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Portfolio Optimization and the Momentum- Contrarian Strategy (MCS)- based Performance: Evidence from Tehran Stock Exchange

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Abstract
This study was conducted to determine the stock portfolio with the *best return and low-risk investments* using momentum-contrarian strategies (MCSs). The momentum-Contrarian strategy is one of the well-known models to construct the portfolio which suggests buying the stocks with the best performance (the winner stocks) and selling the stocks with the worst performance (the loser stocks). The optimal values of the portfolio's objective function and the weight of all assets in the portfolio that are not necessarily the same are calculated by defining a nonlinear multivariate optimization model combined with momentum-contrarian strategies (MCSs). The return information of companies listed on the Tehran Stock Exchange from 2014 to 2019 was used to select the best optimal portfolio. The results confirmed the stability in the profitability of the contrarian optimal portfolio with minimum risk compared to other optimal portfolios. Furthermore, through MATLAB software the optimal weight of assets in the optimal portfolio is calculated based on statistical data
Keywords: *Optimal Portfolio Momentum, Optimal Portfolio Contrarian, Mean-Variance Model, Portfolio Optimization*

Introduction

Buying stocks with the highest historical return and selling loser stocks with the lowest historical return is one of the capital market strategies. This rule is known as the momentum investing strategy[2]. The existence of momentum means the continuation of the price trend in different time horizons and contradicts the Efficient Market Hypothesis[3] (EMH) (Levy R A, 1967). Two research approaches try to justify the momentum: The first approach is based on the classical financial model and the second approach is based on the behavioural financial model. Proponents of the first approach believe that the momentum strategy is more effective than other strategies due to the high risk of strategies, while the second group believes that behaviourally biases are the main factor. According to the traditional momentum model, the weight of all the

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[2] Momentum investing is an investment strategy aimed at purchasing securities that have been showing an upward price trend or short-selling securities that.
[3] The efficient-market hypothesis is a hypothesis in financial economics that states that asset prices reflect all available information. A direct implication is that it is impossible to "beat the market" consistently on a risk-adjusted basis since market prices should only react to new information.

stocks in the portfolio is considered the same. While a portfolio with higher returns and lower risk can be achieved by considering different weights. The amount of risk[4] and return on capital assets are two important components in investing decisions. The optimal portfolio is selected by exchanging risk and return. As asset risk increases, higher returns are expected. Portfolio optimization is the selection of the best combination of financial assets in a way that maximizes the return on the investment portfolio and minimizes its risk.

One has often heard the expression that one should not put all eggs into one basket. The logic behind this is that if anything happens with that basket, all eggs might be ruined. The logic behind portfolio optimization is based on the same concept as these famous words of wisdom, if anything goes wrong with the stock where all funds are invested, one becomes ruined. The justification for investing in a portfolio rather than a single risky asset is obvious. However, although one decides against investing in a collection of stocks it does not necessarily guarantee that the risk-to-return relationship will be better, it depends on the combination of stocks included. If their correlation is largely positive, the prices will tend to move in the same direction and risk might not be significantly reduced. Contrary to just choosing an arbitrary portfolio (even a well-diversified one), there is portfolio optimization where the right combination of stocks included will create a better risk-to-return relationship for the investment. It means that by combining different stocks one could either obtain a higher expected return with the same level of risk or reversely, lower the level of risk while having the same expected return. The mean of a portfolio is the sum of expected returns times the weight invested in each stock. Let X_i be the weight invested in share i, for i = 1, 2, ..., n, is $E[R_i]$ be the expected return at share i and R_p be the return on the portfolio, then the expression for the latter is given by $R_p = \sum_{i=1}^{n} X_i R_i$ and the expected return is $E(R_p) = E(\sum_{i=1}^{n} X_i R_i) = \sum_{i=1}^{n} E(X_i) R_i$. Furthermore, the risk of the portfolio is a measure of dispersion around the mean, for which there exists various methods of measurement. In this report, the risk measurement used is variance (the average of squared deviations).

The basic idea of the Modern Portfolio Theory (MPT)[5] proposed by Markowitz is that by investing in assets that are not fully correlated, the risk of those assets neutralizes each other's returns and a return with less risk can be achieved (Bayat & Asadi, 2017). It should be noted that the time horizon[6] between trading rules may be different. Investment strategies use relative power to select stocks for periods of three and twelve months. (The relative strength investment strategy[7] is a strategy where a stock with the highest return in the past is bought and stock with the lowest return in the past is sold). The existence of such evidence was explained by the way the market reacted to the information published in the market by showing two phenomena; momentum and contrarian in stock returns.

They react less to short-term horizon information and more action to long-term

[4] Amount at Risk — the protection element of a life insurance policy as calculated by subtracting any cash value from the face amount. It decreases over time as premiums are paid and cash value increases.

[5] The modern portfolio theory (MPT) is a practical method for selecting investments in order to maximize their overall returns within an acceptable level of risk. A key component of the MPT theory is diversification. Most investments are either high risk and high return or low risk and low return.

[6] A time horizon is your investing timeline, or how long you plan to hold an asset before selling it. Time horizon can also be your timeframe for achieving a financial goal, such as retirement.

[7] Relative strength is a strategy used in momentum investing and in identifying value stocks. It focuses on investing in stocks or other investments that have performed well relative to the market as a whole or to a relevant benchmark.

horizon information (Jagadish & Titman, 1993). If there is more reaction in the stock market in the behaviour of investors, the profitable investment strategy when prices return to real market prices is to buy past losers and sell past winners to provide additional returns for the investor. This strategy is called the reverse investment strategy (Shariat Panahi et al., 2014).

A noteworthy point in all models developed based on the Markowitz model is their objective function. These models aim to minimize the amount of investment risk for a certain level of return or to maximize the return for a certain level of risk (Woodside-Oriakhi, 2011).

Literature Review

Researchers have always sought to increase investor satisfaction in portfolio selection. Initially, Markowitz and several other researchers 1952 considered risk and return as two important factors in determining the desirability of investment. Investors using this approach seek to increase the efficiency of their investment by increasing returns and reducing portfolio risk.

This relationship can be written as a mathematical model and solved. But solving this problem alone is not enough. In other words, you can go a little further and take action in choosing the type of stock. Because portfolio optimization ultimately determines the weights of stocks to buy. Thus, we can on what basis are these stocks selected. So far, many factors have been considered for stock selection. For example, some investors choose the stock they want based on their previous stock returns, while others use the liquidity factor in selecting stocks. The history of momentum and contrarian strategies largely goes back to the early studies by Debant and Thaler (1985).

They both showed that one of the common trading strategies in the stock market, namely contrarian (buying past losers and selling past winners), which had the best/worst performance, led to extraordinary profits between 1926 and 1982. Following Debant and Thaler's research, many researchers examined the momentum strategy in different countries and approved the profitability of this strategy with equal weights. These studies include Grinblatt and Titman (1989), Jegadeesh and Titman (1993) for Europe, Chan, Jegadeesh and Lakonishok (1996), Fama and French (1996), Richards (1997) for Asia, Asness (1997) , Rouwenhorst (1998) for Europe, Kun Rad and Cole (1998), Markowitz and Greenblatt (1999), Lee et al. (1999), Hong, Lim and Stein (2000) for the United Kingdom, Choi et al. (2000) for eight countries East Asia, Chan et al. (2000) for Asia; Lee and Swaminathan (2000), Lulen (2002), Swinkeles (2002), Kang et al. (2002), Baird & Whitaker (2003), Griffin et al. (2003) for the US, Europe and Australia, confirm the result and for Asian markets (China and Pakistan) the weakest momentum Predicted Also Hoon and Paulau (2003) for Australia, Han and Tanks (2003) for the United Kingdom, Mengoli (2004) for Italy, Demir et al. (2004) for Australia, Aratz and Lehmann (2005), Doukas and Masnayet (2005), Doges and McKinette (2005) for America and Europe, Nathan (2006), Rasta Racho et al. (2007), Galariotiz et al. (2007), Naranjo and Porto (2007), Mega and Santarmaria (2007) for Latin America, Boys and Saffron (2008), Foster and Kharazi (2008) for Iran, Nathan et al. (2008) for China, Blitz et al. (2011) for the United States, Han (2013) for China, Roning (2016), Don et al. (2016) for Australia, Sapphire et al. (2016) for India, Nnadi and Tanna (2017), Shi and Zhou (2017) for China. Also, studies conducted in this field in Iran that show the profitability of the momentum strategy are Fadaeinejad and Sadeghi (2005), Mehrani and Nonhalfar (2008), Islami et al. (2010), Qalibaf Asl and Kamali (2011), Fallah

Shams and Atai (2013), Ahmadpour and Ghorbani (2013), Hashemi and Mirki (2013), Badri and Fathollah (2014), Sinaei and Ajdarpour (2014), Mousavi Shiri et al. (2015), Makipour and Dastgir (2015), Taghian Dinani and Farid (2015), Bahri Sales et al. (2017), and Safari and Ashna (2018).

