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Dynamic Optimization of Investment Portfolio under Liquidity with Taylor Extension of Value function

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Abstract

Portfolio management is portfolio management created on behalf of the investor by the financial assets to ensure maximum efficiency within the risk rate and duration set by the investors. The most important goal in creating and managing managed portfolios to achieve maximum efficiency is to reduce the risk. This is equivalent to selecting the optimal portfolio from the portfolio of possible portfolios, which is called portfolio selection problem. The dynamic portfolio optimization model solves the complexities caused by the effects of various factors on the problem by focusing step by step on various factors and then combining the results of these investigations. The main issue in this research is the use of a new tool for selecting investment portfolios in view of the lack of high liquidity or low liquidity of firms and portfolio selection models. The statistical sample is considered for 27 active enterprises in the real of time from the beginning of March to 2014. The results show that the use of asset liquidity index to optimize portfolio using two Taylor series expansion methods has created a significant difference in the weight, yield and risk of portfolio compared to the Markowitz model. Also, the results of calculating the trainer criterion showed that the optimization model obtained from the expansion of the Taylor series of value function has a higher performance than the portfolios obtained from the Taylor process.

Keywords: Portfolio, Optimization, Dynamics Method, Asset Liquidity and Taylor Extension.

1. Introduction

A portfolio can be characterized as a new financial asset consisting of multiple securities. The portfolio should be considered as an independent and measurable asset because of the relation between the

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financial assets that make up the portfolio. Portfolio management is portfolio management created on behalf of the investor by the financial assets to ensure maximum efficiency within the risk rate and duration set by the investors. The most important goal in creating and managing managed portfolios to achieve maximum efficiency is to reduce the risk. In portfolio theory, this is called the diversity effect. Traders' attitudes towards risk vary. According to this difference, some investors take extreme risks while others avoid risk or remain indifferent to risk. Investors' attitude towards risk affects portfolio preferences. Investors who want to take risks prefer risky assets such as stocks and derivatives, while risk-avoiding investors prefer low-risk investment instruments such as bonds. The selection of securities to be included in a portfolio and the determination of investment amounts are an important element in order for investors to achieve these objectives. In addition, it should be determined whether the portfolio's expectations are met by measuring the risks and returns of the portfolio. Since the securities portfolio consists of risks, the portfolio management process must be carried out professionally by a scientific method.

Financial markets have the primary function of providing funds to economic units that provide savings by saving less by generating less money than their income and by saving savings that tend to spend more than its income economically. Investors aim to generate revenue by evaluating their savings in the financial markets. Financial markets are the capital market, the derivative market, the gold market and the foreign currency market. The capital market is where the demand and supply for short - term funding occurs. The capital market is defined as the place of demand and supply for medium and long - term funds. Derivative markets consist of forwarding transactions, futures, options and swaps. Derivative markets are speculative investments as well as markets that serve hedging purposes. It is known that there is an important relationship between the economic development of countries and the development of money, capital and derivative markets (Abdul Ali Zadeh and Eshghi, 2016).

Dynamic, incomplete-market portfolio optimization is a challenging task for which there is no analytical solution in most cases. Papers examining such problems have thus extensively relied on numerical approaches to solve the associated dynamic programs. However, many of these numerical approaches are limited in scope because they rely on a normality assumption of the asset returns, and/or on lattice approaches for which it is difficult to handle many assets and state-variables (see for example Brennan et al. (1997), Balduzzi and Lynch (1999), Wang and Judd (2000), Dammon et al. (2001)). In order to avoid these limitations, methods using regressions, and often simulations, have been recently proposed to solve multi-period portfolio problems. Inspired by earlier work for the pricing of American options by Carriere (1996), Tsitsiklis and Van Roy (2001) and Longstaff and Schwartz (2001), these methods can use realistic distributions and time series processes for the returns, and can handle more assets and state-variables than pure lattice based approaches. Brandt et al. (2005), van Binsbergen and Brandt (2007), Garlappi and Skoulakis (2010) are examples where such approaches are applied to a variety of portfolio optimization problems. These algorithms use Taylor series approximations of the value function at every time point, and a combination of least-squares regressions and Monte Carlo simulations (or quadratures) to obtain the required conditional expected values entering these approximate value functions.

