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Research Paper

Explaining Stock Anomalies Using Multifactorial Asset Pricing Models

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ABSTRACT

This study investigates the effects of stock anomalies on excess stock and unexplained returns of multifactorial models in the companies listed at the Tehran Stock Exchange. We selected a sample of 120 companies listed at the Tehran Stock Exchange from 2008 to 2019 using the Fama-Macbeth [18] regression approach. The results revealed that stock anomalies led to considerable differences in excess stock returns of different portfolios, implying that stock returns at different anomaly levels significantly differ. In addition, it was found that the anomalies related to stock characteristics greatly impacted explaining excess stock returns in the three-factor and five-factor models suggested by Fama and French. Besides, in different portfolios of the anomalies, the unexplained return rates were significantly different from each other. Moreover, in Fama and French's three-factor and five-factor models, different anomaly portfolios show significant differences in explaining excess stock returns.

1 Introduction

In the finance literature, there has been considerable attention to the relationship between risk and returns. This research aims to increase the predictive accuracy of expected returns and reduce unexplained errors in previous models. The first model proposed in this field was the Capital Asset Pricing Model (CAPM), which had long been considered the only acceptable model for predicting expected returns and explaining the relationship between risk and returns. This pattern considered asset return a linear function of market risk. There is no doubt that the asset return is associated with its risk in the market. However, whether the market risk is the only determinant of returns or other factors has been a controversial issue. Another problem with this model was related to the assumptions that were not tangible in reality. Since then, a good body of studies has been conducted on the capital asset pricing models in relation to stock returns, which has led to the development of this model [22]. Arttman et al. [6] note that researchers have been attempting to find the relationship between variables other than beta and stock returns since the 1980s. Such attempts were somewhat successful in this respect and included earnings per stock-to-stock price ratio [6], company size variable [4], office-stock market value [38], past stock returns [12],

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leverage [8], and profitability (Haugen & Baker, 1986). Due to various errors and unacceptability of explaining power in terms of returns, this model has been replaced by more comprehensive financial models, including three-factor models of Fama and French [16], the four-factor model of Carhart [11], and five-factors models of Fama and French [17]. These new models could explain the relationship between risk and returns more accurately. One of the most important features of multifactor models is the ease of adding new variables to previous models or even changing previous variables. This feature has led to a variety of studies on explaining stock returns [22]. Despite considerable advances of Fama and French's multifactor models in explaining risk and returns and precise explanation of the impact of a larger set of variables on stock returns, the research in the last two decades has mainly searched for the superior and optimal model and inspected the variables affecting stock returns in this domain.

Previous research indicated that a dominant approach has been to reduce the anomalies in the research models. Anomalies are the variables that have unclear effects on stock return explanations, and multifactor models do not help clarify the nature of those impacts [21]. Previous studies have well documented the effects of such anomalies on stock returns in Iran but failed to examine their impacts on excess stock returns and unexplained returns (alpha coefficient) in the multifactorial asset pricing models of Fama and French. This set of variables includes various stock characteristics, including stock release, stock liquidity, abnormal trading volume, and equity risk.In this paper, we explore the effects of stock anomalies on excess stock returns and unexplained returns (alpha value in multifactorial models) in the listed companies of the Tehran Stock Exchange. In other words, we evaluate the potential of anomalies in explaining the stock returns using multifactor models of Fama and French. The issue that matters is whether some of the unexplained returns of Fama and French's multifactor models can be explained by a set of stock characteristics. In this regard, many researchers have tried to develop the factors in these models and solely examined anomaly impacts on stock returns in an Iranian context. However, there have been rare attempts to identify anomaly effects on excess stock returns and unexplained returns (special returns) in the multifactor models of Fama and French. This new line of research could contribute to developing current theoretical foundations and improving investors' decisions.

2 Theoretical Foundations and Research Background

Determining stock returns plays a key role in market practitioners' decision-making, and research has increasingly examined returns based on easily assessable variables [22]. The first models of return estimation date back to the 1960s, when Markovitz's new stock theory (1952) attracted researchers' attention [19]. The first model of return estimation was the Capital Asset Pricing Model (CAPM) introduced by Sharpe [41], in which the return of each portfolio was only due to the systemic risk (Beta), and became known as the single-factor model. CAPM's single-factor model assumed attractiveness and simple and robust logic in defining the relationship between risk and expected returns. However, multifactor models, such as Ross's [39] Arbitrage Pricing Theory (APT), and Fama and French's [14, 15] Three-Factor Model, criticized this single-factor model [42].

Fama and French [14] criticized the asset pricing model, proposed an efficient market assumption, and added size and office to market ratio to the single-factor model. The three-factor model increased the explanatory power of the model and reduced the beta coefficient through two new variables. They claimed that the role of systematic risk in justifying errors was significantly reduced through these factors. Their results showed that there is a negative relationship between company size and average returns. In addition, they concluded that there is a positive relationship between the office-market ratio and average returns. The anomaly that the three-factor model could not explain was the momentum factor of Jegadeesh and Titman [25]. An important issue that investors and stakeholders have always considered in financial markets, especially the capital market, is the relationship between risk and return. In the finance literature, the first significant study on the relationship between risk and returns is the CAPM [41]. This model assumed that the return of each portfolio was only due to systemic risk (Beta), which has been known as the single-factor model. Multifactor models, such as Arbitrage Pricing Theory (APT) [31] and the Three-Factor Model [14, 15], criticized this single-factor pattern. Fama and French noted the company size and value factors in the single-factor model and claimed that the role of systematic risk significantly decreases in justifying errors. They showed that there is a negative relationship between company size and average returns. Although their model could largely justify the known errors in the CAPM model, such as company size [4], the profit-to-price ratio [6, 9], leverage [8], office-to-market ratio [38], and long-term returns [12], the Momentum strategy (buying and maintaining high-yield stocks and selling low-yield stocks) suggested by Jegadeesh and Titman [25]has still remained unexplained. As noted, Fama and French [15] incorporated the company size and value into the single-factor model, claiming that the role of systematic risk significantly reduces in justifying stock dispersion. Their studies revealed a negative relationship between company size and average stock return. In addition, they concluded that there is a positive relationship between the ratio of office-market value and the average returns in companies [15].

