International Journal of Finance, Accounting and Economics Studies, 3(1), 2022, 23-34.
Print ISSN: 2251-645X Online ISSN: 2383-2517

Islamic Azad University
Science and Research Branch
Faculty of Management and Economics

International Journal of Finance, Accounting and Economics Studies
Journal homepage: https://ijfaes.srbiau.ac.ir

Provide a Modifier Pattern of Capital Assets Pricing Models Using Distress Risk Model and Momentum Premium

Mehrdad Salehi[1]
Rezvan Hejazi [2*]
Ghodratallah Talebnia[3]

[1] *Assistance professor, Department of Accounting, Nourabad Mamasani Branch, Islamic Azad University, Nourabad Mamasani, Iran, salehifinance@gmail.com*
[2] *Professor, Department of Accounting, Khatam University, Management and Finance, Tehran, Iran, rezvanhejazi33@gmail.com*
[3] *Associate professor, Department of Accounting, Science and Research Branch, Islamic Azad University, Tehran, Iran, qodratallahtalebnia@gmail.com*

Article History
Received Date: 10 August 2020
Revised Date: 30 September 2020
Accepted Date: 19 November 2020
Available Online: 19 April 2022

JEL Classification:

Keyword:
Capital Assets
Distress Risk
Momentum Premium
M410

Abstract
The present study aims to provide a modifier pattern of capital asset pricing models (CAPM) using the distress risk model and momentum premium. For this purpose, the researcher uses a theoretical matrix of the most widely used and most influential variables of the predicted model to analyze the data and measure the final model variables. In this research, applying portfolio research approach and significance test method for regression coefficients, and using a sample of 3520 quarterly Tehran Stocks Exchange (TSE) firms during 2008 - 2017, the hypothesis is examined. The empirical pricing model results show that the formed portfolio's average return is influenced by the momentum factor and expressed by the distress risk. After applying financial distress risk, the expected return rate is descending, and the distress premium is negative. The results also indicate that in the most distressed investment portfolio of momentum premium, the winner stock returns are more than the loser stock returns. The loser stocks' portfolio return is less than the winner stocks' portfolio return in healthy firms. The existence of value premium and momentum premium in security returns is one of the critical concepts to examine empirical capital asset pricing models (CAPM). The tendency of a security to continue movement in a single direction known as momentum. Momentum is the underlying factor in trend analysis of stock prices that originated from investors' behavioral factors. The recent research related to risk-based theories determines predictable patterns of macroeconomic variables and business cycle fluctuations. On the other hand, it is said that predictable patterns reflect the market's inefficiency and incorrect pricing. It is assumed that stocks with a high-value ratio (B/M) have higher returns because they are underestimated.

*.Corresponding Author: rezvanhejazi33@gmail.com

1. Introduction

The value premium and momentum premium in security returns are critical concepts to examine empirical capital asset pricing models (CAPM). The tendency of a security to continue movement in a single direction known as momentum. Momentum is the underlying factor in trend analysis of stock prices that originated from investors' behavioral factors**.** Momentum studies on stock returns show that the momentum or the stocks that have been performing well in the past will have a superior performance in the future (Badri,1999)**.**

Evaluating both factors of risk and security returns is essential to select an optimal portfolio. Over the past few years, various models have been proposed to assess risk and security returns. These evaluations indicate that these models' presented factors cannot express the relationship between the risk and portfolio returns alone.

Recent research on risk-based theories determines predictable patterns of macroeconomic variables and business cycle fluctuations (Vassalou, 2003). On the other hand, it is said that predictable patterns reflect the market's inefficiency and incorrect pricing. It is assumed that stocks with a high-value ratio (B/M) have higher returns because they are underestimated. When fluctuations are improved, strong and weak firms will have higher and lower returns, respectively (La porta et al. 1997).

According to Lewellen (1999), "the story of the reasonable pricing is still deficient, and maybe this deficiency will continue until we properly recognize the underlying risks, resources and their behavior."

The evidence suggests that the value ratio (B/M) effect on return shows a higher risk premium, reflecting the higher value ratio (B/M) of firms because the distress risk is more significant. The concept of distress risk can be found in Chan and Chen's (1991); they have examined the effect of size on marginal firms' stocks portfolio (low market value, inefficient production, high financial leverage, and significant cash flow problems). Meanwhile, Fama and Franch were the first who considered the relationship between distress risk and the effect of the value ratio (B/M). They claimed that the predicted profits of the firms are associated with a risk factor in return. Firms whose weak perspective is due to low stock prices and high-value ratios (B/M) are expected to have high Returns and good performance.

In a weak economy, investors need a higher risk premium in critical firms. Because of critical stocks' weak performance, the investor maintains weak performance stocks when the stock value has a higher average return on the investor's incurred additional systematic risk premium. A high return of stock value reflects the compensation for the incurred risks by the investors.

