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RESEARCH ARTICLE

# Market Fragility and Stock Returns: Evidence from Tehran Stock Exchange

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## Abstract

Recognising and investigating stock return behaviour has always been one of the most critical issues in scientific and investment communities. In recent years, factor models have been used in many studies related to stock return prediction. This research is based on a six-factor model, including the Fama-French five-factor model plus the market fragility factor. The explanatory power of this model has been examined in the Tehran securities market from 2009 to 2018 for 117 companies. The results show that the explanatory power of the six-factor model is better than the Fama-French five-factor model in the Iranian capital market. The results also suggest that market fragility has a significant negative relationship with stock returns. Policymakers can consider this result in financial and investment issues and people interested in this issue.

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## 1. Introduction

High wandering liquidity and willingness to make a profit and the greater familiarity of major and small investors with financial markets in recent years have increased individuals' willingness to invest in the stock market and have guided these funds toward financial markets (Ramezani and Kamyabi, 2017). In this regard, the correct pricing of capital assets can provide suitable conditions for investors to enter the investment area with confidence and accept the risk of this type of investment. Based on financial literature, the true value of an asset is determined by its risk and return. An asset with lower risk is selected among different investment options with the same return. Risk refers to the conditions that lead to the real return on assets being different from the predicted return (Hadian, Hashemi and Samadi, 2017). Explaining the relationship between risk, return, and pricing of capital assets has been a topic that has become the dominant paradigm of capital markets in recent decades. Their goal is to increase the accuracy of predicting the expected return and reduce the inconsistencies proposed in previous models (Ramazani and Kamyabi, 2017). Over the last years, various studies have investigated the factors affecting investment risk, and various variables such as market factor, book value to market value, etc., have been introduced as risk factors (Hadian, Hashemi and Samadi, 2017). After presenting the 3-factor and 5-factor Fama French models, the researchers have tried to add a new variable to the 5-factor Fama French model. To help investors and other users, the present study added one variable of market fragility to Fama– the French five-factor model to examine the model presented in the Iranian stock exchange markets .Moreover, the relationship between the market fragility rate variable and the stock returns will be examined. The second hypothesis tests the impact of market fragility on stock returns. As mentioned before, market fragility can occur due to various factors in the capital market. It is expected that the presence of this factor in the capital market of society can affect stock returns. As a result, analysts, investors and firm managers should be aware of the effect of market fragility on stock returns. This awareness can help investors and analysts determine stock returns and help managers foresee the company's stock value. Also, confirming the higher analysis power of the 6-factor model by adding a market fragility variable to the 5-factor model can provide a more effective model for measuring stock returns. Due to the lack of research to investigate the relationship between market fragility and stock returns, the second hypothesis of this research was developed. There are two main questions in this research. First, will adding the market fragility variable to the Fama-French model improve the valuation of the capital assets of this model compared to the 5-factor model? Second, is there a significant relationship between the market fragility rate variable and the stock returns?

## 2. Literature Review and Hypothesis Development

Estimating returns based on variables that are easy to estimate has become an interesting topic for research since it determined that stock returns play a vital role in the decisions of market participants. The first models presented to estimate returns date back to the 1960s when Markowitz's (1952) theory of securities attracted the attention of researchers (Fan and Yu, 2013). The capital asset pricing model (CAPM) was the first model introduced by Sharpe (1964) to estimate returns. In this model, it is assumed that the return of each portfolio results merely from systematic risk (Beta), which is known as the single-factor model (Salehi and Salehi,2016).

Fama and French (1992) provided evidence of experimental failures of the capital asset pricing model. Using cross-sectional regression, they confirmed that firm size, profit to price ratio, book value to market value, and market beta are crucial in describing expected returns. They also emphasised a significant relationship between the mean return and beta of stocks. Many studies have examined the Fama-French model and its development; we refer to some of them here. For example, Abbasian, Tehrani and PakdinAmiri (2021) examined the adjusting effect of market leverage on the explanatory power of the Fama-French model. They found that, by examining the three-factor model, the effect of market factor and size is significant, and the effect of value factor is not significant. Also, their results based on the test of the adjusted three-factor model and considering the market leverage in its calculation indicate that the effect of market factors, value, and size is significant. In both tests, the effect of the market factor is significant and direct, and the effect of the size factor is significant and indirect. Also, the results of their study indicate that the value of the adjusted coefficient of determination in the adjusted three-factor model is higher than the three-factor model and the addition of market leverage improved the model explanation.

