are a series of rules of thumb or mental shortcuts to rapidly solve the complicated problems (Ritter, [26]). Using innovative methods does not always lead to an appropriate decision-

making. Awareness of such behavioral patterns, which are from the rules of thumb and mental shortcuts, help, forecast the probable biases in decision-making. Some of these patterns are as follows:

A.1. Prominence: It is created on the information presented differently from the past. As a result, this information remains well in the individuals' mind and he can easily recover it from the memory. In addition, the phenomena which occur less are highlighted in individuals' mind. In such conditions, the individuals estimate the probability of reoccurrence more than reality.

A.2. Halo effect: It makes the judging person be affected by a favorable characteristic from the studied person or subject and generalize it to other characteristics.

A.3. Delusion on phenomenon accuracy: This delusion is due to the fact that individuals have a higher tendency to accept the accuracy of the subjects which can be processed more easily.

A.4. Mental accounting: It is a kind of mental framework in which the individuals categorize their surrounding world separately into mental accounting. Investors are used to deal with the items of their portfolios separately which can lead to non-efficient decisions.

A.5. Representation: It indicates that individuals make decisions based on clichés. In fact, individuals estimate the probability of a phenomenon according to its similarity to the previous observed events.

A.6. Anchoring: It indicates that individuals are affected by previous estimates or numbers in problem statement while estimating quantitatively.

B. Self-deception: Over-trust is the most significant phenomenon raised on self-deception. There is much evidence showing that individuals trust their knowledge and abilities more than what it is. The forecast of individuals from the probability of phenomena is either highly extreme or deviant. In addition, when the predictability of a phenomenon is low or the evidence and documents are vogue, the experts are exposed to over-trust more than then ordinary people. For example, when a person says that the probability of a phenomenon is 90%, his forecast is usually correct less than 70% (Hirshleifer, [13]).

C. social interactions: Financial experts barely considered the social psychology. Financial theorists studied the effect of information on stock price and turnover but conducted fewer studies on the interaction among the individuals in the market (Shahrabadi and Yousefi, [27]).

Behavioral finance provides a different, highly complicated, and non-ordinary perspective. Behavioral finance shows that investment decision-making is affected by psychological and emotional factors in a large extent. The emotional complexity of human includes the following primary emotions: fear, anxiety, jealousy, frustration, greed, satisfaction, ambition, and pride. All these emotions are most probably involved in specific values of decision-making (Birau, [2]). Under-reaction and overreaction are considered as the observed abnormalities in the capital market. Such phenomena occur when the reaction of stock price reacts is excessively rational according to the new information. This phenomenon is usually associated with price return. The opposite of this phenomenon is true when the stock price in the market is changed less than the logical value according to the new information. However, with the release of news, this phenomenon is associated with price correction which is called under-reaction. Overreaction occurs when the stock price is changed more than the new infor-

mation. This phenomenon is normally associated with price return. Generally, the amount of under-reaction and overreaction depends on how investors understand the primary information. If this information is easily understood by many people, overreaction and under-reaction in the market will be slight. Overreaction and under-reaction are the phenomena questioning the efficiency of the capital; market (Mehrani and Nounahal-e Nahr, [21]). The explanation of this phenomenon is possible by combining the financial management knowledge and psychology. In relation to overreaction and under-reaction of stock price, Daniel and Titman [5] raised a model indicating that the stock price shows more reaction to intangible information. This model inferred that the stock market shows a reaction, more than the appropriate reaction level, to the highlighted, irrelevant, and rumor-like information but shows a reaction less than the appropriate reaction level to the relevant and statistical information. Thus, the probability of being in high-fluctuated and low-fluctuated regimes in the coming periods can be forecasted. Another model was presented in this regard by Daniel and colleagues [5]. In this model presented by Daniel, Hirschliffer and Saberamaniam, two groups of aware and unaware investors were studied. Unaware investors are not expected to be exposed to judgmental biases while the aware investors determining the stock price are affected by two behavioral biases:

1. Over-trust bias that helps the investors excessively trust their personal information on stock value while making decisions, especially if this information was obtained by much effort. The concept of behavioral over-trust bias was derived from a large part of psychology literature. In other words, the individuals are excessively sure about their ability to forecast the events or the accuracy of information. As a result, the individuals estimate their knowledge excessively and estimate risk less than the reality and exaggerate about their ability to control the events (Daniel and Titman, [5]).

