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Modeling Assets Pricing Using Behavioral Patterns; Fama-French Approach

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Abstract

Behavioral finance is a new issue raised by some financial intellectuals over the past two decades and has been quickly addressed by professors, experts, and students throughout the world. Investigating the factors affecting investment decisions is carried out in the field of behavioral finance; in other words, the focus of behavioral finance is on the specific charac-teristics of human behavior and applying them in asset pricing. Empirically, pricing models rarely include psychological factors, but the noticeable point is that nowadays, researchers have found behavioral factors influencing empirical asset pricing models that can manipulate returns on asset mispricing. Behavioral asset pricing is the result of applying behavioral finance theories within traditional asset pricing theories. Thus, despite the existence of many asset pricing models, due to their weaknesses and lack of comprehensiveness, as well as the necessity of reviewing behavioral factors, this study aims to model asset pricing through behavioral models. Using the data from 141 listed firms in Tehran Stock Exchange over the years 2008 to 2017 and multivariate regression, this study is an attempts to model asset pric-ing through employing behavioral models and Fama-French approach. Using Fama-French approach, the results showed that accounting information risk, investors' trading behavior, and investors' sentiment have a direct and significant impact on asset pricing.

Keywords: Accounting information risk Investors' trading behavior, Investors' sentiment, Stock returns, Fama-French approach.

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Introduction

In classical financial research, it was assumed that there is a little correlation between each investor's behavior; therefore, the investors' sentiment and behavior biases would neutralize each other and the market is efficient as a whole (Barberis et al., 2001). However, in the behavioral perspective, investors influence each other and different types of perceptual and emotional biases influence their behavior and their decisions to buy and sell shares. In general, these biases affect market efficiency and cannot be neutralized by the investors' behavior. Therefore, they are in fact factors that can affect the pricing process (Kannadhasan and Aramvalarthan, 2014). In this regard, behavioral finance is a new issue raised by some financial intellectuals over the past two decades and has been quickly addressed by professors, experts, and students throughout the world. In investment issues, the type of investors' decision making and the factors affecting their decisions are very important (Safdar and Yan, 2017). Financial theories have had two different approaches over the past few decades. The first one is neoclassical approach in financial sciences. The basic assumption of financial theories in this approach is market efficiency and investors' rational behavior in the market. It began with Capital Asset Pricing Model and the theory of Efficient Markets in the 1960s and with Pricing Mid-Term Capital Assets Model and Arbitrage Pricing Theory in the 1970s. Over time and via conducting different studies, researchers noticed many movements and disorders in financial markets which could not be justified by market-based theories. This led to the emergence of a behavioral revolution in financial debates (second approach). According to BorjiDolatAbadi (2008), financial theories which are based on this approach have emphasized that investment decisions are not merely influenced by economic indicators and rationality, but other factors affect their behavior and decisions as well. This study examines the role of accounting information risk, investors' trading behavior, and investors' sentiment in pricing assets within the framework of behavioral models and Fama-Franch approach.

So far, several studies have dealt with stock returns, factors influencing it, and its consequences. Unlike previous studies conducted in Tehran Stock Exchange, this study explains stock returns and asset valuation based on behavioral finance concepts. Although stock returns have been a popular topic among Iranian researchers, the impacts of investor's sentiment and trading behavior on stock returns have not been examined in numerous papers published in domestic journals. Thus, this study is innovative in this regard.

Review of the Literature

Theoretical Foundations

Understanding how investor trading behavior and investor sentiment affect stock prices in financial markets is one of the most important issues in finance (Yang and Zhou, 2015). In the early twentieth century, decision-making theories were part of the economics; then, from their simple and abstract form, they gradually came close to reality and entered other sciences, even political sciences. At times, mathematical models for solving decision-making problems could not solve the managers' problems, and on the other hand, if the problem was defined properly, the resulting equations would be very long, nonlinear, and logically complicated. Meanwhile, simplifying a mathematical model raises concerns that the simplified model will be significantly different from the original real-world problem, and will ultimately provide answers that are far from reality and will not reflect the realities of the problem. Intuitive decision making does not require much time and decisions are made quickly. On the other hand, when someone has to make a decision in the shortest time, their life may be threatened without the intuitive decision-making ability. Thus, this divine gift should be appreciated and used with training the cognitive faculty (Wilson et al, 1993). In this regard, Capital Asset Pricing Model (CAPM) relates expected returns from an asset and portfolio to its systematics risk (Market risk). The CAPM proposes that excess rate of return on an asset is directly proportional to its covariance (Beta) with the market return (Pravin and Dhananjay, 2019). According to Hirshleifer (2001), in addition to risk, mispricing should also be involved in pricing assets and finding a relationship to calculate expected returns. In his model, which is comparable to the capital asset pricing model, expected returns increase by increased risk (measured by beta) and undervaluation of the asset in question. He states that in order to determine the level of assets undervaluation, it is possible to use price ratios (such as E/P and B/M), measurements related to general mood, or activities that are likely to be done to use mispricing (such as Security Market Plane).