Following the contrarian strategy, investors are recommended to buy stocks that have performed poorly in the past and sell successful stocks in the past so that they can take a good look at the future periods when the phenomenon of inhibition of return (IOR) occurs (Dreman & Berry 1995). According to Lowe and McKinley (1990), momentum and contrarian strategies are two reciprocal options of trading strategies. Momentum and reverse gains can be explained by cross-sectional differences in the expected return on securities or by predicting the time series of stock returns. In general, the literature has focused on time series predictability, but recently cross-sectional models have received much attention. Makish et al. (2008), examined the profitability of momentum and contrarian strategies in seven Pacific countries in the short term. They concluded that short-term momentum gains were significant only in Japan and Hong Kong, and in the other five countries, the winner's portfolio showed a pattern of price returns in the short term. Furthermore, there was no significant relationship between trading, momentum, momentum and contrarian returns. Safari and Ashna (2018) presented a new model for stock selection based on a momentum strategy, taking into account the change in price and risk.

According to the results, there is a significant difference between the optimal portfolio return from stock selection by the proposed model and the market portfolio return (the total price index of Tehran Stock Exchange), and the optimal portfolio with higher returns in periods 3, 6, 9 and 12 months compared to the market portfolio. Sinai and Ajdarpour (2014) studied the relationship between current returns, and the size and volume of transactions for future forecasting using monthly returns, size and volume of transactions of 45 companies listed on the Tehran Stock Exchange from, 2008 until 2011.

Taheri et al (2019) studied to evaluate the efficiency of the portfolio, the Treynor's ratio was used and attempted to determine Treynor's ratio of the selected optimal portfolio based on each accounting and financial information, non-financial information and risk-return analysis.

Keshavars et al (2022) studied the weekly data, the exponential moving average, the relative strength index, and the moving average had the highest returns. Besides, the true strength and commodity channels had the lowest returns. They also implicitly examined the issue of efficiency. The results of this study did not confirm the usefulness of momentum and reverse strategies in the short term but proposed evidence of the usefulness of reverse strategy in the medium (3-9 months) and long term (24 months). There was also evidence of abnormal returns of reverse strategy for companies with low trading volume and abnormal returns of momentum strategy for small companies after controlling the effect of the size and volume of transactions.

Researchers have studied the profitability of reverse strategy following the research of M. De Bondt and Richard Thaler (1985). The results confirmed the existence of an adverse (overreaction) effect in the long run in the stock markets of many countries. These studies include Howe's (1987) study for the United States, and Chan's (1988), Ball and Kothari's (1989) which examined the instability of the risk of winning and losing portfolios over a long period leading to the profitability of the reverse strategy.

Zarowin (1990), Lo and MacKinlay (1990), Jegadeesh and Titman (1993),

Conrad and Kaul (1993), Lakonishok, Shleifer and Vishny (1994), Chang, McLeavey and Rhee. (1995), Campbell and Limmack (1997) and Dissanaike (1997)) for England, Oswalo and Fox (1998) for New Zealand, Fung (1999) for Hong Kong, Ryan and Donnelly (2000) for Ireland, Hon and Tonks (2003) for the United States, Mengoli (2004) for Italy, Dimitri and Nicholas (2005) for Britain, Chou, Wei and Chung (2007), as well as Kadoya et al. (2008) for Japan, Maheshwari and Dhankar (2015) and Sapphira et al. (2016) for India, Nnadi and Tanna (2017) for South Africa. , Shi and Zhou (2017) and Chen, Hua and Jiang (2018) for China, Kang, Khaksari and Nam (2018) for the United States, and Kashif (2019) for Pakistan confirming the profitability of the contrarian strategy.

However, studies such as Brailsford (1992) for Australia, Kryzanowski and Zhang (1992) for Canada, Mehdian, Nas and Perry (2008) for Turkey, Foster and Kharazi (2008) for Iran, Chaouachi and Douagi (2014) for Tunisia, Doan, Alexeev and Brooks (2016) for Australia have contradicted the long-term overreaction effect (non-profitability of the reverse strategy). Besides, studies conducted in Iran in this field have confirmed the profitability of the contrarian strategy, Nikbakht & Moradi, 2005; Fadaeinejad & Sadeghi, 2006; Qalibaf & Kamali, 2007; Mehrani & Nonhal Nahr, 2008; Demori, Saeeda & Fallahzadeh, 2009; Saeedi & Bagheri, 2010; Islami Bidgoli, Nabavi Chashmi, Yahya Zadeh Far & Ikani, 2010; Moinuddin & Hamkaran, 2013; Sinai & Ajdarpour, 2014; Makipour & Dasgher, 2016; Bahri Sales, Pak Maram, Afroozian Azar & Qaderi, 2018, Salmani Danglani, & Saeedi & Bahramzadeh & &Pourshahabi, F. (2019).

In contrast, a small number of studies in Iran have highlighted the inefficiency of the contrarian strategy (Qalibaf Asl & Kamali, 2011; Ziaei & Bahrami, 2012; Mahdavi et al., 2013).

Research Methodology

Portfolio optimization[8] was addressed using two models in this study. The first model seeks to obtain the highest value of return expectation assuming that the risk (variance) is less than a fixed value, and the second model is run to obtain the lowest value of risk assuming that the return expectation is higher than a fixed value. Return on the capital portfolio is defined as a variable as follows:

$$R_p = \sum_{j=1}^{n} x_j R_j \qquad (1)$$

Where Rp is the return portfolio and x_j is the corresponding return weights of R_j, and variance is defined as follows:

$$\sigma^2 = \sum_{j=1}^{n}\sum_{k=1}^{n} x_j x_k \sigma_j \sigma_k \qquad (2)$$

For this purpose, the stock returns of the winner and losers were obtained using the return information of companies listed on the Tehran Stock Exchange from 2014 to 2019. The equation for the optimization model of the objective function with maximum efficiency is as follows:

$$\begin{cases} Maximize\ R_p(x;\bar{r}) \\ \sigma^2(x) \le \beta \\ \sum_{i \epsilon I} x_i = 1 \\ x_i \ge 0\ ;\ \forall i \in I \end{cases} \qquad (3)$$

The equation of the optimization model of the objective function with the minimum risk is as follows:

[8] Portfolio optimization is the process of selecting the best portfolio (asset distribution) from a set of all portfolios according to some objective. The objective typically maximizes factors such as expected return, and minimizes costs like financial risk. Factors being considered may range from tangible (such as assets, liabilities, earnings or other fundamentals) to intangible (such as selective divestment).

$$\begin{cases} Minimize\ \sigma^2(x) \\ R(x;\vec{r}) \geq \mu \\ \sum_{i\epsilon I} x_i = 1 \\ x_i \geq 0\ ;\ \forall i \in I \end{cases} \quad (4)$$

Jegadeesh and Titman were one of the first studies to document momentum effects in stock markets.