Mirzaei, Khani and Botshekan (2020) expanded asset pricing factor models using the company life cycle. They used the data of companies listed on the Tehran Stock Exchange and OTC between 2004 and 2018 and various test assets in the form of portfolios arranged according to the different characteristics of the companies. The results showed that the expanded models have a better performance in explaining the difference between the stock returns of companies (test assets) compared to the conventional models, and this difference in performance in terms of explanatory power was more evident for test assets formed using the company life cycle than the test assets formed without using the company life cycle. Hou, Xue, and Zhang (HXZ) (2015) proposed a four-factor model known as the q-factor model in 2004. Explanatory variables of this model are beta, firm size, return on equity and investment. In this model, return on equity (ROE) is the difference between the mean return of stocks with high profitability and the mean return of stocks with low profitability. Also, the investment factor (IA) is the difference between the mean return of the stocks with conservative investment and the mean retunes of stocks with bold investment (Hou, Xue, and Zhang 2015). After developing the q-factor model, they added this model's return on equity and investment to their three-factor model and named their new model as Fama-French five-factor model. Therefore, in the Fama-French five-factor model, the explanatory variables are beta, firm size, the ratio of book value to market value, return on equity, and investment.

Fama and French tested their new model and concluded that it could explain changes in stock returns between 69 and 93 percent of cross-sectional changes in expected returns for portfolios of size, B/M, return on equity and investment (Fama-French, 2015). Evaluating the predictive power of the proposed models (alone or by adding a new variable) has always been one of the questions of researchers. Hadian, Hashemi and Samadi (2017) investigated the effect of financial constraint factors on the ability to explain stock returns by the Fama-French three-factor model, Carhart four-factor model, and Fama-French five-factor model. In this study, the effect of financial constraints on the ability to explain stock returns was examined by Fama-French three-factor model, the Carhart four-factor model, and the Fama-French five-factor model. The financial constraint indicator of the company has been estimated using rank-ordered logit regression. The statistical sample consisted of 120 companies listed on the Tehran Stock Exchange from 2008 to 2015. The research results suggest that the stock returns of companies with financial constraints move in line with each other, meaning that financial constraints represent a common and systematic risk dimension. Also, by adding the financial constraint factor to the Fama-French three-factor model and the Carhart four-factor model, the power of these models to explain stock returns increases, but no evidence was found that adding the financial constraint factor to Fama-French five-factor model increases its ability to explain stock returns. Babalooyan and Mozafari (2016), in a study entitled "Comparison of the predictive power of the Fama-French five-factor model with the Carhart four-factor model and HXZ q-factor model in explaining stock returns, showed that, in using the monthly information of companies listed on the

Tehran Stock Exchange from 2010 to 2014, the ability of Fama-French five-factor model to explain stock returns is more than Carhart and HXZ models and showed that, unlike the results of Fama-French in US stock exchanges, the value factor (HML) in the Tehran stock exchange is significant.

The results suggest that among the beta factors, size, value, the tendency to past performance (momentum), return on equity, and investment, momentum and investment in the Tehran Stock Exchange do not affect stock returns. In another study, Ramezani and Kamyabi (2017) examined the explanatory power of stock returns by the six-factor model and compared it with the Fama-French five-factor, Carhart four-factor, and HXZ q-factor models in explaining the expected return on stocks. The results of the research using the monthly data of companies listed on the Tehran Stock Exchange during 2001-2005 showed that the ability to explain stock returns by the Fama-French five-factor is more than the Carhart four-factor, and HXZ q-factor models and increasing the momentum factor did not increase the model's explanatory power. In contrast to the results of Fama-French in US stock exchanges, the value factor (HXZ) is significant in Tehran Stock Exchange and is not known as a redundancy factor. Also, adding two investment and return on equity factors to the model significantly increases its explanatory power.