Some asset pricing behavioral models are presented based on limited consideration and partnership. This means that due to some behavioral patterns, investors' attention is focused only on part of the securities in the market, and as a result, investors' partnership mostly occurs in some parts of the market and securities. Merton analyzed the securities returns in different sections. To do this, he used static asset pricing model. In this analysis, he examined the lack of investors' partnership. The results of his research showed that the lack of partnership and investment in some securities is due to limited attention and

consideration, preference for choosing securities that the investors are familiar with, and salience effect. The main result of this model is that the stocks of firms which are neglected and ignored have high and abnormal expected returns (Hirshleifer et al, 2001). However, for various reasons, including time constraints for decision making and limitations in information processing ability, human beings tend to simplify decisions and ignore complex decision-making processes and to turn to shortcuts of decision-making ways or intuitive methods that lead to appropriate results. In other words, using rule of thumb simplifies the sophisticated decision-making process. Obviously, people do not use mathematical rules, statistics, and probabilities for their everyday decisions, and in some situations, they have to make quick decisions and do not have time to do complex calculations. On the other hand, using complicated methods requires a lot of information that may not be available or may be costly to obtain. Therefore, using rule of thumb or mental shortcuts facilitates this time-consuming and complex process.

The important point is that cognitive biases are not restricted to agents, even experienced and professional people have these biases when using the intuitive method. Since simplification does not take into account all sections of the phenomenon under study, it sometimes leads to harmful results. The least damage caused by employing these methods is facing cognitive biases and errors. But obviously, people widely use this method to make decisions (Saiedi and Farhanian, 2015). In this regard, one of the questions raised in the field of financial markets is how market agents behave. Understanding how investor's trading behavior and their sentiment influence stock prices in financial markets is one of the most important issues in financing. Shiller (2011 and 2014) emphasized that in the light of humans' real behavior, researchers have to take into account individuals' real thoughts and actions. The traditional theory of asset pricing shows that changes in stock returns depend on changes in underlying variables (cash flows and discount rates) and cross-sectional returns only depend on systematic cross-sectional risks (Fama and French, 1993, 1995, 2012, 2015). Fama and Franch (1993) used the whole market factor, the firm size factor, and the book-to-market value factor to describe excess returns. Following Fama and Franch three-factor model (1993), Fama and Franch (2015) used a five-factor model which takes into account the size, value, profitability, and investment patterns in average stock returns. However, one of the most important hidden messages in Fama and French studies (1993, 2012, and 2015) is that most of the problems in asset pricing models are in small stocks, which these articles are unable to explain them. Meanwhile, a large part of the financial literature has shown that excess stock returns cannot be

explained easily by fundamental variables and several studies have concluded that a firm's returns are influenced by investors' sentiment (Baker and Wurgler, 2006, 2007; Baker et al, 2012; Brown and Cliff, 2004; Greenwood and Shleifer, 2014; Kim and Ha, 2010; Liao et al, 2011; Yang and Gao, 2014; Yang and Zhang, 2014; Yu and Yuan, 2011). Also, some recent studies have used the index of investors' sentiment to examine the role of investors' sentiment in explaining stock returns of firms listed in the US Stock Exchange (Cen et al, 2013; Fong and Toh, 2014; Stambaugh et al, 2012, 2014; Yu and Yuan, 2011). In previous studies, it has also been argued that stock returns are influenced by retail investors' behavior or institutional investors (Barber et al, 2009; Chen et al, 2014; Han and Kumar, 2013; Hvidkjaer, 2006; Lee and Radhakrishna, 2000; Malmendier and Shanthikumar, 2007; Qian, 2014). Many recent studies have used the trading data to classify sellers and buyers transactions and to explain a pattern for investors' trading behavior (according to Lee and Ready, 1991). The remarkable point in these studies is that retail investors can direct the market. On the other hand, according to Fama and Laffer (1971), the information has three important benefits of reducing risk, improving the firm's operating decisions, and earning abnormal earnings in trading securities with having access to new confidential information. It is worth mentioning that in the past, financial reporting was only considered in terms of regulatory purposes, but since 1960s, the attention has been drawn to providing users with the information they need to make economic decisions (Higson, 2003). Therefore, the information theory is an alternative or complementary to the supervision theory. One of the reasons of demanding audited financial statements is to provide useful information for investors' decision-making. According to financial texts in investment models, the firm value is determined by calculating the net present value of future cash flows. Evidence also shows that there is a high correlation between future cash flows and accounting information in financial statements (Wallace, 1980).In this regard, Safdar and Yan (2017) provide evidence of significant association of poorer accruals quality with higher future realized stock returns. In overall, their results provide sufficient evidence in support of theories suggesting a role of information risk in investors' pricing decisions and that information risk is a priced risk factor despite, or maybe because of, the notoriously opaque information environment in China.Given these explanations, it is argued that investors' sentiment, investors' trading behavior, and accounting information risk play a significant role in defining stock returns and asset pricing. Consequently, this study examines the role of accounting information risk, investor's trading behavior, and investors' sentiment in determining stock returns and asset pricing, and in doing so, employs Fama-Franch approach.

Background

Li et al. (2018) investigated the asymmetric relationship between investors' sentiment and stock returns: Evidence from a Quantile Non-causality Test. They found out that the causal relationship between investor's sentiment and stock returns is strengthened when a sufficient period of time is regarded. This finding suggests that investors' sentiment can provide incremental forecasts for stock returns in extreme market conditions that cannot be found by using Granger's causality test. In another study, examining the relationship between realized daily skewness and stock returns and the effect of information release on this relationship, Choi and Lee (2017) found that there is a negative relationship between these two variables, but when the information is released, the direction of this relationship will change. Amaya et al. (2015) also showed that there is a positive relationship between realized skewness and the next week stock returns, but this relationship was not significant in all circumstances. Besides, there is no relationship between current week real fluctuations and the next week returns. In a study, Huang and Chang (2014) showed that contrary to previous results indicating that conscious transaction would reduce stock returns fluctuations because it causes the stock price to return to its fundamental value, there is an asymmetric relationship between the conscious transaction and stock return fluctuations, which in fact, is affected by the firm's confidential information.

