Original Article

Providing a model for allocating resources and choosing investment type using Data Envelopment Analysis (DEA) (Case Study: Social Security Organization)

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ABSTRACT

The manner of allocating resources and choosing the type of investment, considering the nature of activities of social security organization, which has a huge responsibility and should be accountable against the people and pension savings of retirees, is very important because the main task of the organization is the proper financing of the funds of the people. The methodology of this research has been functionally and descriptively described based on the results and objectives. The library and field methods are used to collect the required information and the data analysis and selection of the investment portfolio were carried out using the GAMS software. The data of this research are extracted from social security financial statements from 2004 to 2013. The purpose of this research is to provide a model for choosing the right combination of investments in accordance with the obligations of the social security organization. considering the inclusion of data related to the organization and the data analysis, as well as determination of the insurance rate on the output of the model, which represents the insurance rate for the studied years, suggests that, given the insurance rates received, the organization is bankrupt, and with this process the amount of this bankruptcy is increasing. In this study, considering the status of the organization, by studying the results of the actuarial report and short and long-term sources, as well as the limits of assets and outputs to exit the bankruptcy crisis, a portfolio of investments was identified using the proposed model.

Keywords: Determination of Income Maximum Algorithm, Investment Strategies, Resource Allocation, Choice of Investment Type, Social Security Organization

Introduction

The discussion of buying stocks and creating portfolios is one of the most important issues of management. The social security organization, in accordance with its Charter governing its activities, is a social insurance organization whose main mission is to cover the insurance of paid workers (compulsory), and self-employed entrepreneurs (optional). This organization is a public non-governmental organization whose funding comes from the acquisition of premiums (under participation of the insured and employer) and it is not reliant on government resources for the provision and delivery of services. The mainstay of this organization is the tripartite participation of employers, the insured and the government in various policy areas, large-scale decisions and financing. Given the huge cost of providing insurance and health services to more than 40 million covered people, as well as the premiums paid by the productive forces and workers today, who have a major contribution to the total inputs to the social security fund, another potential source of income of the organization to cover part of its long-term commitment to retirees and pensioners, is benefits from investing savings of the insured. Social insurance and pension insurance organizations, based on scientific principles and global experiences, to maintain the continuity of their services, are required to maintain the value of the reserves formed from the premium received from employees and increase it over time. In other words, in order to meet the future commitments of these organizations, it is necessary to

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use the funds in a centralized manner and utilize synergies in different fields of investment. Social and economic activities of the social security organization have begun on the basis of such requirements and continued to grow, and today, given the challenges posed by the increase in the number of pensioners and entry of the fund into the old age, besides making efforts to restore balance to resources and expenditures, the issue of economic activity and investment of these organizations should be taken into consideration more seriously. The purpose of this research is to provide a model for choosing the right combination of investments in accordance with the obligations of the social security organization. In this regard, considering the inclusion of data related to the organization and the data analysis, as well as determination of the insurance rate on the output of the model, which represents the insurance rate for the studied years, suggests that, given the insurance rates received by the organization, the organization is bankrupt, and with this process the amount of this bankruptcy is increasing. In this regard, the amount of investment of different assets of the organization in the studied period was provided to exit from bankruptcy and reach normal levels. Based on the study of previous domestic and foreign research done, there are still gaps in modeling and selecting the optimal investment portfolio, which may be due to the strong economic fluctuations and the complexity of understanding the specific statistical distribution of decision variables. Therefore, a solution to determine the maximum possible income of investment strategies is the use of multi-criteria decision-making methods and mathematical optimization is an appropriate tool for selecting portfolios and managing them. Investment companies, funds, etc., whose main activity is to create portfolios, can first determine their strategy, then differentiate it into different contexts and choose their portfolios using an ideal planning. Using a portfolio of efficient companies for investing will reduce the risk of investment and choosing the appropriate portfolios. Also, using the results of the model, after the ranking the companies, we can analyze their sensitivity and identify the weaknesses and the impact of the variables, in order to increase efficiency of companies and organizations. In this research, after reviewing the status of the organization in a ten-year period and the amount of different investments in the social security organization, a model is provided based on Data Envelopment Analysis and ideal planning and considering efficiency of several equity indices for investment on stock exchange and portfolio selection for the organization. This model uses an asset management strategy (collections of investment rules) so that, at any moment in the decision making, the total value of the asset is over the liabilities of the fund (which is actually measuring the future flow of the debt fund). Another goal of this strategy is to minimize the premium rate by using the employer and active staff of the fund. This includes the manner of adjustment (at any moment in the decision) of the appropriate premium rate and an appropriate investment strategy for the financial sources available to the fund. The model objective function is the expected current value of the fund's premiums. In other words, our goal is to minimize the total cost of the fund compared to the budget, so that there is a balance and a margin of confidence.