2. Self-documentary bias: This behavioral bias makes the individuals care less on general information especially when it is contrary to their personal information. Influenced by this behavioral bias, the individuals attribute their success to themselves but their failures to environmental factors (Daniel and Titman, [5]).

According to Thaler [29], the modern financial management looks at the financial markets and individuals in a tough and flexible way with merely mathematical logic disregarding the fact that the main factor of financial markets is human having psychological emotions, tendencies, and characteristics and many limitations for logical and rational decision-making. The capital market cannot be explained and interpreted well through this thinking. Thus, the strength of efficient markets that was increasing in the 70-90s was decreased by creating some incompatible evidence, the value of systematic risk as the only shadow factor was minimized, and the new intellectual school began through the opinions and thoughts of financial researchers and scholars as well as the capital markets.

Hunton [15] in a study entitled 'The behavioral finance of shareholders on the Chicago stock exchange" identified the behavioral characteristics of shareholders. The studied variables in the research included the effect of market flow on decision-making of investors and the effect of economic-political factors on decision-making. One of the most important findings of this study was that the news and rumors have a high effect on decision-making of investors who pay no attention to financial variables at the company level. Paying attention to risk-taking based on different criteria and determining the effect of economic factors as well as its difference from the other factors are among the obvious features of this study. Wang and colleagues [30] in a study entitled "the psychological mech-

anisms of investors on the China stock exchange" studied the factors affecting the understanding of individual investors from risk and its effects on their behavior in the stock market. The study results showed that among the different types of information affecting the decisions of investors, the policies related to the stock market and inappropriate management of the companies listed on the stock exchange as well as the information of organizational level (that was studied in form of the quality of information disclosure by the companies and allocation of earnings return among the investors) affect the understanding of shareholders from risk. In addition, the findings showed that the perceived risk by investors affect the tendency to reinvestment and satisfaction of investors (that is vital to the development of market). Mankhoff [22] in a study entitled "the acceptance of financial approach by professionals" studied its effect on the behavior of professionals. In this regard, the variables such as investment strategies, information processing, and self-evaluation were studied in two groups one of which agreed on behavioral finance and the other one opposed to behavioral finance. The findings of this study showed that accepting and confirming the behavioral finance significantly affects the understanding of professionals in the market and affects their decisions and behaviors. Fernandez and colleagues [9] classified the behavioral biases into two groups of cognitive biases and emotional biases both cause the irrational decision-making in human. Cognitive biases such as anchoring and availability are rooted in wrong reasoning method. Gaining the biases such as loss aversion and regret aversion are rooted in sudden attitude and emotions and cannot be easily corrected.

4 Research Methodology

In this study,four hypotheses are considered as follows:

1. The probability of using model 1 shows that the stock price at time t had reverse changes than the previous periods while model 2 shows that the changes of stock price at time t has a positive correlation than the previous period.

2. The probability of changing the model from 1 to 2 and vice versa.

3. The probability of stock price changes not to be from adverse changes, sudden jump, and economic bubble.

4. The allowed limit for $L\pi$ and $H\pi$ must be favorable amount to achieve a better forecast of stock price.

This study is applied type in terms of research objective. In this type of research, the objective is to discover a new knowledge following a specific function on a process or product in reality. The population of this study included the companies listed on the Tehran stock exchange selected from 50 companies. In this study, Excel software was used for classifying and integrating the data and MATLAB software was used to test the hypotheses.The main research variables can be stated as follows:

πh: The probability of using model 2

πl: The probability of using model 1

nt : The intrinsic price

and the dependent variables are as follows:

y_t: Revenue shocks

p1 and p2: vector matrices

r: growth rate (interest rate)