Ferguson and Shockley (2003) have provided a theoretical framework of beta estimation error generated from a market value proxy. They believed that the created value ratio (B/M) is related to estimated errors in beta and relative financial distress. If the financial distress risk is high and ignored in the assets pricing model, there will be a positive or negative risk premium. A positive risk premium occurs when there is a high reaction toward bankruptcy risk, and if there is a common reaction to the bankruptcy risk, the negative risk premium will happen. If the market shows a common reaction to bankruptcy risk, then distressed firms will get lower Returns. A lower return continues for the next periods, and we will see the emergence of momentum (Agarwal &Taffler,2008).

In this study, the researcher tries to provide a modifier pattern of capital asset pricing models (CAPM) using the distress risk model and momentum premium. The paper's remainder is organized as follows: Theoretical background, literature review, empirical background, research hypothesis, research method, data analysis, conclusion, respectively.

2. Theoretical Background

Capital Asset Pricing Models (CAPM)

The capital asset pricing model was first introduced in the 1960s when William Sharpe, John Linter, Jan Mossin, and Jack Treynor presented a series of papers and developed the CAPM. CAPM aims to answer how we can price one security, taking into consideration the risk and the return that this security poses; this principle was extended by Harry Markowitz (1959). He presented the "mean-

variance model" or model of portfolio choice. This model is used to determine a theoretically appropriate required rate of return of an asset. Thus the price could also be expected if firms can estimate the expected cash flows. Sharpe (1964) and Linter (1965) extended this model, which depends on the tradeoff between risk and Return, and introduced their models with additional two critical assumptions. The first assumption is borrowing and lending at a risk-free rate; that is, all investors can borrow or lend at the same risk-free rate. The second assumption is that all investors have the same information and beliefs about the distribution of returns. The CAPM is relying on several assumptions include: 1) All investors take a position on the efficient frontier, where all investments are maximizing utility 2) Investors can borrow or lend any funds at the risk-free rate of Return (RFR). 3) All investors have homogenous expectations, which means that they estimate the same distributions for future return rates. 4) All investors hold investments for the same one-period of time. 5) Investors can buy or sell portions from their shares of any security or a portfolio they hold. 6) There are no taxes or transaction costs on purchasing or selling assets. 7) There is no inflation or any change in interest rates. 8) Capital markets are in equilibrium, and all investments are fairly priced. Investors can not affect prices (Reilly & Brown, 2003).

Although the CAPM is widely used as it measures the expected rate of return of a security and relates it to expected risk, however, the empirical evidence shows that it is "weak enough to invalidate the way it is used in application"(Fama & French,2004)

Literature Review

Sharpe (1964) and Linter (1965) developed the CAPM to relate the asset excess returns to its beta to measure systematic or non-diversifiable risk. The investor requires the return both for the time value of money and the compensation of systematic risk. The total expected return on an asset is equal to the risk-free rate (rate on the zero beta asset) and the risk premium required to compensate for the risk. The same relation also holds for portfolio returns, i.e., the expected return on a portfolio equal to the risk-free rate plus the market risk premium's beta times. Linter (1966) and Doukas (2004) are the earliest ones who conduct CAPM tests on individual stocks in excess returns. They have found that the intercept has values much larger than the risk-free rate of return, while the coefficient of beta statistically has a lower value. However, it is statistically significant, and the residual risk affects asset returns. Black, Jenson, and Scholes (1972) applied a time series regression model on all the stocks listed on the New York stock exchange from 1931 to 1965 by forming portfolios and revising the linear relation between portfolio returns and their systematic risk. They develop a zero beta form of the portfolio were risk-free rate change in each period. Extending the Black, Jensen, and Scholes (1972) study, Fama and MacBeth (1973) presented a study to examine the relationship between average return and risk for New York Stock Exchange (NYSE) common stocks. The research's theoretical basis was the "two-parameter" portfolio model and market equilibrium models derived from the two-parameter portfolio model. Their findings seem to be a positive tradeoff between return and risk, with risk measured from the portfolio viewpoint. Their results indicated the critical testable implications of the two-parameter model. The results showed that the observed fair game properties of the coefficients and residuals of the risk-return regressions are consistent with an efficient capital market. In this market, securities prices fully reflect available information.

Roll and Ross (1976) proposed the Arbitrage Pricing Theory (APT) as an alternative version of CAPM. The theory assumes that asset returns can be estimated by depending on a random process shown by various risk factors included in the model and are expected to affect the returns generated by all assets. The APT relies on three key propositions: i) a factor model, ii can describe security returns) there are sufficient securities to diversify away firm-specific risk, and iii) Well-functioning security markets do not allow for the persistence of arbitrage opportunities. Reilly and Brown (2003) illustrated that the APT differs from the CAPM in that it is less restrictive in its assumptions. The main difference between the two models, the CAPM and the APT, is that the latter includes more risk factors or multiple dimensions of risk

inherent in the investments. Simultaneously, the CAPM relies on a single market risk factor, the systematic investment risk when estimating individual securities return or portfolio returns.