Dirkx and Peter (2020) concluded that the 6-factor model compared to the 3-factor model does not provide any justifiable superiority. Considering the importance of predicting stock returns, efforts continue to provide models with a higher ability to explain changes in stock returns. With the increasing attention to capital markets in recent years, investigating the factors affecting stock returns has become one of the most important and controversial topics in financial management. Gharibnia et al. (2018) examined firm size as one of the factors affecting stock returns. In this study, among the companies listed on the Tehran Stock Exchange, 70 companies were selected from 2008 to 2015. In previous studies in which the Fama-French multifactor model has been used, the relationship between firm size and stock returns was examined as a simple linear relationship. In contrast, this relationship may not be linear. In this study, by adding the square of the firm size factor to the Fama-French models, the hypothesis of a non-linear relationship between firm size and stock returns was tested. The model estimation results showed that the coefficients of firm size and squared firm size variables are positive and negative, respectively, and statistically significant. The non-linear relationship between the firm size and stock returns in the Tehran Stock Exchange is confirmed. Hajiannejad, Izadinia and Ebrahimi (2014) showed that multifactor models are more appropriate than the one-factor capital asset pricing model. The study results also showed that the Carhart four-factor model does not have a comparative advantage over the Fama-French three-factor model. Among the variables of premium risk, market, size, and momentum, only two variables (premium risk and size) affected stock returns. Also, due to the recent financial crisis and the effect of financial falls on investors' wealth, many studies have proposed new variables that can predict the probability of market crash or acute events, including the market fragility index. Bauguess (2017) argued that no rule we contemplate today could prevent future market stress events. Still, the timely collection of current market information and practices will enable both regulators and the market participants they monitor to more clearly assess and respond to emerging and ongoing risks in the industry using accurate and reliable data. Various factors can lead to market fragility. Some examples are as follows: Raman et al. (2020) stated that the withdrawal of algorithmic traders has a significant propensity to generate feedback loops that can make markets more "fragile". Specifically, they found that a reduction in algorithmic trading or algorithmic liquidity provision significantly increases the probability of extreme market conditions. The potential for fragility is further exacerbated by the fact that algorithmic traders in a stock withdraw significantly from that stock even in the absence of stressful conditions when another similar-sized stock experiences an extreme event. Thus, withdrawal of algorithmic traders displays significant contagion and correlation across stocks, even when stressful market conditions do not. Moreover, Kozhan et al. (2021) found another source of market fragility. They showed that liquidity providers' portfolio inventory management was also potentially a source of market fragility. In addition, the likelihood and the number of extreme volatility episodes significantly increase with the magnitude of aggregate correlated portfolio inventories and decrease with the dispersion of these correlated portfolio inventories across different VLPs[1]. Choi (2014) believes that easing credit constraints remains the most effective means of achieving financial stability in a small open economy, and comprehensive efforts are essential. so easing credit constraints is essential to maintain market stability. In addition to the market fragility variable, stock price fragility has also been investigated by researchers. Francis et al. (2021) showed a positive relationship between stock price fragility and bank loan cost. They argued that this relationship is manifested more especially when lenders consider more value to institutional shareholders as a regulatory factor in the company or when loans rely on information received through existing relationships with the company. Rajizade et al. (2021) concluded a positive and significant relationship between stock fragility and the speed of stock price convergence. The market fragility index is the market sensitivity to a shock to the market that manifests itself in the market index. Lin and Guo (2019) considered the market fragility a factor of stock price volatility in the face of regional shocks and tensions. They have considered the study of large shareholders' data as a reasonable indicator for identifying the potential for systematic fragility in their listed companies. In addition to the mentioned studies, Koulovatianos, Li and Weber (2018) concluded that market participants had prioritised corporate stocks to invest instead of bonds. However, instead of observing higher bond rates, paradoxically, the stock has been completely negative since the fall of Leman-Brothers. This increase in market fragility can lead to a decline in bonds and the tendency to buy stocks and dividends. Sensoy Ozturk and Hacihasanoglu (2014) proposed a new framework for constructing a financial fragility index by combining the five main variables in developing countries using principal component analysis and dynamic conditional correlation. The study's main result was the creation of financial fragility index at different times for emerging economies such as Turkey. Bernoth and Pick (2011) reported a close relationship between companies operating in the banking and insurance industries and the importance of proposing a new framework.

Sandhu, Georgiou and Tannenbaum (2015) concluded that the fragility or ability of the system to fail in the face of accidental turbulence is negatively related to the geometric concept of Ricci curvature. Berger and Pukthuanthong (2012) showed that the high levels of fragility index presented indicated a significantly higher probability of market crash among many countries. They argue that the risk measure presented by them reflects the periods in itself, and, in case of any shock during these periods, the greatest harm can be expected. In other words, they argue that the mentioned shock effect can be at its highest during periods of high fragility. The key point is that fragility alone does not necessarily lead to a crash. In this framework, the occurrence of the crash can depend on the fragile system and the occurrence of shock (Berger and Pukthuanthong, 2012).

Berger and Pukthuanthong (2016) combined their fragility risk measures with a number of economic variables that identify periods of market stress. These periods can be considered periods of

[1] voluntary liquidity provider

market turmoil in which shocks are most likely to occur. It is argued that the intersection of increasing fragility, reflecting a system's vulnerability to shock, will precede many market failures by increasing market stress, which indicates a potential shock. The results of the new risk measure show that before moving to conservative investment, in which prices are adjusted for risk innovations, the risk measure increases. These results suggest that the intersection of fragility and market stress is strongly correlated with the mean of subsequent weak conditional returns. They showed that neither fragility nor market stress included combined risk measure information. Koulovatianos et al. (2018) explained that it is crucial to avoid misinterpreting seemingly good market trends as market robustness at times of underlying market fragility. Market fragility always implies weaker investment in the real economy. This weakness alters the effects of planned fiscal and monetary policies.

It can be concluded that adding and examining newer variables can change the reliability of the 5-factor Fama French model (Roy, 2021; Roy and Shijin, 2018). Therefore, in this research, market fragility is added to the model as a surplus variable to examine its effects on the original model. In addition, when the market is fragile, stock returns can increase or decrease. Therefore, in addition to comparing the 5-factor and 6-factor models, this study also examines the relationship between market fragility and stock returns. In case of a shock to the market, investors or companies may make irrational decisions that could affect the market and future stock returns. The point is that since the Iranian market has faced severe economic sanctions in recent years, most Iranian firms have had financial problems (Salehi, Tarighi and Rezanezhad, 2019). Regardless of the political factors and sanctions that have affected Iran's economy and its capital market, there are many similarities between Iran's economy and other emerging countries, including inflation rate, unemployment rate, economic growth rate, mono-productivity, and low labour cost and so on. It can be concluded that these factors, in addition to companies, also affect the capital market and sometimes cause market fragility. These factors make it possible to generalise the results of this study to similar countries.

