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Performance Enhancement Model of Stock Market Portfolio of Iran Social Security Organization

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Abstract

This paper primarily aims to introduce a model to enhance the performance of the stock market portfolio of the Iran Social Security Organization. Performance indices were measured using documentary-based research and

expert interviews based on theoretical saturation to evaluate the stock portfolio performance of the Iran Social Security Organization relative to companies listed on the Tehran Stock Exchange (T.S.E.) during 2016-2020. The Delphi technique was employed to ensure the validity of the indices. Drawing on the analytical hierarchy process (A.H.P.), the indices were prioritized and ranked based on the weight vector. The Iran Social Security Organization was found to have poor stock portfolio performance based on risk, return, liquidity, Sharpe ratio, and T.O.P.S.I.S. Hence, several solutions were identified based on expert interviews through thematic analysis to improve the stock portfolio performance of the Iran Social Security Organization. The solutions were validated through the Delphi technique, prioritizing and quantifying the performance improvement indices using the A.H.P. Based on expert views and T.O.P.S.I.S., a stock portfolio performance improvement model was proposed for the Iran Social Security Organization. Handling the non-profitable, low-return, and out-of-strategy companies is the optimal solution for the portfolio performance improvement of the I.S.S.O., with portfolio modification based on liquidity, effective stock market-making, return-based stock risk management, synergy between the portfolio and value chain completion, and value-added creation approach to stock management and exchange having the second-fifth ranks, respectively.

Keywords: Social Security Organization, Stock market investment portfolio, Performance indicators, Model.

Introduction

Investing in the financial market has become an increasingly routine activity by individuals who find an opportunity to increase their capital in this market (Wu et al., 2022). The incursion into these financial activities occurs through the purchase and sale of financial instruments, which generate value in specific market situations—situations that are typically inherent to risk and market volatilities because, in general, assets and financial instruments are frequently affected by a myriad of variables that can very quickly lead the investor from economic prosperity to total misfortune (Narang et al., 2022).

Choosing a portfolio is one of the most critical steps in the long-term investment of insurance funds, so it requires careful attention. (Leung Wang, 2022). Investors tend to evaluate the performance of their stock portfolios. Portfolio performance evaluation is essential since it represents the extent to which the actual performance of the portfolio meets the demands of investors (Vukovic et al., 2022). The portfolio performance evaluation of the Iran Social Security Organization (I.S.S.O.) using return, risk, and liquidity indices, Sharpe

ratio, and T.O.P.S.I.S. relative to that of companies listed on the Tehran Stock Exchange (T.S.E.) would help the I.S.S.O. cope with its liquidity deficiency, fulfill its legal obligations, and preserve and enhance its servers. Therefore, it is required to evaluate and compare the performance of the I.S.S.O. companies listed on the T.S.E., considering the high dispersion and variety in most economic fields, large and small industries, and strategic and non-strategic contexts with different profitability rates, safety, and liquidity levels based on performance indices.

This study reviews works that criticized the negligence of the other preferences of investors and argued liquidity to be a significant portfolio decision determinant. Based on Iranian and non-Iranian studies, portfolio evaluation criteria are identified through expert interviews upon theoretical saturation using thematic analysis. Interviews and thematic analysis are utilized to introduce solutions for stock portfolio performance improvement. To ensure the fitness of the proposed solutions, the Delphi method was used, prioritizing and quantifying the portfolio performance improvement solutions through the analytical hierarchy process (A.H.P.). Finally, a portfolio performance improvement model is proposed based on expert views and T.O.P.S.I.S. Therefore, the present study primarily sought to evaluate the portfolio performance of I.S.S.O. companies listed on the T.S.E. during 2016-2020 and introduce a model to enhance the portfolio performance of the I.S.S.O. This study sought to determine whether the I.S.S.O.'s stock investments were successful based on the return, risk, and liquidity indices. This work hypothesized a significant return, risk, and liquidity difference between the stock market portfolios of the I.S.S.O. and other companies listed on the T.S.E., and efficient solutions would be proposed to enhance the portfolio performance of the I.S.S.O...

Literature Review

In standard portfolio selection, Markowitz (1959) assumed that all investors make choices based on the return and risk criteria; however, many studies criticized the negligence of the other investor preferences in Markowitz's Model. In portfolio selection, investors often need to consider contradictory objectives, e.g., return, risk, and liquidity. Amihood and Mandelson (2008) studied the role of liquidity in asset pricing for the first time and concluded that liquidity impacts the cross-section of stock returns. Andrew et al. (2003) argued that stock liquidity is a significant criterion for investors in the portfolio mean-variance standard optimization framework. Anderson (2017) reported that liquidity improvement would reduce capital costs and increase predicted

cash flows, positively impacting the stock return. Zhai and Bai (2018) proposed the mean-variance model using the transaction cost, liquidity, and background risk in the framework of uncertainty theory. They showed how the background risk and liquidity impacted the efficient frontier. Atooneh et al. (2018) believed that stock liquidity impacted corporate performance, stock value, and corporate innovation level. Raei et al. (2015) argued that liquidity helps better discover prices and market efficiency, creates value for firms differently, and raises investor arrivals in the financial market, leading to higher capital attraction in financial markets and economic growth. Therefore, liquidity is a major determinant of investment performance.