Background of the research

Bayat et al. (2015) investigated the optimal investment strategies for the stock market in a paper entitled "Optimal Portfolio Selection Process by the Method of Value at Risk" [1]. In this study, in addition to describing the process of computing the value at risk, its implementation on an investment portfolio, based on portfolio shares returns, portfolio returns, portfolio risk, taking into account an emphasis on the value at risk without considering a specific hypothesis. Afshar et al. (2015) investigated optimal investment strategies based on clustering using genetic algorithm in a research entitled "Optimal portfolio selection based on clustering using genetic algorithm" [2]. The results of this research show that in a more clustered manner, investors' tastes can be applied in the portfolio selection, which allows investors to get more desirability, while without clustering, the investors' preferences and tastes are not considered in the portfolio selection. Ebrahimi et al. (2015), in a study entitled "Comparison of the Investment Period in Selecting the Optimal Portfolio Using the Conditional Value at Risk Index", studied the optimal investment strategies using the Conditional Value at Risk Index [3]. The results showed that considering the two levels of confidence of 33% and 30% in this study, leads to different results in selecting portfolios during risk aversion change. Therefore, the level of confidence the investor seeks will lead to change in the composition of the proposed portfolio. The research showed that in the 0-day investment period, the investor would suffer losses. Therefore, the investment period should be longer than 0 days in order to compensate for the losses. Falahpour et al. (2014) investigated the investment optimal strategies using a sustainable model in a research entitled "Application of the Sustainable Model in Selecting Optimal Portfolios" [4]. The results of out-of-sample test in the study showed that the sustainable portfolio had a better performance than the Markowitz portfolio (which expected returns are consistent with the expected return on the sustainable portfolio), based on the Sharp index. Kim (2015) studied the investment strategies in a research entitled "Some experimental facts about investment strategies" [5]. The researcher in this paper studied the empirical facts about investment strategies related to the allocation of assets of general investors. By analyzing the background of investment, the index of the risk of returning bonds to a large extent was related to the level of current performance and type of stock and affected the business cycle. In this study, considering these factors, the characteristics of account, average, variance and fluctuations of stocks and bonds are estimated. Based on the estimates, the investment climate for the next five years is likely to be very weak. As a result, the work environment for asset managers and general investors is expected to be much worse than the past three decades.

Spottkin et al. (2015) investigated the investment strategies in a research entitled "The Relationship between the Profitability of Investment Strategies and Functioning of the Market of Romanian Investing Companies". In this research, researchers have argued that defining, implementing and overseeing the investment strategies are important coordinating factors for administrating companies among investors, and they may significantly affect investors' perceptions of financial performance. In this research, the researchers examined the assumption that effective investment strategies had a major impact on the net asset value (NAV) reported by investment firms, and implicitly on stock prices. The research is followed by identifying a specific pattern of portfolio structure from these individuals and measuring some correlation with the market performance. In this paper, a trade or premium discount is defined as the price of a unit of net asset value (NAVPU) in order to measure investors' perception according to the asset management function defined as market performance. The correlation test has been used as an effective analytical method in relation to inventory data and asset management industry. Iyoloythis et al. (2014) investigated the investment strategies in a research paper titled "Investment Strategies and Strategies for a Manager of the Fund for Optimization of Average Variance" [6]. In this study, they introduced a continuous mathematical framework for solving dynamic variance control problems. By obtaining theoretical results for two classes of functions: the first, depends on the path spectral of the control process and the 2nd, is value of its final time. These results are capable of developing numerical methods for the mean of variance problems for a predetermined coefficient for risk aversion. Antonioty et al. (2014) investigated the investment strategies in a research entitled "Green Tangible Investment Strategies and Export Performance, an Investigation at the Level of Enterprise" [7]. In this study, they empirically investigated the relationship between investment in environmental equipment and export performance of the company. In this paper, the researchers adopted a two-stage model that we first estimated the impact of green tangible investment strategies (GTIS) on the level of Total Factors Productivity (TFP), and then evaluated the productivity from the desire and intensity of exports. The results of the research showed that companies with higher productivity, among other factors of green investments, including the environmental mix and the goals of increasing revenue, show higher export productivity. Specifically, the increased productivity level of GTIS increases the likelihood of exports in foreign markets by adjusting the environment more precisely. Leser et al. (2014) investigated the investment strategies in a research entitled "Investment Strategies Based on the Belief in Green Social Responsibility, Screening Activity Issues. [8]" In this study, analyzing more than 200 sustainable investment international funds, they conclude that investment based on beliefs and green social responsibility, should be considered as a different way in this area of sustainable investment. While social responsibility and green funds tend to non-crisis markets and faith-based funds in each and every similar market situation, as well as their own conventional situations. Suitable screening activities of budgeting significantly contribute to the financial performance of sustainable investment in international markets. Specifically, social screens lead to poor performance of social responsibility, while the energy screens lead to green budget performance.

Methodology of the Research:

The research method is descriptive-applied with the approach of mathematical modeling. The research community of this research is also the Social Security Organization. After collecting the financial statements of the social security organization and implementing the mathematical model presented with these data in GAMS software, the investment strategies of this organization were defined.

Mathematical Model

The objective function of the model is the expected current value of the fund's premiums. In other words, our goal is to minimize the total cost of the fund compared to the budget, so that there is a balance and a margin of confidence. In this study we will have two stages of modeling. First, we will review and present a model for examining the financial statements and type of social security organization's investments and forecast the organization's process over a 10-year period. In the following, after reviewing the organization, using an ideal planning model and data envelopment analysis method, we will present a method for selecting the optimal stock portfolio and appropriate investment for this organization.

- **Mathematical model for examining financial statements and type of investment:**
  - **Parameters:**

ρ 0: The scale factor that translates the initial cash position into monetary value (set to 1, for simplicity). I = number of paths

K (I, t) = Return node function (for example, the number of groups) through which it passes through the sample path i at time t. N = number of assets.

ψ = The lower limit for finding the ratio of budget of the sample amount, to ψ it is about 1 or higher. I0 = initial payment made by this fund

ψ_{end} = Low limit to find the budget ratio, in the last time of the frame of the time period. $\xi_{(n, t)}^{low}$ = The lower limit in the position of the tool n at time t.

Pn, 0 = the initial price of the asset market and (for all, up to 1, small assets). w_t = CVaR limitation level at time t.

$V_t^{\ k}$ = The set of paths i passing from the node k at time t. τ^{low} = Low limit on the cash position.

ν = The upper bound in the relative position of the asset in the stock basket ($0 \le \nu \le 1$).

$\xi_{n, t}^{up}$ = The upper bound in the position of the tool n at time t.

A0 = total initial value of all assets. γ = discount factor for future help. k_t = a set of all nodes at time t.

W0 = total initial wage. α = confidence level in CVaR. y = lower bound in share rate.

T = number of time intervals $\bar{y}$ = upper bound in the share rate.