Fama and French (1992) developed the three-factor model. Because of its simplicity in development, this model has been the subject of many academic debates and empirical applications. Fama and French (1992,1993) found that besides beta, two additional factors - size and book-to-market ratio play an essential role in determining the expected stock returns' cross-section. They described these three factors as risk factors. Fama and French (1992,1993) used the time series regression model by Block, Jensen and Scholes (1972) to examine the combined roles of market beta, firm size(ME), earing to price ratio(E/P), leverage, and book-to-market equity (BE/ME) in the cross-section of average stock returns. Their findings showed that used alone or in combination with other variables, the market beta has little information about average stock returns. The three-factor model emphasizes market beta, firm size (ME), and book-to-market equity (BE/ME) to determine and explain average stock returns. Jagannathan and Wang (1993) presented a study to examined two common assumptions in CAPM, i.e. i) the return to the value-weighted portfolio of all stocks is a reasonable proxy for the return on the market portfolio of all assets in the economy, and ii) betas of assets remain constant over time. They argued that these two auxiliary assumptions are not reasonable and demonstrated that the CAPM's empirical support is reliable when these assumptions are relaxed. Their findings indicated that the CAPM, with these assumptions, can explain only about 1 percent of the cross-sectional variation in average returns of the 100 sizes/beta portfolio constructed using the Fama-French sorting procedure. Doukas and McKnight (2003) conducted an empirical investigation of two non-risk-based models by Barberis et al. (1998) and Hong and Stein (1999) in a sample of 13 European countries during the period 1988 to 2001 to explain momentum in stock returns. The model of Barberis et al. (1998) showed that momentum originates in investors' conservatism bias and that investors do not take into account the weight of new information adequately. Hong and Stein (1999) assumed that the slow diffusion of private information among the new investors leads to momentum because they cannot extract other private information from prices. Their findings indicated that momentum results from systematic errors that investors make when they use the information to form an expectation about future cash flows and their conservatism and underreacting to information with high weight when adjusting their beliefs.

Distress Risk

Financial distress is a term used in general to indicate a condition when promises of a business entity to creditors are broken or honored with difficulty. Since Chan and Chen (1991) and Fama and French (1992) suggested financial distress risk as a potential explanation for the value premium, several academic studies have examined the performance of distress stocks. If the distress risk is high and ignored in the assets pricing model, there will be positive or negative risk premiums in the distress stocks. Positive risk premium occurs when there is an overreaction toward failure risk, and if there is an under reaction to the failure risk, the negative risk premium will happen. If the market shows under reaction with the failure risk, then distress firms will get a lower return. A lower return continues for the next periods, and we will see the emergence of momentum (Agarwal &Taffler,2008).

Based on the distress risk factor, small-sized firms and firms with high book-to-market equity are relatively distress, and high return on these firms is compensation for their high risk. Based on the less-than-expected reaction hypothesis, investors are less responsive to distress firms, and they apply a negative risk momentum in the assets pricing model. Therefore, due to investors' ignorance, the information will slowly impact the prices in the next period and, consequently, the return of these firms will be lower than that of healthy firms (Chan & Chen,1991).

Considering the distress risk factor, it is expected that: (1) controlling the size factor (the ratio of book value to market value), financially distress firms will have higher returns than healthy firms; and 2) controlling the distress risk, the return of the small-sized firms (high book-to-market equity) is not

higher than the return of big-sized firms (low book-to-market equity). Considering the less-than-expected reaction hypothesis, it is also expected that: (1) the return on financially distressed firms is lower than the return on the stocks of healthy firms; and (2) the momentum exists only in financially distressed firms.

Momentum Premium

A momentum phenomenon is a form of the prior return effects, with the other well known as the contrarian phenomenon. Simply put, the superior performance of stocks/portfolios during the prior periods can be expected to prolong during the subsequent periods; the stocks/portfolios with weak performance in the previous periods are inclined to extend their loss in the subsequent periods. The momentum premium has been well documented since 1993 when Jegadeesh and Titman1 showed that an equity strategy of simultaneously buying past winners and selling past losers could generate abnormal returns over holding periods from three to 12 months. Momentum's strategy includes investments in the market direction and states that the past investments' positive or negative returns will continue in the future. In this strategy, other returns can be achieved by purchasing past winning stocks and selling past losing stocks (Fama & French, 2012).

