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RESEARCH PAPER

Modeling Asset Pricing Using Behavioral Variables: Fama-Macbeth Approach

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Abstract
Investors generally make decisions based on risk and stock returns, and their decisions are influenced by two factors, namely macroeconomic variables and microeconomic variables. The behavioral factors affecting investment decisions are investigated in the area of behavioral finance. In other words, behavioral finance focuses on specific human behavior attributes and their utilization in asset pricing. Behavioral asset pricing is the result of applying behavioral finance theories within traditional asset pricing theories. Although there are many asset-pricing models, due to their weaknesses and incompleteness as well as the necessity of investigating behavioral factors, this study attempted to model asset pricing using behavioral models.The population of the study included all listed firms in Tehran Stock Exchange over the years 2008 to 2018, and the sample was selected through systematic elimination of the population. Given these conditions, 141 firms were selected as the sample. The hypotheses were then tested by designing multivariate regression models.The results showed that using Fama-Macbeth approach, accounting information risk, investors' trading behavior, and investors' sentiments had a significant and direct impact on firms' stock returns.Thus, it is argued that behavioral variables can play a significant role in Modeling Asset Pricing.

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

Introduction

The Capital Asset Pricing Model (CAPM) has been a cornerstone of the modern asset pricing theory (Antypas et al., 2020) that challenges the traditional approach to asset pricing and argues that judgments in this respect have a short time horizon and are constantly subject to several risks and costs (De Long et al., 1990). It also argues that prices can somehow be set through traders' artificial emotions and sentiments, which is mainly true for investors whose decisions are not based on a thorough analysis of opportunities and are mostly based on emotionsand unreasonable beliefs (Kumar & Lee, 2006). Financial markets have a psychological dimension in their true sense (Luo et al., 2014). Behavioral finance is one of the new topics raised by some financial scholars over the past two decades and has quickly received the attention of professors, scholars, and students of this field around the world. According to (Seif Elahi et al., 2015), financial theories have had two different approaches in recent decades. The first one is the neoclassical approach in financial sciences. According to this approach, the underlying premise of financial theories is market efficiency and investors'

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rational behavior in the market. This approach began with the Capital Asset Pricing Model and Efficient Market Theory in the 1960s and the mid-term Capital Asset Pricing Model and Miller and Modigliani Arbitrage Pricing Theory in the 1970s. Over time and through conducting different research, researchers noticed many disorders in financial markets, which could not be justified by efficient market theories. This led to the behavioral revolution in financial discourses in 1979. On the other hand, theories suggest that risks and errors in asset pricing are correlated with returns, and the information related to this correlation can be used to predict future returns. Empirically, pricing models rarely incorporate psychological factors, but the point is that researchers nowadays can identify influential behavioral factors in empirical asset pricing models that can seize the manipulation of returns resulting from asset mispricing (Lin, 2014). As a result, despite the existence of many asset-pricing models, due to their weaknesses and incompleteness as well as the necessity to investigate behavioral factors, this study attempted to model asset pricing using behavioral models. Thus, in summary, the motivators of the present study are the problems of previous models and the weakness in identifying the role of behavioral factors.In this regard, the Fama-Macbeth model is used becauseit is a practical way of testing how various factors describe portfolio or asset returns.This model has survived most of the empirical results to become a standard methodology in the financial literature for its undeniable merits of simplicity and clarity (Pasquariello, 1999). Therefore, the question is if we can show (using Fama-Macbeth approach) that the accounting information risk, investors' trading behavior, and investors' sentiment influence firms' stock returns.

Theoretical Foundations

The purpose of investing in stocks is to receive appropriate returns. Generally, investors' decision-making is based on risks and stock returns and is influenced by two factors, namely macroeconomic and microeconomic variables. Macro variables include economic growth, inflation, etc., which have a general impact on all securities; however, micro economic variables such as accounting earnings are substantially firmspecific (Chen et al., 2014;Fong & Toh, 2014). Recognizing these firm-specific factors and relationships can therefore play an important role in investors and managers' decision making for deeper analysis and more efficient use of resources (Bozorg Asl & Razavi, 2008). There are already many asset-pricing models that explain assets value, but there is still a significant difference between the theoretical price of securities and their trade value in the market. It seems that other models need to be sought in order to estimate the price more accurately. One new pricing method is market-based pricing, which reflects the effect of the behavioral factor of investors' sentiment on stock pricing. Behavioral Finance Theory states that perceptual errors and sentiments have a significant impact on financial decision-making (Salehi et al., 2020). Behavioral asset pricing is the result of applying behavioral finance theories within traditional asset pricing theories (Xin-ke, 2014).

Accounting Information Risk and Stock Returns

Questions about the role of information risk in determining capital cost and whether information risk is flexible or not remain as unresolved issues in the accounting literature. A number of recent empirical and theoretical studies have attempted to address this issue. For example, traditional capital asset pricing model and the Fama and Frenchthree-factor model do not incorporate any information risk factors (Fama & French, 1993). Contrary to this view, Easley and O'Hara's (2004) theoretical model assumed that stocks with more confidential information would be more risky because they have more news to be disclosed to investors. Hughes and Liu also argued that having controlled systematic risk, information asymmetry would not affect firms' capital cost. However, they argued that higher information asymmetry about systemic factors leads to higher capital costs (Hughes & Liu, 2007). Lambert et al.(2012), too, suggested that in a perfectly competitive market, information asymmetry cannot influence capital cost, but information accuracy can do so. Besides, in imperfect markets, information asymmetry and information accuracy play a decisive role in the firm's capital cost. Thus, it is argued that in Iran Capital Market, a firm's accounting information risk can affect asset returns and pricing.