- ## Random data:

ρ_t^i = Equivalent to a market price for cash at time t in path i. This is a conversion factor that turns cash position variables τ and ξ into a monetary value. W_t^i = total wage at time t in path i.

L_t^i = measurement of the debt that must be met, or exceeds the total value of all assets in the fund at time t on path i.

$p_{n,t}^i$ = the market price of asset n for the period t-1 to t in path i.

l_t^i = Payment from the fund at time t on path i.

- ## Decision variables

ξ_t^k= The fabricated variable that is close to α-Var in the optimal solution at time t, for deciding in the node k.

z_t^l = The fabricated variables associated with the restriction of α-CVaR at time t and in path i. τ 0= additional amount of cash belonging to time 0

$\xi_{n,t}^k$ = total value (number of shares) of the asset n (n = 0, …, n) at time t in the node k. τ_t^i = cash amount at time t on the path belonging to i.

q^l = The amount of money borrowed at T-1 in the path I.

B^l = The size of budget deficit at time T in the path i.

Y_t^k = contribution rate at time t in the node k.

a_t: the value of all assets belonging to the fund at time t (random variables).

w_t: The wage earned by active members at time t (random variables).

y_t: The premium rate, in other words, the premium paid by the sponsor and / or the active employee as a fraction of (proper portion) of the salary at time t (decision variable).

l_t: Payments made by this fund to retirees at time t (random variables).

$x_{n,t}$: Money invested in asset n at time t (decision variable).

$r_{n,t}$: return on investment in asset n in the period t (random variable).

L_t : Debts (Future Debt Settlement Measurement) of this fund at the time t (random variable).

In addition, h (y1 …, yT) denotes an indicator of fund costs, this can be the average of participation rates or the current value of all contributions $W_t y_t$. We assume that h (y1, …, yT) is non-additive in linear parameter yt and in yt.

Relation 1

$$\sum_{n=0}^{N} x_{n,t=}A_t + W_t y_t - l_t$$

That the sum of all investments $\sum_{n=0}^{N} x_{n,t}$ is equal to assets, A_t, plus premiums $W_t y_t$ minus debts l_t. The value of the asset at time t is the sum of the investments at time t-1, $\sum_{n=0}^{N} x_{n,t-1}$.

$$A_t = \sum_{n=0}^{N} x_{n,t-1}\,(1 + r_{n,t})$$

In each period when t = 1, …, T, the debt limit must exist:

Relation 2:

$$A_t = \sum_{n=0}^{N} x_{n,t-1}\,(1 + r_{n,t}) \geq L_t$$

We consider the issue of minimizing the cost of the fund:

Relation 3:

$$\min h(y_1, \ldots, y_T)$$

Provided that the balance of debt is established, the ratio of assets to debt, A_t / L_t, is usually defined as the ratio of the fund's budget. The target budget ratio ψ can be included in the limit (2). The new limit is:

Relation 4:

$$A_t = \sum_{n=0}^{N} x_{n,t-1}\,(1 + r_{n,t}) \geq \psi L_t$$

The value of ψ> 1 is often added to this limitation to add more safety margins. For example, the value of ψ = 1.2 is an additional margin of 20% of the amount of debt.

The conditional value at risk when the equation (4) is violated indicates the deficit of available resources.

Relation 5:

$$f_\psi(x; r, L) = \psi L - \sum_{n=0}^{N} x_n\,(1 + r_n)$$

To measure this fraction we use the right and left difference of the equation (4). Therefore, we can consider the following relation instead of (4).

Relation 6:

$$f_\psi(x; r, L) \leq 0$$

If P is the size of the probability of subscript vector (r, L) with the symbol ϕψ (ζ; x), then the distribution of the cumulative probability of losses is:

$$\Phi_\psi(x, \zeta) = \Pr\big(f_\psi(x; r, L) \leq \zeta\big) = \int_{f_\psi(x;r,L)\leq\zeta}^{1} \Pr(dr, dL)$$

According to the definition of this relation includes the probability that the losses of $f_\psi(x; r, L)$ does not exceed the limit of ζ. Now, if α is a level of confidence, the equation (6) will not be violated. Inequality 6 can be expressed as follows:

Relation 7:

$$\zeta_{\alpha,\psi}(x) \leq 0$$

$$\zeta_{\alpha,\psi}(x) = \min\{\zeta \in \mathbb{R}: \Phi_\psi(x, \zeta) \geq \alpha\}$$

In this equation, the value of ζ_ (α, ψ) (x), α - is known as value at risk. The notion of limitation 7 means that the minimum loss of 100α% must be less than or equal to zero. VaR is a risk indicator whose bugs are:

This index does not take excessive losses of VaR. It may offer a contradictory picture for the level of confidence.

There is no sub-aggregate, for example, diversity of portfolios may increase the risk. The function is non-convex, therefore, it is difficult to calculate the risk management.

These disadvantages are shared by the conditional value at risk (CVaR). This is the weighted average of the var and the greater loss than the risk value. Therefore, the value at risk is defined as follows.

$$\phi_{a.\psi}(x) = \lambda\,\zeta_{\alpha,\psi}(x) + (1-\lambda)\phi_{a.\psi}(x)^{+}$$

This relation is the weighted average of var, and the probable math probability of losses is significantly more than the VAR, in which the weight is equal to:

$$\lambda = (1-\alpha)\left(\phi_{.\psi}\left(x, \zeta_{\alpha,\psi}(x)\right) - \alpha\right) \in [0,1]$$

CVaR is always greater than or equal to VaR. Therefore, we can replace Equation 7 with the following limitation.

Relation 8:

$$\phi_{\alpha,\psi}(x) \le \omega$$

For w = 0, we have a risk-related constraint that overcomes the constraint of α -VaR (7). By using a negative ω, this restriction can be made more difficult, while with ω this limitation becomes freer. Limit 8 can be written with the system of linear constraints.

