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Determining the Optimal Stock Portfolio of Agricultural Companies in Tehran Stock Exchange

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Abstract

Efficient Asset allocation and investment portfolio selection are among the most critical and challenging issues in investment management and a continuous concern for investors. When investors invest in the capital market, they expect their portfolio to perform well. Therefore, this study determines the optimal stock portfolio of agricultural companies in the Tehran Stock Exchange (TSE). Thirty-two most important agriculture companies in the (TSE), with monthly data from 2014-2020, were selected from Iran's two most essential agriculture industries, the food and beverage industries, and the sugar industry. Two portfolios for the food and beverage industry and sugar industry goals: minimizing portfolio variance and maximizing portfolio return using the Markowitz model with two different scenarios and applying two minimum investment constraints of 1% and optimized maximum investment of 20% without considering these two constraints. The efficiency, variance, and Sharp ratios are also calculated. The results showed that both food and beverage industry portfolios and the sugar industry portfolios became more efficient when optimized to maximize portfolio returns. The result also indicates the food and beverage industry was more efficient than the portfolio of the sugar industry. In this portfolio, the amount of investment for the shares of Salmin Company was 86.7% and for Mehram Company was 13.3%.

Keywords: Markowitz Model, Optimization, Portfolio Return, Risk, Sharp Ratio

Introduction

As one of the pillars of the Iran economy, it has an essential role in attracting small savings and financial resources and allocating them to finance large economic projects. There is no doubt that economic growth, development of welfare and social justice, and expansion of financing mechanisms depend on the growth of the capital market in proportion to other components of the economic system (Sadeghi, 2014). Iran is one of the countries whose traditional part of the agricultural market, due to economic inefficiency, does not meet the country's needs. Still, economic conditions have caused many problems for farmers, consumers, and even traders of agricultural products. Astray capital in the society can invest in the farming sector through the Tehran Stock Exchange, which creates a boom in agriculture production in the farming sector and creates for the shareholders of this sector to profit from the investment. Agricultural companies in the farming industry are essential in the growth and development of the country's agricultural industry in the conversion and processing of raw materials in the farming industry. In Iran, the industries related to this sector are financially weak and have not been able to grow and develop like developed

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countries; As a result, they need financing their investment in various ways. Therefore, the stock market provides the required capital for the companies in question and contributes to the country's economic growth. This is possible when the investor's profit from this investment is not ignored. Therefore, the main problems faced by investors are selecting securities for investment and creating an optimal portfolio of stocks (Hoseini Kasgari *et al*., 2017). Thus, this study provides a way to identify the stock risk of companies in these industries, which investors can use to maximize profits and reduce investment risk; in other words, determine the optimal stock portfolio of companies related to these industries. Each agricultural company in the (TSE) market has different risks and returns (Alipoor Leili, 2018). In order to invest in these companies, it is essential to examine the risk and return of each TES stock to identify the optimal portfolio for investment.

There are 43 agriculture industries in the Tehran Stock Exchange. Five sectors are classified as agriculture, textiles, wood products, sugar, and food and beverage industries related to the agricultural sector. Table 1 shows the correlation coefficients between the returns of agricultural industries. As it can be seen, there is no complete correlation between the returns of the agricultural industries under study, and the process of their returns is not entirely in line with each other. Therefore, we can diversify our portfolio by including different companies from each industry, thereby reducing the variance of the portfolio and optimizing the portfolio.

Table 1- Correlation coefficients between the returns of agricultural industries

Industry	The correlation coefficient
Food – sugar	0.58
Food – Agriculture	0.48
Food – Textiles	0.27
Food- Wooden	0.31
Sugar – Agriculture	0.36
Sugar – Textiles	0.10
Sugar – wood	0.25
Agriculture – Textiles	0.15
Agriculture – wood	0.25
Textiles – wood	0.03

Source: Research findings

Based on economic theories, it is assumed that investors are always looking to maximize their desirability while investors are investing in terms of risk and return. In other words, the basis of investment decisions is the relationship between risk and return. Investors always pay attention to two factors of risk and return to determine the optimal portfolio of their stocks. Empirical studies have demonstrated that unsystematic risk can be virtually eliminated in 30 to 40 randomly selected stocks portfolios. Of course, if investments are made in closely related industries, more securities are required to eradicate the unsystematic risk. The investors inhabiting this hypothetical world are assumed to be risk-averse. This notion, which agrees for once with the world most of us know, implies that investors demand compensation for taking on risk. In financial markets dominated by risk-averse investors, higher-risk securities are priced to yield higher expected returns than lower-risk securities.

Each investment has its own risk and return, and the combination of these two factors influences the investor's decision to choose the optimal portfolio. Depending on their degree of risk aversion, they choose the investment portfolio with the lowest risk and maximum return (Joonz, 1943). Therefore, according to the presented materials, this research identifies the optimal portfolios of agricultural companies in the Tehran Stock Exchange, and the most efficient portfolio is selected.