On the other hand, Carhart claims that his four-factor model significantly reduces the pricing error of the CAPM and three-factor models. Carhart's findings show that the four-factor pattern contained more explanatory power for the formed portfolios. However, like other models, even the four-factor model failed to explain all market anomalies. Hou et al. [20] presented a new four-factor model called the Q factor, which responded to the anomalies that three-factor and four-factor models could not deal with. The four factors included systematic risk (beta), the difference in portfolio returns of small and large companies, the difference in stock portfolio returns of companies with low and high investment, and the difference in portfolio returns of companies with high and low profitability. Finally, Fama and French were affected by cash/liquidity profit reduction in establishing the five-factor model in 2015 and added two new factors, including Robust Minus Weak operation (RMW) and Conservative Minus Aggressive investment (CMA), to their previous model. They claimed that the High Minus Low B/M ratio (HML) is redundant and additional in order to measure the explanatory power of the new model compared to previous models [42].In terms of asset pricing models, the latest studies were undertaken by Konstantin et al. [29] during the COVID-19 epidemic. They analyzed and compared the performance of the multifactor asset pricing model in the coronavirus pandemic in developed and emerging markets. The results show that in addition to market beta, size, value, profitability, and specific investment patterns of FAMA and French, there should be other factors to explain the development of fundamental asset returns during the pandemic. During the pandemic, emerging markets generally do not outperform developed markets. In another study, Gabriel et al. (2022) evaluated liquidity risk valuation in Latin America using Fama-French three- and five-factor models and Carhart's four-factor model. In this research, the liquidity factor was constructed based on two proxies that involve different liquidity dimensions and are more suitable for low-frequency data. GRS statistics showed that the average returns involving an improved Fama-French five-factor model better explain liquidity risk. As the estimates were made by GMM-IVd, the results did not change significantly due to possible endogenous problems caused by liquidity. The results were stronger compared to the January effect. Furthermore, the sample period was divided into two sub-periods that were statistically significant, though explanatory power was higher under the second period. Philipp & Franziska [35] evaluated the five-factor model of Fama and French plus momentum factor in the German capital market. Additional factors do not add considerable explanatory power to the analysis in the six-factor model compared to the three-factor model. We conclude that the relationship between profitability and investment factors in international asset pricing studies cannot be transferred to the specific German market. In the studies on pricing models, Sundqvist [43] tested the multifactor models of Fama and French in the Nordic stock market. The results showed that in all three portfolio models sorted by size and profitability, the average return is not well explained, and small stocks in the Nordic market generally had less systematic risk than large stocks. Finally, the five-factor models explained the average return more thoroughly than others. Bin et al. [9] probed into the Chinese stock market using the five-factor pricing model of Fama and French. Their findings showed a strong pattern of size, price, and profitability in the average return, while the investment factor had a weak relationship with average return. The researchers reported that the investment factor in the Chinese stock market was redundant during the project, as their tests revealed. In contrast, the price factor in this market was not regarded as a redundant variable. Lin [33] investigated controversial pricing and the new five-factor CAPM in Shanghai and Shenzhen stock markets. Their findings were similar to those of Bin et al. [9] and confirmed the superior performance of the five-factor model compared to the eight-factor model in the Chinese stock market.

Kubota and Takahara [30] explored the five-factor model of Fama and French in Japan. The results showed that profitability and investment factors are not statistically significant in the model and, as a result, cannot be used for the research data from 1978 to 2014. Soleimanian et al. [42] investigated the performance of value, momentum, and market factor pricing models in explaining excess portfolio returns resulting from accrual anomalies and financial constraints and compared them with competing factor models through the GRS test. The model test results and hypotheses indicate a convergence between value and momentum factors and excess stock returns in the portfolios based on value/momentum characteristics, value/size, accruals/size, and financial constraints/size. These two factors lead to portfolio risks based on value/momentum characteristics, accruals/size, and financial constraints/size. By implementing GRS test statistics, the three-factor model based on value, momentum, and market risk has offered the best performance compared to the capital asset pricing models, such as CAMP and Fama and French three-factor models. Kiamehr et al. [26] scrutinized the role of stock market anomalies in capital asset pricing. The findings show that stock market anomalies affect capital asset pricing and increase portfolio risk in all capital asset pricing models, such as Fama and French three-factor [15], Carhart's four-factor, and Fama and French five-factor models [16]. Additionally, in all pricing models, presenting a capital asset pricing model based on stock market anomalies increases the predictive power of common capital asset pricing models. Rahimpour and Ghaemi [36] evaluated pricing patterns and the time-calendar portfolio approach in a long-term research project. The results show that the performance of companies' stock prices, in the long run, should be evaluated three years after an event. Besides, they suggested several suitable patterns in the three years, including a four-factor model based on stock liquidity in ordinary least squares framework and three-factor models of Fama and French, a four-factor model based on stock liquidity, a four-factor model based on the stock beta, and four-factor model based on accruals in the rhythmic least squares method. Farzinfar et al [5], merged the multifactorial model of capital asset pricing and the penalty function/method to evaluate stock returns. They concluded that the widespread use of penalty function simulation algorithms in the form of P and PCA

estimation methods improves the efficiency of multifactorial methods in evaluating stock returns. Moreover, compared to the exclusive use of multifactor models, using a combined algorithm of penalty and multifactor functions offers higher accuracy in estimating stock returns. Bashir Khodaparsati et al. [5] investigated the efficiency of Fama and French's five-factor model in aggressive and defensive stocks and identified price and size factors as redundant variables. The profitability factor had a negative and significant effect on the excess return of defensive stocks and no impact on those of aggressive stocks. Finally, investment in aggressive stocks was found to be effective, which was not the case in defensive stocks. Ranjbar et al. [37] evaluated CAPMs and compared them with the five-factor models using economic variables, such as exchange rate, inflation, import, and liquidity.
The results showed that the five-factor model of Fama and French, introduced in 2014, performed better than others. The CAPM, the three-factor model, and the consumer CAPM ranked after the five-factor model. Arabzadeh et al. [3] examined accrual anomalies using a multifactor pricing model in Tehran Stock Exchange. Based on the test results, accrual characteristics, rather than accrual coefficients, predicted the return. These results showed that investors misinterpret accrual characteristics and make logical risk interpretation doubtful. Bozorg Asl and Masjed Mousavi [10] compared the explanatory power of return prediction models in the Tehran Stock Exchange. The results of the Wang test showed that there was a significant difference between the CAPM and the five-factor model in explaining returns. However, the CAPM and the three-factor model did not significantly differ, and the three-factor and five-factor models showed no differences. It was also found that further investment led to increased returns. The literature on the pricing models suggests that researchers' key challenge has concerned their quest for a superior and optimal model. There has been a consensus that reducing anomalies would be the best approach. Anomalies are variables that have unclear effects on stock returns (especially unexplained returns of multifactor models) [21]. This collection encompasses stock features, including stock release, stock liquidity, abnormal trading volume, price content information, and stock risk. The present study investigates the effects of stock characteristics on stock returns using the three-factor and five-factor models of Fama and French in the listed companies of the Tehran Stock Exchange. In other words, we identify the stock anomalies affecting the unexplained returns of multifactor models. Our study could be a step towards promoting those models in the future.

3 Research hypotheses

The respective research hypotheses in this study are listed in Table 1.