In the following, we present the investment methodology and commonly found revisions of the model. At the beginning of each month t, the stocks are ranked in ascending order on basis of the last J month's compounded returns. Based on this performance ranking, 10 equally weighted portfolios are formed. The top 10% portfolio is called the "winner" portfolio, and the bottom 10% is the "loser" portfolio. The weights on each security i ∈ (1, N) in the portfolios are given by $\omega_i = \frac{1}{N}$ where N is the number of stocks in each portfolio. In each month t, the investor initiates a long position in the winner portfolio and a short position in the loser portfolio. Each position is held for K months. Thus, after a start-up period, we hold K portfolios in each momentum strategy if we allow for overlapping portfolios. With the passage of time, the value of each portfolio in the momentum strategy change. JT initially addresses this in two ways; 1. Calculating the returns to a series of buy and hold portfolios by averaging the total holding period return of portfolio 2. Calculating returns to a strategy with monthly rebalancing to maintain equal weights on each portfolio and each constituent the results cited in their article are based on the second. The rebalancing entails selling a portion of the portfolios that performed over average and investing the proceeds in those portfolios with worse than average performance. The momentum portfolio can be written as W – L where W is the winner portfolio and L is the loser portfolio. Hence, this describes a zero-cost self-financing portfolio with no regard for trading costs. Denote b r_{it} the return If stock i in month t. With equal we weighting of constituent stocks in each portfolio, the return in each month r_{pt} of each portfolio is given by $r_{pt} = \frac{1}{N}\sum_{i=1}^{N} r_{it}$ with monthly re-balancing of each portfolio to keep equal weights, the monthly return for the zero-cost momentum strategy can be found by

$$r_{tot,m} = \frac{1}{MN}\sum_{m=1}^{M}((\sum_{i=1}^{N} r_{im})W-(\sum_{i=1}^{N} r_{im})L) \quad (5)$$

$$\sum_{j=1}^{N} \omega_i = 0 \quad (6)$$

where: r_{it}= Monthly return to each constituent $r_{tot.m}$= Monthly return to the strategy M = Number of portfolios in holding, N = Number of stocks in each portfolio, W, L = Subscripts of the winner and loser portfolio, respectively Positive returns to the portfolio are per dollar (or NOK) invested.

In this research, we did not set the weights of the winning and losing portfolios the same, unlike the Jagadish and Titman model, based on which the momentum portfolio model was obtained as follows:

$$\sum_{i=1}^{n}(x_i w_i - y_i l_i) \quad (7)$$

Where $X = [x_1, x_2, \dots, x_n]$, $W = \begin{bmatrix} w_1 \\ \vdots \\ w_n \end{bmatrix}$ is the return vector of the winner portfolio (where w_i is the return on the high-yield stocks), $Y = [y_1, y_2, \dots, y_n]$, and $L = \begin{bmatrix} l_1 \\ \vdots \\ l_n \end{bmatrix}$ is the return of the loser portfolio (where l_i is the return of low-yield stocks). Thus, this study seeks to determine that using the momentum portfolio what weights from the winner portfolio and what weights from the loser portfolio will optimize the portfolio. For this purpose, the optimized formula of the objective function

the maximum efficiency (1) was combined with the momentum strategy, and the following equations were obtained:

$$\begin{cases} Maximize\ E(\sum_{i=1}^{n}(x_i w_i - y_i l_i)) \\ \sigma^2(\sum_{i=1}^{n}(x_i w_i - y_i l_i)) \le \beta \\ \sum_{i=1}^{n}(x_i - y_i) = 1 \\ x_i\ , y_i \ge 0 \end{cases} \quad (8)$$

$$\begin{cases} \text{Minimize } \sigma^2(\sum_{i=1}^{n}(x_i w_i - y_i l_i)) \\ E(\sum_{i=1}^{n}(x_i w_i - y_i l_i)) \ge \mu \\ \sum_{i=1}^{n}(x_i - y_i) = 1 \\ x_I\ , y_i \ge 0 \end{cases} \quad (9)$$

In the same way, the reverse portfolio optimization was achieved by defining the inverse portfolio as follows:

$$\sum_{i=1}^{n}(x_i l_i - y_i w_i) \quad (10)$$

The results of optimizing the objective function with the maximum return and minimum risk were obtained using the above equations using the data obtained from the winner and loser portfolio, momentum portfolio, contrarian portfolio, mean portfolio (the average winner and loser portfolio), and then using MATLAB. Besides, the stock weights in the optimal portfolio have been calculated.

This study first obtained the return for the formation period of 6.3 months using Excel after collecting the stock prices in the periods of 3, 6, 9, 12 to 48 months in companies active in the Tehran Stock Exchange. Then, the stocks of the companies are arranged in descending order based on the returns of the previous periods and were divided into 10 categories. The stocks with the highest average return over 6.3 months are called the first floor of the winner's portfolio and the stocks with the lowest average return over 6.3 months are called the last floor of the loser's portfolio.

Momentum and Contrarian portfolio was obtained by subtracting the average yield of selected stocks of the winner/loser portfolio from the average yield of selected stocks of the loser/winner portfolio. After identifying the winner and loser stocks, the optimal weights were obtained using MATLAB. The portfolio's average in calculations also means the average of the winner portfolio and the loser portfolio. The statistical population of this study included all companies listed on the Tehran Stock Exchange. The following limitations were considered in selecting the samples:

1. Companies whose fiscal year ends late each year.
2. Companies that were not considered financial intermediaries (banks, insurance companies, and leasing companies).
3. Companies whose symbol has not stopped for three months and whose shares have been traded in the years under study.
4. The companies that provided the data needed for data analysis in this study.

A total of 160 companies were studied based on the information obtained from the database of the website of the Iranian Financial Information Processing Center affiliated with the Tehran Stock Exchange (www.fipiran.com) and the site of the Tehran Stock Exchange (www.tsetmc.com). These companies were ranked in each period based on the highest returns of the first quarter or six months of the period of formation of 10 classes in descending order. Then, the winner's portfolio was selected from the first-class data with the highest return and the loser's portfolio from the last-class data that had the lowest return.

The four shares with the highest returns were selected from the first-class data and the four shares with the lowest returns were selected from the data from the last category due to the complexity of the calculations, taking into account the ten per cent winner-loser portfolio, and the optimal momentum and contrarian portfolio were obtained from them.

The research procedure

Step 1: Collecting the winner/loser stock data

Step 2: Determining the winner/loser portfolio

Step 3: Momentum and Contrarian portfolio was obtained using the following model and historical data.

The return portfolio yield is considered as follows: where $\boldsymbol{w_i, x_i}$ are weight and return of high-yield stocks, respectively, and $\boldsymbol{l_i, y_i}$ are the weight and return of low-yield stocks, respectively. In this case, the $\boldsymbol{x_i}$ and $\boldsymbol{y_i}$ are positive. The goal is to find the optimal weights of the winner/loser stocks. Here, rewrite the contrarian portfolio assuming $n = 4$ and $\boldsymbol{x_{i+4} = y_i}$. The momentum portfolio returns are obtained by subtracting the winner portfolio from the loser portfolio.

Step 4: Optimizing the momentum and reverse portfolio using MATLAB.

According to the Markowitz model, portfolio optimization of the maximum momentum return and minimum reverse risk were formulated as follows:

$$\begin{cases} Maximize\ E(\sum_{i=1}^{4}(x_i w_i - x_{i+4} l_i)) \\ \sigma^2(\sum_{i=1}^{4}(x_i w_i - x_{i+4} l_i)) \le \beta \\ \sum_{i=1}^{4}(x_i - x_{i+4}) = 1 \\ x_i \ge 0\ , i = 1, \ldots, 4 \end{cases} \quad (1\text{-}1)$$

$$\begin{cases} \text{Minimize } \sigma^2(\sum_{i=1}^{4}(x_i w_i - x_{i+4} l_i)) \\ E(\sum_{i=1}^{4}(x_i w_i - x_{i+4} l_i)) \ge \mu \\ \sum_{i=1}^{4}(x_i - x_{i+4}) = 1 \\ x_i \ge 0\ , i = 1, \ldots, 8 \end{cases} \quad (1\text{-}2)$$

Where, E and σ^2 indicate expectation and variance, and β and μ indicate the level of risk and expected return, respectively.