Hosseini Kasgari *et al*. (2017) studied to provide a method for selecting the optimal portfolio of stocks of food industry companies in the Tehran Stock Exchange using the model of mean skewness variance with six objective functions. In their research, to select the optimal stock portfolio, first, the stock price was predicted, and then two methods of mean variance-skewness and mean variance pattern were used, and the optimal stock portfolio was determined. Mousavi *et al*. (2016) optimized the portfolio of Sepah Bank Investment Company using the combined model of

Markowitz and GARV multivariate. The main purpose of their research paper was to optimize the portfolio of Sepah Bank Investment Company using the risk minimization method compared to the expected return. They considering the expected return, the optimal risk of the investment portfolio containing four industries has been calculated. Findings showed that whenever there is less risk in each industry, their share in the investment portfolio is higher. In addition, among these four industries, the highest average share is related to the non-metallic mineral extraction industry, and the metal mineral extraction industries, large multidisciplinary companies, and the chemical materials and products industry are in the positions, respectively. Therefore, it is appropriate for Sepah Investment Company to consider such prioritization in order to minimize its risk at all times as well as to achieve the expected return. Ghadiri Moghaddam and Rafiei Darani (2010), in their research, have examined and determined the optimal stock portfolio of companies active in the food industry of the Tehran Stock Exchange based on the value at risk index (VaR).

Table 2- Companies active in the food and beverage industry in the Tehran Stock Exchange

Industry	Sub-industry	Company
Food and beverage products other than sugar	Growing and preserving fruits, vegetables	1- Murghab plain 2- Piazer cultivation and industry 3- Iranian nectar 4- Noush Mazandaran 5- Pure Martyrs of Khorasan
	Production of animal and vegetable oils	6- Nili Sanat Kerman Production Complex 7- Margarine 8- Behshahr Industrial 9-Development of Behshahr industries 10-Behpak Industrial
	Dairy production	11-Kalber Dairy 12- Pak Dairy 13-Pegah of East Azarbaijan 14-Pegah of Azerbaijan 15-Pegah Fars 16-Pasteurized milk of Pegah Khorasan 17-Isfahan Pegah pasteurized milk 18-Pasteurized milk of Pegah Golpayegan 19-Pegah Golestan pasteurized milk
	Production of starch and related food products	20-Glokozan
	Production of ready-made animal feed	21-Pars livestock feed
	production of bread and related products	22-Georgian biscuits 23-Salmin 24-Vitana 25-Saturn 26-Pars Minoo
	Production of cocoa, chocolate, and sweets	27-Minoo Industrial (Khorramdareh) 28-Self-sufficiency of freedmen 29-Shokopars 30-Minoo Shargh Food Industries 31-Gaz Coin
	Other food products	32- China Agriculture and Industry China 33-Produced by Mehram 34-Behshahr Industries Development (Holding) 35-Congratulations 36-Noush Pooneh Mashhad 37-Agriculture and industry of Khorasan spring flowers
	Production of barley and beer	38-Behnoosh Iran
	Soft drinks and mineral water	39-Pakdis

Source: Tehran Stock Exchange 2019

The main purpose of their study was to determine and study the optimal portfolio of stocks of companies active in the food industry of the stock exchange based on the value-at-risk index, which is used mathematical planning with integers. Abroad, Basuki *et al*. (2019) have used linear algebra equations to determine the optimal portfolio in an article. The results of their studies have shown that it is suitable for determining the optimal portfolio by linear algebra method. Poor Nima and Ramesh (2016) chose the optimal portfolio with the help of the Sharp single index model and using risk-return analysis in the automotive and pharmaceutical sectors. Campbell *et al*. (2001) determined the optimal stock portfolio by maximizing the expected return with limited value at risk. The problem of portfolio selection therefore remains to maximize the expected returns, however, while minimizing the downside risk taken by the risk-taking value, and using this approach allows a very general framework for create a portfolio selection. Therefore, by reviewing the other research to determine the optimal portfolio stock of agricultural companies In Tehran Stock Exchange it is necessary to use the Markowitz optimal portfolio method.

One of the industries related to the agricultural sector in the Tehran Stock Exchange is the food and beverage industry. This industry is non-periodic; There is a constant demand for products in all seasons and different economic situations (Shirzad, 2016). Table 2 shows the names of companies active in the food and beverage industry separately.