The results of the mentioned studies led the researcher to add a market fragility variable to the Fama-French five-factor model and present a six-factor model and compare it with the Fama-French five-factor model to provide a model that can have more explanatory power so that the shareholders, market participants, and the officials can make better decisions using it and provide more public welfare with economic growth and prosperity.

Based on the theoretical foundations and background of the studies and according to the aim of this study, the hypotheses of this study are presented as follows:

Hypothesis 1: The six-factor model can better explain the stock returns of companies than the five-factor model.

Hypothesis 2: There is a significant relationship between the market fragility rate variable and the stock returns of companies.

## 3. Research Methodology

The present study is applied in terms of aim and is correlational. This study uses a deductive-inductive approach and is one of the regression analyses among all types of correlational research. The data used in the present study are real and historical information, so the present study can be considered a post-doc analysis. The statistical population of the present study included all companies listed on the Tehran Stock Exchange from 2009 to the end of 2018. A systematic elimination method was used to determine the statistical sample. For this purpose, 117 companies were selected to estimate the models and test the research hypotheses. Their data have been reviewed monthly for ten years. In other words, the final sample consisted of 14040 companies-months. Also, to develop the theoretical foundations of research, the library method was used. The information provided on the Central Bank and financial statements submitted to the Stock Exchange Organization and other related information such as Tadbir Pardaz and Rahavard-e Novin databases collected the desired data.

### 3.1. Research model and variables

To test the hypotheses in this study, two multivariate regression equations were developed as follows:

The first model was derived from the Fama-French five-factor model (2015):

$$R_i - R_f = \alpha_0 + \beta_1\left(R_m - R_f\right) + \beta_2 SMB_{it} + \beta_3 HML_{it} + \beta_4 RMW_{it} + \beta_5 CMA_{it} + \varepsilon_{it}$$

The second model, in which fragility was added to examine our hypotheses, was derived from the Berger and Pukthuanthong model (2016; 2012).

$$R_i - R_f = \alpha_0 + \beta_1\left(R_m - R_f\right) + \beta_2 SMB_{it} + \beta_3 HML_{it} + \beta_4 RMW_{it} + \beta_5 CMA_{it} + \\ + \beta_6 fragility_{it} + \varepsilon_{it}$$

To test the first hypothesis, the first and second models were compared. Then, the second model was used to test the second hypothesis.

Where the variables are defined in this way:

Market premium risk factor (Rm-Rf): Surplus of the return expected from the market portfolio relative to the risk-free rate of return

Size factor (SMBit): The difference between the returns of portfolios consisting of large corporate stocks and portfolios consisting of small corporate stocks

Book value to market value ratio (HMLit): The difference between the return on a portfolio consisting of stocks of companies with a high book value to market value ratio and low book value to market value

Return on equity factor (RMWit): The difference between stock portfolio returns with a strong return on equity and stock portfolios of companies with low return on equity.

Investment factor (CMAit): The difference between the stock portfolio returns with high investment and the stock portfolio of companies with low investment. Fama and French believe these companies have conservative and bold strategies.

This variable was derived from the research conducted by Berger and Pukthuanthong (2016).

Fragility: Fragility is the market's sensitivity to a shock the market that manifests itself in the market index.

$\text{Fragility}_{i,t} = \text{FI} \quad \rightarrow$ Fragility Index

To obtain fragility, the regression of monthly surplus return for each industry is calculated relative to the mean market return during the t-1 month and the t-12 to t-1 months.

## 4. Research Findings

### 4.1. Descriptive research statistic:

Descriptive statistics provide an overview of the status of research data distribution. Descriptive statistics related to research variables are presented in Table (1).

**Table 1**. Descriptive statistics of research variables

| Description | Mean | Median | Max | Min | SD | Skewness | Kurtosis | Number of observations |
|---|---|---|---|---|---|---|---|---|
| Investment factor | 0.003 | 0.500 | 0.500 | -0.500 | 0.500 | -0.013 | 1.000 | 14040 |
| Book value to market value factor | -0.238 | -0.500 | 0.500 | -0.500 | 0.439 | 1.083 | 2.174 | 14040 |
| Stock return | 3.337 | -0.150 | 313.403 | -55.490 | 16.281 | 2.997 | 26.083 | 14040 |
| Markey premium risk factor | 1.447 | 1.083 | 66.509 | -31.262 | 3.471 | 6.606 | 155.152 | 14040 |
| Return on equity factor | -0.146 | -0.500 | 0.500 | -0.500 | 0.478 | 0.611 | 1.374 | 14040 |
| Size factor | 0.137 | 0.333 | 0.333 | -0.333 | 0.303 | -0.903 | 1.816 | 14040 |
| Fragility factor | 0.915 | -0.732 | 1.055 | -5.427 | 0.912 | -1.235 | 5.453 | 14040 |