In Iran, Derakhshande and Ahmadi (2017) evaluated the role of investors' beliefs in priceorientation and turnovers in the capital market. Factor loadings from the collected data reveal that both groups of behavioral and economic variables influence investors' decisions in Tehran Stock Exchange. In the future, a new theoretical and econometric perspective will be shared which is currently undergoing modifications in terms of primary evidence via using sample analysis based on the type of investors (individual investors versus institutional investors). This will be done using the structural equation model for statistical testing of proposed variables and their differences across the sample. The results of the study by Seif Allahi et al. (2016) showed that all factors, except overconfidence, affect investments and the amount of this impact varies for each factor. The rating of these factors in terms of their impact was: relative gain and loss, sentiment effect, conservatism, herding behavior, agency intuition, ownership effect, regret aversion. Moghadam et al. (2013) also examined this issue. Their results showed that there is a significant relationship between the ratios of market price to earnings per share, market price to book value, market price to sales price and earnings per share, and forecasted stock returns.

Methodology

Hypotheses

Given the statements presented in the theoretical foundation, the hypotheses are as follows:

1. Using Fama-Franch approach, accounting information risk has a direct and significant impact on asset pricing.

2. Using Fama-Franch approach, investors' trading behavior has a direct and significant impact on asset pricing.

3. Using Fama-Franch approach, investors' sentiment has a direct and significant impact on asset pricing.

Population and Sample

The population of this study includes all listed firms in Tehran Stock Exchange during the years 2008 to 2017. The sample will be selected through systematic elimination from the population so that it consists all firms in the population which have met the following criteria:

1. Do not have changes in their fiscal period during the study, so that the results of the financial performance can be compared.

2. Be not among firms acting in financial fields, including investment companies, banks, insurance and financial institutions. Due to the fact that the nature of investment companies' activities is different and their main income is earned from investment, and because they are dependent on the activities of other companies, they are different from other companies by nature, and as a result, will be excluded from the sample.

3. The data required for the research variables needs to be available during the period of 2008 to 2017 so that the calculations can be done without flaws.

4. Their fiscal period ends up at 12.29 each year, so that the data can be put together and used in panel form, if needed.

5. Do not have trading halts of more than 3 months so that their stock market information can be used.

Considering the above-mentioned conditions, 141 firms were selected as the sample of this study.

Variables

The following model, which is taken from Yang and Gao (2015) and Rahil and Yaun (2017), is used to test the first hypothesis (β_4):

$$R_{p,t} - R_{f,t} = \beta_0 + \beta_1 RMRF_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 AQ_{i,t} + \beta_5 DIV_{i,t} + \beta_6 LEV_{i,t} + \beta_7 PROF_{i,t} + \beta_8 CF_{i,t} + \beta_9 TANG_{i,t} + \beta_{10} COD_{i,t} + \beta_{11} RISK_{i,t} + \varepsilon_{i,t} \quad (1)$$

The following model, which is taken from Yang and Gao (2015) and Rahil and Yaun (2017), is used to test the second hypothesis (β_4):

$$R_{p,t} - R_{f,t} = \beta_0 + \beta_1 RMRF_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 BSI_{RMRF,t} + \beta_5 DIV_{i,t} + \beta_6 LEV_{i,t} + \beta_7 PROF_{i,t} + a\beta_8 CF_{i,t} + \beta_9 TANG_{i,t} + \beta_{10} COD_{i,t} + \beta_{11} RISK_{i,t} + \varepsilon_{i,t} \quad (2)$$

The following model, which is taken from Yang and Gao (2015) and Rahil and Yaun (2017), is used to test the third hypothesis (β_4):

$$R_{p,t} - R_{f,t} = \beta_0 + \beta_1 RMRF_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 S_{RMRF,t} + \beta_5 DIV_{i,t} + \beta_6 LEV_{i,t} + \beta_7 PROF_{i,t} + \beta_8 CF_{i,t} + \beta_9 TANG_{i,t} + \beta_{10} COD_{i,t} + \beta_{11} RISK_{i,t} + \varepsilon_{i,t} \quad (3)$$

The Dependent Variable:

Market net returns (R_{pt}-R_{ft}):

That is the difference between total market returns and the risk-free interest rate is as follows:

R_{pt} = Total market returns (growth rate of total market index in year t compared to year t-1) in year t.

R_{ft} = Risk-free interest rate (interest rate on government bonds) in year t.

Independent Variables:

- Investors' sentiment ($\mathbf{S_{RMRF,t}}$):

In order to calculate this variable, first S_t is calculated through using the factor analysis of the four indices. These factors are as follows:

1. Relative strength index (RSI)

To calculate RSI, first RS_t needs to be calculated:

$$RS_t = \frac{\sum_{t=1}^{6} \max(P_t - P_{t-1}, 0)}{\sum_{t=1}^{6} \max(P_{t-1} - P_t, 0)} \quad (4)$$

Where: P_t is the stock price at the end of t time period; and P_{t-1} is the stock price at the end of t-1.

Then, RSI_t is computed:

$$RSI_t = 100 \times RS_t/(1 + RS_t \quad (5)$$

It should be noted that time period t for Ps is considered as a two-month period because t is regarded from one to six and the other data is based on the annual basis. In this way, RS_t is calculated on an annual basis and RSI_t is also calculated annually.

2.Psychological line index (PSY)

The following equation is used to compute PSY:

$$PSY_t = \frac{T^u}{T} \times 100 \quad (6)$$

Where: T^u is the number of days during the year that the firm stock price has had an increase as compared to the previous day; and T is the number of trading days during the year.

3.Trading Volume (VOL)

To calculate the trading volume of a firm's stock, the natural logarithm of the number of shares traded by the firm throughout the year is employed.