Another industry related to the agricultural sector that operates on the stock exchange is the sugar industry. As a nutrient needed by the body and the primary sweetener and its high consumption in the daily basket of the household, sugar has the highest consumption in industries such as beverage, canned and compote, sweets, and chocolate. In addition to its nutritional importance, it has always been considered a strategically important material politically and economically. Therefore, most countries try to supply and produce it and meet their domestic needs as much as possible, and several countries earn a significant share of their revenues from the export of this product. In Iran, the primary uses of sugar are households, confectionery factories, cakes and chocolates, beverage and beverage factories, pharmaceutical factories, and livestock and poultry industries. Still, the most important are households and factories. The name of the sugar industry is shown in Table 3.

Table 3- The name of Companies in the sugar industry on the Tehran Stock Exchange

Industry	Sub-industry	Company
Sugar	Sugar production	1-Isfahan Sugar 2-Qazvin sugar factories 3-Hegmatan Sugar 4- Nectar 5-Lorestan Sugar 6-Marvdasht Sugar 7-Neyshabur Sugar 8-Food and sugar products of Piranshahr 9-Fixed sugar of Khorasan 10-Shahroud Sugar 11-Torbat Jam sugar 12-Sugar Shirvan Quchan 13-Khorasan sweet sugar 14-The role of sugar in the world 15-Food products and Chaharmahal sugar

Source: Tehran Stock Exchange 2019

Fluctuations in stock returns of agricultural industries, one of the criteria for measuring risk in the capital market, have been studied in graphs to indicate the possibility of risk in stocks of these industries due to changes in stock returns. These fluctuations from 2014 to 2020 have been studied for different agricultural industries. Figure 1 shows the trend of stock returns of the food and beverage industry during the years 1993 to 1998. The stock return of this industry had the lowest value of -0.12 in 2014, and this amount reached its highest level, 1.9 in 2020. Figure 2 also shows the trend of stock

returns in the sugar industry. In 2014 the industry started its lowest stock return with -0.62, and in 1998, it reached its highest level of 1.41.