Source: Research findings

Table 1 presents the descriptive statistics on the research variables. It shows the descriptive parameters for each variable separately. These parameters mainly include information about central indices, such as maximum, minimum, mean and median, and dispersion indices, such as standard deviation. The most critical central index is the mean, which indicates the distribution's balance point and center of gravity. It is a good index to show the centrality of the data. For example, the mean of the fragility variable is -0.915, indicating that most of the data on this variable are centred on this point. In general, dispersion parameters are the standard for determining the degree of dispersion of data with each other or their dispersion relative to the mean. One of the most important dispersion parameters is the standard deviation. For example, the value of this parameter for the fragility variable is 0.913. The Descriptive statistics of this research are consistent with Barvels (2015), Martins, and Eid (2015) and inconsistent with Acaravci and Karaomer (2017).

### 4.2. Testing the normality of research variables

In this research, the ordinary least squares method is used to estimate the model parameters. The results of the Jarque-Bera test for the dependent variable are presented in Table 2.

**Table 2.** Jarque-Bera statistics for research dependent variables

| Normality test | RI_RF |
|---|---|
| Jarque-Bera | 7.514909 |
| Significance | 0.000 |
| Number of observations | 14040 |

Source: research findings

Based on Table 2, since the value of the Jarque-Bera statistic is smaller than the significance level of 0.05, the variables are not normal. Hence, the data should be transformed by appropriate statistical methods. In this project, Box-Cox transformation in Minitab software was used. As shown below, the Jarque-Bera test was performed again on the transformed data.

**Table 3.** Jarque-Bera statistic for research dependent variable after normalisation

| Normality test | RI_RF |
|---|---|
| Jarque-Bera | 3.332735 |
| Significance | 0.000 |
| Number of observations | 14040 |

Source: research findings

The dependent variables gained from the mentioned methods were somewhat close to the normal distribution. Due to the non-normality of stock exchange data, the central limit theorem was used in this study due to the large sample size (N> 30) and the high number of observations. Based on the central limit theorem, it can be concluded that when the base volume in the sampling is larger, the variance among the samples will be less. The mean distribution of the sampled populations will be closer to the normal distribution. The normality of the desired distribution increases with an increasing number of replications (n) (Badri and Abdolbaghi, 2011).

### 4.3. Testing the stationarity of variables (unit root)

The Phillips Perron unit root test was used to examine the research variables. If the time series used in the regression are not stationary, we may experience false regression. The Phillips Perron unit root test for the study variables is given below.

**Table 4.** Examining the stationarity of variables

| Variable | Phillips Perron test | | Result |
|---|---|---|---|
| | Statistic | sig | |
| CMA | 530.3540 | 0.000 | Stationary |
| FRAGILITY | 275.515 | 0.000 | Stationary |
| HML | 390.4579 | 0.000 | Stationary |
| RI_RF | 570.7234 | 0.000 | Stationary |
| RM_RF | 933.498 | 0.000 | Stationary |
| RMW | 740.7124 | 0.000 | Stationary |
| SMB | 13.1607 | 0.000 | Stationary |

Source: research findings

The results of Table 4 show that the probability value of all tests is less than 0.05 for all variables, indicating that all research variables are stationary.

### 4.4. Collinearity of variables

In linear econometrics, collinearity occurs when two or more explanatory (independent) variables in a multivariate regression are highly correlated. The correlation coefficient was used to investigate the collinearity among the explanatory variables in this study. The results are shown in Table 5.

The maximum absolute value of the correlation coefficient among the variables is 0.674, and other values are small, indicating no high collinearity between the explanatory variables.

### 4.5. Testing the research hypotheses

**Model recognition test**

The type of estimation method should first be determined to estimate the model related to hypotheses. Therefore, Chow's (F-Limmer) statistic is calculated to determine whether the pooling or panel data methods should be used.