Trading Behavior, Sentiment, and Stock Returns

Understanding how trading behavior and investors' sentiment influence stock prices in financial markets is one of the most important issues in financing. Schiller (2014) emphasized that in the light of real human behavior, researchers need to consider real thoughts and actions of individuals. Standard Decision Theory holds the view that individuals act logically and rationally. Behavioral finance replaces the Behavioral Portfolio Theory with the Mean-Variance Portfolio Theory, proposes a Behavioral Asset Pricing Model (BAPC) for Capital Asset Pricing Model (CAPM), and suggests other models that determine expected returns by risks. Behavioral finance also identifies rational markets for efficient market disputes and tests why many investors believe it is easy to hit the market. Moreover, while adhering to standard finance, behavioral finance extends the financial domain beyond the asset pricing portfolio and market efficiency, (Statman, 2014). According to Ritte (2003), behavioral finance is based on psychology, and the human decision-making process derives from several cognitive illusions.

Studies of psychology researchers shows that for a variety of reasons, the cognitive process is not properly performed. As a result, series of cognitive biases that are the source of false cognition are examined. Due to psychological foundations, human beings are exposed to these biases, which affect their reactions to the phenomena and the decisions that must be made. Of course, in different conditions, these biases can occur more or less. However, when it comes to "false cognition," it is argued that if someone felt out of things, he/she would have different cognitions and judgments, and now that he/she has been subjected to certain circumstances and biases, his/her cognitions and judgments have been impressed. Cognitive biases mainly occur in the absence of information and in uncertainty (Saeedi & Farhanian, 2015). Yet, a large body of financial literature shows that excess returns cannot be explained easily by fundamental variables, and numerous studies have concluded that stock returns and a firm's assets value are influenced by investors' sentiment. Previous studies have also argued that stock returns are influenced by the trading behavior of retail or institutional investors. The notable point in these studies is that retail investors can direct the market (Yang & Zhou, 2015).

Background

Antypaset al. (2020)introduce a methodology that deals with possibly integrated variables in the specification of the betas of conditional asset pricing models. The results provide evidence that the residuals of possible cointegrating relationships between integrated variables in the specification of the conditional betas may reveal significant information concerning the dynamics of the betas. Chauhan et al. (2019) attempted to find empirical evidence of herding in two different cross-sections of financial markets using cross-sectional deviations of stock returns to measure the dispersion of individual stock returns from average market return. They showed whether the cross-sectional dispersion of stock returns in large-cap stocks were lower compared to that in small-cap stocks, implying stocks with higher market capitalization and trading volume were less prone to herding. Paraboni et al.(2018) examined the relationship between sentiment and risk in financial markets. Their results are consistent with Prospect Theory, indicating that when liquidity is thought to be low, investors try to reduce the negotiations that positively influence risk. On the other hand, based on the reverse scenario, when sentiments indicate high liquidity, there is an increase in the volume of negotiations, and thus, a decrease in risk. In another study, Zaremba and Konieczka (2017) observed that portfolios which were based on four factors of size (market value), value (book-to-market value), momentum (annual rate of returns excluding dividends for 12 months prior to November 31), and liquidity (average daily turnovers in the past month) had positive stock returns. According to the results of Conrad et al. (2016), there is a negative relationship between predicted volatility and future returns and a positive relationship between ex ante skewness and stock returns. Moreover, the predicted returns with negative skewness will result in higher future returns. Likewise, Adusei (2014)examined the relationship between inflation and stock market returns. Using the data from Ghana Stock Exchange as an emerging market, his results showed that in the short run, there was an inverse relationship between inflation and stock returns, while this relationship would be direct in the long run.

In Iran, Kardan et al. (2017)'s results indicated an increase in the explanatory degree of CAPM by adding sentiment indices. Similarly, Khajavi and Fa'al Qayyum (2016) reported that earnings announcement had influenced skewness and returns. Accordingly, when earnings are not announced, the relationship between skewness and returns is negative and significant, but by earnings announcement, the relationship loses its significance. In addition, Hejazi et al. (2015) examined the impacts of market, liquidity, and momentum on major stock price changes. The results showed a significant relationship between the variables under study and major stock price changes. Among the factors studied, liquidity was the most important variable to explain the probability of stock price decline, and market was the most influential variable on the probability of stock price increase.

Hypotheses

Given the explanations in Theoretical Foundations section, the hypotheses are proposed as follows:

1. Using Fama-Macbeth approach, accounting information risk has a direct and significant impact on a firm's stock returns.
2. Using Fama-Macbeth approach, investors' trading behavior has a direct and significant impact on a firm's stock returns.
3. Using Fama-Macbeth approach, investors' sentiment has a direct and significant impact on a firm's stock returns.