4.Adjusted Turnover Rate (ATR)

The following equation is used to calculate ATR:

$$ATR_{it} = \frac{R_{it}}{|R_{it}|} \times \frac{VOL_{it}}{\text{shares outstanding at time t}} \quad (7)$$

Where: R_{it} is stock returns of firm i in year t, calculated as follows:

$$Total\ Stock\ Return = \frac{(P_1 - P_0) + D}{P_0}$$

$$P_0 = Initial\ Stock\ Price$$
$$P_1 = Ending\ Stock\ Price(Period\ 1)$$
$$D = Dividends \quad (8)$$

VOL_{it}= the number of shares traded in firm i in year t.

Shares outstanding at time t= the number of outstanding shares of firm i in year t.

After calculating these four factors, they are combined and S_t Index is calculated through using factor analysis. Then, the following regression model is estimated:

$$S_t = b_0 + b_1 RMRF_t + \varepsilon_{pt} \quad (9)$$

Where: $RMRF_t$= Market excess returns in year t and, in fact, the difference between the stock index growth and the risk-free interest rate (interest rates on participation bonds).

S_t= its calculation has been described in the above section.

The residual of the above model for each fir-year, called $S_{RMRF,t}$, will be a criterion for calculating investors' sentiment.

-Investors' trading behavior (BSIRMRF,t):

To compute this variable, first, the following model must be calculated:

$$BSI_{it} = \frac{BV_{it} - SV_{it}}{BV_{it} + SV_{it}} \quad (10)$$

Where: BV_{it}= the volume (number) of firm i stock purchase during year t.

SV_{it}= the volume (number) of firm i stock sales during year t.

After calculating BSI_{it}, the following model is estimated:

$$BSI_{it} = b_0 + b_1 RMRF_t + \varepsilon_t. \quad (11)$$

Where:$RMRF_t$= Market excess returns in year t and, in fact, the difference between the stock index growth and the risk-free interest rate (interest rates on

participation bonds).

BSI_{it}= its calculation has been described in the above section.

The residual of the above model for each fir-year, called $BSI_{RMRF,t}$, will be a criterion for calculating investors' trading behavior.

- Accounting information risk (AQi,t):

To calculate the accounting information risk, the Dichu and Dichu accruals quality model modified by Francis, is used:

$$TCA_{i,t} = \phi_{o,i} + \phi_{1,i}\ CFO_{i,t-1} + \phi_{2,i}CFO_{i,t} + \phi_{3,i}CFO_{i,t+1} + \phi_{4,i}\Delta Rev_{i,t} + \phi_{5,i}PPE_{i,t} + \upsilon_{i,t} \quad (12)$$

Where:$TCA_{i,t}$= total current accruals of firm i in year t, which is net profit plus depreciation cost minus operating cash flow divided by total assets.

$CFO_{i,t-1}$= operating cash flow of firm i in year t-1, which is the operating cash flow divided by total assets.

$CFO_{i,t}$= operating cash flow of firm i in year t, which is the operating cash flow divided by total assets.

$CFO_{i,t+1}$= operating cash flow of firm i in year t+1, which is the operating cash flow divided by total assets.

$\Delta REV_{i,t}$= changes in sales revenue of firm i in year t, which is sales revenue in year t minus sales revenue in year t-1 divided by total assets.

$PPE_{i,t}$= property, machinery, and equipment account of firm i in year t, which is the property, machinery, and equipment account divided by total assets.

After estimating the model at the firms' level and calculating its coefficients, the model residual will be computed. The absolute value of the residual is used as an inverse measure for accruals quality and a direct measure for accounting information risk.

Control Variables

$RMRF_t$= Market excess returns, and in fact, the difference between the stock index growth and the risk-free interest rate (interest rates on participation bonds) in year t.

SMBt= the size factor or magnitude in year t that results from the difference between big firms' stock returns and small firms' stocks (the sample is classified into three categories in terms of the assets logarithm. The firms listed

at the top one-third are identified as big, and the firms at the bottom one-third are considered as small, and the average of their stock returns is compared).

HML_t= The ratio of book-to- market value in year t, which is the difference between stock returns with a high book-to-market ratio and stock returns with a low book-to-market ratio (The sample is classified into three categories in terms of the ratio of book value to stock market value. Firms at the top one-third are considered as firms with a high book-to-market value, and firms at the bottom one-third are recognized as firms with a low book-to-market value, and the average of their stock returns are compared with each other).

$DIV_{i,t}$= cash dividends of firm i in year t, which is the ratio of cash dividends per share to net profit per share.

$LEV_{i,t}$= debt level of firm i in year t, which is the ratio of debts to assets.

$PROF_{i,t}$= profitability of firm i in year t, which is the ratio of net profit to assets.

$CF_{i,t}$= operating cash flow of firm i in year t, which is the ratio of operating cash flow to assets.

$TANG_{i,t}$= the tangibility of assets of firm i in year t, which is the ratio of tangible assets to total assets.

$COD_{i,t}$= cost of debts of firm i in year t, which is the ratio of financial costs to total debts.

$RISK_{i,t}$= The risk of firm i in year t, which is the ratio of the standard deviation of the operating cash flow of the company over the past three years to assets.

Results

The findings are presented as 1 descriptive statistics and 2 inferential statistics below.

Descriptive Statistics

In this section, the mean, median, standard deviation, maximum, minimum, skewness, and kurtosis of the variables are calculated and presented in Table 1.