λ: The probability of model change

4.1 Research Models

The mathematical model of investors' behavior that was derived from the study of Burberris and colleagues is introduced in this section. Assume that the revenue is $n_t = n_{t-1} + y_t$ at time t in which y_t is the revenue shock at time t that can have one of the +y or −y values. Assume that the total revenue is paid as the stock interest. Investors believe that y_t value is determined by either model 1 or model 2 depending on the economic regime. The structure of models 1 and 2 is the same and both processes are Markov. A Markov chain is a special kind of probable process in which the next mode of the system only depends on the current mode of the system not the previous modes. Most variables have the parts in which the series behavior significantly changes. In other words, each macroeconomic variable or financial data in the long term encounters many failures. Such obvious changes in time series may be the result of war, a general fear in financial markets, or significant changes in governmental policies (Hamiltom, [11]). Markov process is a random discrete approach. The discrete Markov process is called Markov chain. In discrete models, the evaluation criterion of the desired mode is classified in several models that the probability of being at any mode in the future only depends on the current mode and is independent from the previous modes (the process of achieving the current mode). It should be noted that if a process was changed in the past it may face such changes in the future that must be considered in forecasts. In addition, the changes in the regime must not be considered as a predictable and certain problem and the change in the regime is a random and exogenous variable (Hamiltom, [11]). The main difference between these two processes is in probability of transfer, in other words, the transfer matrices for the two models include:

Model 1	$y_{t+1} = y$	$y_{t+1} = -y$		Model 2	$y_{t+1} = y$	$y_{t+1} = -y$
$y_t = y$	π_L	$1 - \pi_L$		$y_t = y$	π_H	$1 - \pi_H$
$y_t = -y$	$1 - \pi_L$	π_L		$y_t = -y$	$1 - \pi_H$	π_H

In model 1, the revenue shocks are positive or negative as every other one (under-reaction) but in model 2 a positive shock is followed by another positive shock (overreaction). πl includes small values and its value is between 0 and 0.5 related to model 1 that the revenue shocks are positive and negative as every other one (under-reaction). πh includes the big values and its value is between 0 and 0.5 related to model 2 that the revenue shocks are as a positive shock followed by another positive shock (overreaction). Stock market and fluctuations of stork return can be divided into two regimes: St =

1for the first regime that is the revenue shock at time t, i.e. yt is produced by model 1. St= 2for the second regime that is the revenue shock at time t, .e. yt is produced by model 2.

	$S_{t+1} = 1$	$S_{t+1} = 2$
$S_t = 1$	$1 - \lambda_1$	λ_1
$S_t = 2$	λ_2	$1 - \lambda_2$

Parameters λ_1 and λ_2 are the probability of model change from 1 to 2 or vice versa.

4.2 Calculating the Estimated Stock Price

In the presented model, the price was deviated from the integer. Thus, the random step model was not user for forecasting the real stock price but a combination of models 1 and 2 which were not random steps forecasted the real stock price better. The following formula showed the changes of mode states as well as the estimated stock price appropriately.

$$pt = \frac{Nt}{\delta} + yt \, (\, p1 - p2 \, qt \,)$$

In the above equation:

pt: The estimated stock price

$\frac{Nt}{\delta}$: The intrinsic price

yt (P1 − p2 qt): The error (the difference between the market price and forecasted price) of the price deviation from the intrinsic value.

P1 and P2 are the vector matrices as constant values.

$$P1 = \frac{1}{\delta} \, (\, \gamma1'0 \, (1 + \delta)[I(1 + \delta) - Q]\text{-}1 \, Q\gamma1)$$

$$P2 = -\frac{1}{\delta} \, (\, \gamma2'0 \, (1 + \delta)[I(1 + \delta) - Q]\text{-}1 \, Q\gamma2)$$

4.3 Testing The Hypotheses

Testing the first hypothesis; the probability of using model 1 showed that the stock price at time t had reverse changes than the previous period while model 2 showed that the stock price changes had a positive correlation at time t than the previous period. In general, the amount of overreaction and under-reaction depends on how investors understand the primary information. If the information can be understood easily by many people, the overreaction and under-reaction in the market will be very low. In order to understand the function of models, look at the following Table that is related to the stock price of the Telecommunication Company of Iran. In periods 1 to 4, positive shocks yt were alternative with negative stocks. Since model 1 stated that the shock was likely to be reverse in consecutive periods (under-reaction), three consecutive and positive shocks were observed in periods 6 and 7.