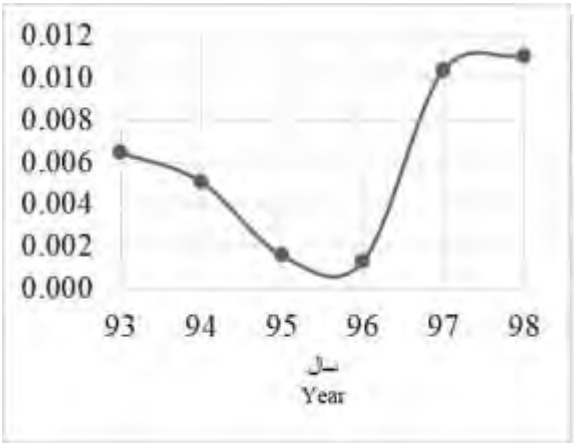

Fig. 2- Trend of stock returns of sugar industry

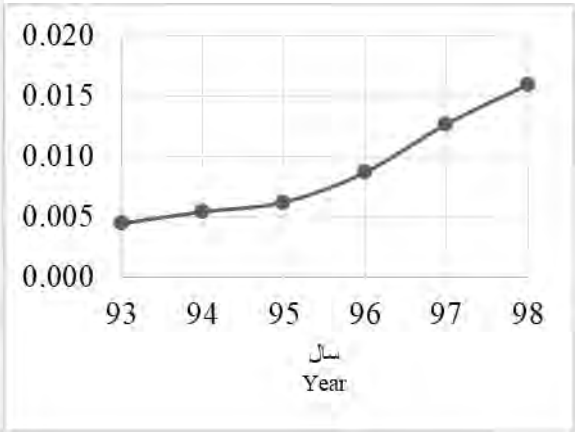

Fig. 1- Trend of stock returns of food and beverage industry

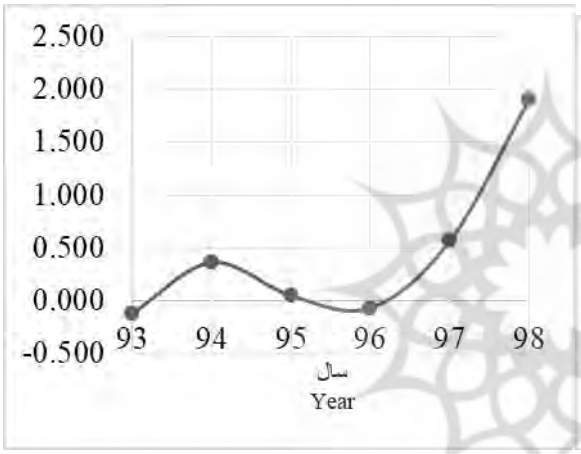

Fig. 3- Risk of food and beverage industry stocks

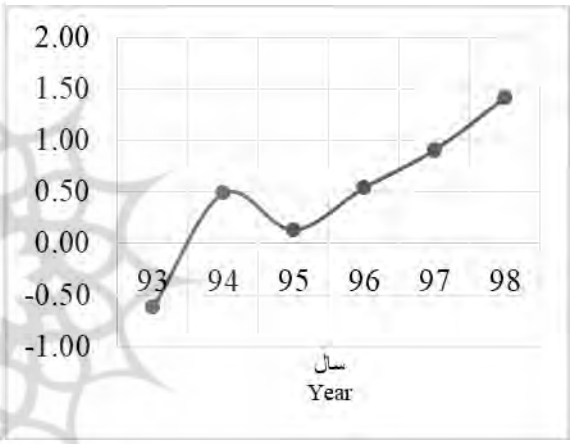

Fig. 4- Risk of Sugar industry stock

Figure 3 shows the stock risk of the food and beverage industry. In 2014, the stock risk of this industry was 0.006, which in 1996 reached its lowest level of 0.001, and in 1998 its highest level of 0.011. The stock risk of the sugar industry is shown in Figure 4. In 2014, this industry had its lowest risk amount of 0.004, which had an upward trend until 1998, and this year has reached its highest level of 0.016.

Research Methodology

The term portfolio, in simple terms, refers to a combination of assets formed by an investor to invest. This investor can be an individual or an institution. In other words, a portfolio includes a set of real assets invested by an investor. In this study, our emphasis is on financial assets. Financial assets include various securities such as equity securities, common stock, preferred stock, and financial derivatives (Joonz, 1943). But in this study, our financial assets are stock of agriculture companies. The modern portfolio theory was proposed in 1952 by Harry Markowitz. This theory states that part of the risk can be eliminated or at least reduced by diversifying securities. In 1959, Markowitz was the first to introduce variance or standard deviation as a measure of risk. He stated that decision-makers in portfolio selection minimize the return variance to a certain level of expected return or maximize the expected return to a certain level of variance. This approach provides an efficient boundary that portfolios on the efficient frontier (Figure 5) show the minimum risk per return (Salim Odloo, 2017).

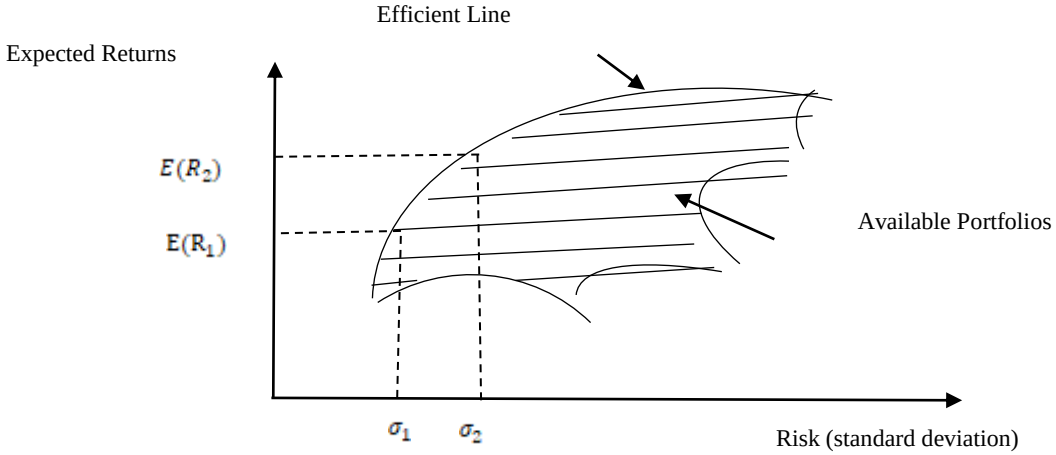

Fig. 5- Markowitz efficient frontier

A portfolio is a set of two or more activities that Markowitz (1959) formulated portfolio theory in this way. The investor should consider different efficient combinations of standard deviation and expected returns and choose his portfolio based on his preferences and degree of risk aversion. Portfolio theory states that a variety of two stocks whose returns are not fully correlated provides a combination whose fluctuations are less than the fluctuations of individual stocks. Modern portfolio theory shows that specific risks can be removed or at least mitigated through the diversification of a portfolio. The trouble is that diversification still does not solve the problem of systematic risk; even a portfolio holding all the shares in the stock market cannot eliminate that risk. Therefore, when calculating a deserved return, systematic risk most plagues investors.