Although the reverse strategy has been highly regarded in university literature, especially in the 1990s-1980s, recent literature on market efficiency focuses more on a strategy called the Momentum Relative Power Strategy. Jegadeesh and Titman (1993) have proved momentum in creating meaningful economic and statistical abnormal returns. Their studies were the basis for further studies. Since the 1990s, research in this area has significantly increased, and as an investment strategy, momentum has become more common among institutional investors (Jegadeesh & Titman, 1993).

In the literature, the effect of momentum is defined as the sequential covariance of successive sample return of stocks. Typically, the momentum effect is defined as a direct and positive relationship between stock returns over a given period with its deferred return. The earliest evidence of the existence of the effect was reported in Jegadeesh and Titman (1993). The definition of the momentum of individual stocks can be represented as follow:

$$E\{\frac{1}{N}\sum_{i=1}^{N}(r_{i,t-1}-\bar{r}_{t-1})(r_{i,t}-\bar{r}_{t})\}>0 \qquad (1)$$

In the above equation, $r_{i,t}$ is the stocks return "i" at time t, $\bar{r}$ the average return at time t and N is the number of stocks, momentum strategies are examined and determined in the midterm of formation and maintenance of 3 to 12 months. (The same source)

Empirical Background

Jegadeesh and Titman (1993) studied stock trading performance on the NYSE and AMEX over the period 1965 to 1989. Specifically, the first ranked all the listed-stocks based on their past 3, 6, 9, 12-month returns, then put them into 10 portfolios (the portfolio consists of stocks with highest past returns is labelled as "winner" portfolio; the portfolio consists of stocks with lowest past returns is labeled as "loser" portfolio) based on their past-return ranking, and subsequently held these 10 portfolios for 3, 6, 9, 12 months by going long on "winner" portfolios and going short on "loser" portfolios.

Based on the empirical results, Dieche (1998), Griffin, and Lemon (2002), using the Olson model, found that the value ratio (B/M) in the wrong pricing should be considered (1980). They also understood that distressed firms' portfolio includes firms with low B/M ratio and higher stocks return.

Recently, Jegadeesh and Titman (2001) stated that if the momentum premiums are due to a cross-sectional difference in efficiency, then the past winners (the past losers) should continue their higher (lower) returns indefinitely in the future. But they concluded that the return of the momentum portfolios (winners minus losers) after the formation of the portfolio was only positive for the first 12 months, and if nothing happens, the returns would be negative after twelve months.

Agarwal & Toffler (2008) proposed a result that was contrary to the financial distress operating hypothesis. They showed that in a relatively long period, from 1979 to 2002, the

investors' reaction to distress created momentum in these firms. The effects of size and value ratios (B/M) on a distressed firm's return have not had a significant impact.

In the four regions (North America, Europe, Japan, and Asia) Fama and French (2012) examined, there are value premiums in average stock returns that, except for Japan, decrease with size. Except for Japan, there is return momentum everywhere, and spreads in average momentum returns also decrease from smaller to more significant stocks. They investigated whether empirical asset pricing models capture the value and momentum patterns in international average returns and whether asset pricing seems to be integrated across the four regions.

Fama and French (2014) acknowledged that the four-factor model of Carhart can be used as the basis and put other variables in the model's waste. Still, the problem is that all factors' effect is considered unpredictable other factors must be used among the research variables. As a result, they added the fifth factor as a profitability factor to Carhart's four-factor model. Their research results showed a significant relationship between profitability and stocks return.

James (2016), in a study entitle″ A New Perspective on the Size, Value, and Impact of Momentum in Europe ″form 2011to 2015, showed that although the value and momentum premium of admitted firms in the European stocks exchange are influential factors in capital assets pricing, but the effect of the size of firms is more contributing to the explanation of the capital assets pricing model.

Research Hypothesizes

The first hypothesis: the distress risk and momentum premium affect the asset pricing.

The second hypothesis: the experimental pricing model explains the average returns of a formed portfolio based on the momentum factor.

The third hypothesis: the applied distress risk in the experimental pricing model explains the average return of a formed portfolio.

The fourth hypothesis: the momentum premium in the empirical pricing model explains the average returns of a formed portfolio.

The fifth hypothesis: the applied distress risk in the empirical pricing model explains the average return of a formed portfolio based on momentum.

3. Research Method

In this study, the researcher uses a theoretical matrix of the most widely used and most influential variables of the predicted model to analyze the data and measure the final model variables. Therefore, applying the portfolio research approach and significance test method for regression coefficients and using a sample of 3520 quarterly Tehran Stocks Exchange (TSE) firms during 2008 -2017, the research hypothesizes are examined.