Methodology

Since conclusions are made by testing the available data, this research will be grouped into positive theories. On the other hand, managers, investors, and analysts can employ the results of this study; therefore, in terms of objectives, it is considered as an applied research. In terms of nature and content, this study is among correlational research, because regression and correlation techniques will be used to explore the relationships between variables. Thus, in terms of reasoning, it is considered deductive. Regarding time, it is a longitudinal study. It is worth mentioning that the proposed models are tested at the level of listed firms in Tehran Stock Exchange and the results will be summed up.

Population and Sample

The population of this research included all firms listed in Tehran Stock Exchange during the years 2008 to 2018. The sample was selected through systematic elimination from the population. As a result, the sample consisted of all firms in the population that met the following criteria:

- They made no changes in the fiscal period during the research period so that the results of the financial performance are comparable.
- They were not active in financial activities, including investment firms, banks, insurance, and financial institutions. Since investment firms are different in terms of the nature of their activities (their main income is from investmentand they are dependent on the activities of other firms), they are different from other firms. As a results, they are removed from the sample under study.
- The data required for the research variables must be available during the period of 2008 2018 so that the calculations can be made without any flaws.
- Their fiscal period ends on 12/29 SH each year so that data can be put together and used in panel form, if necessary.
- They do not have trading halts for more than 6 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.

Table 1. Population and Sample

Active companies in the study date	516
Subtract:	
Companies that were listed on the stock exchange during the period of review	124
Companies that had changed the financial period	26
Active companies in the area of financial activities	42
Companies whose information was not fully available	151
Companies whose financial period did not finish at 12/29 of each year	32
Modified community (sample)	141

Models and Variables

The following models, which are taken from (Yang, C.; Zhou, L., 2015)and (Raheel & Yan, 2017)were used to test the hypotheses:

$$R_{i,t} = \beta_0 + \beta_1 SIZE_{i,t} + \beta_2 BM_{i,t} + \beta_3 AQ_{i,t} + \beta_4 BETA_{i,t} + \beta_5 SOE_{i,t} + \beta_6 DIV_{i,t} + \beta_7 LEV_{i,t} + \beta_8 PROF_{i,t} + \beta_9 CF_{i,t} + \beta_{10} TANG_{i,t} + \beta_{11} COD_{i,t} + \beta_{12} RISK_{i,t} + \varepsilon_{i,t}$$

$$R_{i,t} = \beta_0 + \beta_1 SIZE_{i,t} + \beta_2 BM_{i,t} + \beta_3 BSI_{RMRF,t} + \beta_4 BETA_{i,t} + \beta_5 SOE_{i,t} + \beta_6 DIV_{i,t} + \beta_7 LEV_{i,t} + \beta_8 PROF_{i,t} + \beta_9 CF_{i,t} + \beta_{10} TANG_{i,t} + \beta_{11} COD_{i,t} + \beta_{12} RISK_{i,t} + \varepsilon_{i,t}$$

$$R_{i,t} = \beta_0 + \beta_1 SIZE_{i,t} + \beta_2 BM_{i,t-1} + \beta_3 S_{RMRF,t} + \beta_4 BETA_{i,t} + \beta_5 SOE_{i,t} + \beta_6 DIV_{i,t} + \beta_7 LEV_{i,t} + \beta_8 PROF_{i,t} + \beta_9 CF_{i,t} + \beta_{10} TANG_{i,t} + \beta_{11} COD_{i,t} + \beta_{12} RISK_{i,t} + \varepsilon_{i,t}$$

Where:

Dependent Variable

- Stock Returns ($R_{i,t}$): is the ratio of total profit (loss) of an investment over a given period to the capital used to the capital spent to obtain that profit at the beginning of the period:

$$\text{Total return} = \frac{\substack{\textit{gross dividend per share+ per share price differential at the beginning and at the end of fiscal year+} \\ \textit{rights issue benefits+ bonus shares benefits}}}{\text{the last share price at the end of the previous fiscal year}}$$

Independent Variables

- Investors' Sentiment ($S_{RMRF,t}$): To calculate this variable, St is first calculated using factor analysis of four indices. These factors are as follows:

(1) Relative strength index (RSI)

In order to calculate RSI, first RS_t is calculated:

$$RS_t = [\Sigma^6_{t=1}\max(P_t–P_{t-1} , 0)]/[(\Sigma^6_{t=1} \max(P_{t-1}–P_t , 0)]$$

Where:

Pt- stock price at end of period t; and Pt-1 is the stock price at end of period t-1.

Then, (RSI_t) is calculated:

$$RSIt = 100 * RS_t/(1+RS_t)$$

It is worth mentioning that since t is considered from one to six and the other data are considered annually, the time period t for Ps is considered bimonthly. Thus, RS_t is calculated on an annual basis and RSI_t is calculated annually.

(2) Psychological Line Index (PSY)

The following equation is used to calculate PSY:

$$PSY_t = (T^u/T)*100$$

Where:

T^u is the number of days during the year that the firm's stock price has increased compared to the previous day; and T is the number of trading days during the year.

(3) Trading Volume (VOL)

The natural logarithm of the number of shares traded during the year is used to calculate the trading volume of a firm's stock.