Hence the investor tries to reduce changes through some less correlated stocks or negatively correlated with each other. The advantage of this theory is that it considers stock returns and risk together. Return on a portfolio is the weighted average return on the portfolio of stocks in which the weight of each stock is the share of those stocks in the portfolio (Equation 1).

$$E(R_p) \quad \sum_{i=1}^{N} W_i R_i \qquad (1)$$

In this regard, $E(R_p)$ is the total return on the portfolio, W_i is the stock weight i, R_i is the stock return i, and N is the number of companies in the portfolio. And the stock returns of each company in a portfolio are obtained using (Equation 2) (6).

$$R_{it} \quad \frac{P_{it} \quad P_{it\ 1} \quad D_{it}}{P_{it\ 1}} * 100 \qquad (2)$$

R_{it} is i's stock rate of return in period t, P_{it} is the i-share price at the end of the period, P_{it-1} is the stock price i at the beginning of the period. D_{it} is a dividend cash dividend in period t.

The dividend is the amount a company pays to investors from dividends made. The variance of the portfolio also depends on the covariance between the stocks, which, if there is no complete positive correlation between them, reduces the variance of the entire portfolio to (Equation 4). The variance of shares of each company is also obtained from (Equation 3).

$$\sigma_i^{\ 2} \quad \sum_{i\ 1}^{N} (R_i \quad E(R_i))^2 \Pr_i \qquad (3)$$

$$p \quad \sqrt{\ ^2_p} \quad \sqrt{\sum_{i\ 1}^{N} w_i^{\ 2}\ ^2_i \quad \sum_{i\ 1}^{N}\sum_{j\ 1}^{N} \operatorname{cov}(R_i, R_j)} \qquad (4)$$

$$\operatorname{cov}(R_i, R_j) \quad r_{ij\ \ i\ \ j} \qquad (5)$$

In these two relations, (Equations 4 and 5), σ_i^2 is the stock variance i, pr_i is the probability of occurrence of any rate of return for a company i , σ_p^2 is the total variance of the portfolio, cov (R_i,R_j) is the covariance of the return between shares i and j, r_{ij} is the correlation coefficient

between the returns of companies i and j, σ_i is the standard deviation of a company i and σ_j is the standard deviation of company j. The selection of the optimal point of each person on the efficient boundary is based on the tangent point of each individual's utility function and the efficient frontier.

Mean-Variance Analysis is a technique that investors use to make decisions about financial instruments to invest in, based on the amount of risk they are willing to accept (risk tolerance). Ideally, investors expect to earn higher returns when investing in riskier assets. When measuring the level of risk, investors consider the potential variance (the volatility of returns produced by an asset) against the expected returns of that asset. The mean-variance analysis essentially looks at the average variance in the expected return from an investment. The mean-variance analysis is a component of modern portfolio theory. This theory assumes that investors make rational decisions when they possess sufficient information. One of the theory's assumptions is that investors enter the market to maximize their returns while at the same time avoiding unnecessary risk.

When choosing a financial asset to invest in, investors prefer the asset with lower variance when given choosing between two otherwise identical investments. An investor can achieve diversification by investing in securities with varied variances and expected returns. Proper diversification creates a portfolio where a loss in one security is counter-balanced by again in another. The mean-variance analysis is comprised of two main components, as follows:

Variance measures how distant or spread the numbers in a data set are from the mean or average. A large variance indicates that the numbers are further spread out. A small variance indicates a small spread of numbers from the mean. The variance may also be zero, which indicates no deviation from the mean. When analyzing an investment portfolio, variance can show how a security's returns are spread out during a given period.

The second component of the mean-variance analysis is the expected return. This is the estimated return that security is expected to produce. Since it is based on historical data, the expected rate of return is not 100% guaranteed. If two securities offer the same expected rate of return, but one comes with a lower variance, most investors prefer that security.

Similarly, if two securities show the same variance, but one of the securities offers a higher expected return, investors opt for the security with the higher return. When trading multiple securities, an investor can choose securities with different variances and expected returns.

The E-V standard performance set can be achieved using appropriate mathematical programming techniques or linear programming such as Linear Programming-Risk simulator (LP-RS). The general form of this approach is expressed in the form of (Equation 6 and 7) (Narayan, 1990).

$$MinV_p \quad \sum_{i=1}^{N} w_i^2 \sigma_i^2 \quad \sum_{i=1}^{N}\sum_{j=1}^{N} \mathrm{cov}(R_i, R_j) \qquad (6)$$

S.t

$$\sum_{i=1}^{N} w_i E(R_i) \quad E$$

$$\sum_{i=1}^{N} w_i \quad 1$$

$$w_i \quad 0 \quad \text{for i=1, 2,…,N}$$

In this case, E is the minimum expected return level. The goal in this model is to minimize portfolio variance for a given level of return. The first limitation also states that the return on the portfolio must be such that it is greater than or equal to the minimum expected return. The second constraint, the primary investment constraint, states that the total amount invested in each stock equals one. The third constraint says that each company's share in the portfolio is zero or greater.