Table 1: The overreaction and under-reaction of stock price

Row	Company name	stock price	Yt	Model change
1	Telecommunication Company of Iran	2650	+	0
2		2581	-	1
3		2625	+	1
4		2576	-	1
5		2058	-	2
6		2199	+	1
7		2287	+	2
8		2930	+	2

Since this normal behavior was determined by model 2 (overreaction), the above Table showed that overreaction and under-reaction were possible based on the final data.

Testing the second hypothesis; the probability of changing the model from 1 to 2 and vice versa. The following Figure shoes the probabilities of model change forecasting and fluctuations (under-reaction and overreaction) from 2006 to 2015 for the Telecommunication Company of Iran.
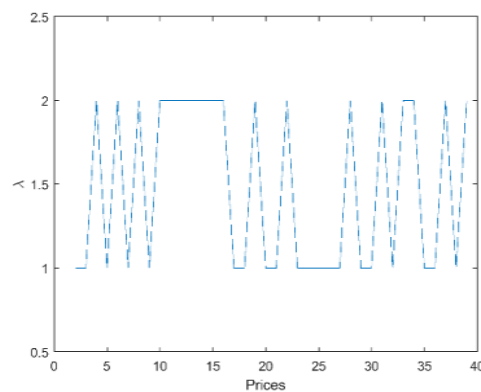
Fig. 1: The probability of model change

Stock market is affected by news and information which is one of the most important factors continuously causing under-reaction and overreaction modes for the stock market. As these forecasts are more accurate, they are more reliable and can give appropriate strategy to the policy makers of the stock market to forecast the severe fluctuations.

Testing the third hypothesis; the probability of changing the stock price from adverse changes, sudden jump, or economic bubble.

The term "bubble" in financial science refers to the situation where the price of an asset is higher than the basic price and value of that asset with a considerable difference. During a bubble, the prices are significantly inflated for a financial asset or a group of financial assets. Thus, there is a slight relationship between the intrinsic value of that group of assets with their prices in the market (Levin and Zajac, [19]). The following Table shows the comparison of the stock market price to the intrinsic price (estimated price) of stock for the Telecommunication Company of Iran. Testing the fourth hypothesis; the allowed area for $L\pi$ and $H\pi$ must be selected as a favorable value. By the appropriate selection of these values, the better forecast of stock price can be achieved.

Table 2. Comparing the price of the stock market to the intrinsic price

Row	Company name	Date	Market price	Estimated price
1	Telecommunication Company of Iran	93/03/31	2650	2474
2		93/06/31	2581	2432
3		94/03/31	2058	1813
4		94/06/31	2199	1942

Since the determined values by the model for π_L is in the range 0 and 0.5 and determined values for π_H in the range 0.5 and 1, the overreaction and under-reaction can be observed in the following Figure by replacing different values for π_L and π_H. If the values π_L and π_H are high, overreaction will occur which means that a positive shock occurs after another positive shock.
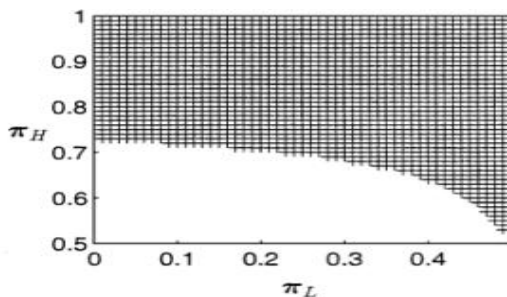