We first examined the research variables to achieve a modifier model of the capital asset pricing model using a momentum premium. The predicted general model to examine the research hypothesizes is presented as follow:

$$R_{i(t)} - R_{f(t)} = \beta_0 + \beta_1 [R_{m(t)} - R_{f(t)}] + \beta_2 SMB_{(t)} + \beta_3 HML_{(t)} + \beta_4 ZML_{(t)} + \beta_5 WML_{(t)} + \varepsilon \quad (2)$$

In this equation, $R_i(t)$ is the return on equity "i" at *t*.

$R_f(t)$:is the risk-free rate

Rm(t): Market index return at *t*. denotes the average monthly return of the market portfolio

SMB(t) is the difference between the returns on diversified portfolios of small and big stocks, *HML(t)* is The difference between the returns on diversified portfolios of high and low B/M stocks.

WML(t): Portfolio returns consist of winner stocks minus portfolio returns consist of loser stocks (prior period).

ZML(t): Distress Risk.

$e_i(t)$*:* Template Disturbance section

Dependent variable

In this research, portfolios' quarterly returns for capital asset pricing are considered a dependent variable.

Independent variables

Market Risk Premium: market risk premium is the beta factor presented by CAPM and obtains by the difference in market return and risk-free return. The market return is obtained by:

$$RMt = \left(\frac{Index\boldsymbol{t} - Index{-}1}{Index{-}1}\right) \quad (3)$$

In this equation, *RMt* is market return, *Index* is the end of the month stocks index, and *Index t-1* is the beginning of the month. Also, the interest rate on bonds represents a risk-free return. This rate is based on reports from the Central Bank of the Islamic Republic of Iran that have been published on the bank's economic indexes.

Size: The difference between the average returns of small and large investment portfolios is called size factor. This factor is represented by the SMB and obtained as follow:

$$SMB = \left(\frac{\left(\frac{S}{L}+\frac{S}{M}+\frac{S}{H}\right)}{3}\right) - \left(\frac{\left(\frac{B}{L}+\frac{B}{M}+\frac{B}{H}\right)}{3}\right) \quad (4)$$

$\frac{S}{L}$: is small-sized firms with a ratio of low book-to-market value.

$\frac{S}{M}$: is small-sized firms with a ratio of fair book-to-market value.

$\frac{S}{H}$: is small-sized firms with a ratio of high book-to-market value.

$\frac{B}{L}$: is big-sized firms with a ratio of low book-to-market value.

$\frac{B}{M}$: is big-sized firms with a ratio of fair book-to-market value.

$\frac{B}{H}$: is small-sized firms with a ratio of high book-to-market value.

In this research, the firm's stock market value is used as the firm's size and is derived from the logarithm of the multiplication of the stock market price on the last day of forming a portfolio in the number of issued stocks.

$$\boldsymbol{Market.value_t = n \times p}$$
$$Size_t = log(Market.value_t)$$

n: number of stock issued
p: stock's price on the last day of portfolio formation

Value: The difference between the average return on investment portfolios with the ratio of book value to high market value and book value and the low market value, called value and shows by the HML. It (value) is calculated as follow:

$$HML = \left(\frac{\left(\frac{S}{H}+\frac{B}{H}\right)}{2}\right) - \left(\frac{\left(\frac{S}{L}+\frac{B}{L}\right)}{2}\right) \quad (5)$$

$\frac{S}{L}$: is small-sized firms with a ratio of low book-to-market value.

$\frac{S}{H}$: is small-sized firms with a ratio of high book-to-market value.

$\frac{B}{L}$: is small-sized firms with a ratio of low book-to-market value.

$\frac{B}{H}$: is small-sized firms with a ratio of high book-to-market value.

It should be noted that to calculate the ratio of book-to-market value, the book value of common stocks is calculated using the latest firms balance sheet information. By multiplying the common stocks market price of the last day of the formation of a portfolio in the number of stocks issued, stocks market value will be earned.

$$\frac{\text{BV}}{\text{MV}} = \frac{book\ value}{market\ value} \quad (6)$$

Momentum premium: is the additional returns from past to future performance of stocks ratio to market. In other words, it includes purchasing stocks with superior performance in the past short period and selling stocks with weak performance. To calculate the momentum premium, the sample stocks are ranked according to the quarterly return of the formation period in ascending order and kept for the next three months. Then, the sample stocks are divided into three classes based on the formation period's return and the 30-40-30 strategy. The first class (P1) consists of 30% of the sample stocks with the worst performance of the 'loser stocks'; the second class (P2) consists of 40% of the sample stocks and has a moderate performance, and the third class (P3) consists of 30% of the stocks and has the best performance "Winner stocks" and momentum premium is a positive difference between the average return of the first and third class (P3-P1) during the maintenance period that is shown with WML.

$$WML = \left(\frac{\frac{S}{W}+\frac{B}{W}}{2}\right) - \left(\frac{\frac{S}{L}+\frac{B}{L}}{2}\right) \quad (7)$$

$\frac{S}{W}$ *:* is small-sized firms with a high momentum value.