Table 1: Research hypotheses

Number	Description
Main hypothesis 1	There is a significant difference between the excessstock returns of different portfolios in terms of stock characteristics.
Sub-hypothesis 1-1	There is a significant difference between the excessstock returns of different portfolios in terms of stock release.
Sub-hypothesis 1-2	There is a significant difference between the excess stock returns of different portfolios in terms of stock liquidity.
Sub-hypothesis 1-3	There is a significant difference between the excess stock returns of different portfolio stocks in terms of the abnormal stock trading volume.
	There is a significant difference between the excess stock returns of different portfolios in terms of stock equity risk.

Table 1: Continue

Number	Description
Sub-hypothesis 1-4	There is a significant difference between the excess stock returns of different portfolios in terms of stock content information.
Sub-hypothesis 1-5	
Main hypothesis 2	Stock characteristics of companiessignificantly affect the explanation of excess stock returns, and there is a significant difference between the alpha values of the model (unexplained returns) in different portfolios.
Sub-hypothesis 2-1	The stock release has a significant effect on the explanation of excess stock returns, and there is a significant difference between the alpha values of the model (unexplained returns) in different portfolios.
Sub-hypothesis 2-2	Stock liquidity has a significant effect on the explanation of excess stock returns, and there is a significant difference between the alpha values of the model (unexplained returns) in different portfolios.
Sub-hypothesis 2-3	Abnormal stock trading volume has a significant effect on the explanation of excess stock returns, and there is a significant difference between the alpha values of the model (unexplained returns) in different portfolios.
Sub-hypothesis 2-4	Stock equity risk has a significant effect on the explanation of excess stock returns, and there is a significant difference between the alpha values of the model (unexplained return) in different portfolios.
Sub-hypothesis 2-5	Stock content information has a significant effect on the explanation of excess stock returns, and there is a significant difference between the alpha values of the model (unexplained returns) in different portfolios.
Main hypothesis 3	There is a significant difference between three-factor and five-factor models in explaining the stock returns of stock anomaly portfolios across levels.
Sub-hypothesis 3-1	There is a significant difference between three-factor and five-factor models in explaining stock returns of stock release portfolios across levels.
Sub-hypothesis 3-2	There is a significant difference between three-factor and five-factor models in explaining stock returns of stock liquidity portfolios across levels.
Sub-hypothesis 3-3	There is a significant difference between three-factor and five-factor models in explaining stock returns of abnormal stock trading portfolios across levels.
Sub-hypothesis 3-4	There is a significant difference between three-factor and five-factor models in explaining stock returns of stock equity across levels.
Sub-hypothesis 3-5	There is a significant difference between three-factor and five-factor models in explaining stock returns of stock content information portfolios across levels.

4 Methodologyand Variable Measurement

4.1 Data Collection

In this study, we used a library method to establish theoretical foundations and a field method to collect financial data. Besides, various sources, such as companies' financial statements, CDs of Tehran Stock Exchange, Rahavard Novin software, and the Stock Exchange Organization (Kodal) website, were used. Excel software was used to categorize, dispose, and create databases, and Eviews version 10 was used to test the hypotheses. Our data mainly include annual financial statements, daily stock returns, and stock trading volumes

4.2 Population and Statistical Sample

The sample in this study includes the companies listed in the Tehran Stock Exchange, which met the following conditions and were selected through a systematic elimination method:

1. The financial information of the company is available in the research period from 2008 to 2019.
2. Their fiscal year ends in March and does not change in the period under consideration (the same fiscal year for all companies).
3. Companies that have been accepted by the stock exchange up to 21/04/2008 (i.e., have been accepted on the stock exchange before 2008) are considered, and company title has not been removed from among the list suggested by the Tehran Stock Exchange during the period under investigation.
5. Financial institutions, banks, investment companies, etc. (due to the specific nature of their activities) are not included.
6. The companies do not have a trading interruption above six months.

Considering the above-presented criteria, we could spot 120 companies from 2008 to 2019 that met the conditions. Thus, we included all companies for investigation. It should be noted that the information from previous years (2003-2007) was considered in the case of some variables.

4.3 Dependent variable

The dependent variable of this research is the excess stock return, which is the difference between daily stock and risk-free returns (daily). The investment return in typical stocks in a certain period was estimated according to the first and last prices of the period, ownership benefits, and the increase in the company's capital. We used the following equation:

$$R_{it} = \frac{(1 + \alpha_{it}) \times P_{it} - P_{i\,(t-1)} + D_{it} - M}{P_{i\,(t-1)}} \tag{1}$$

Where:

$R_{i,t}$: the return of i shares in the t period.

$P_{i,t}$: Stock price i in the t period.

$D_{i,t}$: dividend benefit of stock i in the t period.

M: the cash from the shareholders, and

$\alpha_{i,t}$: The ratio of capital increase of company i in the t period.

4.4 Independent variables

Independent variables in this study include a set of anomalies related to the company's stocks. Anomalies affect stock returns in an unclear way, and we intend to deal with their effects on excess stock returns and unexplained returns (specific returns) of multifactorial pricing models suggested by Fama and French. The following stock anomalies are considered in this study:

4.4.1 Equity Release

The pure stock release is measured using the difference between the natural logarithm of the number of stocks at the beginning and end of the fiscal year.

4.4.2 Equity Risk

The stock equity risk is obtained using the variance of the remaining values in Fama and French'sthree-factor model. It is annually estimated based on daily returns [21].

$$R_{i,t} - R_{ft} = \alpha_{p,t} + \beta_{1,it}MRKT_t + \beta_{2,it}SMB_t + \beta_{3,it}HML_t + \varepsilon_{i,t} \quad (2)$$

Finally,

$$RVAR_{i,t} = VAR(\varepsilon_{i,t}) \quad (3)$$

4.4.3 Stock Liquidity

Liquidity is buying or selling an asset in the shortest time and at the lowest cost. To measure the stock liquidity in this research, we used Amihud's [2] Non-Liquidity Criterion based on the trading conditions. This model is calculated using daily data.

$$\mathrm{LIQ_{it}} = -\left[\frac{1}{\mathrm{D_{it}}}\sum_{\mathrm{d=1}}^{\mathrm{D_{it}}}\left(\frac{|\mathrm{R_{itd}}|}{\mathrm{VOL_{itd}}}\right)\right] \quad (4)$$

In this ratio:

$LIQ_{i,t}$: stock liquidity ratio,

$D_{i,d,t}$: the number of trading days of stock i in month t,

$R_{i,d,t}$: stock i return on day d in month t,

$V_{i,d,t}$: trading volume of stock i on day d in month t.

According to this model, when the trading volume and the number of trading days are low in a certain period, the stock has low liquidity. In fact, a lower ratio corresponds to a higher stock liquidity, and vice versa. By adding a negative coefficient to Amihud's non-liquidity criterion, the amount of stock liquidity is obtained.