Fig. 2: OVERREACTION only

If π_L and π_H are low, under-reaction overreaction will occur which means that a negative shock occurs after a positive shock.
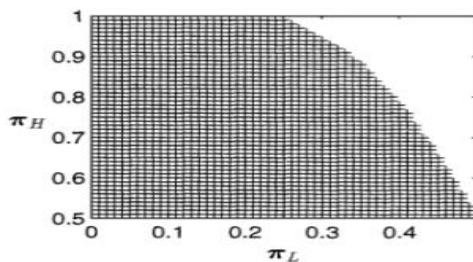

Fig. 3: UNDERREACTION only

For the better forecast f stock price, π_L and π_H values must be selected in such a way that the stock price is both in overreaction and under-reaction regimes. Thus, adjusting $\pi_{L=./42}$ and $\pi_{H=./85}$ places us in a stable way in a region where the stock price of both overreaction and under-reaction is shown.
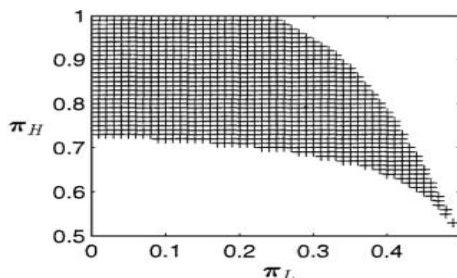

Fig. 4: Allowable region for πL and πH

5 Conclusions

Behavioral finance school or attitude, created by the combination of psychology and finance, suggests that psychology plays a role in financial decision-making. Since the cognitive errors and deviations affect the investment ideas, they affect the financial options. The relationship between financial science and other social sciences, known as financial psychology, made the researchers to conduct many studies on investors' behaviors in financial markets by using them in different situations. Today's, the idea of purely rational behavior of investors who always maximize their utility is not sufficient for justifying the market behavior and reaction. There is even evidence that many patterns of behavioral finance are rooted in the depths of individuals and are difficult to be dealt with through training. Behavioral finance helps to better understand the capital market by formulating the behavioral models to be efficient in dealing with some obstacles resulting from the behavioral patterns. One of the most significant factors in the stock market is news and information affecting the stock market continuously. For example, the news and information on weather, labor strikes, raw materials shortages, international crises and general economic conditions affect the stock prices. If the market is efficient, the arrival of new news and information is correlated with the appropriate reaction of investors while the stock market price will show a rapid, complete, and unreserved reaction to the news and information adjusted to the real price. Considering the first hypothesis analyzing the overreaction and under-reaction of stock market, it was shown that the stock market is affected by news and information. One of the most critical factors affecting the stock market is news and information which continuously affects the stock market and causes the stock market to be in an overreaction or under-reaction state. In relation to overreaction or under-reaction of stock price, Daniel and Titman [5] suggested a model stating that stock prices show more reaction to intangible information. In this model, it was deduced that the stock market shows a reaction lower than the correct reaction level to relevant information full of statistics and numbers while it shows a reaction higher than the correct reaction level to irrelevant and rumor-like information. The second hypothesis states that the probability of the stock price fluctuations is not from adverse fluctuations, sudden jump or economic bubble; financial markets, in particular the capital market, are the most critical tools for financing and allocating the funds. Given the strategic and financial significance of this market, there is a serious problem when it comes to the massive allocation of financial resources. One of the factors that cause this issue is the economic bubble; in fact, the bubble of pricing is based on a reaction to price rises. Based on the results of the hypothesis test, no economic bubble occurred during 2006-2015. This conclusion was drawn from the results of Samadi et al. [28] investigating the efficiency and existence of economic bubbles on the Tehran Stock Exchange using the filter rule and CAPM pattern and showing that the Tehran Securities Market was not performing at a weak level and there was no bubble based on the CAPM model at prices while the stock price was close to its intrinsic value during the studied period. The results of the third hypothesis that might change the model from 1 to 2 and vice versa stated that despite the shocks upon the potential market, the exposure to high-fluctuated (overreaction) regimes and low-fluctuated (under-reaction) regimes is possible and it cannot be said that the stock market is only in a high-fluctuated or low-fluctuated regime. The modeling with the 4-month final prices proved that the stock price is not significantly different from the market price while the stock price is closer to its intrinsic value.