$\frac{B}{W}$ is big-sized firms with a high momentum value.

$\frac{S}{L}$ *:* is small-sized firms with a low momentum value.

$\frac{B}{L}$ *:* is big-sized firms with a low momentum value.

To calculate momentum, the average stocks return of firms has been considered in the past three to nine months. The results indicate that if the momentum value is more than middle momentum, the firm has a high momentum and vice versa.

Distress risk: In this study, the Z-Score model has been used as an index to measure firms' financial distress. As Altman (1968) and Agarwal & Toffler (2008) stated, Z-Score is a weighted average of several financial ratios that derived from its primary financial statements. To use this model, the model's variables and coefficients are modified in the environmental conditions of Iran. For this purpose, the calculated Z-Scoe by Soleimani Amiri (2003) is used to estimate distress indicators, which is as follow:

$$Z\text{-Scoe} = -1.24 - 0.014_{X1} + 0.003_{X2} + 0.019_{X3} + 0.012_{X4} + 0.006_{X5} \quad (15)$$

$_{X1}$: Ratio of working capital to total assets.

$_{X2}$: Current asset ratio to current liability.

$_{X3}$: Ratio of Profit before interest and tax to total assets.

$_{X4}$: Ratio of Equity to Total Assets.

$_{X5}$: The ratio of sale to total assets.

Results of the estimation of the final model parameters

In this study, we designed a theoretical matrix table for the variables with the most use and efficiency in the model. Also, two new variables of the distress Risk and momentum premium were added to the original model variables to modify the model. Creating a portfolio to maximize return, minimize risk, and maximize entropy will be optimal to form an investment portfolio. By presenting this new model of measurement, we will try to create an optimal portfolio. The variance-covariance matrix in the mentioned models is estimated using E-views. After estimating the variance-covariance matrix, it is time to create an optimal portfolio and obtain optimal weights for it. Therefore, weight allocation for each index is presented separately from the models used.

c: Fixed coefficient matrix
A: Matrix of coefficients by entering a new variable (Distress Risk)
B: Matrix of coefficients by entering a new variable (Momentum Premium)
The results of estimating the final model's parameters with the modifier role of the variables (Distress Risk and Momentum Premium) are presented to modify the model.

As it is clear, in this model, the maximum and the minimum weight in the investment portfolio are B4 and B5, respectively. In the following table (2), the average optimal weights of each of the investment portfolio variables are observed for the considered models.

In general, it can be stated that the size of coefficients variance plays a significant role in their contribution to the investment portfolio. The coefficients that have more variance, in other words, are more fluctuate and have a smaller share of the portfolios. Considering the coefficient obtained from the momentum premium, it can be noted that adding the momentum factor increases the explanatory power of the new model of capital asset pricing. As already mentioned, the market risk premium is not always positive; therefore, in assessing the relationship between risk and return; the positive and negative risk premium conditions should be considered an influential variable on actual returns.

subsequently, taking into account that risk premium is positive or negative, the conditional model of capital asset pricing (CAPM) is presented about the actual return. The results of the rate of expected average return review, before and after the interference of the distress risk are as follow (tables section):

Considering that the calculated *t* statistic with the value of 2.874 is larger than the critical statistics, in other words, the calculated

level of significance is less than five hundredths, therefore, the hypothesis is rejected at 95% confidence level, and the opposite hypothesis is accepted as a verified hypothesis. Therefore, there is a significant difference between the expected return rate before and after the interference of distress risk. Since the average is higher after the interference of distress risk, it is concluded that the rate of expected return is higher than the period before the distress risk, too. In the assessment of capital assets pricing models, the expected returns rate before and after distress risk is compared in parallel.

Considering the significant level and coefficient sign of Z, we observe that after the distress risk interference, the expected return rate is negative, that is, the rate of expected return after the distress risk was descending. In other words, the rate of risk-free return is higher than the rate market returns and the adverse risk premium market is descending.

In view of Z's significant level and sign, we observe that before the distress risk interference, the rate of expected returns is positive, that is, the rate of expected return after the distress risk was increasing. In other words, the rate of risk-free return is higher than the rate market returns and the negative risk premium market is ascending.

The results of the research test (controlling the momentum index)

We examine the quarterly return of portfolios for the pricing of capital assets with the ratio of market value and book-to-market value and the distress risk through the momentum index.

As shown in table 5, in the most distressed investment portfolio of momentum premium (the positive difference between average return), the winner portfolio returns are more than the loser portfolio returns. In healthy firms, the loser stocks' portfolio return is less than the winner stocks' portfolio return. Therefore, the behavior pattern of the momentum premium in the Tehran Stocks Exchange is by the developed stocks exchanges.