(4) Adjusted Turnover Rate (ATR)

The following equation is used to calculate ATR:

$$ATR_{it} = (R_{it}/|R_{it}|)*(VOL_{it}/\text{shares outstanding at time t})$$

Where: Rit is stock return of firm i in year t, which is calculated as follows:

$$\text{Total return} = \frac{\substack{\textit{gross dividend per share+ per share price differential at the beginning and at the end of fiscal year+} \\ \textit{rights issue benefits+ bonus shares benefits}}}{\text{the last share price at the end of the previous fiscal year}}$$

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

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

After calculating the four indices, using factor analysis, they are combined and St is calculated. Then, the following regression model is estimated:

$$S_t = b_0 + b_1RMRF_t + \varepsilon_{pt}$$

Where:

$RMRF_t$: is the market excess returns in year t, and indeed, the difference between stock market growth index and the risk-free interest rate (government bonds interest rate).

St= its calculation is described as follows.

The residual of the above model for each firm-year, called SRMRF, will be a criterion for calculating investors' sentiment.

- Investors' Trading Behavior ($BSI_{RMRF,t}$)

To calculate investors' trading behavior variable, first the following formula needs to be calculated:

$$BSI_{it} = (BV_{it} - SV_{it})/(BV_{it} + SV_{it})$$

Where:

BV_{it} is the volume (number) of buying firm i shares during the year t.

SV_{it} is the volume (number) of selling firm i shares during the year t.

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

$$BSI_{it} = b_0 + b_1RMRF_t + \varepsilon_t$$

Where:

$RMRF_t$ is the market excess returns in year t, or indeed, the difference between the stock market growth index and the risk-free interest rate (government bonds interest rate).

BSI_{it} is calculated as follows.

The residual of the above model for each firm-year, called BSIRMRF, will be a criterion for investors' trading behavior.

- Accounting Information Risk ($AQ_{i,t}$):

To calculate accounting information risk, Dicho and Dicho (2002) accruals quality model modified by Francis et al. (2005) is used:

$$TCA_{i,t} = b_0 + b_1CFO_{i,t-1}+ b_2CFO_{i,t} + b_3CFO_{i,t+1}+ b_4\Delta REV_{i,t}+ b_5PPE_{i,t}+ \varepsilon_{i,t}$$

Where:

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

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

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

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

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

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

After estimating the above model at the level of firm totality and calculating the model coefficient values, the model residual is calculated. Residuals absolute value is used as the reverse measure of accrual quality and a direct measure for accounting information risk.

Control Variables

$SIZE_{i,t}$= firm i size in year t, which is equal to the natural logarithm of total assets.

$BM_{i,t-1}$ = growth opportunities of firm i in year t-1, which is the ratio of the book value of equity to the market value of equity.

$BETA_{i,t}$= Systematic risk of firm i in year t which is used to calculate beta coefficient. Beta coefficient uses the sample firms' stock return (Ri) and market return portfolio (Rm):

$$\beta = (Cov(R_i,R_m))/\delta^2 Rm$$

$SOE_{i,t}$= State ownership of firm i in year t. If state ownership exists in the firm, this variable is set to one, and zero otherwise.

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

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

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

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

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

$RISK_{i,t}$= risk of firm i in year t, which is the ratio of the standard deviation of the firm's cash flow over the past three years to assets.

Findings

Descriptive Statistics

In this section, mean, median, standard deviation, maximum, minimum, skewness, and kurtosis of the variables are calculated and presented in Table 2.

Table 2. Descriptive Statistics

Variables	Symbol	Mean	Median	Maximum	Minimum	Standard deviation	Skewness	Kurtosis
Stock Returns	Ri,t	0.337	0.124	6.445	-0.783	0.812	2.703	4.118
Investors' Sentiment	SRMRF,t	0.605	0.584	2.938	-1.199	0.426	0.738	7.866
Investors' Trading Behavior	BSIRMRF,t	-0.012	0.007	0.869	-0.964	0.165	-0.68	7.622
Accounting Information Risk	AQi,t	0.091	0.067	0.479	0.00003	0.082	1.332	4.771
Size	SIZEi,t	13.821	13.616	19.149	10.031	1.568	0.726	3.749
Growth Opportunities	BMi,t-1	0.625	0.492	3.264	0.023	0.439	1.485	5.886
Systematic Risk	BETAi,t	0.669	0.579	7.303	-3.822	0.996	0.732	6.895
State Ownership	SOEi,t	0.312	0.000	1.000	1.000	0.463	0.811	1.658
Dividend	DIVi,t	0.638	0.512	4.618	0.000	0.675	2.003	9.206
Debt Level	LEVi,t	0.58	0.593	0.987	0.089	0.187	-0.27	2.5
Profitability	PROFi,t	0.111	0.091	0.644	-0.4	0.126	0.621	4.798
Operating Cash Flow	CFi,t	0.108	0.1	0.556	-0.393	0.116	0.244	4.601
Asset Tangibility	TANGi,t	0.265	0.265	0.892	0.002	0.179	0.842	3.223
Cost of Debt	CODi,t	0.059	0.059	0.238	0.000	0.04	0.84	3.903
Risk	RISKi,t	0.062	0.062	0.439	0.001	0.051	2.411	8.283

As shown in Table 2, the mean and median values of stock returns are 0.337 and 0.124, respectively. In general, dispersion measures are measures that compare and contrast dispersion observations around the mean. One of the most important criteria for dispersion is standard deviation. Given the above table, thismeasure for the stock returns variable is 0.812.