**Table 5.** Value of correlation coefficient

| | RIRF | RMRF | SMB | HML | RMW | CMA | FRAGILITY |
|---|---|---|---|---|---|---|---|
| RIRF | 1.000 | | | | | | |
| RMRF | 0.089 | 1.000 | | | | | |
| SMB | -0.039 | 0.008 | 1.000 | | | | |
| HML | 0.173 | 0.038 | 0.101 | 1.000 | | | |
| RMW | 0.674 | 0.073 | -0.035 | 0.193 | 1.000 | | |
| CMA | 0.010 | 0.005 | -0.047 | 0.332 | 0.096 | 1.000 | |
| FRAGILITY | -0.318 | -0.281 | 0.105 | -0.136 | -0.260 | -0.044 | 1.000 |

Source: research findings

**Table 6**. F-Limmer test results

| Model | F-Limmer statistic | df | p-value | result |
|---|---|---|---|---|
| Firs model | 1.822 | (116.139) | 0.000 | Panel method |
| Second model | 1.669 | (116.139) | 0.000 | Panel method |

Source: research finding

Considering that the p-value in both models is less than the error level of 0.05, the null hypothesis of this test, which states that the pooling method is preferred over the panel method, is rejected, and the panel method is preferred for estimation. The intercept must be considered for the equation.

**Estimation of the model with fixed or random-effects model:**

The panel method should test the fixed-effects model versus the random-effects model. The Hausman test is used for this purpose.

**Table 7**. Hausman test results

| Model | Hausman statistic | df | p-value | result |
|---|---|---|---|---|
| First model | 140.517 | 5 | 0.000 | Fixed effects |
| Second model | 193.642 | 6 | 0.000 | Fixed effects |

Source: research findings

Since the significance value of the Hausman test for both models is less than the error level of 0.05, the null hypothesis based on equation estimation by random effects is rejected. The models should be estimated using fixed effects.

**Model estimate**

**Autocorrelation test**

The autocorrelation test is one of the classical regression assumptions.

**Table 8.** Estimation of the first research model

| Variable | Y= RI_RF Coefficient | Statistic t | p-value |
|---|---|---|---|
| RM_RF | 0.199 | 3.155 | 0.001 |
| SMB | -0.825 | -1.186 | 0.235 |
| HML | 3.723 | 6.952 | 0.000 |
| RMW | 22.75 | 21.735 | 0.000 |
| CMA | -2.703 | -5.468 | 0.000 |
| C | 7.416 | 12.980 | 0.000 |
| Model general fit | $R^2$=0.471<br>Adjusted R-squared= 0.467<br>F= 102.802<br>Prob (F)= 0.000<br>D.W= 1.925 | | |

Durbin-Watson statistic is a test statistic used to examine the existence of autocorrelation between residues in regression analysis. The results of estimating the regression model of both models are reported in Tables 8 and 9. The model estimation results and F significance level are less than 0.05, indicating that the input variables, including control and independent variables, are significant at the 95% confidence level and suitable model fit.

**Results of testing the first research hypothesis**

In the five-factor model (second model), the value of the Adjusted R square is 0.467355, the F-statistic of the test is 102.8027, and its significance value is 0.000, which is less than the error level of 0.05, indicating that the regression model is significant. The value Adjusted R square indicates how much of the dependent variable of stock returns can be explained by independent variables. Independent variables can explain 47% of the dependent variable changes in this case.

**Table 9**. Estimation of the second research model

| variable | Y= RI_RF<br>Coefficient | Statistic t | p-value |
|---|---|---|---|
| RM_RF | 0.037 | 3.666 | 0.000 |
| SMB | 0.142 | 0.199 | 0.841 |
| HML | 3.162 | 6.589 | 0.000 |
| RMW | 21.703 | 22.837 | 0.000 |
| CMA | -2.613 | -5.215 | 0.000 |
| FRAGILITY | -2.639 | -5.283 | 0.000 |
| C | 4.841 | 11.614 | 0.000 |
| Model general fit | $R^2$=0.489<br>Adjusted R-squared= 0.485<br>F= 109.451<br>Prob (F)= 0.000<br>D.W= 1.996 | | |

Source: research findings

In the six-factor model (second model), the value of the Adjusted R square is 0.485187, and the F-statistic of the test is 109.4516. Its significant value is 0.000, less than the error level of 0.05, indicating that the regression model is significant. The Adjusted R square indicates how much of the dependent variable of stock returns can be explained by independent variables. Independent variables can explain 49% of the dependent variable changes in this case. Thus, according to the research findings, the adjusted R square and F-statistic values in the six-factor model are larger and more robust than in the five-factor model. It can be stated that the six-factor model can be better than the five-factor model of stock returns of companies listed in Explain the Iranian stock market, and the first hypothesis is confirmed.

**Results of testing the second research hypothesis**

In the third model, the coefficient of the effect of the independent variable of fragility on the dependent variable of stock return (RI_RF) is -2.639086, and the t-test statistic is -5.283131, whose absolute value is greater than the critical value of t at the error level of 5%. It means that the observed coefficient is significant. The significance value is also 0.0000, smaller than the error level of 0.05 and confirms the above finding. Thus, it can be stated that, with a 95% probability, there is a significant negative relationship between the fragility rate variable and the stock returns of companies listed on the Iranian stock market, and the second hypothesis is confirmed.