Table1. Descriptive Statistics

Variables	Symbol	Mean	Median	Maximum	Minimum	Standard Deviation	Skewness	Kurtosis
Stock returns	$R_{i,t}$	0.337	0.124	6.445	-0.783	0.812	2.703	4.118
Market net returns	R_{pt}-R_{ft}	0.11	0.007	0.877	-0.438	0.422	0.453	1.991
Investors' sentiment	$S_{RMRF,t}$	0.605	0.584	2.938	-1.199	0.426	0.738	7.866
Investors' trading behavior	$BSI_{RMRF,t}$	-0.012	0.007	0.869	-0.964	0.165	-0.68	7.622
Accounting information risk	$AQ_{i,t}$	0.091	0.067	0.479	0.00003	0.082	1.332	4.771
Market excess returns	$RMRF_t$	0.11	0.007	0.877	-0.438	0.422	0.453	1.991
Size or magnitude factor	SMBt	-0.42	-0.674	1.321	-3.02	1.188	-0.502	3.051
Book-to-market value factor	HML_t	0.597	-0.277	10.917	-2.8	3.704	2.006	6.174
Dividend	$DIV_{i,t}$	0.638	0.512	4.618	0.000	0.675	2.003	9.206
Debt level	$LEV_{i,t}$	0.58	0.593	0.987	0.089	0.187	-0.27	2.5
Profitability	$PROF_{i,t}$	0.111	0.091	0.644	-0.4	0.126	0.621	4.798
Operating cash flow	$CF_{i,t}$	0.108	0.1	0.556	-0.393	0.116	0.244	4.601
Assets tangibility	$TANG_{i,t}$	0.265	0.226	0.892	0.002	0.179	0.842	3.223
Cost of debt	$COD_{i,t}$	0.059	0.053	0.238	0.000	0.04	0.84	3.903
Risk	$RISK_{i,t}$	0.062	0.05	0.439	0.001	0.051	2.411	8.283

As shown in Table 1, the mean and median of stock return variable are 0.337 and 0.124. In general, dispersion criteria examine and compare the observation dispersion around the mean. One of the most important criteria for dispersion is standard deviation. Given the above table, this criterion for the stock return variable is 0.812. It is worth mentioning that the highest value of stock returns variable is 6.445 and its lowest value is -0.783. Skewness and kurtosis of this variable are 2.703 and 4.118, respectively. Another variable examined in this study is investor's behavior, with the maximum and minimum values of 2.938 and -1.199, respectively.

Inferential Statistics

Estimating the Information Accounting Risk Model (Accruals)

To estimate the coefficients of accruals quality, Chaw and Hauseman tests are used to determine an appropriate method for estimating the model Table 2.

Table2. Chaw and Hauseman Tests Results

Test	Test Statistics	Level of Significance	H_0	H_1
Chaw (fixed effects vs panel data)	15.111	0.000	Using panel data model	Using fixed effects model
Result			Rejected	Confirmed
Hauseman (fixed effects vs random effects)	139.252	0.000	Using random effects model	Using fixed effects model
Result			Rejected	Confirmed

As shown in Table 2, fixed effects method is preferred to the other two methods, and as a result, the model is estimated using fixed effects method. The results are illustrated in Table 3.

Table3. The results of information accounting risk (accruals) model

$$TCA_{i,t} = \phi_{o,i} + \phi_{1,i}\ CFO_{i,t-1} + \phi_{2,i}CFO_{i,t} + \phi_{3,i}CFO_{i,t+1} + \phi_{4,i}\Delta Rev_{i,t} + \phi_{5,i}PPE_{i,t} + \upsilon_{i,t}$$

Variable	Coefficients	SD	T statistics	Level of Significance	VIF
Fixed value	0.133	0.005	24.533	0.000	-
Previous year's perating cash flow	0.102	0.015	6.497	0.000	1.28
Current year's operating cash flow	-0.873	0.152	-5.727	0.000	1.436
Next year's operating cash flow	0.102	0.014	7.123	0.000	1.365
Changes in sales revenue	0.098	0.007	13.916	0.000	1.017
Account of assets, machinery, and equipment	-0.14	0.016	-8.532	0.000	1.064
F Statistics		35.143	R-squared		0.821
F Statistics Level of Significance		0.000	Adjusted R-squared		0.798
White diagonal correction (eliminating the possible effects of variance heterogeneity			Dourbin-Watson Value		1.828

Given the results of Table 3 and the described approach, the accounting information risk (accruals) is calculated.

Factor analysis of RSI, PSY, VOL, and ATR to calculate investor's sentiment

As described earlier, after calculating RSI, PSY, VOL, and ATRvia using the factor analysis approach, a single variable called S_t is defined, which is used in the regression model for calculating investors' sentiment. Factor analysis is utilized here becauseit can put together and combine various variables in a balanced way with respect to their values. Thus, it is the most appropriate solution for combining multiple variables and forming a new one. It is used to find out the underlying variables of a phenomenon or summarizing a set of data. The primary data for factor analysis is the correlation matrix between variables.

Table 4. Factor analysis of RSI, PSY, VOL, and ATR

Headings	Factor loading
Relative strength index	0.005
Psychological line index	0.36
Trading volume	0.008
Adjusted turnover	0.774
KMO index	0.525
Bartlett statistics	455.187
Bartlett significance level	0.000

Given the KMO index value, which is above 0.5, the identified factors are suitable for factor analysis. Moreover, since the significance level of the Bartlett test is less than 0.05, factor analysis has been successfully performed. As illustrated in Table 4, the variables' coefficients are used as weights in calculating the mean value.

Estimating Investors' Sentiment

To estimate the coefficients of investors' sentiment model, Chaw and Hauseman tests are used in order to determine an appropriate method for estimating the model Table 5.