Relation 9 and 10

$$\zeta + \frac{1}{I(1-\alpha)}\sum_{i=1}^{I} z^i \le \omega$$

$$\sum_{i=1}^{I}(1+r_n^i)\,x_n - \zeta \le z^i$$

$$z^i \ge 0 \quad \text{for } i = 1, \dots, I$$

In this relation z^i are artificial variables. If the constraint 9 is enabled for an answer to the problem, the corresponding optimal value, if unique, is VaR. If there are several values of ζ, then the VaR value of the endpoint of the interval is optimal. The left side of the inequality 9 equals to the CVaR value.

4-1-4- The final model of the optimization problem

Relation 11:

$$\text{Minimize} \quad W_{0y0} + \frac{1}{I}\sum_{i=1}^{I}\sum_{t=1}^{T-1}\frac{W_t^i y_t^{k(i,t)}}{(1+\gamma)^t} + \lambda_1\frac{1}{I}\sum_{i=1}^{1}\frac{q^i}{(1+\gamma)^T} + \lambda_2\frac{1}{I}\sum_{i=1}^{1}\frac{B^i}{(1+\gamma)^T}$$

Relation 12:

$$\sum_{n=0}^{N} p_{n,0}\xi_{n,0} + p_{0,0\tau0} = A_0 - l_0 + W_{0y0}$$

Relation 13:

$$\sum_{n=0}^{N} p_{n,t}^i\left(\xi_{n,t}^{k(i,t)} - \xi_{n,t-1}^{k(i,t-1)}\right) + p_t^i(\tau_{t-1}^i) = W_t^i y_t^{k(i,t)} - l_t^i, t = 1, \dots, T-1, \forall i$$

Relation 14:

$$\psi L_t^i - \sum_{n=0}^{N} p_{n,t}^i\,\xi_{t-1}^{k(i,t-1)} - p_t^i\tau_{t-1}^i - \zeta_t^{k(i,t-1)} \le z_t^i\forall_i, t = 1, \dots, T$$

Relation 15:

$$\zeta_t^K + \frac{1}{(1-a)|V_{t-1}^k|}\sum_{i\epsilon V_{t-1}^k} z_t^i \le \omega_t, \qquad t = 1, \dots, T, k\epsilon K_{t-1}$$

Relation 16:

$$p_{\mathcal{T}}^i\tau_{T-1}^i + q^i \ge 0, \forall i$$

Relation 17:

$$\sum_{n=0}^{N} p_{n,T}^i\xi_{n,T-1}^{k(i,T-1)} + p_T^i\tau_{T-1}^i + B^i \ge \psi_{end}L_T^i, \forall i$$

Relation 18 and 19:

$$\frac{1}{|V_t^k|}\sum_{i\epsilon V_t^k} p_t^i\tau_t^i \ge 0, k \in K_t, t = 1, \dots, T-1$$

$$\frac{1}{v}p_{n,0}, \xi_{n,0} \le \sum_{m=0}^{N} p_{m,0}\xi_{n,0}, \forall n$$

Relation 20:

$$\frac{1}{v}p_{n,t}^i\xi_{n,t}^{k(i,t)} \le \sum_{m=0}^{N} p_m^i\xi_{m,t}^{k(i,t)} \quad \forall i, \forall n, t = 1, \dots, T-1$$

Relation 21:

$$\xi_{n,t}^{low} \le \xi_{n,t}^k \le \xi_{n,t}^{up} \qquad t = 0, \dots, T-1$$

$$\forall n, k \in K_t$$

Relation 22:

$$0 \le z_t^i, \qquad \forall i, t = 1, \dots, T$$

Relation 23:

$$0 \le \tau_0$$

Relation 24 and 25:

$$\tau^{low} \le \tau_t^i, \ \forall i, t = 1, \dots, T-1$$

$$0 \le q^i, \forall i$$

Relation 26:

$$0 \le B^i, \forall i$$

Relation 27:

$$y_0 \quad \text{is} \quad \text{free}$$

Relation 28:

$$\underline{y} \le y_t^k \le \bar{y} \qquad t = 1, \dots, T-1 \qquad \forall i, k \epsilon K_t$$

Relation 29:

1. ζ_t^k is free, $t = 1, \dots, k \in K_t$

- **A model for selecting the stock portfolio:**
  - **Ideal planning model:**

After identifying efficient companies, including 12 companies according to the table, we will select the appropriate basket of stocks from these companies. In the first approach, only the returns and risks ideals are presented in the model. In the second approach, liquidity is also added.

The objective function in this model is as follows:

Relation 50:

$$\min p_1 d_1 + p_2 d_2 + p_3 d_3$$

Where d_1, d_2, d_3 are the expected deviation of expected return, risk and liquidity of the expected value and p_1, p_2, p_3 are the coefficients of importance of each of these variables in basket selection.

- **Return restrictions**

Relation 51:

$$\sum_{i=1}^{n} R_i x_i + d_1^- - d_1^+ = r_e$$

Where x_i is the percentage of the investment of each share in the basket of shares and R_i is the geometric mean of the return of the last three years of each share and r_e is the arithmetic mean of the return on the contribution of the efficient companies. d_1^- and d_1^+ is the rate of deviation of the total returns from the expected yield of the basket.

Relation 52:

$$18.75\, x_1 + 22.82\, x_2 + \cdots + 19.36\, x_{11} + d_1^- - d_1^+ = 17.34$$

- **Risk Limits:**

Relation 53:

$$\sum_{i=1}^{n} \delta_i x_i + d_2^- - d_2^+ = \delta_e$$

Where δ_i is the standard deviation of the last three years of each share and δ_e is the arithmetic average of the standard deviation of the efficient companies. d_2^- and d_2^+ are the amount of deviations.