It is worth mentioning that the highest value of stock returns is 6.445 and its lowest value is -0.778. The skewness and kurtosis of the mentioned variable are 2.703 and 4.818, respectively. Another variable considered in this study is investor's sentiment, and its maximum and minimum values are 2.938 (owned by Indamin Shock Absorber Company in 2009) and -1.199 (owned by Alumrad Company in 2015).

Inferential Statistics

1. Estimating Accounting Information Risk Model (Accruals)

In order to estimate accrual quality model coefficients, Chaw and Hausman (Azar & Momeni, 2005) (…) tests were used to identify an appropriate method for estimating the model (Table 3).

Table 3. Chaw and Hausman Test Results

Tests	Tests Statistics	Significance Level	H0	H1
Chaw (fixed effects vs. panel)	15.111	0.000	Using panel data method	Using fixed effects method
	Result		Rejected	Confirmed
Hausman (fixed effects vs. random effects	139.252	0.000	Using random effects method	Using fixed effects method
	Result		Rejected	Confirmed

According to Table 3, the fixed effects method is preferable to the other two methods; therefore, the model was estimated using the fixed effects method. The results are presented in Table 4.

Table 4. Accounting Information Risk (Accruals) Test Results

$TCA_{i,t} = b_0 + b_1CFO_{i,t-1} + b_2CFO_{i,t} + b_3CFO_{i,t+1} + b_4\Delta REV_{i,t} + b_5PPE_{i,t} + \varepsilon_{i,t}$					
Variable	**Coefficients**	**SD**	**T statistics**	**Significance level**	**VIF**
Fixed value	0.133	0.005	24.533	0.000	-
Previous year's operating 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
Accounts of property, plant, and equipment	-0.14	0.016	-8.532	0.000	1.064
F statistics		35.143	**R-squared**		0.821
F statistics significance level		0.000	**Adjusted R-squared**		0.798
White diagonal correction (eliminating possible effects of heteroscedasticity)			**Dourbin-Watson value**		**1.828**

According to the results of Table 4 and the described approach, the values of accounting information risk (accruals) are calculated.

2. Factor Analysis of Four Variables of RSI, PSY, VOL, and ATR in Order to Calculate Investors' Sentiment

As explained earlier, after calculating the four variables of RSI, PSY, VOL, and ATR using the factor analysis approach, a single variable, named St, was defined, which was used in the regression model for calculating the investor's sentiment variable. The reason for employing factor analysis was that it has the ability to put together the various variables in a balanced way and according to their values, and then combine them. Thus, the most appropriate solution for combining multiple variables and forming a new one is factor analysis. Factor analysis is used to identify the underlying variables of a phenomenon or to summarize a set of data. The primary data for factor analysis are correlation matrixes between the variables.

Table 5. Factor Analysis of RSI, PSY, VOL, and ATR

Headings	Factor loading
RSI	0.005
PSY	0.36
VOL	0.008
ATR	0.774
KMO index	0.525
Bartlett test statistic	455.187
Bartlett test significance level	0.000

Given the KMO index value, which is above 0.5, the identified factors were suitable for factor analysis. In addition, since the significance level of Bartlett's test is less than 0.05, factor analysis has been successful. As shown in Table 5, the variable coefficients are used as a weight in calculating the mean value.

3. Estimating Investors' Sentiment Model

In order to estimate the coefficients of the investors' sentiment model, Chaw and Hausman tests were used to determine an appropriate method for estimating the model (Table 6).

Table 6. Chaw and Hausman Test Results

Tests	Test Statistic	Significance Level	H0	H1
Chaw (fixed effects vs. panel)	1.394	0.000	Using panel data method	Using fixed effects method
	Result		Rejected	Confirmed
Hausman (fixed effects vs. random effects	22.922	0.000	Using random effects method	Using fixed effects method
	Result		Rejected	Confirmed

As is evident in Table 6, fixed effects method is preferred over the other two methods, and hence, the model is estimated using fixed effects method. The results are presented in Table 7.

Table 7. Investors' Sentiment Model Test Results

$S_t = b_0 + b_1 RMRF_t + \varepsilon_{pt}$					
Variable	**Coefficients**	**SD**	**T statistic**	**Significance level**	**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 statistic		32.765	**R-squared**		0.536
F Statistic Significance Level		0.000	**Adjusted R-squared**		0.51
White diagonal correction (eliminating possible effects of heteroscedasticity)			**Dourbin-Watson value**		2.084

According to the results of Table 6 and the described approach, the values of investors' sentiment are calculated.

4. Estimating Investors' Trading Behavior Model

In order to estimate the coefficients of investors' trading behavior model, Chaw and Hausman tests are used to identify an appropriate method for estimating the model (Table 8).

Table 8. Chaw and Hausman Test Results

Tests	Test Statistic	Significance Level	H0	H1
Chaw (fixed effects vs. panel)	3.917	0.000	Using panel data method	Using fixed effects method
	Result		Rejected	Confirmed
Hausman (fixed effects vs. random effects	23.827	0.000	Using random effects method	Using fixed effects method
	Result		Rejected	Confirmed

As can be seen in Table 8, fixed effects method is preferred over the other two methods, and thus, the model is estimated using fixed effects method. The results are presented in Table 9.