$$MaxE(R_p) \quad \sum_{i=1}^{N} W_i E(R_i)$$

S.t

$$\sum_{i=1}^{N} w_i^2 \sigma_i^2 \le \sum_{i=1}^{N}\sum_{j=1}^{N} \mathrm{cov}(R_i, R_j) \le V \qquad (7)$$

$$\sum_{i=1}^{N} w_i \quad 1$$

$$w_i \quad 0 \quad \text{for i=1, 2,…,N}$$

In this regard, variable V is the maximum level of variance accepted. The goal of this model is to maximize portfolio returns for a given level of variance. The first limitation also states that the variance of the portfolio must be such that it is less than or equal to the maximum level of variance expected. The second and third constraints are repeated as in the previous model. Finally, solving these models gives us the share of each company

in the optimal stock portfolio. Different metrics can be used to evaluate portfolio performance. The Sharp ratio or return to variability ratio is one of the criteria developed by Sharp (1996) to measure portfolio performance. The Sharp ratio is obtained by dividing the portfolio's excess returns by the standard portfolio deviation. In fact, by using this ratio, we are looking to calculate the monetary amount that an investor receives to bear the entire risk. The Sharp ratio is calculated using equation (8):

$$Sh_p \quad \frac{E(R_p) \quad R_f}{\sigma_p} \qquad (8)$$

In this regard, $E(R_p)$ is the return on the portfolio, σ_p is the standard deviation of the portfolio, and R_f is the rate of return on the risk-free investment (Luenberger, 1997).

The data used in this study include the monthly returns of 32 companies listed on the Tehran Stock Exchange, the data of which existed monthly from 1993 to 1999. These companies are in the two sectors industries of food and beverage and sugar industry and are in the agriculture sector.

Results and Discussion

In order to determine the optimal portfolio of shares of agricultural companies, the results of using the Markowitz model to optimize the two portfolios of the food and beverage industry and sugar industry with two objectives of minimizing variance and maximizing portfolio returns are shown in Tables 4, and 5, respectively.

As it is shown in Table 4, in the second column, portfolio optimization has been done with two restrictions: minimum investment and maximum investment, and in the third column, optimization has been done without considering these two restrictions. In the second column, the minimum investment on each company is 1%, and the maximum investment on the shares of each company is 20%. In this paper, we compare the portfolio optimization of the food and beverage industry with two goals of minimizing variance and maximizing the portfolio's expected return, considering the two constraints of minimum and maximum investment. Due to the increasing share of some companies such as Pars Mino, Pegah Azerbaijan, Pegah Isfahan, and Salmin in this industry's portfolio, we conclude that these companies have maximized the return of the portfolio a good return. The companies are Georgian Biscuit, Behshahr Industrial Development, Murghab Plain, Behpak Industrial, Glucosane, Margarine, and Cultivation and China's industry has lower returns. The results of portfolio optimization of this industry, without considering the two constraints of minimum investment and maximum investment, also show that when we optimized the portfolio intending to maximize returns, the participation of companies in the portfolio decreased, and the portfolio share towards Salamin and Mehram companies is gone. The Sharp ratios also show that a portfolio is more efficient when optimizing a portfolio intending to maximize returns.

Also, in Table 5, the portfolio of the sugar industry has been optimized with the two objectives of minimizing variance and maximizing portfolio returns. In the second column, portfolio optimization has been done with two restrictions of minimum investment and maximum investment. In the third column, optimization has been done without considering these two restrictions. In the second column, the minimum investment in each company is 1%. The maximum investment on the shares of each company is 20% as a result of comparing the portfolio optimization of the sugar industry with two goals of minimizing variance and maximizing the expected return of the portfolio by considering the two constraints of minimum investment and maximum investment. It shows that when we maximize the portfolio return, we can say that these companies have excellent returns due to increasing the share of some companies such as Isfahan and Qazvin, and Marvdasht sugar companies. The Nectar, food products and Chaharmahal sugar companies, Khorasan fixed sugar, and Lorestan sugar has lower returns. The results of portfolio optimization of this industry, without considering the two constraints of minimum investment and maximum investment, also show that when we optimized the portfolio intending to maximize returns, the companies' participation in the portfolio decreased, and the whole portfolio was allocated only to Piranshahr Sugar Company. The resulting Sharp ratios also show that a portfolio is more efficient when optimizing a portfolio intending to maximize returns.