## 5. Conclusion

After the financial crisis of 2007 and 2009, many studies proposed measurement criteria that could predict the phenomena of crash or development. In the model presented in the research, stock returns are calculated based on market fragility. The results suggest that fragility has a significant negative relationship with stock returns, indicating that market returns are sensitive to shocks in the stock market. In other words, with increasing market fragility, stock returns decrease, which might be due to psychological issues related to the personality type of investors in Iran. These results are in line with those of studies conducted by Bernoth and Pick (2011), who studied fragility in the banking and insurance industry and Sensoy, Ozturk and Hacihasanoglu (2014), who studied fragility index in the emerging economies of Turkey, Zaremba and Konieczka (2013), Berger and Pukthuanthong (2016), Pukthuanthong and Roll (2009), Lin and Guo (2019), Sandhu, Georgiou, and Tannenbaum (2015) who examined the fragility of the market.

The F-statistic of the models shows that both models are generally significant, but what is essential is the coefficient of determination of each model, which is 47% in the Fama-French five-factor model and 49% in the Fama-French five-factor model six-factor model presented. Hence, the six-factor model has more explanatory power than the Fama-French five-factor model. This result aligns with the outcome of research conducted by Abbasian, Tehrani and PakdinAmiri (2021) and Mirzaei, Khani and Botshekan (2020). Hence, even though there is relative evidence that liquidity risk can affect and explain returns by liquidity, policymakers and economic officials of the country should set rules to inform listed companies on the economic events in the area of releasing additional information. The stock exchange organisation can also play an essential role in the effectiveness and efficiency of information in creating suitable conditions for making optimal economic decisions by actual and potential investors by paving the way for designing and implementing relevant information disclosure.

## References


1. Abbasian, E., Tehrani, R., PakdinAmiri, M. (2021). Market Leverage Effect in Fama Frech Model. *Journal of Financial Management Perspective*, 11(33), pp. 9-31. (In Persian). https://doi.org/10.29252/jfmp.2021.96096
2. Acaravci,S.K and Karaomer,Y. (2017). Fama-French Five-Factor Model: Evidence from Turkey," *International Journal of Economics and Financial Issues, Econjournals*, 7(6), pp. 130-137.
3. Babalooyan, S and mozafari, M. (2016). To compare the explanatory power of the five-factor Fama french model with Carhart and q-factor models: evidence from Tehran stock exchange. *Financial knowledge of security analysis*, 9(30), pp. 17-32. (In Persian).
4. Badri, A. and Abdolbaghi, A. (2011). Fundamental analysis strategy and abnormal return. *Journal of financial accounting research*, 3(3), pp. 19-38. (In Persian).
5. Barvels, D. W. (2015). Using The Fama-French Five-Factor Model To Predict Industry Market Returns, University of North Dakota, United States
6. Bauguess, S. W. (2017). Market Fragility and Interconnectedness in the Asset Management Industry. Austin, Texas, United States
7. Berger, D. and Pukthuanthong, K. (2016). Fragility, stress, and market returns. *Journal of Banking & Finance*, 62(11), pp. 152-163. https://doi.org/10.1016/j.jbankfin.2015.11.003
8. Berger, D., and Pukthuanthong, K. (2012). Market fragility and international market crashes. *Journal of Financial Economics*, 105(3), pp. 565-580. https://doi.org/10.1016/j.jfineco.2012.03.009
9. Bernoth, K. and Pick, A. (2011). Forecasting the fragility of the banking and insurance sectors.

*Journal of Banking & Finance*, 35(4), pp. 807-818. https://doi.org/10.1016/j.jbankfin.2010.10.024