Non-Iranian literature

Early published works using multicriteria methods for selecting stock portfolios have been proposed by Hababou and Martel (1998), Bouri et al. (2002), and Costa and Soares (2004). Hababou and Martel (1998) introduce the multicriteria method PROMETHEE II to select a portfolio. The proposed methodology involved four steps: (1) defining a list of potential solutions to the considered problem, (2) defining a list of critical criteria, (3) eval uating the performance of each solution according to each criterion, and (4) aggregating these performances by using the PROMETHEE II multicriteria method. Bouri et al. (2002) include the investor's attitude to solvency and liquidity in solving a stock portfolio problem with a multicriteria issue, which should be tackled using appropriate techniques. Costa and Soares (2004) present a model to select a portfolio of stocks based on the fund managers' fieldwork results and using direct rating, M.A.C.B.E.T.H., and optimization techniques (Wu, et al. 2022). patariri et al. (2018) compare the efficiency of four M.C.D.M. methods, identifying the The best-performing approach was applied to two comprehensive samples of U.S.U.S. stocks. The compared methods are median-scaling (M.S.M.S.), T.O.P.S.I.S., analytic hierarchy process (A.H.P.), and additive data envelopment analysis (A.D.D.E.A.). The results show that all evaluated approaches could successfully be applied to the equity portfolio selection problem. Abdelaziz and Mallek (2018) focused on solving the multicriteria portfolio optimiza tion problem by applying two different models derived from the theory of optimal stopping problems. An interactive method against solution-based algorithms is applied. Alali and Tolga (2019) proposes an approach based on the well-known multicriteria decision-making method, called T.O.D.I.M., to the portfolio problem. The proposed approach uses variance, correlation, and returns applied to different empirical U.S.U.S. stock data periods. The validation period demonstrated that obtained portfolios by

T.O.D.I.M. configurations yield significantly better results than equally weighted portfolios and inferior results than the theory proposed by the Sharpe ratio. Galankashi et al. (2020) propose an approach based on the well-known fuzzy analytic network process (F.A.N.P.) to select the portfolio problem on the Tehran Stock Exchange market. A literature review allowed the selection of the main criteria for portfolio selection, and then a chosen criterion was applied within the F.A.N.P. scheme to rank ten different portfolios. The results indicated that profitability, growth, market, and risk are the most critical portfolio selection criteria.

Nguyen et al. (2020) propose a ranking for the agriculture stocks belonging to the Vietnam Stock Exchange Market. The former approach uses a combined approach of the A.H.P. with a grey relational analysis (G.R.A.), multi-objective optimization ratio analysis (M.O.O.R.A.), and T.O.P.S.I.S. The results suggest that the integrated Model efficiently makes decisions in different agricultural sectors. Other alternative schemes, such as COPRAS, K.E.M.I.R.A., and E.D.A.S. could be employed to evaluate other companies' financial performance in different sectors. Finally, Frej et al. (2021) developed a BCR-based approach for selecting portfolios under asymmetric information of the market. The proposed methodology is applied to the Brazilian market to illustrate its practical applicability.

McDonald (1974) estimated the Sharpe, Treynor, and Jensen ratios for 123 investment funds using daily data during 1960-1963. It was demonstrated that most funds had not performed as efficiently as the New York Stock Exchange (NYSE) index. Jayadio (1999) studied the performance of two growing investment companies, Magnum and Mastergain, in India using the Sharpe, Treynor, and Jensen ratios from June 1992 to March 199. It was found that Magnum did not have stocks of high intrinsic values in the portfolio at the time, even though it had a diverse portfolio. Shamsher et al. (2000) measured the performance of 41 active and non-active Malaysian funds using the Sharpe, Treynor, and Jensen ratios for 1995-1999. They showed that the funds had lower returns than the market portfolio return. Redman et al. (2000) investigated and ranked seven investment companies in the United States using the Sharpe, Treynor, and Jensen ratios for 1985-1989 and 1990-1994. Artikis (2003) analyzed the performance of 10 domestic Greek investment companies based on the Sharpe, Treynor, and Jensen ratios during 1995-1998. They showed that the companies had lower returns than the Athens Stock Exchange. Debasish (2009) studied investment scheme performance based on risk and return models. They examined a total of 23 schemes offered by six private companies and three public companies during 1996-2009 based on the mean

return, Beta risk, coefficient of determination, Sharpe ratio, Treynor ratio, and Jensen's alpha. They concluded that Franklin Templeton and U.T.I. had the highest performance, while Birla Sun Life, H.D.F.C., and L.I.C. (life insurance companies) had the lowest performance. To evaluate the performance of cement companies in Turkey, Ertogrul and Karakaslioglu (2009) used the fuzzy A.H.P. (F.A.H.P.) to weigh the criteria and ranked the companies using the T.O.P.S.I.S. Bayraktaroglu and Kahraman (2009) evaluated the banking sector in Turkey. They weighted the criteria using the F.A.H.P. and ranked the banks using the T.O.P.S.I.S. Wu et al. (2009) evaluated the performance of Taiwanese banks by weighting the criteria using the F.A.H.P., ranking the banks based on T.O.P.S.I.S.