Table 9. Investors' Trading Behavior Model Test Results

$BSI_{it} = b_0 + b_1RMRF_t + \varepsilon_t$					
Variable	**Coefficients**	**SD**	**T statistic**	**Significance level**	**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 statistic		12.718	**R-squared**		0.617
F Statistic Significance Level		0.000	**Adjusted R-squared**		0.573
White diagonal correction (eliminating possible effects of heteroscedasticity)			**Dourbin-Watson value**		2.099

Given the results of Table 9 and the described approach, the values of investors' trading behavior are calculated.

5. Estimating H1 Model

In order to estimate the coefficients of H1, Chaw and Hausman tests were used to identify an appropriate method for estimating the model (Table 10).

Table 10. Chaw and Hausman Test Results

Test	Test Statistic	Significance Level	H0	H1
Chaw (fixed effects vs. panel)	8.543	0.000	Using panel data method	Using fixed effects method
	Result		Rejected	Confirmed
Hausman (fixed effects vs. random effects	17.962	0.000	Using random effects method	Using fixed effects method
	Result		Rejected	Confirmed

As is evident in Table 10, fixed effects method is preferred over the other two methods, and thus, the model is estimated using fixed effects method. The results are presented in Table 11.

Table 11. Results of Estimating H1

$R_{i,t} = \beta_0 + \beta_1 SIZE_{i,t} + \beta_2 BM_{i,t} + \beta_3 AQ_{i,t} + \beta_4 BETA_{i,t} + \beta_5 SOE_{i,t} + \beta_6 DIV_{i,t} + \beta_7 LEV_{i,t} + \beta_8 PROF_{i,t} + \beta_9 CF_{i,t} + \beta_{10} TANG_{i,t} + \beta_{11} COD_{i,t} + \beta_{12} RISK_{i,t} + \varepsilon_{i,t}$					
Variables	**Coefficients**	**SD**	**T statistic**	**Significance level**	**VIF**
Fixed value	1.102	0.237	4.641	0.000	-
Size	-0.051	0.01	-5.019	0.000	1.148
Growth opportunities	-0.999	0.308	-3.239	0.001	1.315
Accounting information risk	0.38	0.064	5.885	0.000	2.209
Systematic risk	0.746	0.17	4.386	0.000	1.12
State ownership	0.257	0.031	8.146	0.000	1.1
Dividend	0.235	0.025	9.398	0.000	1.078
Debt level	1.117	0.203	5.498	0.000	1.714
Profitability	4.143	0.524	7.895	0.000	2.125
Operating cash flow	-0.237	0.035	-6.632	0.000	1.397
Asset tangibility	-0.235	0.037	-6.325	0.000	1.133
Cost of debt	11.232	3.682	3.05	0.002	1.203
Risk	-0.504	-0.066	-7.535	0.000	1.034
F statistic		25.398	**R-squared**		0.653
F statistic significance level			**Adjusted R-squared**		0.643
White diagonal correction (eliminating possible effects of heteroscedasticity)			**Dourbin-Watson value**		2.112

Given the results of Table 11, since the t statistic of accounting information risk is greater than + 1.965 and its significance level is less than 0.05, a significant and direct relationship is established between accounting information risk and stock returns. Thus, the first hypothesis – i.e., using Fama-Macbeth approach, accounting information risk has a direct and significant impact on the firm stock returns – is confirmed.

6. Estimating H2 Model

In order to estimate the coefficients of H2, Chaw and Hausman tests were used to determine an appropriate method for estimating the model (Table 12).

Table 12. Chaw and Hausman Test Results

Test	**Test Statistic**	**Significance level**	**H0**	**H1**
Chaw (fixed effects vs. panel)	7.981	0.000	Using panel data method	Using fixed effects method
	Result		Rejected	Confirmed
Hausman (fixed effects vs. random effects	23.809	0.000	Using random effects method	Using fixed effects method
	Result		Rejected	Confirmed

As can be seen in Table 12, fixed effects method is preferred over the other two methods; thus, the model is estimated using fixed effects method. The results are presented in Table 13.

According to the results of Table 13, since t statistic of investors' trading behavior is greater than + 1.965 and its significance level is less than 0.05, there is a significant and direct relationship between investors' trading behavior and stock returns. Therefore, the second hypothesis of the study – which states using Fama-Macbeth approach, investors' trading behavior has a direct and significant impact on the firm stock returns – is confirmed.

Table 13. Results of Estimating H2

$$\mathbf{R_{i,t} = \beta_0 + \beta_1 SIZE_{i,t} + \beta_2 BM_{i,t} + \beta_3 BSI_{RMRF,t} + \beta_4 BETA_{i,t} + \beta_5 SOE_{i,t} + \beta_6 DIV_{i,t} + \beta_7 LEV_{i,t} + \beta_8 PROF_{i,t} + \beta_9 CF_{i,t} + \beta_{10} TANG_{i,t} + \beta_{11} COD_{i,t} + \beta_{12} RISK_{i,t} + \varepsilon_{i,t}}$$