Based on the fourth hypothesis, by examining the values of the parameters π_l and π_h providing enough conditions for overreaction and under-reaction, and since the model determined the range π_l as $0 < \pi_l < 0.5$ and the range π_h as $0.5 < \pi_h < 1$, the prices will show both overreaction and under-reaction by replacing different values for π_l and π_h as well as observing different values of stock prices ,comparing them with market prices, and adjusting π_l on 0.42 and π_h on 0.85 . By selecting the above-mentioned values for π_l and π_h, it can be concluded that a better forecast of stock prices can be obtained, so that the stock market price is close to the stock price. Today, recognizing this new branch of the financial science can make people avoid many misconceptions. Studying the fluctuations is very interesting due to the fact that fluctuations are rapidly affecting the real activities of the economy. Therefore, forecasting the fluctuations can play a significant role in the policy of the stock market in each country. With the timely identification of the probability of severe fluctuations, the stock market policymakers can prevent their occurrence and harmful effects on the economy of the country. The authorities, with a greater understanding of behavioral finance, can consider the behavior of these models while making decisions on such models as well as other issues raised in financial behavior. In order to address the negative aspects and strengthen the positive aspects, they must take some legal measures. Investors should be aware of the behavioral biases in financial markets to be more self-discipline, have fairer judgments, and finally make decisions more rationally.

References

[1] Badri, A., Sadeghi, M., *Effect of different days of week on returns, volatility and volume of transactions in Tehran Stock Exchange.* Management Message, 2005, 17, P.55-83. (In Persian)

[2] Birau, f. R., *The meanings of efficient market paradigm in the context of emerging capital markets. An analysis of weak-form efficiency on the Bucharest Stock Exchange*, The International Conference,, competitiveness And Stability In The Knowledge Based Economy, The Faculty of Economics and Business Administration, University of Craiova, Romania, 4-5 November *2011*.

[3] Birnberg, J., *A Proposed Framework for Behavioural Accounting Research*. Journal Behavioural Research in Accountin. 2011, 23, P.1-43. DOI: 10.2308/bria.2011.23.1.1

[4] Brinberg, J., Luft, J., Shields, M., *Hand Book of Management Accounting Research*. Elsevier Ltd. 2007.

[5] Daniel, K., Titman, S., *Market reaction to tangible and intangible information*. Journal of Finance. 2006, 4, P.1605-1643. DOI: 10.3386/w9743

[6] Darabi, R., Chenary-e Bukat, H., Valikhani, M., *Dimensions and Approaches of Behavioral Finance Theory*, Iranian Accounting and Auditing Studies, 2016, 5. (In Persian)

[7] Eslami-e Bidgoli, G., Kordlouy, H., *Behavioral Finance: Transition from Standard Financial to Neurofinance*, Journal of Financial Engineering and Portfolio Management, 2010, 1, P.19-36. (In Persian)

[8] Frydman, C., Camerer, C., *The Psychology and Neuroscience of Financial Decision Making*. Journal Trends in Cognitive Sciences, 2016, 20.

[9] Fernandes, J., Pena, J., Benjamin, T., *Behavior finance and estimation risk in stochastic portfolio optimiza-*

tion, banco central do brasil, 2009, Working paper.184.

[10] Golami Jamkarani, R., Mokhtari, D., *Effect of Conservative Reporting on Investors Opinion Divergence at Time of Earnings Announcement*. Journal Advances in mathematical Finance & applications. 2018, 3, P.81-95. (In Persian)

[11] Hamiltom, J. D., *A new approach to the economic analysis of non-stationary time series and the business cycle,* Econometrica, 1989, 57, P.357- 384. DOI: 10.2307/1912559

[12] Hellmann, A., *The role of accounting in behavioural finance*. Journal of Behavioural and Experimental finance. 2016, 9, P.39-42. DOI: 10.1016/j.jbef.2015.11.004

[13] Hirshleifer, D. *Investor psychology and asset pricing*. Journal of Finance, 2002, 56, P.1533-1597.