Iranian literature

Matinfard (2002) evaluated the investment of Alborz Insurance in the stocks of companies listed on the T.S.E. from different aspects (i.e., Sharpe ratio, risk, and return) using the capital asset pricing model (CAPM), with a comparison to the market index (T.S.E. index). It was concluded that the securities portfolio of Alborz Insurance had poor performance (return, risk, and Sharpe ratio) during the five years. Kabari (2003) investigated firms investing in the T.S.E. during 1997-2000 and evaluated their portfolio performance using the Sharpe ratio. Rezazadeh (2006) studied the performance of fourteen firms investing in the stocks of 188 companies from March 2002 to February 2004 based on the return, systematic risk, non-systematic risk, Tryenor, Sharpe, and Jensen ratios, and M2, comparing to the market index. It was demonstrated that the investing firms did not perform better than the market portfolio. Madani-Mohammad (2006) proposed a model for evaluating and prioritizing brokerage firms inspired by the balanced scorecard approach. Other measures, e.g., financial and productivity evaluations, complemented the Model. The Model was combined with T.O.P.S.I.S. to evaluate and rank the firms. Momeni and Najafimoghaddam (2004) used T.O.P.S.I.S. to measure and Rank companies listed on the T.S.E. They utilized nine criteria for 170 companies in 13 different industries, and the weights of the criteria were obtained via the entropy weight method. The weights were introduced to T.O.P.S.I.S. to rank the companies. Sheykh (2011) evaluated and ranked the financial performance of the brokerage companies of the T.S.E. using F.A.H.P. and T.O.P.S.I.S. based on five criteria, including liquidity, profitability, security, efficiency, and growth, and nineteen sub-criteria. They selected 39 T.S.E. Brokerage companies active in 2007 with available financial statements as samples. Then, the criteria were weighted based on expert views and F.A.H.P., evaluating and ranking the companies using T.O.P.S.I.S. Sarlak et al. (2013) studied the stock

portfolio performance of insurance companies listed on the T.S.E. relative to other companies listed on the T.S.E. based on the risk and return criteria using a combined model. The Model was developed based on the CAPM and Sharpe ratio, and the statistical population consisted of four insurance companies during 2002-2009. The Sharpe ratio comparisons of the insurance companies and base index supported the central hypothesis that the insurance companies and other companies listed on the T.S.E. had a significant stock portfolio performance difference. Karbasi and Daryabari (2015) studied stock liquidity shocks and expected returns. They argued that risk, return, and liquidity are substantial in investment. Adeli (2016) evaluated and ranked mutual funds using data from February 2010 to January 2015. They ranked the selected mutual funds based on traditional methods and data envelopment analysis (D.E.A.). Then, the funds were ranked using the T.O.P.S.I.S. based on the criteria. It was found that Firouzeh, Boursiran, and Agah Funds, among the seventeen funds, had the first, second, and third ranks, respectively. On the other hand, Pishgam, Keshavarzi Bank, and Ganjineh Refah Funds had the last ranks.

Markowitz's Model in standard portfolio selection assumes that all investors make choices based on the return and risk criteria. At the same time, several studies criticized Markowitz's idea and argued that liquidity is also a major determinant in portfolio decision-making. The portfolio performance criteria were identified. Experts were interviewed until theoretical saturation was achieved, extracting evaluation indices through thematic analysis.

Research Methodology

The I.S.S.O. stock investment data were extracted from valid references, e.g., audited financial statements, calculating the identified indices, and comparing and ranking portfolios. Then, several solutions were proposed to improve the portfolio performance of the I.S.S.O.

Stock liquidity

Liquidity refers to the ability to rapidly exchange a large quantity of securities quickly at a low cost with minimal impacts on asset pricing during the order and purchase. It has been considered to be a stock return determinant since the mid-1980s. Several stock liquidity measures have been proposed. This study calculated the liquidity rank as follows:

$$\text{Liquidity Rank} = \frac{1}{\frac{1}{\text{No. of Buyers}} + \frac{1}{\text{Exchange Frequency}} + \frac{1}{\text{Transaction Days}} + \frac{1}{\text{No. of Exchanged Stocks}} + \frac{1}{\text{Turnover}} + \frac{1}{\text{Mean Daily Value}}}$$

Return on stocks

The return is an essential criterion for decision-making and portfolio evaluation. The return on common stocks in a given period is obtained based on the initial and final prices and ownership interest. The ownership interest belongs to stockholders over periods in which an assembly has been held. It may be paid to the stockholders differently, most commonly increased capital reserve (bonus shares), raising capital through debts, and cash contributions. Here, the return rate is calculated as:

$$r = \frac{Div + P_{t+1}(1 + \alpha + \delta) - P_t - P_c.S}{P_t + P_c.\delta} \times 100$$

r=return on each stock

α=capital increase percentage through reserves

δ=increased capital through cash contributions and debts

Div=Dividends

Pt=Initial stock price in the period

Pt+1=Final stock price in the period

Pc=Payment on each stock for contribution to the increased capital

Portfolio return

The return of a given portfolio is the weighted mean return of stocks in the portfolio:

$R=W_0R_0+W_1R_1+\ldots\ldots$

R: Portfolio return w: Portfolio share percentage r: Stock return

T.S.E. portfolio return

To calculate the market portfolio return, the change in the T.S.E. index was employed:

$RM= (L_{t-1}- L_t) / L_t$

Lt-1: T.S.E. index at the beginning of the year. Lt: T.S.E. index at the end of the year

Risk

The risk, volatility, or return variation over a given period is calculated using the standard deviation:

$$\sigma = \sqrt{\frac{\sum (r_i - \bar{r})2}{n}}$$

σ: Return deviation or risk ri: Return $\bar{r}$: Mean return n: Number of periods

Portfolio risk

The risk of a portfolio is calculated as:

$\sigma_P = \Sigma n_{i=1} \Sigma m_{j=1} \sigma_{i2} W_{i2} + \sigma_{j2} W_{j2} + W_i W_j \text{ cov } (i, j)$

Sharpe ratio

The Shape ratio is an essential portfolio evaluation criterion. It represents the ratio of the reward to the risk. The standard deviation is assumed to be a risk criterion, while the risk-free (R.F.R.F.) rate is the rate of return on stocks of zero risk (bond rate).

$$\text{Sharp} = \frac{Ri - Rf}{\sigma i}$$

R_i= return R_f= Risk-free return rate (bond rate)

σ_i: Standard deviation or return variation over the period

A portfolio with a larger Sharpe ratio is a better portfolio. A negative Sharpe ratio suggests that the corresponding portfolio is unsuitable and does not cover the risk-free rate (bond rate). This study assumed the return rate expected by investors without risk to be 15.

TOPSIS

TOPSIS is a multicriteria decision-making (M.C.D.M.) method that ranks alternatives. It uses the ideal solution and is similar to the ideal solution. It is based on the assumption that the alternative should have the shortest distance from the positive ideal solution and the longest from the negative ideal solution. Hence, it defines the similarity to the positive ideal solution and distance from the negative ideal solution. Then it selects the alternative with the highest similarity to the positive ideal solution. An alternative similar to the ideal solution has a higher ran. The ideal solution is the best alternative in all aspects. The T.O.P.S.I.S. inputs include the decision matrix and weight vector,

and T.O.P.S.I.S. is implemented in the following steps:

Step 1: Decision matrix undimensionalization

The decision matrix is undimensionalized into Matrix D through the Euclidean undimensionalization method.

$$r_{ij} = \frac{r_{ij}}{\sqrt{\sum_{i=1}^{m} {r_{ij}}^2}}$$

Step 2: Weighted un-dimensionalized matrix

To obtain the weighted un-dimensionalized matrix V, the un-dimensionalized matrix D is multiplied by the diagonal weight matrix as:

$$V = D \times w_{n\times n}$$

where $w_{n\times n}$ is a diagonal matrix of the Weights.

Step 3: Positive ideal solution A+ and negative ideal solution A-

To define the positive ideal solution A+, the largest value of the positive indices and the smallest value of the negative indices are selected to form a set:

$$A^+ = \{V_1^+, V_2^+, \ldots, V_n^+\}$$

where V_1^+,…, V_n^+ denote the best values in columns 1, …, n in matrix V.

To define the negative ideal solution A-, the smallest value of the positive indices and the largest value of the negative indices are selected:

$$A^- = \{V_1^-, V_2^-, \ldots, V_n^-\}$$

where V_1^-,…, V_n^- represent the worst values in columns 1, …, n in matrix V.

Step 4: Distances of each alternative from the positive ideal solution and negative ideal solution (d1+ and d1-)

The distance from the positive ideal solution di+ is calculated as:

$$d_i^+ = \sqrt{\sum_{j=1}^{n} (V_{ij} - V_j^+)^2} \quad , \quad i = 1,2,\ldots,n$$

The distance from the negative ideal solution di- is calculated as:

$$d_i^- = \sqrt{\sum_{j=1}^{n} (V_{ij} - V_j^-)^2} \quad , \quad i = 1,2,\ldots,n$$

Step 5: Relative closeness to the ideal solution CLi

The relative closeness of an alternative to the ideal solution is calculated as:

$$CL_i = \frac{d_i^-}{d_i^- + d_i^+} i = 1,2,\ldots,n$$

Where CLi varies from 0 to 1, and a larger CLi represents higher desirability.

A.H.P.

Decision-making refers to selecting or prioritizing one solution from a set of solutions. M.C.D.M. techniques have been increasingly considered in recent years. The A.H.P. is a popular M.C.D.M. approach and reflects humans' natural behavior and thinking. It investigates complex problems based on their interactions and solves them in a simplified form. The comparison of only two alternatives is simple. However, the comparison becomes complex when the number of alternatives to be compared increases, and it is required to obtain the consistency rate to validate the comparisons. Research has shown that an inconsistency rate below 0.10 represents acceptable comparison consistency; otherwise, the comparisons must be reconsidered. The consistency rate is calculated in the following steps:

Step I: Calculating the weighted sum vector

The pairwise comparison matrix is multiplied by the relative weight column vector in order to obtain the weighted sum vector.

Step II: Calculating the consistency vector

The elements of the weighted sum vector are divided by the relative priority vector to find the consistency vector

Step III: Calculating λ_{max}

Here, λ_{max} is obtained using the mean of the consistency vector elements.

Step IV: Calculating the consistency index

The consistency index is defined as:

$$CI = \frac{\lambda_{max} - n}{n-1}$$

Where *n* is the number of alternatives.