As can be seen, the average percentage of market value in the portfolio of distressed firms is lower than that of healthy firms. Also, the average percentage of book-to-market value in the portfolio of distress risk firms is lower than that of healthy firms. The average return of portfolios consist of stocks of distressed firms is lower than that of healthy firms.

In the portfolio consist of the winner stocks, this behavior is the same. In this case, the empirical model of pricing, the average returns of a formed portfolio, is influenced by the momentum factor. The applied distress risk in the empirical pricing model also explains the average return of formed portfolios based on momentum.

5. Conclusions

In an optimal selection of investment, the investor requires examining the tools, methods, and models. This study introduces the models of predicted stock return and their criticisms. We examine and present a modifier pattern of capital assets pricing models (CAPM) using the distress risk model and momentum premium for the first time. The empirical pricing model results show that the average return of the formed portfolio is influenced by the momentum factor and expressed by the distress risk. After applying financial distress risk, the expected return rate is descending, and the distress premium is negative. The results also show that in the most distressed investment portfolio of momentum premium, the winner stock returns are more than the loser stock returns. In healthy firms, the loser stocks' portfolio return is less than the portfolio return of the winner stocks. The evidence shows that despite the factor of market risk premium, the size and ratio of book-to-market value, other factors such as distress risk and premium momentum play an essential role in explaining firms' stock returns in Tehran Stocks Exchange. The applied distress risk in the empirical pricing model also explains the average return of a formed portfolio based on momentum.

References

Agarwal, Vineet & Richard, Taffler. (2008). "Does Financial Distress Risk Drive the Momentum Anomaly?", *Financial Management*, 461-484.

Altman E.I. September. (1968). Financial ratios, discriminant analysis and the

prediction of corporate bankruptcy. Journal of Finance, Vol. 23, nr. 4, p. 589-609.

Badri, Ahmed. (1999). Behavioral financial knowledge and asset management. First Edition. Tehran: Kayhan.

Barberis, N., Shleifer, A. and Vishny, R. (1998). 'A model of investor sentiment', Journal of Financial Economics, Vol. 49, pp. 307–43.

Black, F. Jensen,M. Scholes,M. (1972). «The capital asset pricing model: some empirical tests», Studies in the theory of capital markets.

Chan, K. & N. Chen. (1991). Structural and Return Characteristics of Small and Large Firms. Journal of Finance 46, 1467-1484.

Carhart, M. M. (1997). On persistence in mutual fund performance. Journal of Finance, 52, 57-82.

Dichev, I.D. (1998). Is the Risk of Bankruptcy a Systematic Risk?. Journal of Finance 53, 1131-1147.

Doukas, J., Kim, C. and Pantzalis, C. (2004). 'Divergent opinions and the performance of value stocks', Financial Analysts Journal, Vol. 60, pp. 55–64.

Douklas J., & McKnight P. (2003), "European momentum strategies, information diffusion, and investor conservatism" *European Financial Management*, vol 11, no 3, p.p 313–338.

Fama, E. F., & French, K. R. (1992). The Cross-section of expected stock returns. *Journal of Finance*, 47(2), 427–465.

Fama, E. and K. French. (1993), Size and Book-to-market factors in earnings and returns, *Journal of Finance* 50, 131-155.

Fama, E. F., & French, K. R. (2004). The Capital Asset Pricing Model: theory and evidence. *Journal of Economic Perspectives*, *18*(3), 25–46. http://dx.doi.org/10.1257/089533004216243 0.

Fama, E. and K. French. (2012). Size, value, and momentum in international stocks returns. *Journal of Financial Economics*, 105, 457-472.

Fama, E. and K. French. (2014). Size, value, and momentum in international stocks returns. *Journal of Financial Economics*, 105(3), 457-472.

Fama, E.F. &J.D. MacBeth. (1973). Risk, Return and Equilibrium: Empirical Tests. Journal of Political Economy 81: 607-636

Ferguson, M.F. and R.L. Shockley. (2003), Equilibrium 'Anomalies', *Journal of Finance* 58, 2549-2580.

Foye, james. (2016). A new perspective on the size, value, and momentum effects: Broad sample evidence from Europe. *Review of Accounting and Finance*, No. 2, pp. 18-32.

Griffin, J. M. and Michael L. Lemmon. (2002). Book-to-market equity, distress risk, and stockss returns, Journal of Finance 57, 2317-2336.

Hong, H. and Stein, J. (1999). 'A unified theory of underreaction, momentum trading and overreaction in asset markets', Journal of Finance, Vol. 54, pp. 2143–84.

Jegadeesh, N., & Titman, S. (1993). Returns to buying winners and selling losers: Implications for stockss market efficiency. Journal of Finance, 48, 65-91.