Relation 54:

$$5.43\, x_1 + 6.18\, x_2 + \cdots + 7.60\, x_{12} + d_2^- - d_2^+ = 4.69$$

- **liquidity limits:**

Phrase 55

$$\sum_{i=1}^{n} L_i x_i + d_3^- - d_3^+ = L_e$$

Where L_i is the rating of the liquidity of each share and L_e is the average of the arithmetic of the liquidity rating of the effective companies and d_3^- and d_3^+ the amount of deviations.

Phrase 56

$$80\, x_1 + 100\, x_2 + \cdots + 9\, x_{12} + d_3^- - d_3^+ = 43.58$$

- **system constraint:**

This limitation refers to the total percentage of investment in shares of different companies in the stock portfolio, which is set out below.

Phrase 57

$$\sum_{i=1}^{n} x_i = 1$$

This limitation is expanded in two approachs:

Phrase 58

$$x_1 + x_2 + \cdots + x_{12} = 1$$

Research Findings

- **Review of financial statements and type of investments by the social security organization**

In the following, we implemented the model data model in the GAMS software with respect to the data related to the social security organization. The inputs of this model are presented in the tables.

Table 1. Value associated with scalars model

Variable defining	The amount of	Variable defining	The amount of
Bound down for premium rates	3/0	Confidence level	0/95
Bound down the status of the fund	0	Bound down the budget rate	1/2
Bound for asset position	2/0	Bound high budget rates	1/3
Total initial value of all assets	24970078	Current value discount factor	0/15
Starting total wage	38681006	Fiscal deficit coefficient on time horizon	1
Initial payment by fund	18920358	Debt penalty coefficient at time horizon	1

Conversion factor	1	Top Bound for premium rates	0/2
Bound down relative position of an asset	0	Bound above relative position of an asset	0/2

Table 2. Total wage at time t on different Ways

	First Way	Second Way	Third Way	Fourth Way	Fifth Way	Sixth Way	Seventh Way	Eighth Way
first year	1357051450	1357051450	1357051450	1357051450	1357051450	1357051450	1357051450	1357051450
second year	1080967637	1080967637	1080967637	1080967637	1080967637	1080967637	1080967637	1080967637
third year	831955610	831955610	831955610	831955610	831955610	831955610	831955610	831955610
forth year	656593827	656593827	656593827	656593827	656593827	656593827	656593827	656593827
fifth year	446856543	446856543	446856543	446856543	446856543	446856543	446856543	446856543
sixth year	348352760	348352760	348352760	348352760	348352760	348352760	348352760	348352760
seventh year	270650617	270650617	270650617	270650617	270650617	270650617	270650617	270650617
eighth year	202137933	202137933	202137933	202137933	202137933	202137933	202137933	202137933
ninth year	153459060	153459060	153459060	153459060	153459060	153459060	153459060	153459060
tenth year	128936687	128936687	128936687	128936687	128936687	128936687	128936687	128936687

Table 3. The amount of CVaR limits in different years

Year	CVaR restriction level at the beginning of each year	The limit of CVaR
First Year	0	30000416
Second Year	0	39322199
Third Year	0	52318031
Fourth Year	0	68493490
Fifth Year	0	91370351
Sixth Year	0	115280898
Seventh Year	0	137653921
Eighth Year	0	159118815
Ninth Year	0	211123972
Tenth Year	0	289344269

Table 4. Definition of parameters

Number	Initial asset price in the market	Asset price
First asset	0/77	19304899
Second property	0/03	691372
Third asset	0/02	550015
Fourth estate	0/14	3472636
Fifth asset	0/03	861861
Sixth asset	0/01	89295

Table 5. The upper bound of the tool position in different directions and times

	First Way	Second Way	Third Way	Fourth Way	Fifth Way	Sixth Way	Seventh Way	Eighth Way
First Year	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}
Second Year	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}
Third Year	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}
Fourth Year	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}
Fifth Year	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}
Sixth Year	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}

Seventh Year	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}
Eighth Year	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}
Ninth Year	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}
Tenth Year	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}	9×10^{17}

Table 6. Fund payments at time t on different Ways

	First Way	Second Way	Third Way	Fourth Way	Fifth Way	Sixth Way	Seventh Way	Eighth Way
First Year	1	3	1	2	2	3	1	1
Second Year	2	1	1	2	1	2	1	2
Third Year	1	1	3	1	3	1	3	1
Fourth Year	2	1	3	2	3	2	3	2
Fifth Year	3	2	1	3	1	2	3	3
Sixth Year	2	1	1	2	1	1	2	2
Seventh Year	1	2	1	1	1	2	1	1
Eighth Year	3	3	3	3	3	2	1	1
Ninth Year	2	2	2	2	2	1	3	1
Tenth Year	1	1	1	1	1	2	3	1

Table 7. Equivalent to market prices for assets in different ways

	First Way	Second Way	Third Way	Fourth Way	Fifth Way	Sixth Way	Seventh Way	Eighth Way
First Year	5720385710	5720385710	5720385710	5720385710	5720385710	5720385710	5720385710	5720385710
Second Year	3650037840	3650037840	3650037840	3650037840	3650037840	3650037840	3650037840	3650037840
Third Year	4093769669	4093769669	4093769669	4093769669	4093769669	4093769669	4093769669	4093769669
Fourth Year	4631927000	4631927000	4631927000	4631927000	4631927000	4631927000	4631927000	4631927000
Fifth Year	80659558	80659558	80659558	80659558	80659558	80659558	80659558	80659558
Sixth Year	60794560	60794560	60794560	60794560	60794560	60794560	60794560	60794560
Seventh Year	46271635	46271635	46271635	46271635	46271635	46271635	46271635	46271635
Eighth Year	34586781	34586781	34586781	34586781	34586781	34586781	34586781	34586781
Ninth Year	26170505	26170505	26170505	26170505	26170505	26170505	26170505	26170505
Tenth Year	18920358	18920358	18920358	18920358	18920358	18920358	18920358	18920358