Step 5: A comparison was made between the momentum and reverse portfolio and their returns with the average portfolio and optimal momentum and contrarian portfolio (the objective function with minimum risk and objective function with maximum return) and the best strategy was selected from them. The return on the winning portfolio W is written as $W = \sum_{i=1}^{n} x_i w_i$. Moreover, the return on the loser portfolio L is written as $L = \sum_{i=1}^{n} y_i l_i$. In this study, the collected data were analyzed to optimize the momentum and contrarian portfolio with both equations 1-1 and 1-2, which are related to the maximum return and minimum risk of the momentum and contrarian portfolios.

Step 6: The data were analyzed using SPSS software.

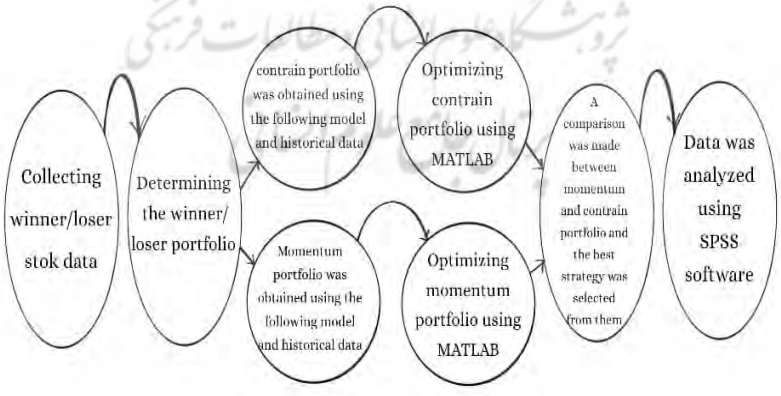

Figure 1. *Markowitz model*

Findings

Table 1 shows the descriptive statistics for the returns on winner/loser portfolios, the difference in returns (the momentum and contrarian portfolio), the portfolio's average, the value of the objective function with the maximum return, and the value of the objective function with the minimum risk for a period of 6 years until March 1998 with a 3-month formation period. In general, the

average yield of the winner's portfolio is relatively small, 0.277, and the dispersion is 0.350, and the average yield of a loser's portfolio is -0.260, which is relatively small and the dispersion is 0.389, which has a relatively small dispersion. Moreover, the momentum portfolio has a mean of 0.537, the contrarian portfolio has a mean of -0.537, and the dispersion is 0.447 which has a small dispersion. The mean values for the portfolio, the objective function with the maximum momentum return, the objective function with the maximum contrarian return and the objective function with the minimum contrarian risk have averages are 0.014, -1.256, -0.376, and 0.008, with relatively small dispersions. In addition, most variables, except the objective function with the maximum momentum efficiency, have positive skewness, but except for the objective function, their kurtosis is positive with the maximum contrarian efficiency, indicating that they are narrower than the normal distribution function.

Table 1.
Descriptive statistics for the stock returns with the 3-month formation and holding period

Maximum	Minimum	Kurtosis	Skewness	Std. Deviation	Mean	portfolio
1.208	-0.247	-0.086	0.719	0.350	0.277	Winning returns
1.299	-0.828	4.889	1.707	0.389	-0.26	Loss returns
1.556	-0.326	-0.506	-0.111	0.447	0.537	Momentum
0.326	-1.556	-0.506	0.111	0.447	-0.537	Contrarain
1.138	-0.416	3.689	1.519	0.295	0.008	mean
0.340	-1.944	0.200	-0.786	0.518	-0.376	Objective function with the maximum momentum efficiency
-0.388	-1.953	-0.082	0.412	0.350	-1.256	Objective function with the maximum contrarian efficiency
0.164	0.0005	22.341	4.328	0.026	0.014	Objective function with the minimum contrarian efficiency

other than (portfolio mean) is less than the error level of 0.05, so in all cases except (portfolio mean), the following claim is rejected: The population mean the test is equal to zero.

The results related to the mean of the population (is it equal to zero or not?), are shown in Table (2), the obtained data show that the absolute value of the -T statistic in all cases except (the mean of the portfolio) is more than 1.96, and the significance level

Table 2.
Average stock return test with the3-month formation and holding period

Test Value = 0						
95% Confidence Interval of the Difference		Mean Difference	Sig. (2-tailed)	Df	T	
Upper	Lower					
0.376	0.178	0.277	0.00	50	5.648	Winning portfolio returns
-0.15	-0.369	-0.260	0.00	50	-4.774	Loss portfolio return
0.663	0.411	0.537	0.00	50	8.571	Momentum portfolio

0.411	-0.663	-0.537	0.00	50	-8.571	Contrarain portfolio
0.091	-0.074	0.008	0.836	50	0.208	Portfolio means
-0.23	-0.522	-0.376	0.00	50	-5.186	Objective function with the maximum momentum efficiency
-1.158	-1.355	-1.256	0.00	50	-25.608	Objective function with the maximum contrarian efficiency
0.022	0.007	0.014	0.00	50	4.026	Objective function with the formula of minimum contrarian efficiency

The data in Table 3 indicate a significant difference between the means of the two communities (p, 0.05) (the objective function with contrarian maximum return, the objective function with contrarian risk minimum formula). Thus, the null hypothesis of equality of variances is rejected. Besides, the absolute t-value is greater than 1.96 (p, 0.05), so the hypothesis of the equality of the means of two population means is rejected, confirming a significant difference between the two populations. Because the t-value is negative, the mean of population 1 (the objective function with the contrarian maximum return) is smaller than that of population 2 (the objective function with the contrarian minimum risk). While the t-value is more than 1.96 for population 1 (mean portfolio) and population 2 (the objective function with the maximum contrarian return) in the case of equality of variances and ($p<0.05$), the null hypothesis of equality of variances is rejected, and the two populations are significantly different because the t-value is positive, so the mean of population 1 (mean portfolio) is greater than that of population 2 (the objective function with the maximum contrarian return).

In the case of population 1 (mean population) and population 2 (the objective function with contrarian risk minimum), the absolute t-value is less than 1.96 in the case of inequality of variance ($p>0.05$). Therefore, the null hypothesis of equality of variances is rejected, confirming no significant difference between the two societies. Because the t-value is negative, the mean of population 1 (the mean of the portfolio) is smaller than that of population 2 (the objective function with the least contrarian risk). In the case of population 1 (mean population) and population 2 (objective function with the maximum momentum efficiency), the t-value is more than 1.96 ($p<0.05$), so the hypothesis of equality of variances for two populations is rejected, showing a significant difference between the two populations. Thus, the mean of population 1 (mean population) is greater than that of population 2 (the objective function with the maximum return efficiency).