10. Choi, G. (2004). Financial Stability of a Small Open Economy under Credit Constraints. Working Paper, Korea Institute of Finance, South Korea
11. Dirkx, P. and Peter, F. J. (2020). The Fama-French five-factor model plus momentum: Evidence for the German market. *Schmalenbach Business Review*, 72(4), pp. 661-684. https://doi.org/10.1007/s41464-020-00105-y
12. Fama, E. F. and French, K. R. (1992). The cross-section of expected stock returns. *the Journal of Finance*, 47(2), pp. 427-465. https://doi.org/10.1111/j.1540-6261.1992.tb04398.x
13. Fama, E. F. and French, K. R. (2015). A five-factor asset pricing model. *Journal of financial economics*, 116(1), pp. 1-22. https://doi.org/10.1016/j.jfineco.2014.10.010
14. Fan, S. and Yu, L. (2013). Does the Alternative Three-Factor Model Explain Momentum Anomaly Better in G12 countries? *, Journal of Finance & Accountancy*,12(1), pp. 1-1
15. Francis, B., Hasan, I., Shen, Y. V. and Ye, P. (2021). Stock price fragility and the cost of bank loans. *Journal of Empirical Finance*, 63(7), pp. 118-135. https://doi.org/10.1016/j.jempfin.2021.06.001
16. Gharibnia, z., sinaei, h., zaranezhad, m. and beygi, t. (2018). Non-linear test of the effect of firm size on stock return in Tehran stock exchange. *Journal of securities exchange*, 11(41), pp. 153-176. (In Persian).
17. Hadian, r., Hashemi, s. and Samadi, s. (2017). Evaluation of the effect of financial constraints factor on explanatory power of Fama-french three-factor model, Carhart four-factor model and Fama-french five-factor model. Financial accounting, 9(34), pp. 1-34. (In Persian).
18. Hajiannejad, a., izadinia, n. and ebrahimi, m. (2014). A comparison between basic Fama-French three factor model and basic Carhart four factors model in explaining the stock return on the Tehran stock exchange. *Journal of asset management and financing*, 2(3), pp. 17-28. (In Persian).
19. Hou, K., Xue, C. and Zhang, L. (2015). Digesting anomalies: An investment approach. The Review of Financial Studies, 28(3), pp. 650-705. https://doi.org/10.1093/rfs/hhu068
20. Koulovatianos, C., Li, J. and Weber, F. (2018). Market fragility and the paradox of the recent stock-bond dissonance. *Economics Letters*, 162(37), pp. 162-166.
21. Kozhan, R., Raman, V. and Yadav, P. K. (2021). Correlated Portfolio Inventory Risk of Liquidity Providers: Frictions and Market Fragility. working paper, http://dx.doi.org/10.2139/ssrn.3669329
22. Lin, L., and Guo, X. Y. (2019). Identifying fragility for the stock market: Perspective from the portfolio overlaps network. Journal of International Financial Markets, Institutions and Money, 62(8), pp. 132-151. https://doi.org/10.1016/j.intfin.2019.07.001
23. Markowitz, H.M.(1952*)*, Portfolio Selection, *the journal of finance*. 7(1), pp. 77-91. https://doi.org/10.1111/j.1540-6261.1952.tb01525.x
24. Martins, C.C. and Eid, W. (2015). Pricing Assets with Fama and French 5-Factor Model: a Brazilian market novelty. Working paper. South America
25. Mirzaei, M., Khani, A. and Botshekan, M. (2020). Developing Multifactor Asset Pricing Models Using Firm's Life Cycle. *Financial Research Journal*, 21(4), pp. 545-569. . (In Persian). https://doi.org/10.22059/frj.2019.278769.1006850
26. Pukthuanthong, K. and Roll, R. (2009). Global market integration: An alternative measure and its application. *Journal of Financial Economics*, 94(2), pp. 214-232. https://doi.org/10.1016/j.jfineco.2008.12.004
27. Rajizade, S., Noghondari, A. T., and Zeinali, H. (2021). The Effect of Stock Fragility on The Speed of Stock Price Convergence. Journal of Financial Accounting Knowledge, 8(1), 175-196.
28. Raman, V., Robe, M. A. and Yadav, P. K. (2020). Man vs. Machine: Liquidity Provision and

Market Fragility. https://ssrn.com/abstract=3757848

29. Ramezani, J. and Kamyabi, Y. (2017). Comparing the Six-Factor Model with Capital Asset Pricing Models in Explaining the Expected Investor Returns. *Iranian Journal of Economic Research*, 22(70), pp. 207-231. (In Persian). https://doi.org/10.22054/ijer.2017.7970
30. Roy, R. (2021). A six-factor asset pricing model: The Japanese evidence. *Financial Planning Review*, 4(1), pp. 1-18. https://doi.org/10.1002/cfp2.1109
31. Roy, R. and Shijin, S. (2018). A six-factor asset pricing model. *Borsa Istanbul Review*, 18(3), pp. 205-217. https://doi.org/10.1016/j.bir.2018.02.001
32. Salehi, A. and Salehi, B. (2016). A comparison between the Fama and French three-factor and five-factor models to describe the return of the growth and value stock. *Journal of Investment Knowledge*, 5(19), pp. 129-144. (In Persian).
33. Salehi, M., Tarighi, H. and Rezanezhad, M. (2018), Empirical study on the effective factors of social responsibility disclosure of Iranian companies, *Journal of Asian Business and Economic Studies*, 26(1), pp. 34-55. https://doi.org/10.1108/JABES-06-2018-0028
34. Sandhu, R., Georgiou, T. and Tannenbaum, A. (2015), Market Fragility, Systemic Risk, and Ricci Curvature, https://doi.org/10.48550/arXiv.1505.05182
35. Sensoy, A., Ozturk, K. and Hacihasanoglu, E. (2014). Constructing a financial fragility index for emerging countries. *Finance Research Letters*, 11(4), pp. 410-419. https://doi.org/10.1016/j.frl.2014.07.007
36. Sharpe, W. F. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. *The journal of finance*, 19(3), pp. 425-442. https://doi.org/10.1111/j.1540-6261.1964.tb02865.x
37. Zaremba, A. and P. Konieczka., (2013), Momentum, Value, Size and Liquidity Factors in the Polish Market, http://ssrn.com/abstract=2349875> 2014/01/08