4.4.4 Abnormal stock trading volume

In order to measure the abnormal stock trading volume, we first use the following regression model, which is processed on a three-year basis, and measure the normal stock trading volume. Then, the remaining values are calculated using the values obtained for different coefficients [31].

$$\mathrm{Turn_{i,t}} = \alpha_{\mathrm{i}} + \sum_{\mathrm{k=1}}^{3}\gamma_{\mathrm{i,k}}\mathrm{Turn_{t-k}} + \varepsilon_{\mathrm{i,t}} \quad (5)$$

In the above model:

$Turn_{i,t}$:The trading volume of stock i in month t

$Turn_{t-k}$: Stock trading volume in each of the last three months (last month, last two months, and last three months).

Finally, the abnormal trading volume is measured using the remaining values in the model. It should be noted that the above regression is examined for months t-2 to t-36.

4.4.5 Stock price content information

Collins and Durnevet al. define content information as the return potential in tracking expected future profits. In this definition, the current stock return is considered as a function of unexpected current benefits and expected future benefits, which is obtained through the following regression model [34]:

$$r_t = a + b_0 \Delta E_t + \sum_\tau b_\tau \Delta E_{t+\tau} + \sum_\tau c_\tau r_{t+\tau} + u_t \quad (6)$$

In this model:

r_t: Annual stock return of the company

ΔE_t: the Ratio of changes in stock benefit of the current year to the absolute magnitude of stock benefit of the last year

$\Delta E_{t+\tau}$: Changes in the company's profitability in the upcoming years

$r_{t+\tau}$ Futures stock return

τ: The next years, including 1, 2, and 3 years after the current year

Then, the content information of the stock price is measured based on the final Future Earnings Incremental Explanatory Power (FINC), which is the increase in the adjusted coefficient of the above regression model compared to the following model:

$$r_t = a + b_0 \Delta E_t + u_t \quad (7)$$

4.6 Research model and assumption testing

In this study, we tried to explain the respective anomalies using the multifactor models of Fama and French. The statistical analysis was carried out as follows:

4.6.1 Comparison of excess stock returns in different portfolios in terms of stock anomalies

In order to obtain a general view of each research variable, we first examine the descriptive statistics. Then, the sample companies are divided into five portfolios (portfolios 1 and 5havethe lowest and the highest number of anomalies, respectively) each year based on stock anomaly variables. We then compare the average excess stock returns of different portfolios in terms of anomalies. The means of portfolios are compared using an ANOVA test. This test examines whether the anomalies can lead to differences in the excess return efficiency of different portfolios.

4.6.2 The effect of anomalies on excess stock return explanations in multifactor models

In this section, using the three- and five-factor models of Fama and French (as follows), we inspect the effect of anomalies on excess return explanations. Fama-Macbeth's [18] regression approach is used to estimate three- and five-factor models. In more specific terms, each of the models of Fama and French is separately examined for each portfolio based on the desired anomalies. In addition, due to the use of two models, five portfolios, and five anomalies, a total of 50 regressions are investigated (5×5×2).

After examining the multifactorial models based on different portfolio anomalies, we estimate the unexplained returns (alpha coefficient (α_(i,t)) to determine the effective anomaly factors in excess and unexplained returns in the models (These models are annually evaluated using daily data).

To differentiate the performance of different portfolios and models of Fama and French, A|α_i | and A|α_i |⁄A|s ̅_i | and A(α_i^2)⁄A(m ̂_i^2) are compared using ANOVA and paired t-tests. High A|α_i | indicates a greater distance of model intercepts from zero, which leads to less explanatory power. A|α_i |⁄A|s ̅_i | compares the intercept dispersion rate and the average return. Moreover, A(α_i^2)⁄A(m ̂_i^2) is a proportion of the actual return value, which is not explained through the regression. A|α_i | shows the average absolute value of the intercept in Fama and French's model, and s ̅_i represents the difference between portfolio i return and the average return of total portfolios. Finally, A(α_i^2)⁄A(m ̂_i^2) shows the ratio of the average intercept square to the average square s ̅_i [21]. The three-factor model of Fama and French [15]:

$$R\_(i,t) - R\_ft = \alpha\_(i,t) + b\_(i,t)\ MRKT\_t + s\_(i,t)\ SMB\_t + h\_(i,t)\ HML\_t + \varepsilon\_(i,t) \qquad (8)$$

The five-factor model of Fama and French[17]:

$$\begin{aligned} R_{i,t} - R_{ft} = \alpha_{i,t} + b_{i,t}MRKT_t + s_{i,t}SMB_t + h_{i,t}HML_t \\ + r_{i,t}RMW_{i,t} + c_{i,t}CMA_{i,t} + \varepsilon_{i,t} \end{aligned} \qquad (9)$$

Table 2: Factors and their estimation methods

Model factor	Estimation method
R_(i,t)-R_ft	-The difference between portfolio p returns per month t and risk-free returns in that month.
MRKT	-Capital market risk, which is the difference between market returns in the period under study and risk-free returns for the same period (in this study, the risk-free return is the stock return rate of the central bank).
SMB_(i,t)	-The difference between the portfolio returns composed of large company stocks and portfolios composed of small company stocks (size factor). In fact, this variable is proposed to determine and control the company size factor in an excess return of Fama and French' model, which is measured using the following relationship:
HML_(i,t)	-The difference between portfolio returns consisting of high and low capitalist companies (the ratio of office to market). This variable is the difference between the average return of the companies with high and low price ratios, which is calculated using the following relationship: $\mathrm{HML} = \frac{(S/H + B/H)}{2} - \frac{(S/L + B/L)}{2}$
RMW_(i,t)	- The difference in portfolio returns consisting of high- and low-profit companies. Profitability is the ratio of pre-tax profit to total assets. $\mathrm{RMW} = \frac{(S/R + B/R)}{2} - \frac{(S/W + B/W)}{2}$
CMA_(i,t)	-The differences in portfolio returns between the companies with low (conservative) and high investment (bold). Investment is the percentage of total asset growth relative to the previous year. $\mathrm{CMA} = \frac{(S/C + B/C)}{2} - \frac{(S/A + B/A)}{2}$

In Fama and French's models, all companies are ranked based on size at the end of each year, and the middle-ranked company is then used to divide the stocks into two categories. The first group consists of stocks with a market price of less than the median, and the second group has a market price greater than the median level. Subsequently, all companies in one of the above groups are ranked each year based on the office-to-market ratio and then divided into three categories. In this classification, 30% of stocks are divided into portfolios with high office-market ratios and 30% to low-office-market price ratios. The middle 40% are categorized in the portfolios with an average office-market price ratio. As a result, six portfolios are obtained combining these two divisions, which are as follows:

- S/H, S/M, S/L: These portfolios contain small-sized stocks and have office-market price ratios of high, median, and low, respectively.

- B/H, B/M, B/L: These portfolios contain large-sized stocks and have office-market price ratios of high, median, and low, respectively.

We use this categorization due to Fama and French's claim that the office-market price ratio has a stronger role in justifying stock returns compared to stock size.