Step V: Calculating the consistency ratio

The consistency ratio is obtained by dividing the consistency index by the random index.

$$IR = \frac{CI}{RI}$$

Table 1 reports the random index.

Table 1. Random index

N	١	٢	٣	٤	٥	٦	٧	٨	٩	١٠
RI	٠	٠	٠/٥٨	٠/٩	١/١٢	١/٢٤	١/٣٢	١/٤١	١/٤٥	١/٥١

Data Collection

Data were collected by reviewing the literature and interviewing and surveying experts in stock market exchanges. Furthermore, data were collected and processed using the audited financial statements of companies, the T.S.E. software pack, and the I.S.S.O. investment database to calculate the indices.

Research Area

This study sought to evaluate the return, risk, and liquidity parameters. The research area consisted of the investing companies of the I.S.S.O., companies listed on the T.S.E., and the 100 companies with the highest liquidity in the T.S.E. The research period included 2016-2020.

Statistical population and samples

The statistical population consisted of I.S.S.O. companies and other corporations listed on the T.S.E. during 2016-2020. To compare the liquidity of the I.S.S.O. companies, the top 100 liquid companies were used. A panel of thirteen experts in investing, stock exchange, and I.S.S.O. investment regulations was interviewed to collect expert views.

Data Analysis

This study adopted a mixed methodology. First, a literature review was used to identify the portfolio performance indices of the I.S.S.O. Then, thirteen experts were interviewed until theoretical saturation had been achieved. The portfolio performance criteria of the I.S.S.O. were identified through thematic analysis. The Delphi method was used to validate the indices. The indices were prioritized using A.H.P. and expert views, ranking the indices based on the index weight vector. Expert interviews and thematic analysis were utilized to introduce solutions for portfolio performance improvement, and the Delphi method was used to ensure the effectiveness of the solutions. The portfolio performance improvement indices were prioritized and quantified using the

A.H.P., proposing a model to improve the portfolio performance of the I.S.S.O. using expert views and T.O.P.S.I.S.

Questionnaire reliability and validity

The reliability of a questionnaire indicates the degree to which the outcomes would be the same if the parameter under study were re-surveyed by the same questionnaire under the same conditions. In other words, it represents whether the questionnaire can be utilized in similar applications while yielding the same outputs. In the A.H.P., the inconsistency rate is calculated to measure reliability. It reveals whether the expert responses could be more consistent. A re-survey is required when the inconsistency rate is above the threshold (10%). Apart from the consistency rate, the questionnaires were handed out to experts in two stages to implement a retest and evaluate the differences between the responses in the two stages. The consistency of the responses in the two stages represents reliability. Validity implies whether the questionnaire measures the parameter under study precisely. The questionnaire would be valid since the experts verified it.

Results

Return

To calculate the return of I.S.S.O., the dividends, stock sale profits, and value difference (the difference between the initial and final values during the year) were calculated and summed; then, the sum was divided by the initial daily value. The returns of the companies listed on the T.S.E. were also calculated based on the growth of the T.S.E. index.

Moreover, the portfolio returns were calculated based on the portions of companies owned by the I.S.S.O. during 2016-2020, as shown in Table 2.

Table 2. Return during 2016-2020

Year	2016	2017	2018	2019	2020	Mean
ISSO	-٣,١٥	١٨,٠٧	٧٨,١٥	١٩٢,٦٣	١٧٥,٩٣	٥٧,٧
Companies listed on TSE	-٣,٧	24	٨٥	١٨٧	149	٥٨,٤

As can be seen, the total T.S.E. return was higher in 2017 and 2018, whereas the I.S.O. had higher returns than the T.S.E. in 2016, 2019, and 2020. The I.S.S.O. had a smaller geometric mean of return than the companies listed on the T.S.E.

Risk

As can be seen, the I.S.S.O. had lower risks during 2016-2019 than the companies listed on the T.S.E., while the risk of the companies listed on the T.S.E. was smaller than that of the I.S.S.O. in 2020. The companies listed on the T.S.E. had a smaller geometric mean of risk than the I.S.S.O. during 2016-2020.

Table 3. Risk during 2016-2019

Year	2016	2017	2018	2019	2020	Mean
ISSO	۹,۲۷	۹,۸٤	۱۹,٥	۲۰,٦۹	۲٥,۷٤	۱٥,۷
Companies listed on TSE	۱۰,٥	۱۳,۸	۲۱,۸۹	۲۱,۱۸	۲۳,٤٥	۱۷,٤

Sharpe ratio

The Sharpe ratio was calculated based on the risk-free (R.F.R.F.) return rate equivalent to the interest rate of participating bonds, as shown in Table 4.

Table 4. Sharpe ratio during 2016-2020

Year	2016	2017	2018	2019	2020	Mean
ISSO	-1.96	۰,۳1	۳,۲4	۸.59	٦.25	۳
Companies listed on TSE	۱.78	۰..65	۳,۲	۸,۱2	٥,۷1	۳.1

A portfolio with a larger Sharpe ratio has higher performance. As can be seen, the I.S.S.O. had higher Sharpe ratios in 2019 and 2020, while its Sharpe ratio was lower than the T.S.E. in 2016 and 2017. The mean Sharpe ratio of the T.S.E. was greater than that of the I.S.S.O.