The results of GAMS software are presented in tables according to social security data.
The value of the objective function derived from the implementation is:

function bjectiveo 152/659 = xl VARIABLE

Table 8. Premium rates on different Ways

	First Way	Second Way	Third Way	Fourth Way	Fifth Way	Sixth Way	Seventh Way	Eighth Way
First Year	0/300	0/300	0/300	0/300	0/300	0/300	0	0
Second Year	0/171	0/171	-38/68	0/171	0/171	-38/68	0/171	0/171
Third Year	0/171	0/171	0/3	0/171	0/171	-0/278	0/171	0/171
Fourth Year	0/171	0/171	0	0/171	0/171	0/300	0/171	0/171
Fifth Year	0/175	0/175	0	0/175	0/175	0/300	0/175	0/175
Sixth Year	0/181	0/181	0	0/181	0/181	0	0/181	0/181
Seventh Year	7/054	7/054	3/39	7/054	7/054	3/39	7/054	7/054
Eighth Year	4/9	4/9	0/3	4/9	4/9	0/3	4/9	4/9
Ninth Year	0/3	3/37	4/4	3/4	3/4	3/4	3/4	3/4
Tenth Year	0/300	0/300	0/300	0/300	0/300	0/300	4/2	4/2

Table 9. The amount of investment in different years of the third Way

	Investing in stocks	Bonds	given facilities	Bank deposits	Managed funds	Real estate
First Year	0	0	0	0	0	0
Second Year	58/299	5733/954	0	0	0	0
Third Year	0	1249/123	912/470	484/720	2751/408	4579/254
Fourth Year	32/543	1268/162	2314161	266/820	3630/107	3705/585
Fifth Year	26/970	3134/217	1488/260	74/344	5423/148	21478/808
Sixth Year	34/461	2142/433	1457/697	208/813	4523/148	8116/003
Seventh Year	22/317	0	0	41/343	9471/167	18082/482
Eighth Year	15/641	791/860	1285/710	453/524	0	0
Ninth Year	16/894	1492/391	1067/686	193/863	3274/679	31582/757
Tenth Year	0/300	0/300	0/300	0/300	0/300	0/300

Table 10. Investment in different years of the sixth Way

First asset		Second asset	Third asset	Fourth asset	Fifth asset	Sixth asset
First Year	61	0	0	0	0	0
Second Year	59	842	578	0	0	1145
Third Year	35	438	257	125	1064	1549
Fourth Year	29	377	964	52	0	454
Fifth Year	15	872	0	79	1034	0
Sixth Year	7	1062	238	44	1182	0
Seventh Year	22	0	0	42	9471	18082
Eighth Year	15	791	1285	453	0	0
Ninth Year	16	1492	1067	193	3274	31528
Tenth Year	0	0	0	127	0	51614

- ## Model of stock selection in the stock exchange with regard to efficiency:

In the following, after examining the different investments in the social security organization, the study of investment in the stock exchange and the selection of appropriate portfolios using data envelopment analysis and ideal planning and considering the performance of several stock indices We will discuss the purpose of the data envelopment analysis model based on the variable representing the efficiency of each unit. If this variable is one, the unit is efficient, otherwise the unit is inefficient. After defining the objective function, we define the input constraints relating to the amount of assets and capital as follows.

✓ Entry Limits:

➢ Property Limits

Phrase 30

$$A_1\lambda_1 + \cdots + A_n\lambda_n - A_j\theta \le 0$$

Where λ_i, i-th unit of decision, A_i $i = 1.\dots.n$ is the asset of each unit to the billion Rials and A_j is the amount of assets of the jth unit of decision-making. Given that the data envelopment model is applied to each industry separately, the first part of the model for the three banking, petrochemical and pharmaceutical industries, with the corresponding digits for the first decision-making unit in each industry, is as follows.

Banking:

Phrase 31

$$181\lambda_1 + 221\lambda_2 + 312\lambda_3 + 509\lambda_4 + 181\lambda_6 + 221\lambda_7 + 312\lambda_8 - 181\theta \le 0$$

Petrochemicals:

Phrase 32

$$1314227\lambda_1 + 2555502\lambda_2 + \cdots + 5255194\,\lambda_{11} - 1314227\theta \le 0$$

Medicine:

Phrase 33

$$1509\lambda_1 + 1667\lambda_2 + \cdots + 356\,\lambda_{24} + 469\,\lambda_{24} - 1509\theta \le 0$$

➢ Capital Limitations:

Phrase 34

$$B_1\lambda_1 + \cdots + B_n\lambda_n - B_j\theta \le 0$$

Where B_i, $i = 1.\dots.n$ is the capital of the i-th decision unit, B_j the amount of assets per unit to billion Rials and B_j the capital amount of the j unit of the decision They are done.

Banking:

Phrase 35

$$8000\lambda_1 + 13200\lambda_2 + \cdots.. + 20000\lambda_7 + 45000\lambda_8 - 80000\theta \leq 0$$

Petrochemicals:

Phrase 36

$$160000\lambda_1 + 300000\lambda_2 + \cdots + 950000\lambda_{11} - 160000\theta \leq 0$$

Medicine:

Phrase 37

$$378\lambda_1 + 150\lambda_2 + \cdots + 35\,\lambda_{24} + 40\,\lambda_{24} - 378\,\theta \leq 0$$

✓ Output limits:

➢ Return on equity limits:

Phrase 38

$$C_1\lambda_1 + C_2\lambda_2 \ldots + C_n\lambda_n - C_j \geq 0$$

Where C_i is the return on equity of the i-th unit of decision-making and C_j is the return on equity of j-th unit of efficiency. This restriction is written for the three selected industries as follows:

Banking:

Phrase 39

$$1.92\lambda_1 + 1.82\lambda_2 + \cdots.. + 0.68\,\lambda_7 + 4.46\lambda_8 \geq 1.92$$

Petrochemicals:

Phrase 40

$$33.99\,\lambda_1 + 20.57\,\lambda_2 + \cdots + 42.71\lambda_{11} \geq 33.99$$

Medicine:

Phrase 41

$$32.31\,\lambda_1 + 37.31\,\lambda_2 + \cdots + 44.89\lambda_{23} + 20.07\,\lambda_{24} \geq 32.31$$

➢ Return on assets limits:

Phrase 42

$$D_1\lambda_1 + D_2\lambda_2 \ldots + D_n\lambda_n \geq D_j$$

Where D_i is the return on the assets of the i-th unit of decision-making and D_j is the return on the assets of the j-th unit of performance. This restriction is written for the three selected industries as follows:

Banking:

Phrase 43

$$28.97\,\lambda_1 + 25.77\lambda_2 + \cdots.. + 18.51\,\lambda_7 + 39.43\lambda_8 \geq 28.97$$

Petrochemicals:

Phrase 43

$$11.04\,\lambda_1 + 6\,\lambda_2 + \cdots + 21\,\lambda_{11} + 19.29\lambda_{11} \geq 33.99$$

Medicine:

Phrase 44

$$16\,\lambda_1 + 14.26\,\lambda_2 + \cdots + 11.08\,\lambda_{23} + 3.05\,\lambda_{24} \geq 16$$

✓ Net profit margin limits:

Phrase 45

$$E_1\lambda_1 + E_2\lambda_2 \ldots + E_n\lambda_n \geq E_j$$

In which E_i is the net profit margin and the i-th decision unit, and E_j is the net profit margin of the j-th unit of performance. This restriction is written for the three selected industries as follows:

Banking:

Phrase 46

$$41.74\,\lambda_1 + 11.05\,\lambda_2 + \cdots.. + 8.53\,\lambda_7 + 30\,\lambda_8 \geq 411.74$$

Petrochemicals:

Phrase 48

$$16.01\,\lambda_1 + 10.7\,\lambda_2 + \cdots + 0.15\,\lambda_{10} + 32.48\,\lambda_{11} \geq 16.01$$

Medicine:

Phrase 49

$$21.66\,\lambda_1 + 23.27\,\lambda_2 + \cdots + 11.61\,\lambda_{24} + 5.92\,\lambda_{25} \geq 21.66$$

• Ideal planning model:

After identifying efficient companies, including 12 companies according to the table, we will select the appropriate stock basket among these companies. In the first approach, only the returns and risks are presented in the model. In the second approach, liquidity is also added.

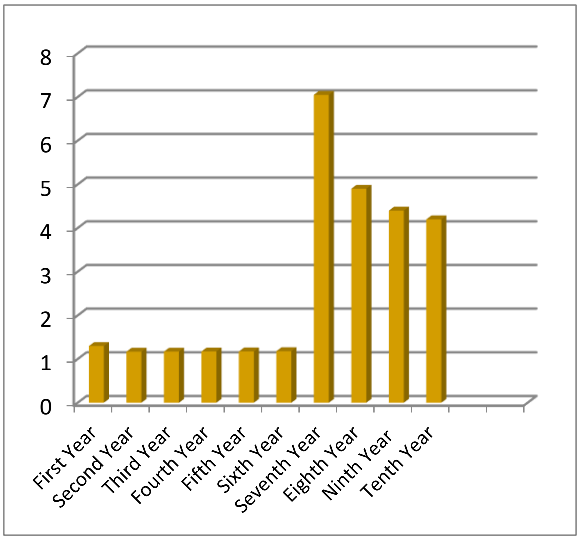

Figure 1. Trend rate trends for the 10-year period

Considering the inclusion of data related to the organization and the analysis of data with regard to determining the insurance rate at the output of the model (Figure 1), which indicates the insurance rate for the years under review, this results According to the insurance rates received by the organization, this organization is in a hurry, and with this process the amount of this instability is increasing. In this regard, the amount of investment of different assets of the organization in the period under review was provided for reaching out to the normal limit.

- **Optimal investment in stock exchange method:**

The results of the following tables are obtained by solving the models presented in the previous section using the GAMS software.

Table 11. Decision variables

Stocks	Variable	Stocks	Variable	Stocks	Variable
Eghtesad Novin Bank	x_9	Tehran Daru	x_5	Pars Daru	x_1
Parsian Bank	x_{10}	Bisoton Petrochemicals	x_6	Tehranshimi	x_2
Karafarin Bank	x_{11}	Pardis Petrochemicals	x_7	Abureyhan Daru	x_3
Sina Bank	x_{12}	Farabi Petrochemicals	x_8	Iran Daru	x_4

Table 12. The efficiency of the companies

Banking							
Pasargad Bank	0/3957142	Parsian Bank	1/000000	Eghtesad Novin Bank	1/000000	DMU	0
Karafarin Bank	1/000000	Mellat Bank	0/2000000	Saderat Iran Bank	0/1746267	Sina Bank	1/000000
Petrochemicals							
Pardis Petrochemical	1/000000	Amir Kabir Petrochemical	0/1167395	Isfahan Petrochemical	0/5307376	Abadan Petrochemical	0/4571125
Shiraz Petrochemical	0/5155782	Shazand Petrochemical	0/6096790	Zagros Petrochemical	0/6094914	Khark Petrochemical	0/8085493
Fanavaran Petrochemical		0/5897896		Farabi Petrochemical		1/000000	
Medicine							
Darupakhsh factories	0/060000	Sobhan Daru	0/250000	Farabi Daru	0/081000	Jaber Ibn-Hayyan Daru	0/0210000
Eksir Daru	0/066000	Darupakhsh Materials	0/205000	Razak Daru	0/130000	Alborz Daru	0/013800
Tehran Shimi	1/000000	Sina Daru	0/278000	Pars Daru	1/000000	Kimi Daru	0/0210000
Abureyhan Daru	1/000000	Ruz Daru	0/336000	Zahravi Daru	0/150000	Kousar Daru	0/190000
Faravardeh Tazrighi	0/340000	Amin Daru	0/251000	Loghman Daru	0/128000	Abidi Daru	0/180000
Tehran Daru	1/000000	Darupakhsh Shimi	0/306000	Iran Daru	1/000000	Razak Dellamaran Daru	0/264000