5 Results

5.1 Research model and assumption testing

This study used descriptive indicators, such as mean, median, standard deviation, skewness, and kurtosis indices. In some research variables, we eliminated the outliers using a trimmed mean technique. Also, based on the studies on the normality of the dependent variable, we ensured that the excess stock return variable has a near-normal distribution. In terms of homogeneity and duration, the research variables lack false regression and abnormal relationships (due to limited space, the results are not reported here). The descriptives are illustrated in Table 3.

Table 3: Descriptive Statistics of Research Variables

Variable		Mean	Median	Standard deviation	skewness	kurtosis	Minimum	Maximum
Title	Symbol							
Excess stock re-turn	Ri-Rf	0.234	0.006	0.786	0.257	1.164	-0.713	3.395
Capital market risk	MRKT	0.052	0.005	0.296	-0.063	-1.299	-0.429	0.484
size	SMB	0.031	0.030	0.125	0.049	-1.073	-0.161	0.245
Marketvalue	HML	-0.514	0.477	0.305	-0.144	-0.887	-1.093	-0.015
earning	RMW	0.195	0.206	0.172	0.321	-0.874	-0.051	0.534
capital	CMA	-0.212	-0.130	0.206	-1.008	0.603	-0.719	0.084
Stock release	ISSUE	0.071	0.000	0.145	2.281	4.905	0.000	0.731
Stock equity risk	RVAR	0.115	0.048	0.174	2.586	6.142	0.005	0.766
Stock liquidity	LIQ	-.0.001	0.000	0.003	-.3545	9.571	-0.016	0.000
Abnormal trading volume	TURN	0.496	0.418	0.271	1.298	1.396	0.157	1.429
Stock content information	FINC	0.498	0.484	0.233	0.083	-0.937	0.079	0.947

According to Table 3, the average excess stock return (Ri-Rf), which indicates the difference between stock and risk-free returns and stock risks, is 0.234 in the sample companies. The results show that the annual return was nearly 23% higher than risk-free returns. Additionally, the average capital market risk (MRKT), which indicates the difference between capital market and risk-free returns (also referred to as the market factor in Fama and French's models), is 0.052, which is surplus to risk-free returns in the whole capital market during the research period. The average stock return difference of portfolios consisting of small and large companies (SMB)is 0.031, which corresponds to the size factor in Fama and French models. This value is positive, indicating that the stock return of small companies is higher than the one in large companies. The average difference between stock returns of portfolios constituting companies with high and low office-market price ratios (HML), which indicates the market value ratio in the model, is 0.514. This value is negative, indicating that the stock return of companies with high office value ratio was lower than those of companies with low office value ratios. Besides, the average profitability factor (RMW), which is the difference between monthly stock returns of high-profitability and low-profitability companies, is equal to 0.195, meaning that the monthly return of high-profitability companies is higher. The average investment factor (CMA), which indicates the difference between monthly stock returns of companies with conservative (low) and bold (high) investments, is -0.212. Thus, conservative companies have low monthly stock returns compared to bold investment companies. The stock anomalies show that the average new stock release (ISSU) in the sample companies was 0.071. This means that about 7% capital, on average, is added annually in these companies. The average stock risk (RVAR) is 0.115. The larger amounts indicate higher stock return risk in the companies. Further results show that the average stock liquidity (LIQ) measured by Amihoud's criterion is -0.001. Larger algebraic values correspond to higher stock liquidity in the companies. The average unusual stock trading volume (TURN) in the sample companies is 0.496, which is about half of the total trading volume of the company stocks. Finally, the average stock content information (FINC) is 0.498. Higher values show increased stock content information levels.

5.2 Comparing excess stock returns in different portfolios in terms of stock anomalies

In this section, the sample companies are first divided into five portfolios (portfolio 1 has the lowest value, and portfolio 5 has the highest amount of anomalies). Then, the average excess stock returns of portfolios in terms of stock anomalies are presented. The mean comparisons among portfolios using ANOVA are shown in Table 4.

Table 4: Differences in the excess stock returns of portfolios in terms of anomalies

Anomaly		Portfolio 1 (the lowest)	portfolio 2	Portfolio 3	Portfolio 4	portfolio 5 (the highest)	ANOVA
Title	Sym-bol						
Stock release	ISSUE	0.137	0.192	0.334	0..292	0.217	2.891**
Stock equity risk	RVAR	-0.070	0.214	0.113	0.296	0.811	67.542***
Stock liquidity	LIQ	0.335	0.289	0.196	0.153	0.199	2.644**
Abnormal trad-ing volume	TURN	0.184	0.275	0.275	0.306	0.132	2.496**
Stock content information	FINC	0.238	0.277	0.159	0.257	0.220	0.752
Significant at 90%			Significant at 95%				Significant at 99%

As Table 4 reveals, the average excess stock return of the portfolio with the lowest stock release (Portfolio 1) is 0.137, which is 0.217 in the portfolio with the highest earning quality (Portfolio 5). The results of ANOVA show a significant difference among the excess stock returns of portfolios in terms of anomalies. Comparing the average excess stock returns in other portfolios indicate a significant difference among stock equity risk (RVAR), stock liquidity (LIQ), and abnormal stock trading volume (TURN) at a 95% confidence level. However, no differences are observed in the stock content information (FINC) in terms of anomaly. Totally, it was found that out of the five sub-hypotheses related to the first main hypothesis, four hypotheses are confirmed at a 95% confidence level. Thus, the first main hypothesis is confirmed, and there is a significant difference between the excess stock returns of portfolios in terms of stock characteristics.

5.3 Anomaly impacts on excess stock return explanations in multifactor models

In this section, using the three- and five-factor models of Fama and French and the regression approach of Fama and Macbeth [16], we examine anomaly effects on excess stock return explanations. In the section below, the unexplained returns (alpha value or intercept) in multifactor models separated by different portfolios-anomalies (using three indices of A|α_i | and A|α_i |⁄A|s ̅_i |, and A(α_i^2)⁄A(m ̂_i^2)) are compared.

5.3.1 The impact of stock release anomaly on excess stock return explanations

In Table 5, the potentials of Fama and French's three- and five-factor models in explaining the excess stock returns in terms of stock release anomalies are shown.