Liquidity

Table 6 reports the top ten companies with the highest liquidity on the T.S.E. As can be seen, only 33 of the 100 companies belonged to the I.S.S.O.

Three of the 33 companies were owned by the I.S.S.O. above 50%, and the I.S.S.O. ownership of 18 was lower than 1%. The I.S.S.O. companies listed on the T.S.E. had a total value of 56,000 billion IRR, while the other companies on the T.S.E. had a value of 1,626,000 billion IRR. Therefore, only 3.5% of the stock value of the I.S.S.O. was in the top 100 liquid companies. Furthermore, only 13 of the top 50 liquid companies on the T.S.E. belonged to the I.S.O., accounting for 0.5% of the total value (i.e., 8,196,000 billion IRR).

Table 5. I.S.S.O. companies in the list of the top 100 liquid companies in 2020

No.	Company	Ownership (%)	Stock Value	No.	Company	Ownership (%)	Stock Value
١	Ghadir Petrochemical Co.	٦٧,٥٧	١٣٩٢,٤	١٨	B.I.D.C.I.M. Holding	٠,١٣	١٤,٤
٢	PIIC Group	٦٧	٩٢٥٣,٣	١٩	Paxan Co.	٠,١٢٤	٢١,٦
٣	Fars and Khuzestan Cement Co.	٦٢,٨	٤٩٠١,٢	٢٠	Amin Pharmaceutical Co.	٠,١٠٩	٠,٢
٤	Esfahan Steel Co.	٥٥,٩٤	٢٢٥٠٩,١	٢١	Ghaltaksazan Sepahan Co.	٠,٠٨٣	١٥
٥	Shahroud Cement Co.	٥١,٦٣	٧٨٢,٦	٢٢	Machine Sazi Arak	٠,٠٦٤	٢٩,٨
٦	Abadan Petrochemical Co.	٣٤,٤٧	٥٦١,٦	٢٣	South Kaveh Steel Co.	٠,٠٥٦	٧٥,٩
٧	Khuzestan Cement Co.	٢٣,٥	٨٢٧,٧	٢٤	Khuzestan Steel Co.	٠,٠٥٥	١٠٩,٨
٨	Shazand Petrochemical Co.	١٦,٦٩	١٨٧٨,٩	٢٥	Civil Pension Fund Inv.	٠,٠٥	٣٢,٣
٩	Sepahan Cement Co.	١٢	٥٧٠,٢	٢٦	Pars Arian Fund Inv.	٠,٠٥	٢٩,٣
١٠	Melat Insurance Co.	١٠,٧٣	٣٢٧,٩	٢٧	Fajr Petrochemical Co.	٠,٠٤٧	٣٥,٧
١١	Mazandaran Cement Co.	١٠	٢٠٠,٩	٢٨	Kermanshah Petrochemical Co.	٠,٠٤٥	٤٤,٧
١٢	Amin Reinsurance Co.	٦,٩٧	٢٠٠,١	٢٩	Ghadir Investment Co.	٠,٠٤٤	١٠٥,١
١٣	Dana Insurance	٦,٤٥	٣١٢,١	٣٠	Mobile Telecommunication Co.	٠,٠٣	٥٠,٨
١٤	Mobarakeh Steel Co.	٤,٤	١١١١٩,١	٣١	Parsian Oil and Gas Development Co.	٠,٠٢٨	٣٩,٤
١٥	Shargh Cement Co.	٣,٧	٢٢٢,١	٣٢	Kerman Motor	٠,٠٢	٢,٨
١٦	Pardis Petrochemical Co.	٠,٤٦	٤٩٣,٢	٣٣	Parsian Insurance	٠,٠٠٢	٠,٧
١٧	Rail Pardaz Seair Co.	٠,١٦٢	٢٤	Total			٥٦١٨٣,٨

T.O.P.S.I.S. ranking

The T.O.P.S.I.S. was employed to rank the I.S.S.O. portfolio relative to the other companies listed on the T.S.E. based on the risk, return, liquidity, and Shape ratio. The five-point Likert scale was adopted to obtain liquidity ranks, in which the scores of 1, 2, 3, 4, and 5 represented very bad, bad, moderate, sound, and excellent, respectively. As the I.S.S.O. had a low liquidity contribution to the top 10 liquid companies, a score of 2 was assumed to represent a poor liquidity rank. In contrast, a score of 4 represented a good liquidity rank.

Table 7. Geometric means of the return, risk, and Sharpe ratio

Alternative - Criterion	Return	Risk	Sharpe Ratio	Liquidity
ISSO	٧٥,١	١٦,٨٣	٣,٢١	٢
Companies listed on TSE	٧٤,٦	١٨٠٥	٣,١٢	٤

As mentioned, the companies would be ranked using the T.O.P.S.I.S. in five steps.

Step 1: The decision matrix was undimensionalized using $r_{ij} = \frac{r_{ij}}{\sqrt{\sum_{i=1}^{m} {r_{ij}}^2}}$, as shown in Table 8.