[14] Hui-chu, S., *Investor mood and Financial markets*. Journal of Economic Behaviour & organization, 2010, 76, P.267-282. DOI: 10.1016/j.jebo.2010.06.004

[15] Hunton, J. E., *Toward an understanding of the risky choice behavior of professional financial analysts*, Journal of Psychology and Financial Market. 2005, 20, P.182-189. DOI: 10.1207/S15327760JPFM0204_2

[16] Jagongo, A., Mutswenje, V., *A surrey of the Factors Individual Investors at the NSE* International Journal of Humanities and Social Science,2014, 4.

[17] Keshavarz-e Haddad, G., Rezaei, M., *Testing and analyzing the existence of herd behavior among institutional investors of the Iran Stock Exchange.* Quarterly Journal of Economic Research, 2010, P.103-138. (In Persian)

[18] Khademi-e Grashi, M., Ghazizadeh, M., *Investigating the Factors Affecting the Decision-making of Shareholders in Tehran Stock Exchange based on the Structural Equation Modeling,* Daneshvar Journal of Research, Shahed University of Medical Sciences, 2007, 23. (In Persian)

[19] Levin, S., Zajac, E., *The social Life of Financial*. Journal Illinois, Wesleyan University.2001, 23, P.1-8.

[20] Malekian, E., Fakhari, H., Ghasemi, J., Farzad, S., *Predict the Stock Price of Crash Risk by Using Firefly Algorithm and Comparison With Regression.* Journal Advances in mathematical Finance & applications. 2018, 3, P.43-58. (In Persian)

[21] Mehrani, S., Nounahal-e Nahr, A., *Investigating blow-the-expectation behavior of investors in Tehran Stock Exchange,* Journal of Accounting and Auditing, 2008, 54. (In Persian)

[22] Menkhoff, L., Nikiforow, M., *Professional endorsement of behavioral finance: Dose it impact their perception of markets and themselves?* Journal of Economic Behaviour & Organization, 2009, 71, P.318- 329. DOI: 10.1016/j.jebo.2009.04.004

[23] Opera, C., Tanasescu, C., *Effect of Behavioural Financial on Emerging Capital Markets*. Procedia Economics and Finance Journal, 2014, 15, P.1710- 1716. DOI: 10.1016/S2212-5671(14)00645-5

[24] Rahnemay-e Roudposhti, F., Zandieh, V., *Behavioral Finance and Neurofinance (New Financial Paradigm) from Theory to Practice*, Islamic Azad University Publications, Organization of Printing and Recruitment. 2012, (In Persian)

[25] Raei, R., Fallahpour, S., *Behavioral Finance, Different Approaches in the Area of Finance*, Financial Research, 2004, 18, P.77-106. (In Persian)

[26] Ritter, J. R., *Behavioral finance,* Pacific-Basin Finance Journal. 2003, 11, P.429-437. DOI: 10.1016/S0927-538X(03)00048-9

[27] Shahrabadi, A., Yousefi, R., *An Introduction to Behavioral Finance*, Stock Exchange Journal, 2007, 9, P.51-70. (In Persian)

[28] Samadi, S., Nasrollahi, Z., Zahedmehr, A., *Testing the Efficacy and price bubble in Tehran Stock Exchange using the filter rule and CAPM pattern*, Quarterly Economic Reviews, 2007, 4, P.91-113. (In Persian)

[29] Thaler, R. H., *The end of behavioral finance*, Financial Analyst Journal, 1993, 55, P.12-17. DOI: 10.2469/faj.v55.n6.2310

[30] Wang, l., Shi, K., Xiafan, H., *Psychological mechanisms of investor in Chinese stock market.* Journal of Economic Psychology, 2006, 27, P.762- 780. DOI: 10.1016/j.joep.2006.06.007