Table 4- Results of food and beverage industry portfolio optimization with two objectives of minimizing variance and maximizing portfolio efficiency

Company	The percentage share of each company with two constraints of minimum and maximum amount of investment on the shares of each company		Percentage share of each company without two constraints of the minimum and maximum amount of investment on the shares of each company	
	Minimize portfolio variance	Maximize portfolio returns	Minimize portfolio variance	Maximize portfolio returns
Behnoush	1	1	0	0
Georgian Biscuits	12.9	1	14	0
Pars Minoo	1	6	0	0
Pegah of Azerbaijan	3.9	20	4.2	0
Pegah Isfahan	6.2	20	6	0
Pegah Khorasan	1	1	0	0
Behshahr Industries Development	10.3	1	10.9	0
Plain Morghab	3.6	1	2.3	0
Salmin	5.9	20	6.2	86.7
Minoo Shargh Food Industries	1.2	1	0	0
Behpak Industrial	4.1	1	4.4	0
Behshahr Industrial	1	1	0	0
Minoo Industrial (Khorramdareh)	1	1	0	0
Glokozan	7.9	1	7.6	0
Pak Dairy	1.2	1	1.9	0
Kalber Dairy	1	1	0	0
Margarine	5	1	5.8	0
Mahram	20	20	23.8	13.3
China Agro-industry China	11.9	1	12.2	0
Monthly Portfolio Returns	2.4	4	2.5	5.8
Monthly Portfolio Variance	0.006	0.008	0.006	2
Sharp 1.25%	14.5	30.8	17.1	31.9
Ratio 1.83%	6.8	24.3	9.3	27.8

Source: Research findings

Table 6 shows the participation of companies in optimal portfolios. The stocks of companies in the food and beverage industry and the sugar industry do not have the power to attract investors whose expected return on companies' stocks is high. Investors with high expected returns do not spend their money buying stocks of companies related to these two industries. The difference between these companies' risk (variance) is more minor, and their risk is closer to each other than their return.

Food industry companies have a high multiplication rate in creating employment and added value, effectively increasing revenue, reducing waste, improving the quality of products, stimulating increased demand for agricultural products, presence in global markets, and business prosperity. The small share of the food industry in the production of 90 million tons of Iranian agricultural products and the closure of activity of less than the capacity of some food industry companies, along with the high volume of food imports, shows the importance of investing in this field and the presence of more food companies in the stock market. It is the stock of Tehran. Many food companies need low-cost banking facilities to raise their working capital. Due to high inflation and consequently high-interest rates, it is practically impossible for them to receive this capital, and their competitiveness does not increase. Therefore, the following suggestions are based on the results obtained in this study.

Comparing the optimization results of the two portfolios of the food and beverage industry and the sugar industry, considering the two constraints of minimum investment and maximum investment was obtained when the return of the portfolio is maximized when the variance is minimized. The share of some companies increased, and the share of others decreased. Due to this increase and decrease in share, the companies in each of the two

portfolios were divided into low-yield and high-yield groups, which are given in Table 7. Also, the optimization results of these two portfolios, without considering the two constraints of minimum investment and maximum investment, show when the portfolios were optimized to maximize returns, the companies' participation in the portfolio decreased, and the entire portfolio was allocated to only three companies, indicating that these companies differed from each other in terms of high returns. Salmin and Mehram companies are the most profitable companies in the food and beverage industry, and Piranshahr sugar company is the most profitable company in the sugar and sugar industry. In the last row of Table 7, these companies are listed in each of the two portfolios.

Table 5 - Results of portfolio optimization of sugar industry with two objectives of minimizing variance and maximizing portfolio return

Company	The percentage share of each company with two constraints of minimum and maximum amount of investment on the shares of each company		percentage share of each company without two constraints on the minimum and maximum amount of investment on the shares of each company	
	Minimize portfolio variance	Maximize portfolio returns	Minimize portfolio variance	Maximize portfolio returns
Nectar	8.3	1	11.2	0
Sugar of Shahroud	1	1	0	0
Food Products and Chaharmahal Sugar	11.7	1	12	0
Isfahan Sugar	19.5	20	3.4	0
Piranshahr Sugar	20	20	42.	100
Torbat Jam Sugar	1	1	0	0
Khorasan Fixed Sugar	5.1	1	8.3	0
Shirvan Quchan Sugar	1	1	0	0
Qazvin Sugar	1	20	0	0
Lorestan Sugar	9.4	1	10.2	0
Marvdasht Sugar	1	12	0	0
Neyshabur Sugar	1	1	0	0
Hegmatan Sugar	20	20	12.8	0
Monthly Portfolio Returns	2	2/9	2	3.6
Monthly Portfolio Variance	1.2	1.4	1.1	1.5
Sharp 1.25%	6.9	13.8	7.2	18.8
Ratio 1.83%	1.5	8.9	1.6	14

Source: Research findings

Table 6- The level of participation of companies in the optimal portfolio

Portfolio	The level of participation of companies in the optimal portfolio	
	Minimize portfolio variance	Maximize portfolio returns
Food and beverage industry portfolio	63%	10%
Sugar industry portfolio	53%	7%

Source: Research findings

Table 7- Classification of companies according to the results of portfolio optimization