Variables	Coefficients	SD	T statistic	Significance level	VIF
Fixed value	1.292	0.16	8.077	0.000	-
Size	-0.047	0.02	-2.328	0.02	1.133
Growth opportunities	-0.663	0.288	-2.298	0.021	1.245
Investors’ trading behavior	7.682	0.797	9.634	0.000	1.041
Systematic risk	0.637	0.153	4.154	0.000	1.116
State ownership	0.328	0.04	8.148	0.000	1.1
Dividend	0.156	0.026	5.894	0.000	1.052
Debt level	1.646	0.243	6.757	0.000	1.61
Profitability	1.622	0.161	10.022	0.000	2.221
Operating cash flow	-0.138	0.038	-3.619	0.000	1.403
Asset tangibility	-0.216	0.036	-5.911	0.000	1.132
Cost of debt	7.914	3.242	2.44	0.014	1.193
Risk	-0.572	0.042	-13.484	0.000	1.031
F statistic		25.398	**R-squared**		0.691
F statistic significance level			**Adjusted R-squared**		0.673
White diagonal correction (eliminating possible effects of heteroscedasticity)			**Dourbin-Watson value**		2.109

7. Estimating H3 model

In order to estimate the coefficients of H3, Chaw and Hausman tests were used to determine an appropriate method for estimating the model (Table 14).

Table 14. Chaw and Hausman Test Results

Test	Test Statistic	Significance level	H0	H1
Chaw (fixed effects vs. panel)	8.445	0.000	Using panel data method	Using fixed effects method
	Result		Rejected	Confirmed
Hausman (fixed effects vs. random effects	26.717	0.000	Using random effects method	Using fixed effects method
	Result		Rejected	Confirmed

As illustrated in Table 14, fixed effects method is preferable to the other two methods; hence, the model is estimated using fixed effects method. The results are presented in Table 15.

Table 15. Results of Estimating H3

$$\mathbf{R_{i,t} = \beta_0 + \beta_1 SIZE_{i,t} + \beta_2\ BM_{i,t-1} + \beta_3 S_{RMRF,t} + \beta_4 BETA_{i,t} + \beta_5 SOE_{i,t} + \beta_6 DIV_{i,t} + \beta_7 LEV_{i,t} + \beta_8 PROF_{i,t} + \beta_9 CF_{i,t} + \beta_{10} TANG_{i,t} + \beta_{11} COD_{i,t} + \beta_{12} RISK_{i,t} + \varepsilon_{i,t}}$$

Variables	Coefficients	SD	T statistic	Significance level	VIF
Fixed value	1.065	0.173	6.129	0.000	-
Size	-0.056	0.014	-3.838	0.000	1.138
Growth opportunities	-0.873	0.287	-3.043	0.002	1.239
Investors’ sentiment	1.097	0.282	3.882	0.000	1.008
Systematic risk	0.668	0.145	4.585	0.000	1.114
State ownership	0.39	0.071	5.452	0.000	1.1
Dividend	0.141	0.019	7.267	0.000	1.053
Debt level	1.143	0.24	4.754	0.000	1.593
profitability	3.318	1.553	2.136	0.032	2.194
Operating cashflow	-0.115	0.02	-5.681	0.000	1.399
Asset tangibility	-0.107	0.03	-3.516	0.000	1.122
Cost of debt	9.999	3.371	2.966	0.003	1.184
Risk	-0.516	0.171	-3.011	0.002	1.029
F statistic		26.792	**R-squared**		0.659
F statisticsignificancelevel		0.000	**Adjusted R-squared**		0.65
White diagonal correction (eliminating possible effects of heteroscedasticity)			**Dourbin-Watson value**		2.121

According to the results of Table 15, since t statistic of investors’ sentiment variable is greater than + 1.965 and its significance level is less than 0.05, a significant and direct relationship is established between investors’ sentiment and stock returns. Thus, the fifth hypothesis of the study – which states using Fama-Macbeth approach, investors' sentiment has a direct and significant impact on the firm stock returns – is confirmed.

Conclusion

In order to test the first hypothesis of the study – which suggests using Fama-Macbeth approach, accounting information risk has a direct and significant impact on the firm stock returns – a model consisting of a dependent variable of stock returns and an independent variable of accounting information risk was used. The results showed that using Fama-Macbeth approach, accounting information risk has a direct and significant impact on the firm stock returns. In this regard, it is worth noting that, according to Fama and Laffer, information has three major benefits, namely reducing risk, improving the firm operating decisions, and making abnormal earnings in trading securities through gaining access to new confidential information. It is worth mentioning that in the past, financial reporting was solely taken into account in terms of regulatory purposes, but since the 1960s, attention was shifted to providing users with the information they need to make economic decisions (Higson, 2003). Therefore, the information hypothesis is an alternative or a complement to the supervision hypothesis. One reason for demanding audited financial statements is to provide useful information for investors’ decision-making. According to the financial literature on investment models, the value of a firm is determined by calculating the net present value of future cash flows. Research evidence also suggests that there is a high correlation between future cash flows and accounting information reflected in financial statements (Fama & French, 1993). Given the aforementioned points, it is argued that investors’ sentiment, investors’ trading behavior, and accounting information risk play a significant role in defining stock returns and asset pricing. This result is in accordance with the results of Jorgensen and Li Jing (2012),Choi and Lee (2017), and Hejazi et al.(2015), but it is in contrast with the results of Khajavii and Fa’al Qayyum (2016).