Table 5: Excess stock return explanations based on stock release anomaly

Variable		**Explanations based on stock release anomaly**				
Title	Symbol	Portfolio1 (the lowest)	Portfolio2	Portfolio3	Portfolio4	Portfolio5 (the highest)
Intercept	α	0.003*	0.002	0.003***	0.003***	0.005***
Capital market risk	MRKT	0.001	0.001	0.002*	0.001	0.000
Three-factor size	SMB	0.004**	0.002*	0.001	0.000	0.001
Market value	HML	0.005**	0.000	-0.002	-0.002***	-0.005***
Portfolio coefficient of determination		0.325	0.102	0.253	0.122	0.514
Absolute value (alpha)	A|ai|	0.024	0.043	0.027	0.025	0.024
Intercept dispersion	A|ai|/A|si|	6.598	10.159	7.178	7.028	5.688
Actual unexplained values	$A(\alpha_i^2)/A(\hat{m}$	233	429	284	266	178
Intercept	α	0.003**	0.003***	0.003***	0.003**	0.005***
Capital market risk	MRKT	0.001	0.000	0.002*	0.001	0.000
Five-factor size	SMB	0.004*	0.003***	0.000	0.001	0.001
Market value	HML	-0.005	0.002	-0.003	-0.002*	-0.006***
Capital factor	CMA	-0.001	0.001	-0.003**	-0.001	-0.001
Earning	RMW	0.002**	0.003***	0.000	0.001	0.001
Portfolio coefficient of determination		0.329	0.373	0.373	0.126	0.532
Absolute value (alpha)	A|ai|	0.028	0.037	0.028	0.032	0.532
Intercept dispersion	A|ai|/A|si|	7.431	8.899	7.437	8.803	5.808
Actual unexplained values	$A(\alpha_i^2)/A(\hat{m}$	277	367	298	365	192
Significant at 90%		Significant at 95%			Significant at 99%	

5.3.1.1 Validity and strength of the model

According to Table 5, the coefficient of determination in the portfolio with the lowest stock release (portfolio 1) in the three-factor model equals 0.325. The coefficient is equal to 0.329in the five-factor model. These results indicate that in this portfolio of three- and five-factor models, about 33% of changes in the dependent variable are caused by independent variables. In other portfolios, the coefficient of determination ranges between 10 and 53%. The residual correlation for the remaining factors, carried out using the Durbin-Watson test, was between 1.5 and 2.5 in different portfolios of three- and five-factor models. This indicates the lack of residual correlations (in order to maintain brevity, statistical results are not presented).

5.4 Results of research variables

In the three-factor model, the abnormal monthly capital market return (MRKT) is found to be surplus to risk-free returns. In addition, in the portfolio of companies with the lowest stock release (Portfolio 1), MRKT shows a positive but meaningless effect on the excess stock returns. In other portfolios and the five-factor model, this factor positively affects the dependent variable, which is not statistically meaningful. The size factor (SMB) indicates a difference in stock returns of small and large companies. However, SMB shows a significant positive role in the three-factor model and companies with the lowest stock release (portfolio 1). In other portfolios and models, the size factor positively affects the excess stock return, which is not statistically significant in most cases.

The market value factor (HML) indicates the difference in monthly returns of companies with high and low office-market price ratios. In the three-factor model and portfolios of companies with the lowest stock release (Portfolio 1), HML shows a negative and significant effect on the dependent variable. In the case of other portfolios and the five-factor model, this factor has a negative but meaningless effect on excess stock returns. The capital market factor (CMA) shows differences in monthly returns of companies with conservative and bold investments and has a negative and meaningless effect on excess stock returns in the portfolio with the lowest stock release (Portfolio 1). This variable negatively impacts other portfolios in terms of excess stock return, which is not meaningful in most cases. The profitability factor (RMW) indicates a difference between stock returns of companies with high and low profitability. In addition, in the portfolio of companies with the lowest stock release (Portfolio 1), RMW shows a positive and significant effect on the excess stock returns. In other portfolios, we found a positive, albeit meaningless, role of this variable.

Then, using three indicators, we compared the average absolute values ($A|\alpha_i|$), intercept dispersion ($A|\alpha_i|/A|\bar{s}_i|$), and actual unexplained values $A(\alpha_i^2)/A(\hat{m}_i^2)$ in terms of excess stock return explanations. The smaller values obtained from these indices show higher explanatory power of the anomaly (explaining a greater part of the excess stock return by the factors in the models). We first made the comparisons at a portfolio level (comparison between portfolios) and then at a model level. The results are summarized in Table 6.

Table 6: Comparison among stock release portfolios in terms of excess stock return explanations

Anomaly explanation index		**Stock release**					**ANOVA**
	Multifactorial model	Portfolio1 (the lowest)	portfolio 2	portfolio 3	portfolio 4	Portfolio5 (the highest)	
$A\|\alpha_i\|$	Three-factor	0.024	0.025	0.027	0.025	0.024	45.225***
	Five-factor	0.028	0.037	0.028	0.032	0.024	16.974***
$A\|\alpha_i\|/A\|\bar{s}_i\|$	Three-factor	6.598	10.159	7.178	7.028	5.688	7.964***
	Five-factor	7.431	8.899	7.437	8.803	5.808	4.139***
$A(\alpha_i^2)/A(\hat{m}_i^2)$	Three-factor	233	429	284	266	178	3.766***
	Five-factor	277	367	298	365	192	2.050*
Significant at 90%			Significant at 95%				Significant at 99%

According to Table 6, there is a significant difference between stock release portfolios' mean absolute values (A|α_i |) in terms of excess stock returns. With regard to intercept dispersion (A|α_i |⁄A|s ̅_i |), there is a significant difference between portfolios in both three- and five-factor models. In addition, in terms of unexplained values A (α_i^2)⁄A(m ̂_i^2) in the three-factor model, there is a significant difference between the stock release portfolios in explaining the excess stock return, which was not the case in the five-factor model. Totally, based on the results (due to the significant difference among indices in five available conditions), there is a significant difference among stock release portfolios in explaining excess stock returns at a 95% confidence level. Consequently, sub-hypothesis 1-3is confirmed, and stock release significantly affects the excess stock return explanations in companies. Besides, there is a significant difference between the alpha values of the model (unexplained return) in different portfolios at a 95% confidence level. The explanatory rate of excess stock returns in Fama and French's three- and five-factor models are depicted in Table 7.

Table 7: Excess stock return explanations by stock release anomaly in three- and five-factor models

Anomaly	Anomaly explanation index	Average index		Difference	Paired test
		Three-factor	Five-factor		
Stock release	$A\|\alpha_i\|$	0.028	0.03	-0.002	-3.130***
	$A\|\alpha_i\|/A\|\bar{s}_i\|$	7.330	7.676	-0.346	-2..477**
	$A(\alpha_i^2)/A(\hat{m}_i^2)$	278	300	-22	-1.479*
Significant at 90%		Significant at 95%			Significant at 99%

Table 7 shows a significant difference between the explanation rate of excess stock returns in different stock release portfolios in Fama and French's three- and five-factor models.Hence, sub-hypothesis 1-3 is confirmed at a 95% confidence level, and there is a significant difference between stock release portfolios of three- and five-factor models in explaining excess stock returns.