Table 3.
Equality of variances and means test for return with the 3-month formation and holding period

analysis for the six - month period the mean and variance								
Maintenance period (month)		**Levene's Test for Equality of Variances**		**t-test for Equality of Means**				
		F	**Sig.**	**T**	**Sig.**	**Mean Difference**	**95% Confidence Interval of the Difference**	
							Lower	**Upper**
	population 1: objective function with inverse maximum return formula							
	population 2: objective function with the inverse minimum risk formula							
3	Equal variances assumed	60.653	0	-12.68	0	-0.9586	-1.108	-0.8089
	Equal variances assumed not			-12.68	0	-0.9586	-1.11	-0.8073
6	Equal variances assumed	16.097	0	-9.579	0	-0.9568	-1.157	-0.7569
	Equal variances assumed not			-9.579	0	-0.9568	-1.16	-0.7533
	population 1: Inverse portfolio							
	population 2: objective function with the formula of maximum momentum efficiency							
3	Equal variances assumed	4.134	0.044	8.997	0	0.8586	0.6696	1.0475
	Equal variances assumed not			8.997	0	0.8586	0.6693	1.0477
6	Equal variances assumed	0.001	0.977	7.473	0	1.0355	0.7581	1.3128
	Equal variances assumed not			7.473	0	1.0355	0.7581	1.3128
	population 1: Inverse portfolio							
	population 2: objective function with inverse risk minimum formula							
3	Equal variances assumed	73.693	0	-0.937	0.4	-0.0519	-0.162	0.0578
	Equal variances assumed not			-0.937	0.4	-0.0519	-0.163	0.0589
6	Equal variances assumed	34.817	0	-3.013	0	-0.2937	-0.489	-0.0985
	Equal variances assumed not			-3.013	0	-0.2937	-0.492	-0.0951
	population 1: Inverse portfolio							
	population 2: objective function with inverse maximum return formula							
3	Equal variances assumed	2.531	0.114	9.715	0	0.9067	0.7219	1.0915
	Equal variances assumed not			9.715	0	0.9067	0.7217	1.0917
6	Equal variances assumed	0.349	0.557	4.872	0	0.6631	0.3907	0.9356
	Equal variances assumed not			4.872	0	0.6631	0.3907	0.9356
	population 1: mean population							

analysis for the six - month period the mean and variance								
Maintenance period (month)		**Levene's Test for Equality of Variances**		**t-test for Equality of Means**				
		F	**Sig.**	**T**	**Sig.**	**Mean Difference**	**95% Confidence Interval of the Difference**	
							Lower	**Upper**
population 2: objective function with inverse maximum return formula								
3	Equal variances assumed	5.67	0.019	11.68	0	1.0538	0.8751	1.2326
	Equal variances assumed not			11.68	0	1.0538	0.8748	1.2329
6	Equal variances assumed	0.422	0.518	8.269	0	1.014	0.7686	1.2596
	Equal variances assumed not			8.269	0	1.014	0.7682	1.2599
population 1: mean population								
population 2: objective function with inverse risk minimum formula								
3	Equal variances assumed	55.852	0	1.905	0.1	0.0953	-0.004	0.1943
	Equal variances assumed not			1.905	0.1	0.0953	-0.005	0.1953
6	Equal variances assumed	21.133	0	0.739	0.5	0.0573	-0.098	0.2125
	Equal variances assumed not			0.739	0.5	0.0573	-0.1	0.2149
population 1: mean population								
population 2: objective function with the formula of maximum momentum efficiency								
3	Equal variances assumed	8.004	0.005	10.11	0	0.9341	0.7511	1.1172
	Equal variances assumed not			10.11	0	0.9341	0.7508	1.1175
6	Equal variances assumed	1.698	0.198	7.116	0	0.8921	0.6412	1.143
	Equal variances assumed not			7.116	0	0.8921	0.6407	1.1435

According to the results, the momentum strategy and optimization of the objective function with the minimum contrarian risk had outperformed the others, and the optimization of the objective function with the minimum contrarian risk had the lowest price fluctuation compared to other portfolios and had good performance for risk-averse investors.

The strategies used to select the momentum and reverse portfolios in 2014 are shown in Table 4. The strategies were selected based on winner/loser portfolio returns with a 3-month formation period and a 3-month holding period. Thus, the return of the second quarterly in 2014 was obtained compared to the first 3 months of the formation period. This process was repeated until the fourth quarter of 2017.

Table 4.
Descriptive statistics of the return of the winner/loser portfolio of the year 2014 in the 3-month formation and holding period

	Formation period 3 months								
	Returns compared to the formation period of the first 3 months 2014	Winner portfolio return mean	Loser portfolio return mean	Momentum portfolio	Contrarian portfolio	Mean portfolio	Objective function with the formula of maximum momentum efficiency	Objective function with inverse maximum return formula	Objective function with the inverse minimum risk formula
Maintenance period 3 months	Second quarter 2014	0.3021	-0.4255	0.7276	-0.7276	-0.0617	-0.0481	-1.0332	0.0123
	Third quarter 2014	0.5203	-0.3833	0.9036	-0.9036	0.0685	0.1681	-1.2775	0.0150
	Fourth quarter 2014	0.5070	-0.5031	1.0101	-1.0101	0.0020	0.1151	-1.0845	0.0046
	First quarter 2015	0.4187	-0.5914	1.0101	-1.0101	-0.0864	-0.0471	-1.0797	0.0382
	Second quarter 2015	0.1791	-0.6202	0.7993	-0.7993	-0.2206	-0.3815	-1.0187	0.0005
	Third quarter 2015	-0.0257	-0.6419	0.6162	-0.6162	-0.3338	-0.9312	-0.9895	0.0010
	Fourth quarter 2015	-0.0670	-0.5243	0.4573	-0.4573	-0.2957	-0.8334	-1.0591	0.0011
	First quarter 2016	-0.1010	-0.5008	0.3998	-0.3998	-0.3009	-0.7698	-1.1288	0.0011
	Second quarter 2016	-0.0596	-0.7475	0.6879	-0.6879	-0.4035	-0.8602	-1.2449	0.0010
	Third quarter 2016	0.0128	-0.6705	0.6833	-0.6833	-0.3289	-0.6768	-1.1771	0.0035
	Fourth quarter 2016	0.3016	-0.6683	0.9699	-0.9699	-0.1833	-0.2793	-1.1491	0.0018
	First quarter 2017	0.5074	-0.5104	1.0178	-1.0178	-0.0015	-0.3330	-1.5061	0.0029
	Second quarter 2017	0.4263	-0.6208	1.0471	-1.0471	-0.0972	-0.4528	-1.5392	0.0094
	Third quarter 2017	0.2419	-0.7615	1.0034	-1.0034	-0.2598	-0.5883	-1.5684	0.0095
	Fourth quarter 2017	-0.0052	-0.8281	0.8229	-0.8229	-0.4167	-0.8703	-1.4324	0.0015
	Mean	0.2106	-0.5998	0.8104	-0.8104	-0.1946	-0.4526	-1.2192	0.0069

Momentum

Std. Deviation	0.2344	0.1261	0.2103		0.2103	0.1561	0.3750	0.2003	0.0098
T	0.7090	-2.1900	2.1800		-2.1800	-0.5330	-5.6410	-8.3770	2.2730
Sig. (2-tailed)	0.4880	0.0430	0.0440		0.0440	0.6010	0.0000	0.0000	0.0360

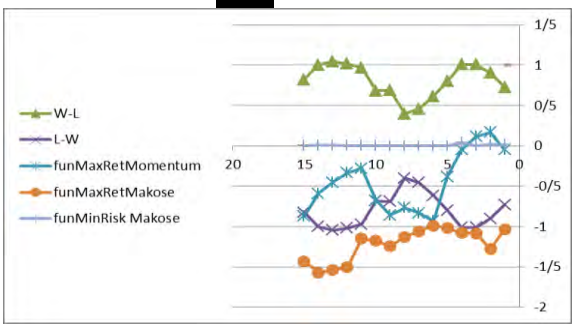

Figure 2. *Comparative diagram of momentum, Contrarian portfolio and their objective function for the return in 2014*

period compared to the formation period of the first 3 months was obtained. The meaning of 93-3-2 in Table 5 is the second quarter with the formation period of the first 3 months of 2014. The rest of the cases are considered in the same way. Stock weight tables for 2015 to 2019 will be provided at the reader's request.

According to the data in Table 5, the weight of the optimal portfolio stock for the winner portfolio stocks with x_1, x_2, x_3, x_4 and the weight of the loser portfolio stock as x_5, x_6, x_7, x_8, where the return period is related to three It is the first month of 2014 and the return of maintenance periods, the return of 3 months after the formation

Table 5.