Rate of return	Food and beverage industry portfolio	Sugar portfolio
Low return	Georgian Biscuits, Behshahr Industries Development, Murghab Plain, Behpak Industry, Glucosan, Margarine and China China	Nectar, food products and Chaharmahal sugar, Khorasan fixed sugar, Lorestan sugar
High return	Salmin, Mehram, Pars Minoo, Pegah Azerbaijan, Pegah Isfahan	Piranshahr sugar, Isfahan sugar, Qazvin sugar and Marvdasht sugar
The most return	Salmin, Mehram	Piranshahr Sugar

Source: Research findings

The main result of this study is the use of the Markowitz portfolio model and for a set of two or more activities that suggest an optimal portfolio for investors with different goals of minimizing risk and maximizing returns that can be achieved at different levels of risk for industries as well as the entire stock market. Given that in both the food and beverage industry portfolios and the sugar industry, the Sharp ratios obtained when maximizing returns have increased relative to when the variance has been minimized, investors are advised to increase investor's behavior of risk aversion.

As a result of comparing the results of portfolio optimization of the food and beverage industry with two goals of minimizing variance and maximizing the expected return of the portfolio, it is suggested to investors in the agricultural sector that the share of some companies such as Pars Mino, Pegah Azerbaijan, Pegah Isfahan and Salemin in the portfolio of this industry, which have good returns, in their investment portfolio.

Optimize the portfolio to maximize returns because this study has shown that this method is more efficient. Given that the results of portfolio optimization of the food and beverage industry to maximize the portfolio's expected return have been the most efficient, investors are advised to buy shares resulting from this portfolio's optimization. Considering the importance of the food and beverage industries and sugar industry in Iran's agricultural sector, it is recommended in future studies to identify risks and policies to reduce risk and create incentives to increase investment in these two industries. The model used in the research is suggested to be solved with other optimization models, including the algorithms mentioned in the research background (shrimp batch meta-algorithm, genetic algorithm, etc.). It is also suggested that in future studies, in proportion to the amount of capital or investment brought by investors, they should consider their amount of money as a constraint in the model used (Markowitz model) and optimize their portfolio according to the amount of capital.

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جلد ۳۵، شماره ٤، زمستان ١٤٠٠، ص ۳۹۷-۳۸۳

تعیین انتخاب سبد بهینه سهام شرکت‌های کشاورزی در بورس اوراق بهادار تهران

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چکیده

تخصیص دارایی و انتخاب سبد سرمایه‌گذاری، یکی از مهم ترین و پرچالش ترین مباحث در مدیریت سرمایه‌گذاری و نیز یکی از دغدغه‌های همیشگی سرمایه‌گذاران به‌شمار می‌رود. هنگامی که سرمایه‌گذاران در بازار سرمایه اقدام به سرمایه‌گذاری می‌نمایند، انتظار دارند سبد منتخب آن‌ها از کارایی مناسبی برخوردار باشد. لذا هدف از این پژوهش، تعیین سبد بهینه سهام شرکت‌های کشاورزی در بورس اوراق بهادار تهران می‌باشد. بدین منظور ابتدا ۳۲ شرکت از کل شرکت‌های بخش کشاورزی در بورس اوراق بهادار تهران که داده‌های آن‌ها از سال ۱۳۹۹ الی ۱۳۹۳ به صورت ماهانه وجود داشت از دو صنعت غذایی و آشامیدنی و صنعت قند و شکر انتخاب شدند. سپس دو پرتفویی صنعت غذایی و آشامیدنی و صنعت قند و شکر با دو هدف حداقل سازی واریانس پرتفویی و حداکثرسازی بازده پرتفویی بااستفاده از مدل مارکوویتز با دو سناریوی متفاوت یک‌بار با اعمال دو محدودیت حداقل سرمایه‌گذاری به میزان ۱ درصد و حداکثر سرمایه‌گذاری به میزان ۲۰ درصد و یک‌بار بدون در نظر گرفتن این دو محدودیت بهینه سازی شدند و بازده، واریانس و نسبت‌های شارپ برای آن‌ها محاسبه شد. نتایج نشان داد هر دو پرتفویی صنعت غذایی و آشامیدنی و صنعت قند و شکر زمانی که با هدف حداکثر سازی بازده پرتفویی بهینه سازی شدند، از کارایی بیشتری برخوردار شدند. هم‌چنین پرتفویی صنعت غذایی و آشامیدنی نسبت به پرتفویی صنعت قند و شکر از کارایی بیشتری برخوردار شد. در این پرتفویی میزان سرمایه‌گذاری برای سهام شرکت سالمین ۸۶/۷ درصد و برای شرکت مهرام ۱۳/۳ درصد به‌دست آمد.

واژه‌های کلیدی: بازده، پرتفوی، کارایی، مدل مارکوویتز، نسبت شارپ

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