Jegadeesh, N. & S. Titman. (2001). "Profitability of Momentum Strategies: An Evaluation of Alternative Explanations", Journal of Finance, 56, 2, 699–720.

Jagannathan,R., & Wang,Z. (1993). The CAPM is Alive and well, Northwestern university and university of minesota.

La Porta, R., Lakonishok, J., Shleife, A., & Vishny.R (1997). Good news for value stocksss: Further evidence on market efficiency, Journal of Finance 52, 859-874.

Lewellen, J. (1999). The time-series relations among expected return, risk and book-to-market, Journal of Financial Economics 54, 5-43.

Lintner, J. (1965). The Valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. *The Review of Economics and Statistic*, *47*(1). http://dx.doi.org/10.2307/1924119 Lucas, R. E. (1978). Asset prices in an exchange economy. *Econometrica*, *46*, 1429–1445.

Markowitz, H. (1959). Portfolio Allocation: E_cient Divarication of Investments, John Wiley & Sons, Inc., New York. A Cowles Foundation Monograph

Ohlson, J. A. (1980). Financial ratios and the probabilistic prediction of bankruptcy, Journal of Accounting Research 18, 109-131.

Reilly, F., & Brown, K. (2003). Investment analysis portfolio management (7th ed.). Thomson, South-Western.

Ross, Stephen A. (1976). "The Arbitrage Theory of Capital Asset Pricing"., *Journal of Economic Theory*, 13, 341–360.

Sharp, W.F. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. *Journal of Finance*, 19(3), 425-442.

Soleimani Amiri, G. R.(2003), Efficiency Evaluation of Financial Crisis Forecast Forms for Iranian Companies, *Journal of Accounting Knowledge*, 2, 139-158.

Vassalou, M. (2003). News related to future GDP growth as risk factors in equity returns, *Journal of Financial Economics* 68, 47-73.

HOW TO CITE THIS ARTICLE
Salehi, M., Hejazi, R., Talebnia, Q.A. (2021). Comparison of Stochastic Sampling and Application in Financial Mathematics. International Journal of Finance, Accounting and Economics Studies, 3(1): 22-32.
DOI:
Url: https://ijfaes.srbiau.ac.ir/article_16609.html
Journal homepage: https://ijfaes.srbiau.ac.ir

Apendixes: Tables

Table (1): Matrix of coefficients by entering of new variables (Distress Risk and Momentum Premium)

B1	B2	B3	B4	B5
c: Fixed coefficient matrix				
0.2645	0.0345	0.0165	0.0005	1.1189
A: Matrix of coefficients by entering a new variable (Distress Risk)				
0.1113	0.0010	0.179	0.0015	-0.356
B: Matrix of coefficients by entering a new variable (Momentum Premium)				
0.8126	0.1126	0.8734	0.0736	0.9993

Table (2): Matrix of coefficients by entering of a new variable (Momentum Premium)

Average weights	B1	B2	B3	B4	B5
Average weights of fixed coefficients matrix	0.3145	0.0806	0.1920	0.2432	0.1560
Average weights of coefficients matrix by entering new variable entry (Distress Risk)	0.3337	0.0710	0.1700	0.2526	0.1670
Average weights of the coefficients matrix by entering a new variable (Momentum Premium)	0.0843	0.0138	0.0343	0.1839	0.2549

Table (3): The result of the comparative test of the rate of expected average return before and after the interference of the distress risk

The comparative test of the average amount of information of financial statements.				
Differential error standard deviation	difference in averages	Error level	Statistics t	Research variable
0.00026	0.01043	0.010	2.874	rate of expected return
Rate of expected return in two periods.				
standard error Average	The standard deviation	Average	the period	
0.0310	0.0356	0.030	Before the distress risk interference	rate of expected return
0.0883	0.0178	0.050	After the distress risk	

Table(4):Results of the comparison of the rate of expected return before and after the interference of distress risk

the period	Z value	Asymptotically significant level (two way)
After	-4.246	0.141
Before	3.585	0.012

Table (5): Investment Portfolios based on Z-Altman (%)

Average weights equal to B/M investment portfolios		Average with weight equal to beta of investment portfolios		Average with weight equal to excess Return on investment portfolios (percent)		Firms
Winner	loser	Winner	loser	Winner	Loser	Momentum
0.74	0.33	0.44	0.05	4.46	1.12	Healthy
0.22	0.04	0.26	0.03	0.80	0.66	Distress

Table (6): The average of the formed portfolio

Momentum average percentage WML		Average percentage B/M HML		Average percentage of market value SMB		**Firms** Symbol	
Winner	Loser	Winner	loser	Winner	Loser	Momentum	
0.09	-0.89	0.52	0.79	2.164	1.024	ZML_L	Healthy
0.06	-0.76	0.19	0.32	1.067	1.003	ZML_H	Distress