5.4.1 Impacts of stock liquidity anomaly on excess stock rerun explanations

Table 8: Explanatory rate of stock returns in different stock liquidity portfolios

		Explanatory rate of stock liquidity portfolios					ANOVA
Anomaly explanation index	Multifactorial model	Portfolio1 (the lowest)	Portfolio2	Portfolio3	Portfolio4	Portfolio5 (the highest)	
$\mathbf{A\|\alpha_i\|}$	Three-factor Five-factor	0.029 0.031	0.031 0.035	0.021 0.025	0.028 0.029	0.026 0.027	9.884*** 10.083***
$\mathbf{A\|\alpha_i\|/A\|\bar{s}_i\|}$	Three-factor Five-factor	6.598 7.148	7.189 8.340	5.230 6.662	7.444 7.446	5.923 6.531	2.804** 1.429
$\mathbf{A(\alpha_i^2)/A(\hat{m}_i^2)}$	Three-factor Five-factor	236 225	252 224	163 230	274 212	191 219	1.261 0.995
Significant at 90%			Significant at 95%				Significant at 99%

The results show a significant difference between stock liquidity portfolios in explaining excess stock returns, as the mean absolute value (A|α_i |) reveals. In terms of intercept dispersion index (A|α_i

⁄A|s ̅_i), there is a significant difference between the portfolios in the three-factor model, which is not the case in the five-factor model (insignificant difference). In terms of actual unexplained values A (α_i^2) ⁄A(m ̂_i^2),other results show insignificant differences among stock liquidity portfolios in explaining excess stock returns in both three- and five-factor models. These results totally reveal that (due to insignificant differences between the indices in three of the six available conditions) there is no significant difference among stock liquidity portfolios in explaining the excess stock returns. Therefore, we reject sub-hypothesis 2-2, that stock liquidity status significantly affects excess stock return explanations. Consequently, there is no significant difference between the alpha values (unexplained return) in different portfolios at the confidence level of 95%.

Table 9: Paired t-test results of stock return explanations by stock liquidity anomaly in three- and five-factor models

Anomaly	Anomaly explanation index	Average index		Difference	Paired test
		Three-factor model	Five-factor model		
Stock liquidity	A|αi |	0.027	0.029	-0.002	-8.559***
	A|αi ⁄A|s ̅i |	6.477	7.285	-0.808	-8.471***
	$A(\alpha_i^2)/A(\hat{m}_i^2)$	223	222	-1	-1.020
Significant at 90%		Significant at 95%			Significant at 99%

Table 9 shows that the stock liquidity anomalies of the two models significantly differ in explaining excess stock returns based on two indices. This result confirms sub-hypothesis 2-3 at a 95% confidence level, and thus there is a significant difference between stock liquidity portfolios of the two models in terms of their explanations of excess stock returns.

5.4.2 The impacts of abnormal trading anomalies on excess stock return explanations

Table 10: Comparison of abnormal trading volume portfolios in terms of excess stock return explanations

		Explanatory rate of abnormal trading volume portfolios					**ANOVA**
Anomaly explanation index	Multifactorial model	Portfolio1 (the lowest)	Portfolio2	Portfolio3	Portfolio4	Portfolio5 (the highest)	
A|αi |	Three-factor Five-factor	0.049 0.050	0.041 0.049	0.029 0.031	0.026 0.027	0.024 0.027	52.362*** 56.459***
A|αi ⁄A|s ̅i |	Three-factor Five-factor	10.868 11.394	10.464 12.595	8.192 9.981	6.819 6.930	4.767 5.231	12.842*** 16.128***
$\mathbf{A(\alpha_i^2)/A(\hat{m}_i^2)}$	Three-factor Five-factor	538 589	542 667	386 478	282 306	189 199	4.868*** 6.318***
Significant at 90%			Significant at 95%				Significant at 99%

Based on the average absolute alpha index (A|α_i |), the results show a significant difference between abnormal trading volume portfolios in explaining excess stock returns. With regard to intercept dispersion (A|α_i ⁄A|s ̅_i |), there is a significant difference between the portfolios of both three- and five-factor models. Moreover, based on the actual unexplained values A (α_i^2) ⁄A(m ̂_i^2) in both models, there is a significant difference between abnormal trading volume portfolios in explaining excess stock returns. The total results (due to significant difference between indices in all six conditions) show a significant difference between abnormal trading volume portfolios in the excess stock returns. This result approves sub-hypothesis 2-3 that the status of abnormal trading volume has a significant effect on excess stock return explanations. Besides, there is a significant difference between the alpha values of the model (unexplained return) in different portfolios at a 99% confidence level.

Table 11: Comparison of abnormal trading volume anomalies in three- and five-factor models

Anomaly	**Anomaly explanation index**	**Average index**		**Difference**	**Paired test**
		Three-factor model	Five-factor model		
Abnormal stock trading volume	$A\|\alpha_i\|$	0.034	0.037	-0.003	-9.420***
	$A\|\alpha_i\|/A\|\bar{s}_i\|$	8.222	9.026	-0.804	-5.889***
	$A(\alpha_i^2)/A(\hat{m}_i^2)$	387	448	-61	-3.496***
Significant at 90%		Significant at 95%			Significant at 99%

The results in Table 11 clearly illustrate a significant difference among abnormal trading volume anomalies of both models in explaining the excess stock return. Thus, sub-hypothesis 3-3 is confirmed, and there is a significant difference between abnormal trading volume portfolios in explaining excess returns in three- and five-factor models at a 99% confidence level.

5.4.3 Impacts of stock equity risk anomaly on excess stock return explanations

Table 12: Comparison of stock equity risk portfolios in terms of excess return explanations

		Explanatory rate of stock equity risk portfolios					ANOVA
Anomaly explanation index	Multifactorial model	Portfolio1 (the lowest)	portfolio 2	portfolio 3	portfolio 4	Portfolio5 (the highest)	
$A\|\alpha_i\|$	Three-factor Five-factor	0.025 0.024	0.028 0.028	0.034 0.035	0.027 0.033	0.027 0.028	8.106***
$A\|\alpha_i\|/A\|\bar{s}_i\|$	Three-factor Five-factor	6.378 6.800	8.506 8.911	8.025 8.359	6.561 7.385	5.662 6.014	3.744*** 3.185**
$\mathbf{A(\alpha_i^2)/A(\hat{m}_i^2)}$	Three-factor Five-factor	277 304	395 442	342 372	221 268	194 222	2.428** 2.186*
Significant at 90%			Significant at 95%				Significant at 99%

The results show a significant difference between stock equity risk portfolios in explaining excess stock returns, which is shown by the differences in the mean absolute alpha values (A|α_i |). In addition, portfolios of both models show significant differences in terms of intercept dispersion index (A|α_i |⁄A|s¯_i |). Regarding actual unexplained values A (α_i^2)⁄A(mˆ_i^2) in the three-factor model, there is a significant difference in stock equity risk portfolios in explaining the excess stock return, while the difference is not significant in the five-factor model. All in all, these results (due to a significant difference between the indices in five of the six available conditions) show a significant difference between stock equity risk portfolios in explaining excess stock returns. As a result, sub-hypothesis 2-4 is confirmed, and stock equity risk significantly affects excess return explanation in the companies. Furthermore, there is a significant difference between the alpha values of the model (unexplained return) in different portfolios at a 95 % confidence level. Considering all three indices and stock risk anomalies in the two models, we conclude a significant difference between stock equity risk portfolios in explaining excess stock returns. This result supports sub-hypothesis 3-4 at a 95% confidence level, and thus there is a significant difference between stock equity risk portfolios of three- and five-factor models in explaining excess returns.