Objective function weights with maximum momentum return and minimum reverse risk 2014

Portfolio formation and maintenance period 2014	Objective function with the formula of maximum momentum efficiency	Objective function with the inverse minimum risk formula	x1		x2		x3		x4		x5		x6		x7		x8	
			Maximum weight of momentum efficiency	Weight minimum risk reverse	Maximum weight of momentum efficiency	Weight minimum risk reverse	Maximum weight of momentum efficiency	Weight minimum risk reverse	Maximum weight of momentum efficiency	Weight minimum risk reverse	Maximum weight of momentum efficiency	Weight minimum risk reverse	Maximum weight of momentum efficiency	Weight minimum risk reverse	Maximum weight of momentum efficiency	Weight minimum risk reverse	Maximum weight of momentum efficiency	Weight minimum risk reverse
93-3-2	-0.04810	0.01234	0.00000	0.00000	0.00000	0.00000	0.99997	1.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00001	0.00000	0.00001	0.05029
93-3-3	0.16810	0.01500	0.00000	0.00000	0.00000	0.00000	0.00002	0.85542	0.00000	0.00000	0.00000	0.00000	0.00002	0.00000	0.99995	0.00000	0.00000	0.00000
93-3-4	0.11510	0.00460	0.00000	0.00000	0.00000	0.00000	0.00000	0.86169	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	1.00000	0.00000	0.00000	0.00000
93-3-5	-0.04710	0.03822	0.00000	0.00000	0.00000	0.00000	1.00000	0.97316	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
93-3-6	-0.38150	0.00054	0.00000	0.15793	0.00000	0.07572	0.37302	0.79473	0.62698	0.00001	0.00000	0.00518	0.00000	0.00097	0.00000	0.02183	0.00000	0.00040
93-3-7	-0.93120	0.00104	0.00000	0.33714	0.00000	0.01573	0.00000	0.64738	1.00000	0.00019	0.00000	0.00011	0.00000	0.00018	0.00000	0.00006	0.00000	0.00010
93-3-8	-0.83340	0.00112	0.00000	0.10838	0.00000	0.24268	0.00000	0.41515	1.00000	0.23381	0.00000	0.00001	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
93-3-9	-0.76980	0.00106	0.00000	0.36219	0.00000	0.17446	0.00000	0.51999	0.99999	0.06567	0.00000	0.12229	0.00000	0.00001	0.00000	0.00001	0.00000	0.00001
93-3-10	-0.86020	0.00105	0.00000	0.22170	0.00000	0.16015	0.00000	0.48969	1.00000	0.18012	0.00000	0.00028	0.00000	0.00014	0.00000	0.05033	0.00000	0.00091
93-3-11	-0.67680	0.00352	0.00000	0.33223	0.00000	0.19887	0.00000	0.17361	1.00000	0.29540	0.00000	0.00002	0.00000	0.00005	0.00000	0.00002	0.00000	0.00002
93-3-12	-0.27930	0.00182	0.99997	0.57739	0.00000	0.03757	0.00000	0.13322	0.00003	0.25205	0.00000	0.00007	0.00000	0.00005	0.00000	0.00004	0.00000	0.00006
93-3-13	-0.33300	0.00289	1.00000	0.49915	0.00000	0.00000	0.00000	0.00000	0.00000	0.50086	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
93-3-14	-0.45280	0.00941	1.00000	0.66344	0.00000	0.00000	0.00000	0.28962	0.00000	0.04694	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
93-3-15	-0.58830	0.00949	1.00000	0.36244	0.00000	0.00000	0.00000	0.49582	0.00000	0.14175	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
93-3-16	-0.87030	0.00153	1.00000	0.18206	0.00000	0.04715	0.00000	0.75824	0.00000	0.01279	0.00000	0.00006	0.00000	0.00008	0.00000	0.00005	0.00000	0.00005

The selection strategies of the reverse basket in 2015 obtained based on the winner and loser portfolio returns with a 3-month formation period and a 3-month holding period are shown in Table 6. As can be seen, the portfolio optimization with the least risk was more profitable than other portfolios.

Table 6.
Descriptive statistics of the return of the winner/loser portfolio of the year 2015 in the 3-month formation and holding period

Formation period 3 months

Maintenance period 3 months	Returns compared to the formation period of the first 3 months 2015	Winner portfolio return mean	Loser portfolio return mean	Momentum portfolio		Contrarian portfolio		Mean portfolio	Objective function with the formula of maximum momentum efficiency	Objective function with inverse maximum return formula	Objective function with the inverse minimum risk formula
	Second quarter 2015	0.0649	-0.4774	0.54233		-0.5423		-0.2063	-0.0854	-0.87405	0.0374
	Third quarter 2015	0.1032	-0.7271	0.83031	Momentum	-0.8303		-0.312	-0.0031	-1.6136	0.0051
	Fourth quarter2015	-0.0138	-0.5061	0.4923		-0.4923		-0.26	-0.40481	-1.5036	0.0127
	First quarter 2016	-0.0592	-0.017	-0.0422		0.0422		-0.0381	-1.328	-1.0934	0.0033
	Second quarter 2016	-0.1651	0.1144	-0.2795		0.2795		-0.0254	-1.3931	-1.059	0.0019
	Third quarter 2016	-0.16150	0.1645	-0.326		0.3260	Contrarian	0.0015	-1.2936	-1.0013	0.0007
	Fourth quarter2016	-0.073	-0.0482	-0.0248		0.0248		-0.0606	-0.7172	-1.5594	0.0019
	First quarter 2017	0.0679	0.0424	0.0255		-0.0255		0.05515	-0.8454	-1.3155	0.0032
	Second quarter 2017	-0.0082	-0.0147	0.0065	Momentum	-0.0065		-0.0115	-0.6888	-1.3108	0.0046
	Third quarter 2017	-0.2477	-0.1205	-0.1272		0.1272		-0.1841	-0.7333	-1.4479	0.0026
	Fourth quarter 2017	-0.105	-0.368	0.263		-0.2630		-0.2365	-0.7661	-1.7258	0.0024
	First quarter 2018	-0.0956	-0.4755	0.3799		-0.3799		-0.2856	-0.7952	-1.9536	0.0011
	Second quarter 2018	-0.0922	-0.1224	0.0302		-0.0302		-0.1073	-0.72229	-1.8329	0.0073
	Third quarter 2018	-0.0066	-0.0195	0.0129		-0.0129		-0.0131	-0.36038	-1.0269	0.0080
	Fourth quarter 2018	-0.0147	-0.2696	0.2549	Momentum	-0.2549		-0.1422	-0.5065	-1.494	0.0207
	Mean	-0.0538	-0.1896	0.1359		-0.1359		-0.1217	-0.7095	-1.3875	0.0075
	Std. Deviation	0.0959	0.2649	0.3198		0.3198		0.1188	0.4111	0.3263	0.0098
	T	-2.171	-2.773	1.645		-1.645		-3.97	-6.685	-16.468	2.973
	Sig. (2-tailed)	0.048	0.015	0.122		0.122		0.001	0	0	0.01

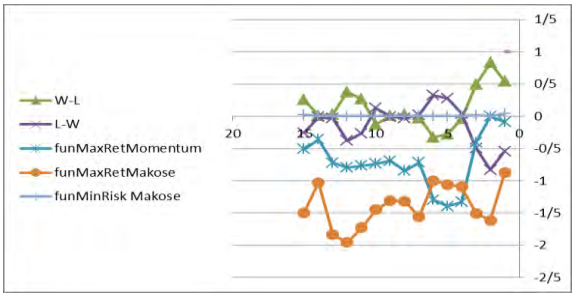

Figure 3. *Comparative diagram of momentum, contrarian portfolio and their objective function for the return in 2015*

Table 7.
Descriptive statistics of the return of the winner/loser portfolio of the year 2016 in the 3-month formation and holding period