Table 8. Undimensionalized decision matrix

Alternative - Criterion	Return	Risk	Sharpe Ratio	Liquidity
ISSO	٠/٧١	٠/٦٨	٠/٧٢	٠/٤٥
Companies listed on TSE	٠/٧٠	٠/٧٣	٠/٧٠	٠/٨٩

Step 2: The undimensionalized weighted sum vector was calculated as $V = D \times w_{n \times n}$.

Since the same weight was initially assigned to all the criteria, a weight of 25% was applied to the criteria, as shown in Table 9.

Table 9. Undimensionalized weighted matrix

Alternative - Criterion	Return	Risk	Sharpe Ratio	Liquidity
ISSO	٠/١٧٠	٠/١٧٧	٠/١٧٩	٠/١١٢
Companies listed on TSE	٠/١٨٣	٠/١٧٦	٠/١٧٤	٠/٢٢٤

Step 3: The positive ideal and negative ideal solutions were determined. The largest value of each positive criterion and the smallest value of each negative criterion would be selected to determine the ideal solution. To

determine the negative ideal solution, on the other hand, the most significant value of each negative criterion and the smallest value of each positive criterion were selected, as shown in Table 10.

Table 10. Undimensionalized weighted matrix with the positive and negative ideal solutions

Positive ideal solution	٠,٢٢٣٦٠٦٨	٠,١٧٩٢١٢٥	٠,١٧٧٣٥٣٣	٠,١٧٠٤٧٢٢
Negative ideal solution	٠,١١١٨٠٣٤	٠,١٧٤٣٠٦٨	٠,١٧٦١٩٨٢	٠,١٨٥٨٦٤٠

Step 4: The distance from the positive ideal solution $d_i^+ = \sqrt{\sum_{j=1}^{n}(V_{ij} - V_j^+)^2}$ and the distance from the negative ideal solution $d_i^- = \sqrt{\sum_{j=1}^{n}(V_{ij} - V_j^-)^2}$ were calculated, as reported in Table 11.

$$d_1^+ = \sqrt{(0/1118 - 0/2236)^2 + (0/1792 - 0/1792)^2 + (0/1773 - 0/1773)^2 + (0/1704 - 0/01740)^2}$$

$$= 0/11180$$

$$d_2^+ = \sqrt{(0/2236 - 0/2236)^2 + (0/1743 - 0/1792)^2 + (0/1762 - 0/1773)^2 + (0/1829 - 0/0104)^2}$$

$$= 0/01338$$

$$d_1^- = \sqrt{(0/1118 - 0/1180)^2 + (0/1792 - 0/1743)^2 + (0/1773 - 0/1762)^2 + (0/1704 - 0/1829)^2}$$

$$= 0/1338$$

$$d_2^- = \sqrt{(0/2236 - 0/1180)^2 + (0/1743 - 0/1743)^2 + (0/1762 - 0/1762)^2 + (0/1829 - 0/1829)^2}$$

$$= 0/11180$$

Table 11. Distances from the positive and negative ideal solutions

d_1^+	d_2^+	d_1^-	d_2^-
0.11180	0.01338	0.13338	0.11182

Step 5: Relative closeness to the ideal solution was obtained using $CL_i = \frac{d_i^-}{d_i^- + d_i^+}$.

$$CL_1 = \frac{d_1^-}{d_1^- + d_1^+} = \frac{0/01338}{0/01338 + 0/11180} = \frac{0/01338}{0/12518} = 0/1069$$

$$CL_2 = \frac{d_2^-}{d_2^- + d_2^+} = \frac{0/1118}{0/1118 + 0/01338} = \frac{0/1118}{0/12518} = 0/8931$$

Table 12 reports the relative closeness results for five scenarios.

Table 12. Relative closeness under five scenarios

Scenario	CL_i	
	I.S.S.O.	Companies listed on T.S.E.
The same weights of the risk, return, Sharpe ratio, and liquidity (25%)	0 /1069	0/8931
Return weight 55%, risk weight 15%, Sharpe ratio weight 15%, and liquidity weight 15%	۰/۱۱۱۲	۰/۸۸۸۹
Risk 55%, return weight 15%, Sharpe ratio weight 15%, and liquidity weight 15%	۰/۲۹۰۲	۰/۷۰۹۸
Liquidity weight 55%, risk weight 15%, Sharpe ratio weight 15%, and return weight 15%	۰/۰۳۱٦	۰/۹٦۸٤
Sharpe ratio weight 55%, risk weight 15%, return weight 15%, and liquidity weight 15%	۰/۱٦۳٦	۰/۸۳٦٤

As can be seen, the I.S.S.O. companies had lower ranks than the other companies listed on the T.S.E. under all five scenarios.

Portfolio performance improvement solutions for the I.S.S.O.

Expert interviews and thematic analysis were used to introduce solutions for the portfolio performance improvement of the I.S.S.O. The Delphi method was employed to ensure the effectiveness of the solutions. Then, the portfolio performance improvement indices were prioritized and quantified using the A.H.P.

Ranking of indices based on the weight vector

Once the portfolio performance indices had been identified by reviewing the literature and interviewing experts based on theoretical saturation and thematic analysis, the Delphi method was employed to validate the indices. Then, the indices were prioritized using the A.H.P. based on their weights, as reported in Table 13.