Table5. The results of Chaw and Hauseman test

Test	Test Statistics	Level of Significance	H0	H1
Chaw (fixed effects vs (panel data	1.394	0.002	Using panel data model	Using fixed effects model
Result			Rejected	Confirmed
Hauseman (fixed effects vs random effects)	22.922	0.000	Using random effects model	Using fixed effects model
Result			Rejected	Confirmed

As shown in Table 5, fixed effects method is preferred to the other two methods, and as a result, the model is estimated using fixed effects method. The results are illustrated in Table 6.

Table6. The results of testing investors' sentiment model

$S_t = b_0 + b_1 RMRF_t + \varepsilon_{pt}$					
Variable	**Coefficients**	**Standard error**	**T statistics**	**Level of Significance**	**VIF**
Fixed value	0..06	0.006	9.022	0.000	-
Market excess returns	0.22	0.015	13.991	0.000	1.000
F Statistics		32.765	R-squared		0.536
F Statistics Level of Significance		0.000	Adjusted R-squared		0.51
White diagonal correction (eliminating the possible effects of variance heterogeneity			Dourbin-Watson Value		2.084

Given the results of Table 6 and the described approach, the investors' sentiment is calculated.

Estimating Investors' Trading Behavior Model

To estimate the coefficients of investors' trading behavior model, Chaw and Hauseman tests are used to determine an appropriate method for estimating the model Table 7.

Table7. The results of Chaw and Hauseman test

Test	**Test Statistics**	**Level of Significance**	**H0**	**H1**
Chaw (fixed effects vs panel data)	3.917	0.002	Using panel data model	Using fixed effects model
Result			Rejected	Confirmed
Hauseman (fixed effects vs random effects)	23.827	0.000	Using random effects model	Using fixed effects model
Result			Rejected	Confirmed

As shown in Table 7, fixed effects method is preferred to the other two methods, and as a result, the model is estimated using fixed effects method. The results are illustrated in Table 8.

Table8. The results of testing investors' trading behavior model

$BSI_{it} = b_0 + b_1 RMRF_t + \varepsilon_t.$					
Variable	**Coefficients**	**Standard error**	**T statistics**	**Level of Significance**	**VIF**
Fixed value	0.107	0.011	9.259	0.000	-
Market excess returns	0.3	0.101	2.961	0.003	1.000
F Statistics		12.718	R-squared		0.617
F Statistics Level of Significance		0.000	Adjusted R-squared		0.573
White diagonal correction (eliminating the possible effects of variance heterogeneity			Dourbin-Watson Value		2.099

Given the results of Table 8 and the described approach, investors' trading behavior is calculated.

Estimating H_1 Model

To estimate the coefficients of H_1, Chaw and Hauseman tests are used to determine an appropriate method for estimating the model Table 9.

Table9. Results of Chaw and Hauseman tests

Test	**Test Statistics**	**Level of Significance**	**H0**	**H1**
Chaw (fixed effects vs panel data)	2.168	0.000	Using panel data model	Using fixed effects model
Result			Rejected	Confirmed
Hauseman (fixed effects vs random effects)	38.976	0.000	Using random effects model	Using fixed effects model
Result			Rejected	Confirmed

As shown in Table 9, fixed effects method is preferred to the other two methods. Therefore, the model is estimated using fixed effects method. The results are illustrated in Table 10.

Table10. Results of testing H1 model

$R_{p,t} - R_{f,t} = \beta_0 + \beta_1 RMRF_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 AQ_{i,t} + \beta_5 DIV_{i,t} + \beta_6 LEV_{i,t} + \beta_7 PROF_{i,t} + \beta_8 CF_{i,t} + \beta_9 TANG_{i,t} + \beta_{10} COD_{i,t} + \beta_{11} RISK_{i,t} + \varepsilon_{i,t}$					
Variable	**Coefficients**	**Standard Error**	**T statistics**	**Level of Significance**	**VIF**
Fixed value	-0.699	0.206	-3.384	0.000	-
Market excess returns	5.588	0.35	15.957	0.000	1.738
Magnitude or size factor	0.272	0.119	2.275	0.023	1.725

Book-to-market value	0.085	0.029	2.904	0.003	1.181
Accounting information risk	0.923	0.292	3.158	0.001	2.119
Cash earnings	0.16	0.074	2.167	0.03	1.083
Debt level	1.564	0.795	1.965	0.049	1.568
Profitability	1.793	0.205	8.728	0.000	2.814
Operating cash flow	0.014	0.005	2.926	0.003	1.388
Assets tangibility	0.012	0.004	-2.823	0.005	1.094
Cost of debt	6.93	3.219	2.152	0.031	1.189
Risk	1.763	0.359	4.906	0.000	1.031
F Statistics		47.016	R-squared		0.728
F Statistics Level of Significance		0.000	Adjusted R-squared		0.712
White diagonal correction (eliminating the possible effects of variance heterogeneity			Dourbin-Watson Value		2.12

Given the results of Table 10, since t statistics of the accounting information risk variable is greater than +1.956 and its significance level is less than 0.05, there is a significant and direct relationship between the accounting information risk and market net returns. Thus, the first hypothesis of the study indicating that using Fama-Franch approach, accounting information risk has a direct and significant effect on asset pricing is confirmed.

Estimating H_2 Model

To estimate the coefficients of H_2, Chaw and Hauseman tests are used to determine an appropriate method for estimating the model Table 11.