		Formation period 3 months							
Maintenance period 3 months	Returns compared to the formation period of the first 3 months 2016	Winner portfolio return mean	Loser portfolio return mean	Momentum portfolio	Contrarian portfolio	Mean portfolio	Objective function with the formula of maximum momentum efficiency	Objective function with inverse maximum return formula	Objective function with the inverse minimum risk formula
Momentum	Second quarter 2016	0.0525	-0.1605	0.21304	-0.213	-0.05402	0.01487	-0.8397	0.011329
	Third quarter 2016	0.3072	-0.0801	0.3873	-0.3873	0.11355	-0.00831	-1.6136	0.001804
	Fourth quarter 2016	0.3028	-0.2813	0.58411	-0.5841	0.01075	-0.01937	-1.5036	0.007632
	First quarter 2017	0.58736	-0.1991	0.78641	-0.7864	0.19416	0.11810	-1.1913	0.014314
	Second quarter 2017	0.52121	-0.216	0.73723	-0.7372	0.1526	0.14040	-1.5577	0.005837
	Third quarter 2017	0.47171	-0.1525	0.62416	-0.6242	0.15963	0.34070	-1.5767	0.016007
	Fourth quarter 2017	0.43112	-0.1512	0.58236	-0.5824	0.13994	0.31780	-1.6743	0.002863
	Mean	0.3820	-0.1772	0.5592	-0.5592	0.1024	0.1292	-1.4224	0.0085
	Std. Deviation	0.1791	0.0630	0.1992	0.1992	0.0900	0.1498	0.3005	0.0055
	T	5.643	-7.443	7.428	-7.428	3.009	2.282	-12.525	4.096
	Sig. (2-tailed)	0.001	0	0	0	0.024	0.063	0	0.006

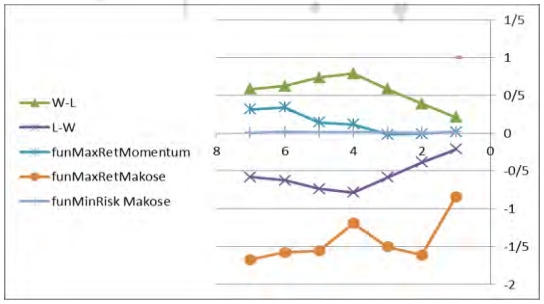

Figure 4. *Comparative diagram of momentum, contrarian portfolio and their objective function for the return in 2016*

Table 8.
Descriptive statistics of the return of the winner/loser portfolio of the year 2017 in the 3-month formation and holding period

Formation period 3 months										
Maintenance period 3 months	Returns compared to the formation period of the first 3 months 2017	Winner portfolio return mean	Loser portfolio return mean	Momentum portfolio	Momentum	Contrarian portfolio	Mean portfolio	Objective function with the formula of maximum momentum efficiency	Objective function with inverse maximum return formula	Objective function with the inverse minimum risk formula
	Second quarter 2017	0.23828	-0.10006	0.33834		-0.33834	0.06911	0.051803	-0.3881	0.011114
	Third quarter 2017	0.25814	-0.24282	0.50096		-0.50096	0.00766	0.014103	-0.4702	0.014345
	Fourth quarter 2017	0.26462	-0.359	0.62362		-0.62362	-0.0472	0.084873	-0.6593	0.020426
	First quarter 2018	0.32828	-0.4786	0.80688		-0.80688	-0.0752	0.13787	-0.6227	0.010527
	Second quarter 2018	0.62353	-0.343	0.96653		-0.96653	0.14027	0.13423	-1.4043	0.02961
	Third quarter 2018	1.2080	-0.1775	1.3855		-1.3855	0.51525	0.092503	-1.8028	0.043612
	Fourth quarter 2018	1.06039	-0.4961	1.55649		-1.55649	0.28215	0.11796	-1.3908	0.013872
	Mean	0.5687	-0.3139	0.8826		-0.8826	0.1274	0.0905	-0.9626	0.0205
	Std. Deviation	0.4102	0.1487	0.4525		0.4525	0.2097	0.0452	0.5574	0.0122
	T	3.669	-5.586	5.16		-5.16	1.608	5.291	-4.569	4.462
	Sig. (2-tailed)	0.01	0.001	0.002		0.002	0.159	0.002	0.004	0.004

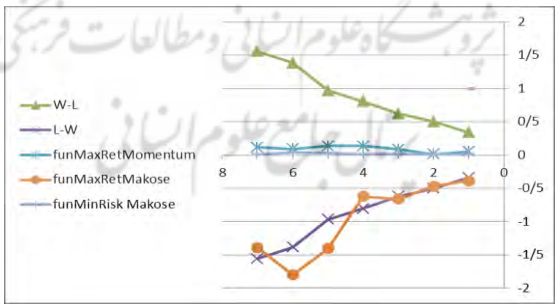

Figure 5. *Comparative diagram of momentum, contrarian portfolio and their objective function for the return in 2017*

Table 9.
Descriptive statistics of the return of the winner/loser portfolio of the year 2018 in the 3-month formation and holding period

Formation period 3 months										
Maintenance period 3 months	Returns compared to the formation period of the first 3 months 2018	Winner portfolio return mean	Loser portfolio return mean	Momentum portfolio	Momentum	Contrarian portfolio	Contrarian	Mean portfolio	Objective function with the formula of maximum momentum efficiency	Objective function with inverse maximum return formula	Objective function with the inverse minimum risk formula
	Second quarter 2018	0.5005	-0.1981	0.69861		-0.6986		0.1512	0.0492	-0.6549	0.006
	Third quarter 2018	0.9054	-0.2267	1.13212		-1.1321		0.33934	0.1083	-1.1481	0.0171
	Fourth quarter 2018	0.8666	-0.3141	1.18071		-1.1807		0.27625	0.2252	-1.3607	0.0025
	First quarter 2019	0.5448	0.1654	0.3794		-0.3794		0.3551	-0.116	-0.9927	0.1645
	Second quarter 2019	0.6432	0.4289	0.2143		-0.2143		0.53605	-0.494	-1.1669	0.0426
	Third quarter 2019	0.70000	0.8554	-0.1554		0.1554		0.7777	-1.137	-1.3425	0.0836
	Fourth quarter 2019	0.9787	1.2992	-0.3205		0.3205		1.13895	-1.944	-1.6262	0.0152
	Mean	0.7342	0.2871	0.4470		-0.4470		0.5107	-0.4727	-1.1846	0.0474
	Std. Deviation	0.1855	0.6114	0.5890		0.5890		0.3426	0.7990	0.3082	0.0588
	T	10.4690	1.2420	2.0080		-2.0080		3.9430	-1.5650	######	2.1310
	Sig. (2-tailed)	0.0000	0.2600	0.0910		0.0910		0.0080	0.1690	0.0000	0.0770

Figure 6. *Comparative diagram of momentum, contrarian portfolio and their objective function for the return in 2018*

Table 10.
General descriptive statistics of stock return with a period of 6 months and maintenance of 3 and 6 months since 93