Table 13. Performance Status of Companies Involved in the Banking Industry

Banking							
Mellat Bank	Inefficient	Sina Bank	Efficient	Pasargad Bank	Inefficient	Eghtesad Novin Bank	Efficient
Karafarin Bank	Efficient	Saderat Iran Bank	Inefficient	Tejarat Bank	Inefficient	Parsian Bank	Efficient

Table 14. Performance Status of Companies Involved in the Banking Industry

Petrochemicals							
Zagros Petrochemical	Inefficient	Pardis Petrochemical	Efficient	Amir Kabir Petrochemical	Inefficient	Abadan Petrochemical	Inefficient
Shazand Petrochemical	Inefficient	Khark Petrochemical	Inefficient	Bisotun Petrochemical	Efficient	Isfahan Petrochemical	Inefficient
Shiraz Petrochemical	Inefficient	Fanavaran Petrochemical	Inefficient	Farabi Petrochemical	Efficient		

Table 15. Performance status of the companies studied in the pharmaceutical industry

Medicine							
Darupakhsh factories	Inefficient	Sobhan Daru	Inefficient	Farabi Daru	Inefficient	Jaber Ibn-Hayyan Daru	Inefficient
Eksir Daru	Inefficient	Darupakhsh Materials	Inefficient	Razak Daru	Inefficient	Alborz Daru	Inefficient
Tehran Shimi	Efficient	Sina Daru	Inefficient	Pars Daru	Efficient	Kimi Daru	Inefficient
Abureyhan Daru	Efficient	Ruz Daru	Inefficient	Zahravi Daru	Inefficient	Kousar Daru	Inefficient
Faravardeh Tazrighi	Inefficient	Amin Daru	Inefficient	Loghman Daru	Inefficient	Abidi Daru	Inefficient
Tehran Daru	Efficient	Darupakhsh Shimi	Inefficient	Iran Daru	Efficient	Razak Dellamaran Daru	Inefficient

Suggestions

According to the approved research proposal, which the RFP provided by the organization, it acknowledged that it is currently targeting investments in small-scale, low-yielding, non-strategic markets, and markets that compete with the private sector, and This combination, regardless of the investment objectives and objectives, and the mission of the social security organization. The purpose of this research is to provide a model for choosing the right mix of investments in accordance with the obligations of the social security organization. In this regard, considering the inclusion of data related to organization and analysis of data With regard to determining the insurance rate at the output of the model (Figure 1), which indicates the insurance rate for the years under review, it is concluded that, given the insurance rates received by the organization, this The organization is frayed and with this process the amount of this bust is increasing. In this regard, a model based on the data envelopment analysis for investing in the stock exchange and the selection of suitable new investment portfolios have been presented in order to exit from the problem of bankruptcy and reach normal levels.

First Approach: From among the effective companies in the three selected industries (including 12 companies), according to the efficiency and risk ideals, the percentage of investment per share in the basket was paid. The results are as follows:

Table 16. Percentage of investment per share in the first approach

Stock	Variable	Percentage of investment per Stock
Tehran Petrochemical	x_2	38/7
Eghtesad Novin Bank	x_9	55/7
Parsian Bank	x_{10}	5/5

Second Approach: In this case, the liquidity quantity is added to the model in addition to two other quantities. The results are as follows:

Table 17. Percentage of investment per share in the second approach

Stock	Variable	Percentage of investment per Stock
Pars Daru	x_1	46/1
Farabi Petrochemical	x_8	45/6
Karafarin Bank	x_{11}	1/5
Sina Bank	x_{12}	6/8

The discussion of stock purchasing and portfolio creation is one of the most important issues in management. Optimal choice of multi-criteria decision-making and mathematical optimization methods is an appropriate tool for portfolio selection and management. Investment companies, funds, etc., whose main activity is the formation of portfolios, can first determine their own strategy, then differentiate it into different contexts and choose their portfolios using an ideal planning. Using a portfolio of efficient companies for investing will reduce the risk of investment and select the appropriate portfolios. Also, using the results of the model, after ranking the companies, they can analyze their sensitivity and by identifying the weaknesses and recognizing the effect of the variables, to increase the level of performance of the companies.

According to the research, the combination of investment changes has been emphasized by emphasizing the need to prioritize the share of more return on investment. The optimal combination of investment portfolios from one side within the framework of industry vision and the combination of short-term and long-term investments, and on the other hand, will be determined by the needs of their shareholders. Here are some suggestions:

1. Increasing the share of short-term investments in the portfolio of capital fund investors.
2. Expansion of the fund's activities in the field of short-term market capitalization of the stock market in order to use its pricing in the market, increasing its ability to convert it into cash.
3. Optimization of the management of resources and funds in the fund's fund as the main task of the economic deputy of the fund.
4. Continuous increase in the share of return on investment in necessary resources. (Gradual provision of pension through return on investments in the future)
5. Increased convertibility into cash for investments in order to secure the timely financing necessary to pay retired funds in probable cases, either within the framework of the current liquidity deficit situation or within the framework of possible future legal requirements.
6. Recognition of the potential output level expected by the investments made in order to make a proper decision about them in terms of increasing the amount of investment.
7. Increasing the ability to convert funds into liquidity is another feature of investment in the economic field.

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