Table11. Results of Chaw and Hauseman tests

Test	Test Statistics	Level of Significance	H_0	H_1
Chaw (fixed effects (vs panel data	1.6	0.000	Using panel data model	Using fixed effects model
Result			Rejected	Confirmed
Hauseman (fixed effects vs random effects)	39.271	0.000	Using random effects model	Using fixed effects model
Result			Rejected	Confirmed

As shown in Table 11, fixed effects method is preferred to the other two methods. Therefore, the model is estimated using fixed effects method. The results are illustrated in Table 12.

Table12. Results of testing H_1 model

$R_{p,t} - R_{f,t} = \beta_0 + \beta_1 RMRF_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 BSI_{RMRF,t} + \beta_5 DIV_{i,t} + \beta_6 LEV_{i,t} + \beta_7 PROF_{i,t} + \beta_8 CF_{i,t} + \beta_9 TANG_{i,t} + \beta_{10} COD_{i,t} + \beta_{11} RISK_{i,t} + \varepsilon_{i,t}$

Variable	Coefficients	Standard Error	T statistics	Level of Significance	VIF
Fixed value	-0.657	0.06	-10.817	0.000	-
Market excess returns	5.829	0.408	14.27	0.000	2.073
Magnitude or size factor	0.187	0.042	4.409	0.000	1.718
Book-to-market value	0.092	0.03	3.009	0.002	1.159
Investors' trading behavior	2.577	1.033	2.493	0.013	1.433
Cash earnings	0.058	0.009	6.533	0.000	1.051
Debt level	0.394	0.077	5.121	0.000	1.511
Profitability	0.349	0.085	4.092	0.000	1.881
Operating cash flow	0.539	0.073	7.359	0.000	1.393
Assets tangibility	0.135	0.043	-3.107	0.002	1.101
Cost of debt	9.715	4.255	2.283	0.022	1.179
Risk	0.213	0.039	5.466	0.000	1.022
F Statistics		47.155	R-squared		0.745
F Statistics Level of Significance		0.000	Adjusted R-squared		0.726
White diagonal correction (eliminating the possible effects of variance heterogeneity			Dourbin-Watson Value		2.143

Given the results of Table 10, since t statistics of investors' trading behavior variable is greater than +1.956 and its significance level is less than 0.05, there is a significant and direct relationship between investors' trading behavior and market net returns. Therefore, the second hypothesis of the study indicating that using Fama-Franch approach, investors' trading behavior has a direct and significant effect on asset pricing is confirmed.

Estimating H_3 Model

To estimate the coefficients of H_3, Chaw and Hauseman tests are used to determine an appropriate method for estimating the model Table 13.

Table13. Results of Chaw and Hauseman tests

Test	**Test Statistics**	**Level of Significance**	**H0**	**H1**
Chaw (fixed effects (vs panel data	1.288	0.016	Using panel data model	Using fixed effects model
Result			Rejected	Confirmed
Hauseman (fixed effects vs random effects)	39.797	0.000	Using random effects model	Using fixed effects model
Result			Rejected	Confirmed

As shown in Table 13, fixed effects method is preferred to the other two methods. Therefore, the model is estimated using fixed effects method. The results are illustrated in Table 14.

Table14. Results of testing H_3 model

$$R_{p,t} - R_{f,t} = \beta_0 + \beta_1 RMRF_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 S_{RMRF,t} + \beta_5 DIV_{i,t} + \beta_6 LEV_{i,t} + \beta_7 PROF_{i,t} + \beta_8 CF_{i,t} + \beta_9 TANG_{i,t} + \beta_{10} COD_{i,t} + \beta_{11} RISK_{i,t} + \varepsilon_{i,t}$$

Variable	**Coefficients**	**Standard Error**	**T statistics**	**Level of Significance**	**VIF**
Fixed value	-0.426	0.057	-7.42	0.000	-
Market excess returns	5.373	0.344	15.605	0.000	1.724
Magnitude or size factor	0.194	0.025	7.577	0.000	1.534
Book-to-market value	0.065	0.028	2.337	0.0019	1.156
Investors' sentiment	0.512	0.054	9.424	0.000	1.007
Cash earnings	0.093	0.026	3.542	0.000	1.051
Debt level	0.121	0.027	4.36	0.000	1.495
Profitability	0.461	0.063	7.279	0.000	1.869
Operating cash flow	0.26	0.019	4.086	0.000	1.39
Assets tangibility	0.073	0.02	3.835	0.000	1.093
Cost of debt	0.066	0.02	3.346	0.000	1.178
Risk	0.2	0.039	5.089	0.000	1.019
F Statistics		49.625	R-squared		0.792
F Statistics Level of Significance		0.000	Adjusted R-squared		0.775
White diagonal correction (eliminating the possible effects of variance heterogeneity			Dourbin-Watson Value		2.225

Given the results of Table 10, since t statistics of investors' sentiment variable is greater than +1.956 and its significance level is less than 0.05, there is a significant and direct relationship between investors' sentiment and market net returns. Therefore, the third hypothesis of the study indicating that using Fama-Franch approach, investors' sentiment has a direct and significant effect on asset pricing is confirmed.

Conclusions

In order to test the first hypothesis of the study, indicating that using Fama-French approach, accounting information risk has a direct and significant effect on asset pricing, a model consisting of a dependent variable of net market returns and an independent variable of accounting information risk was used. The results showed that using Fama-Franch approach, accounting information risk has a direct and significant impact on asset pricing. In this regard, it should be noted that the model of pricing traditional capital assets and Fama and Franch three-factor model (1993) did not contain any factors for information risk. Contrary to this view, Easley and O'Hara (2004)'s theoretical model assumed that stocks with more confidential information would be riskier because they have more news to disclose to investors. Also, Hayes et al. (2007) argued that after controlling systematic risk, information asymmetry was not effective in firms' capital costs. However, they asserted that higher information asymmetry on systematic factors leads to higher capital costs. Lambert et al. (2012) also suggested that in a fully competitive market, information asymmetry cannot influence capital cost, but the information accuracy can. Moreover, in imperfect markets, information asymmetry and the information accuracy play a determinant role in the firm's capital cost. Hence, it is argued that in Iranian capital market, the firm's accounting information risk affects returns and asset pricing. This result is in accordance with the results of Jorgensen et al. (2012) and Choi and Lei (2017).