Maintenance period (month)	Statistics	The term of formation of 6 months							
		Winning portfolio	Loss portfolio	Momentum portfolio	Contrarain portfolio	Portfolio mean	objective function with the formula of maximum momentum efficiency	objective function with inverse maximum return formula	objective function with the inverse minimum risk formula
3	Count	60	60	60	60	60	60	60	60
	Mean	0.1293	0.0935	0.0358	-0.0358	0.1114	-0.8228	-0.9425	0.0161
	median	-0.0009	0.0538	-0.0754	0.0754	0.0216	-0.6156	-0.8339	0.0042
	Std. Deviation	0.4667	0.4111	0.4264	0.4264	0.3847	0.6037	0.5838	0.0466
	Skewness	1.7410	1.2300	0.8010	-0.8010	1.3870	-1.5060	-1.3940	2.3280
	Standard Error of Skewness	0.3090	0.3090	0.3090	0.3090	0.3090	0.3090	0.3090	0.3090
	Kurtosis	3.3080	2.5530	0.0460	0.0460	2.2860	2.3930	2.7860	5.1220
	Standard Error of Kurtosis	0.6080	0.6080	0.6080	0.6080	0.6080	0.6080	0.6080	0.6080
	Minimum	-0.5870	#####	-0.6322	-1.0604	-0.5541	-3.0520	-3.1266	#####
	Maximum	1.8641	1.6167	1.0604	0.6322	1.3918	-0.0337	-0.1813	0.1793
6	Count	30	30	30	30	30	30	30	30
	Mean	0.2274	-0.02	0.2471	-0.2471	0.1038	-0.7883	-0.9103	0.047
	Std. Deviation	0.4893	0.478	0.5203	0.5203	0.4077	0.5525	0.5339	0.12
	Skewness	1.732	0.781	0.537	-0.537	0.972	-0.937	-1.94	3.464
	Standard Error of Skewness	0.427	0.427	0.427	0.427	0.427	0.427	0.427	0.427
	Kurtosis	3.233	0.73	-0.227	-0.227	1.009	0.956	5.965	12.85
	Standard Error of Kurtosis	0.833	0.833	0.833	0.833	0.833	0.833	0.833	0.833
	Minimum	-0.353	-0.825	-0.71	-1.3252	-0.5567	-2.2388	-2.9162	-0.05
	Maximum	1.8318	1.313	1.3252	0.7103	1.2344	0.0158	-0.2793	0.561

Table 10 shows the descriptive statistics for the returns on the winner/loser portfolio, the difference in returns (for the momentum and reverse portfolios), the average portfolio, the value of the objective function with maximum return, and the value of the objective function with minimum risk for 6 years from April 2014 to March 2019 with a 6-month formation period and 3- and 6-month holding period.

Table 11.
The average stock return test with a period of 6 months and maintenance of 3 and 6 months since 93

The term of formation	portfolio	Maintenance period (month)											
		3						6					
		T	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference		T	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
						Lower	Upper					Lower	Upper
6	Winning	2.1450	59	0.0360	0.1293	0.0087	0.2498	2.545	29	0.02	0.2273	0.045	0.4101
	Loss	1.7610	59	0.0830	0.0935	-0.0127	0.1997	-0.227	29	0.82	-0.0198	-0.198	0.1587
	Momentum	0.6500	59	0.5180	0.0358	-0.0744	0.1459	2.602	29	0.01	0.2471	0.053	0.4414
	Contrarain	-0.6500	59	0.5180	-0.0358	-0.1459	0.0744	-2.602	29	0.01	-0.2471	-0.441	-0.0528
	Mean	2.2430	59	0.0290	0.1114	0.0120	0.2107	1.395	29	0.17	0.1038	-0.048	0.256
	the formula of maximum momentum efficiency	-10.5560	59	0.0000	-0.8228	-0.9787	-0.6668	-7.815	29	0	-0.7883	-0.995	-0.582
	the inverse maximum return formula	-12.5060	59	0.0000	-0.9425	-1.0933	-0.7917	-9.339	29	0	-0.9103	-1.11	-0.7109
	the inverse minimum risk formula	2.6780	59	0.0100	0.0161	0.0041	0.0281	2.132	29	0.04	0.0465	0.002	0.0911

less than 1.96 ($p<0.05$). Thus, the assumption of the equality of variances is rejected in all cases except for the average portfolio and objective function with minimum risk.

The data in Table 11 show whether the mean of the population is equal to zero or not. As can be seen, the t-value for the holding period of 3 months in all cases except (mean portfolio and objective function with minimum formula Risk) is

Table 12.
Comparison of means test and analysis of variance for the 6-month formation period

the mean and variance analysis for the six - month period								
Maintenance period (month)		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	T	Sig.	Mean Difference	95% Confidence Interval of the Difference	
							Lower	Upper
	population 1: objective function with inverse maximum return formula							
	population 2: objective function with the inverse minimum risk formula							
3	Equal variances assumed	60.65	0	-12.7	0	-0.96	-1.1083	-0.8089

	Equal variances not assumed			-12.7	0	-0.96	-1.1098	-0.8073
6	Equal variances assumed	16.1	0	-9.58	0	-0.96	-1.1567	-0.7569
	Equal variances not assumed			-9.58	0	-0.96	-1.1602	-0.7533
	population 1: Inverse portfolio							
	population 2: objective function with the formula of maximum momentum efficiency							
3	Equal variances assumed	4.134	0.044	8.997	0	0.859	0.6696	1.0475
	Equal variances not assumed			8.997	0	0.859	0.6693	1.0477
6	Equal variances assumed	0.001	0.977	7.473	0	1.036	0.7581	1.3128
	Equal variances not assumed			7.473	0	1.036	0.7581	1.3128
	population 1: Inverse portfolio							
	population 2: objective function with inverse risk minimum formula							
3	Equal variances assumed	73.69	0	-0.94	0.351	-0.05	-0.1615	0.05778
	Equal variances not assumed			-0.94	0.353	-0.05	-0.1626	0.05887
6	Equal variances assumed	34.82	0	-3.01	0.004	-0.29	-0.4888	-0.0985
	Equal variances not assumed			-3.01	0.005	-0.29	-0.4922	-0.0951
	population 1: Inverse portfolio							
	population 2: objective function with inverse maximum return formula							
3	Equal variances assumed	2.531	0.114	9.715	0	0.907	0.7219	1.0915
	Equal variances not assumed			9.715	0	0.907	0.7217	1.0917
6	Equal variances assumed	0.349	0.557	4.872	0	0.663	0.3907	0.9356
	Equal variances not assumed			4.872	0	0.663	0.3907	0.9356

	population 1: mean population							
	population 2: objective function with inverse maximum return formula							
3	Equal variances assumed	5.67	0.019	11.68	0	1.054	0.8751	1.2326
	Equal variances not assumed			11.68	0	1.054	0.8748	1.2329
6	Equal variances assumed	0.422	0.518	8.269	0	1.014	0.7686	1.2596
	Equal variances not assumed			8.269	0	1.014	0.7682	1.2599
	population 1: mean population							
	population 2: objective function with inverse risk minimum formula							
3	Equal variances assumed	55.85	0	1.905	0.059	0.095	-0.0038	0.1943
	Equal variances not assumed			1.905	0.062	0.095	-0.0048	0.1953
6	Equal variances assumed	21.13	0	0.739	0.463	0.057	-0.098	0.2125
	Equal variances not assumed			0.739	0.465	0.057	-0.1003	0.2149
	population 1: mean population							
	population 2: objective function with the formula of maximum momentum efficiency							
3	Equal variances assumed	8.004	0.005	10.11	0	0.934	0.7511	1.1172
	Equal variances not assumed			10.11	0	0.934	0.7508	1.1175
6	Equal variances assumed	1.698	0.198	7.116	0	0.892	0.6412	1.143
	Equal variances not assumed			7.116	0	0.892	0.6407	1.14351

The data for the 6-month formation and holding period will also be available upon reasonable request.

Results and Recommendations

Making more profit is one of the most important factors that motivate people to invest in the stock market. On the other hand, one of the most important challenges facing capital market participants is always selecting stocks and forming the optimal portfolio. To this end, many researchers have proposed different models based on fundamental and technical analysis.

Numerous studies have confirmed the efficiency of momentum and reverse strategies at different time horizons. Accordingly, the present study investigated the usefulness of a new model for stock selection based on the momentum and reverse strategies in the Tehran Stock Exchange. The model is written in two forms. The first model aims at maximizing the return by considering the maximum risk expected by the investor and the second model seeks to minimize the risk by considering the minimum return expected by the investor. The data indicated that this model is more efficient than other similar models in terms of stock risks. The results showed that the profitability of the momentum strategy, the optimal portfolio with the maximum return of momentum and the optimal portfolio with the minimum reverse risk and in comparison, with them, the stability in profitability during this period with the lowest amount of risk, which has caused better performance than other portfolios, is related to It was proved that the objective function with minimum risk is inverse.

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