In order to test the second hypothesis of the study – which states using Fama-Macbeth approach, investors’ trading behavior has a direct and significant impact on the firm stock returns – a model consisting of a dependent variable of stock returns and an independent variable of investors’ trading behavior was used. The results showed that using Fama-Macbeth approach, investors' trading behavior has a direct and significant effect on the firm stock returns. In this respect, it is worth noting that Schiller (2014)emphasized that in the light of real human behavior, researchers need to take into account real human actions and thoughts. Standard decision theory holds the view that individuals act rationally and logically. Behavioral finance replaces the Behavioral Portfolio Theory with the Mean-Variance Portfolio Theory and proposes a Behavioral Asset Pricing Model (BAPC) for Capital Asset Pricing Model (CAPM), and suggests other models that determine expected returns by risks. Behavioral finance also identifies rational markets in efficient market disputes, and tests the reason for which many investors believe it is easy to hit the market. Moreover, while it adheres to standard finance, behavioral finance extends the financial domain beyond the asset-pricing portfolio and market efficiency. Behavioral finance is based on psychology, and it suggests that the human decision-making process derives from several cognitive illusions. Studies of psychology researchers show that for a variety of reasons, the cognitive process is not properly performed. As a result, series of cognitive biases that are the source of false cognition are examined. Due to psychological foundations, human beings are exposed to these biases that affect their reactions to the phenomena and decisions that must be made. Of course, these biases can manifest more or less in different conditions. However, when it comes to "false cognition," it is argued that if someone felt out of things, he/she would have different cognitions and judgments, and now that he/she has been subjected to certain circumstances and biases, his/her cognitions and judgments have been impressed. Cognitive biases mainly occur in the absence of information and in uncertainty (Saeedi & Farhanian, 2015). Yet, a large body of financial literature shows that excess returns cannot be explained easily by fundamental variables, and numerous studies have also concluded that stock returns and a firm's assets value are influenced by investors' sentiment. Previous studies have also argued that stock returns are influenced by the trading behavior of retail or institutional investors. The notable point in these studies is that retail investors can direct the market (Yang & Zhou, 2015). This result is in accordance with the results of Kumar and Lee (2006), Li et al.(2018), Paraboni et al.(2018), and Seif Elahi et al.(2015), butin contrast with the results of Derakhshandeh and Ali Ahmadi (2017).

To test the third hypothesis of the study – which suggests using Fama-Macbeth approach, investors' sentiments have a direct and significant impact on the firm stock returns – a model comprised of a dependent variable of stock returns and an independent variable of investors' sentiment was employed. The results showed that using Fama-Macbeth approach, investors' sentiments have a direct and significant impact on the firm stock returns. In this regard, it should be noted that understanding how investors' sentiment influences stock prices in financial markets is one of the most important issues in financing. However, a large body of the financial literature has shown that excess stock returns cannot be easily explained by fundamental variables, and numerous studies have also found that a firm's stock returns are influenced by investors' sentiment. In addition, some recent studies have used the investors' sentiment index to examine the role of investors' sentiment in explaining the stock returns of firms listed in the US Stock Exchange. Previous studies have also argued that stock returns are influenced by retail investors or institutional investors' sentiment, and many recent studies have used trading data to classify sellers and buyers transactions and determine a pattern for investors' sentiment. The remarkable point in these studies is that retail investors can direct the market. This result is consistent with the results of Conrad et al.(2016),Li et al. (2018), Luo (2014), Kardan et al.(2017), and Yang and Zhou (2015), butit is in contrast with the results of Derakhshandeh and Ali Ahmadi (2017).

Recommendations

Given the results of testing the first hypothesis – which suggests using Fama-Macbeth approach, accounting information risk has a direct and significant impact on the firm stock returns – it is suggested to investors in Tehran Stock Exchange and market analysts to consider that an increase in the risk level of firms' financial and accounting information can bring higher returns on investments. Researchers believe that taking risks in investments with a higher risk level is greater. The principle that higher returns are possible only by taking higher risks reflects the fact that one cannot take risks and gain returns, and on the other hand, if the investment takes a higher risk, one should naturally expect higher returns.

According to the second hypothesis of the study, investors in Tehran Stock Exchange and market analysts are suggested to take into account that investors' trading behavior - including informed and uninformed trading- can affect the value of a firm's assets and returns. Thus, investors in the capital market can assess and predict stock returns of firms in the capital market by following the investing behavior of other investors and the market totality.

Given the results of testing the third hypothesis, it is suggested to investors in the capital market to consider the fact that if investors' sentiment to trade a particular firm’s stock increases, the stock returns of that firm will increase, too. This is also useful for capital market analysts so that they can maximize returns.

It is worth mentioning that in this study, the listed manufacturing firms in Tehran Stock Exchange were used as the research population. Therefore, it is suggested that in the future studies, banks and financial institutions listed in Tehran Stock Exchange as well as the listed firms in Over the Counter (OTC) might be used as the research population. Besides, one of the independent variables of this study was the firm’s accounting information risk, and Ditcho and Ditcho accruals quality model adjusted by Francis et al. (2005) was utilized to measure it. Therefore, researchers and students are suggested to use other criteria such as the model of Jones accruals model, modified Jones, etc. in future studies and compare the results.

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