Table 13: Comparison of stock equity risk anomalies in terms of excess return explanations

Anomaly	**Anomaly explanation index**	**Average index**		**Difference**	**Paired test**
		Three-factor	**Five-factor**		
stock equity risk	$A\|\alpha_i\|$	0.028	0.030	-0.002	-5.027***
	$A\|\alpha_i\|/A\|\bar{s}_i\|$	7.026	7.494	-0.468	-4.449***
	$A(\alpha_i^2)/A(\hat{m}_i^2)$	286	322	-36	-3.631***
Significant at 90%		Significant at 95%			Significant at 99%

5.4.4 The impacts of stock content information anomaly onexcess stock return explanations

Table 14: Comparison of stock content information portfolios in explaining excess stock returns

		Explanatory rate of stock content information portfolios					ANOVA
Anomaly explanation index	Multifactorial model	Portfolio1 (the lowest)	portfolio 2	portfolio 3	portfolio 4	Portfolio5 (the highest)	
$A\|\alpha_i\|$	Three-factor Five-factor	0.029 0.031	0.026 0.026	0.028 0.031	0.026 0.026	0.029 0.033	1.75 7.683***
$A\|\alpha_i\|/A\|\bar{s}_i\|$	Three-factor Five-factor	6.401 7.058	8.216 8.781	9.333 10.400	7.800 7.978	7.233 8.466	2.718** 2.763**
$A(\alpha_i^2)/A(\hat{m}_i^2)$	Three-factor Five-factor	220 291	390 498	462 537	377 425	236 321	3.158** 2.088*
Significant at 90%			Significant at 95%				Significant at 99%

Table 15: Comparison of stock content information anomalies in explaining excess stock returns in three- and five-factor models

Anomaly	Anomaly explanation index	Average index		Difference	Paired test
		Three-factor	Five-factor		
Stock content information	$A\|\alpha_i\|$	0.028	0.03	-0.002	-7.612***
	$A\|\alpha_i\|/A\|\bar{s}_i\|$	7.796	8.537	-0.741	-6.966***
	$A(\alpha_i^2)/A(\hat{m}_i^2)$	337	414	-77	-5.918***
Significant at 90%		Significant at 95%			Significant at 99%

Based on Table 14, there is a significant difference between stock content information portfolios in explaining excess stock returns in the five-factor model$|\alpha_i|$, while this difference is not significant in the three-factor model. In terms of intercept dispersion index ($A|\alpha_i|/A|\bar{s}_i|$), there is a significant difference between portfolios in both three-factor and five-factor models. Furthermore, with regard to actual unexplained values $A(\alpha_i^2)/A(\hat{m}_i^2)$ in the three-factor model, there is a significant difference between stock content information portfolios in explaining excess stock returns, which is not the case in the five-factor model. Totally, these results (due to a significant difference between indices in four of the six available conditions) reveal a significant difference between stock content information portfolios in explaining excess stock returns. Thus, sub-hypothesis 2-5 with regard to the significant effect of stock content information on excess stock return explanation is approved. Besides, there is a significant difference between the alpha values of the model (unexplained return) in different portfolios at a 95% confidence level.

As the three indices and differences of stock content information anomalies show, there is a significant difference between stock content information portfolios in explaining excess stock returns in the three- and five-factor models of Fama and French. Given this result, sub-hypothesis no. 3-5 is confirmed at a 99% confidence level, and there is a significant difference between stock content information portfolios in explaining excess stock returns of both models. Considering the results presented in the above sections, we approve the second main hypothesis and conclude that stock characteristics significantly affect excess stock return explanations. In addition, there is a significant difference between the alpha values of the models (unexplained returns) in different portfolios. The third main hypothesis is also supported, and there is a significant difference between stock anomaly portfolios of the two models in explaining excess stock returns at a 95% confidence level.

6 Conclusions and Suggestions

In this study, we probed into the effects of stock anomalies on excess stock returns and unexplained returns (alpha value in multifactor models) of the listed companies in the Tehran Stock Exchange. The statistical analyses show that stock release, stock equity risk, stock liquidity, and abnormal stock trading volume have led to significant differences in terms of excess stock returns of different portfolios. This result implies that excess stock return differs significantly across stock characteristic anomalies.

Furthermore, we found that the anomalies related to stock characteristics significantly affect excess stock return explanations. More specifically, the anomalies related to stock characteristics, stock release variables, abnormal stock trading volume, stock equity risk, and stock content information meaningfully affect excess stock returns. Totally, the findings suggest that the amount of unexplained returns (alpha coefficient) in different anomaly portfolios differs significantly. Thus, anomalies have a significant effect on excess stock return explanations in companies. Besides, in Fama and French's three- and five-factor models, significant differences are observed among anomaly portfolios in explaining excess stock returns. This result shows that the unexplained returns (alpha coefficient) differ significantly in stock anomalies of the three- and five-factor models suggested by Fama and French. This finding is consistent with that of Farzinfar et al., [24], and [43]. In these studies, the five-factor model explains the average efficiency more comprehensively compared to the three-factor, and multifactor models perform better compared to single-factor models Jalali Naeini et al., [22].

Our findings related to anomaly effects on unexplained returns (as part of stock returns) are consistent with those of previous studies [21] (e.g., Gabriel et al., 2022 (liquidity anomalies); Goa et al., 2018 (high value and size factor); [42] (accrual anomalies and financial constraints); [26] (stock market anomalies); [3] (accrual anomalies)). On the other hand, the results agree with those of Alamifar et al. that fundamental factors affect the stock returns of companies. Similarly, the findings in this study confirm the theoretical foundations regarding the impact of fundamental factors on stock returns in companies. The results concerning anomaly impacts one excess stock returns, unexplained returns, and portfolio differences reaffirm investors' attention to the fundamental factors in companies. According to the present findings, there is a significant difference between excess stock returns and unexplained return of portfolios in multifactorial models, which shows the efficiency of portfolios in terms of the studied variables. Given this, we recommend that investors and other capital market bodies use the results of this study to measure or predict abnormal returns. In addition, they may consider these variables in their models to fit excess stock returns. Indeed, considering anomaly effects on unexplained returns in stock and portfolio selection can lead to higher stock returns. Moreover, in our study, portfolios differ significantly in explaining stock returns based on different anomalies in three- and five-factor models. In this case, the accuracy of the five-factor model was higher than the three-factor model in fitting the expected returns. Thus, based on this result, investors and researchers can use the five-factor model to increase the measurement accuracy in estimating their expected returns. Furthermore, appropriate parameters increase the accuracy of a model. Given this, further research should identify efficiency parameters, excluding the size and office-market factors. For instance, Lam et al. added the WML parameter (winning portfolios minus the loser portfolios) to Fama and French three-factor model.

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