Here, λ_{max} is the average of the consistency vector elements.

$$\lambda_{\max} = \frac{\lambda_{\max 1} + ... + \lambda_{\max 6}}{6} = 6.09$$

The inconsistency index was calculated as follows:

$$C.I = \frac{\lambda_{\max} - n}{n-1} = \frac{6.09 - 6}{6-1} = 0.018$$

Where n is the number of indices.

Table 13. Consistency matrix and consistency vector

Index	Liquidity	Return and Risk	Compliance	Desirability	Participation	Feasibility	Weighted Sum	Weight	Consistency Vector
Liquidity	0/16	0/17	0/18	0/13	0/16	0/16	0/97	0/16	6/10
Return and Risk	0/28	0/30	0/40	0/27	0/40	0/22	1/86	0/30	6/15
Compliance	0/15	0/13	0/17	0/17	0/20	0/21	1/04	0/17	6/10
Desirability	0/15	0/14	0/12	0/12	0/09	0/12	0/76	0/12	6/06
Participation	0/14	0/11	0/12	0/19	0/14	0/17	0/86	0/14	6/07
Feasibility	0/10	0/14	0/08	0/11	0/09	0/10	0/63	0/10	6/06

The consistency rate was obtained by dividing the inconsistency index by the random index based on the number of indices (1.24 for six indices):

$$C.R = \frac{C.I}{R.I} = \frac{0.018}{1.24} = 0.014$$

The inconsistency rate of the comparisons was found to be 0.014 (<0.1). Therefore, the comparisons were reliable.

The indices were ranked in the order of:

(1) Return and risk

(2) Regulation compliance (at different levels, e.g., corporate governance)

(3) Liquidity

(4) Participation

(5) Desirability (e.g., fitting organizational tasks and strategies and socio-environmental impacts)

(6) Feasibility (of proposals and modifications in the short run)

I.S.S.O. portfolio performance improvement model

The effectiveness of the solutions was verified using the Delphi method, and they were prioritized and quantified using the A.H.P. Then, expert views and T.O.P.S.I.S. were employed to rank the solutions and develop a portfolio performance improvement model for the I.S.S.O., as shown in Table 14.

Table 14. Ranks of the portfolio performance improvement solutions

Solution	CL	Rank
Handling non-profitable, low-return, and out-of-strategy companies	0/5908	١
Portfolio modification based on liquidity	0/5683	٢
Effective stock market-making	0/5393	٣
Return-based stock risk management	0/3778	٤
Synergy between the portfolio and value chain completion	0/3618	٥
Value-added creation approach to stock management and exchange	0/3367	٦
Involvement of the private, public, and foreign sectors	0/3026	٧

Based on the CL values of the solutions, handling the non-profitable, low-return, and out-of-strategy companies is the optimal solution for the portfolio performance improvement of the I.S.S.O., with portfolio modification based on liquidity, effective stock market-making, return-based stock risk management, synergy between the portfolio and value chain completion, and value-added creation approach to stock management and exchange having the second-fifth ranks, respectively.

Questionnaire reliability and validity

Expert views are exploited to complement the decision matrix in T.O.P.S.I.S. A decision matrix is a mathematical matrix that evaluates alternatives based on criteria. Therefore, as with statistical questionnaires, the conceptual variable is not measured; the alternatives are scored for each criterion by experts. Hence, validity and reliability do not apply to the decision matrix. However, the face validity and content validity of the questionnaire were verified by the experts. Since the experts had verified the A.H.P. questionnaire, its validity was confirmed

Discussion and Conclusion

As mentioned in this article, with the help of a combined method, firstly, based on library and documentary studies, the background of the research on the indicators of the status of stock market investment portfolios of the Social Security Organization was collected. Then, using interviews with thirteen experts and experts and based on theoretical saturation, the indicators of the social security organization's portfolio of assets have been identified and extracted using theme analysis. In order to ensure the validity of the indicators, the Delphi method was used. With the hierarchical analysis method and the participation of experts, the indicators were prioritized. Based on the output of

the hierarchical analysis method, the ranking of the indicators was calculated according to the weight vector of the indicators. Also, to identify and introduce solutions to improve the performance of investment portfolios, the method of interviewing experts and using theme analysis was used, and the Delphi method was used to ensure the appropriateness of solutions and implementation proposals. Prioritization and quantification of indicators of improvement and improvement of performance were done with the Analytical Hierarchy Process (A.H.P.) and based on the opinion of experts and using the T.O.P.S.I.S. method, a model for improving the portfolio of stock market investments of the Social Security Organization was presented.

It was found that the portfolio of the I.S.S.O. had lower returns than the other companies listed on the T.S.E.; however, it had poor liquidity. The Sharpe ratio indicated that the other companies on the T.S.E. had higher portfolio performance than the I.S.S.O. The T.O.P.S.I.S. revealed that the I.S.S.O. companies had lower ranks than those listed on the T.S.E. under all five weighting scenarios. It was found that the I.S.S.O. portfolio had poor return and liquidity performance. Several solutions were proposed in order to improve the portfolio performance of the I.S.S.O. These solutions were identified through expert interviews and thematic analysis. Once the effectiveness of the solutions had been ensured through the Delphi method, they were prioritized and quantified using the A.H.P. Finally, a portfolio performance improvement model was developed through expert views and T.O.P.S.I.S. Based on the proposed Model, it is suggested that the portfolio of the I.S.S.O. be modified.

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