In order to test the second hypothesis of the study stating that using Fama-French approach, investors' trading behavior has a direct and significant impact on asset pricing, a model consisting of a dependent variable of market net returns and an independent variable of investor's trading behavior was employed. The results showed that using Fama-Franch approach, investors' trading behavior has a direct and significant impact on asset pricing. In this regard, it is necessary to explain that for various reasons, such as time constraints for decision making and limitations of information processing capability, tendencies to simplify decisions, and not to take into account complex decision making processes, humans turn to shortcut decision making

methods or intuitive methods that lead to appropriate results. In other words, using rule of thumb simplifies the complex decision making process. Obviously, people do not use mathematical rules and statistics and probabilities for their everyday decisions, or in some special circumstances, when they do not have time to do complex calculations, they make quick decisions. On the other hand, using sophisticated methods requires a lot of information that may not be available or may cost a lot to be obtained. For this reason, using rule of thumb or mental shortcuts facilitate the time-consuming and complex process. The important point is that cognitive biases are not restricted to the agents and even experienced and professional people may have these biases when using the intuitive method. Since simplification ignores a part of the phenomenon under investigation, it sometimes leads to harmful results. The least damage caused by these methods is facing cognitive biases and errors. But obviously, people use this method for their decision making. This result is consistent with the results of Lee et al. (2018), Parabooni et al. (2018), Mohammadi et al. (2010), Rameshe et al. (2012), Heidar Pour et al. (2013), and Seif Allahi et al. (2015), and in contrast with the results of Derakhshandeh and Ali Ahmadi (2017).

To test the third hypothesis of the study stating that using Fama-Franch approach, investors' sentiment directly and significantly affect asset pricing, a model consisting of a dependent variable of net market returns and an independent variable of investors' sentiment was used. The results showed that using Fama-Franch approach, investors' sentiment has a direct and significant impact on asset pricing. In this regard, it is worth mentioning that understanding how trading behavior and investors' sentiment influence stock prices in financial markets is one of the most important issues in financing. In the light of real human behavior, researchers must consider individuals' real thoughts and behaviors. Asset pricing traditional theory shows that changes in stock returns depend on changes in the underlying variables (cash flows and discount rates), and cross-sectional returns solely depend on the systematic cross-sectional risks. Researchers used the factors of total market, firm size, and book-to-market value to describe excess returns. Following Fama and Franch three-factor model (1993), Fama and Franch (2015) used a five-factor model which accounts for size, value, profitability, and investment patterns in average stock return. However, one of the most important messages hidden in Fama and French studies is that most of the problems in stock pricing models are in small stocks, which these articles were unable to explain. Meanwhile, a large part of the financial literature has shown that excess stock returns cannot be easily explained by fundamental variables, and several studies have

concluded that a firm's stock returns is influenced by investors' sentiment. Also, some recent studies have used investors' sentiment index to examine the role of investors' sentiment in explaining the stock returns of firms listed in the US Stock Exchange. It has also been argued in previous studies that stock returns are affected by retail investors or institutional investors' behavior. This result is consistent with the results of Yu and Yuan (2011), Baker et al. (2012), Greenwood and Schleifer (2014), Yang and Gao (2014), Yang and Zhang (2014), Kardan et al. (2017), and in contrast with Derakhshandeh and Ali Ahmadi (2017).

Recommendations

Given the results of testing the first hypothesis, suggesting that using Fama-Franch approach, accounting information risk has a direct and significant effect on asset pricing, investors in Tehran Stock Exchange companies and capital market analysts are suggested to consider that increased level of risk in firms' financial and accounting information can bring higher returns on investment. Researchers believe that risk taking is higher in high-risk investments. The principle that higher returns are only possible by taking more risks reflects the fact that gaining returns is not possible without taking risks, and on the other hand, if an investment takes a higher risk, it should naturally expect higher returns. Also, given the results of the second hypothesis, indicating that using Fama-Franch approach, investors' trading behavior has a direct and significant effect on asset pricing, it is recommended that investors in Tehran Stock Exchange and capital market analysts should consider that investors' trading behavior - whether in conscious and unconscious transactions - can affect firms' assets value and returns. Thus, by following the investment behavior of other investors and the whole market, investors in capital market companies can evaluate and forecast the stock returns of listed firms in the capital market. Furthermore, based on the results of testing the third hypothesis, suggesting that using Fama-Franch approach, investors' sentiment directly and significantly affects asset pricing, investors in the capital market companies are recommended to consider the fact that in the event of an increase in investors' sentiment to trade shares of a specific firm, the firm's stock returns will also increase. This is also useful for capital market analysts so that they can have the maximum returns.

Moreover, this study used listed firms in the Tehran Stock Exchange as the population. Therefore, it is suggested that in future studies, the companies of other industries, banks, and financial institutions listed in Tehran Stock Exchange as well as companies listed in the OTC (Over the Counter) should

also be used as the population. Also, this study emphasized on investors' trading behavior and investors' sentiment indices as two of the most important behavioral measures of investors in the capital market. Therefore, it is suggested that future studies retest the models and relationships in this study via using other measures of investors' behavior in the capital market such as turnovers, behavioral biases, etc., and compare the results.

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