What was said is a summary of the asset valuation debate that has long focused on the minds of economists. They should explain how the value and value of securities are shaped, as well as how the individuals choose to choose a basket of assets, and obviously this decision is made in conditions of uncertainty (Abdul Ali Zadeh and Adaghi, 2016).

American economist Irving Fischer was one of the pioneers of the issue of uncertainty in economic analysis. He pointed out that the returns and yields can be matched with a stable, reliable return on the distribution of the probability that they are not preferable to one another. Hicks, by designing indifference curves in the mean space and variance, tried to formulate investor preferences within the framework of economic analysis. These were the preliminary ideas that eventually Newman and Morgenstern based on the theory of expected utility. This theory is a comprehensive theoretical device that covers selection in conditions of uncertainty (jahani et al., 2016).

The publication of the Markowitz book entitled Portfolio Selection can be considered as the launch of a new portfolio theory model. A few years later, Markowitz, in a joint work with Tobin, showed that a modern portfolio theory with a certain assumption about the utility of investors corresponded to the results of the expectation theory of Morgenstern Newman and therefore has strong backing (jahani et al., 2013).

After Markowitz, many scholars criticized him, and some confirmed it and rejected some. Some of Marquis's views on the investment world have gone a long way, and some have gone further, and outlined various criteria for risk and returns in other ways to describe the behavior of investors (jahani et al., 2013).

In this research, we are going to answer the questions of whether liquidity or illiquidity affects portfolio weights and stock returns of firms with Taylor Extension of Value function. In other words, how does the weights of a portfolio of stocks behave in the presence of cash and non-cash assets? Also, the existence of such assets affects risk and return while portfolio investment ratios (due to market information asymmetry) are not fully subject to shareholder control?

It should also be noted that in this research, in order to optimize the dynamic and dynamic method is used, which means that after optimizing each sub problem, its answer is used to find the optimal solution under the next problem, and this is as the recursion continues to cover the whole larger problem.

2. Theoretical bases and overview of the research background

The capital market is regarded as a subset of financial markets. The long-term financial resources required by the manufacturing firms in this part of the financial system are provided. The primary role of financial markets in general and the capital market, in particular, is to help transform the savings of individuals and business units into investments made by other economic entities.

The capital market provides the necessary means for transferring people's savings to other investment opportunities that exist for other entities. In addition, such units require long-term financing, and the basic tools of such a process are financial assets that are created to transfer funds from one person to another, divided into two main parts:

- The banking sector
- Securities markets

In the securities market, investors can more easily allocate funds to the units than the banking sector (Pourhagzouini Mohammadi, 1393).

2.1. Investment

Investors planning to invest in securities face the challenge of choosing multiple securities. This choice is based on security's risk-return nature. Investors will, of course, want to transfer their savings to these securities groups by choosing the most preferred securities. But this time, you are faced with investment decisions to invest. At this point, investors have an infinite number of securities or portfolio options. The risk-return nature of a portfolio differs from that of a portfolio. In this manner, investors need to choose the foremost appropriate portfolio taking under consideration the risk-return nature of all other conceivable portfolios. Continuous changes in the economical and financial environment change the securities' risk-return characteristics and their portfolio. This requires investors to review and modify the portfolio on a regular basis.

You need to create a portfolio of investments for reasonable investment activity. Portfolio management consists of securities analysis, portfolio analysis, portfolio selection, portfolio review and portfolio assessment processes. It also uses analytical techniques and conceptual theories for the rational distribution of savings. Portfolio management is a more profitable and less risky complex process of investing.

Investors leave portfolio management in two ways.

1. The portfolio is entrusted to the manager, but the manager is not authorized to decide. In this case, a manager is generally a passive person who fulfils all orders of the portfolio owner. The manager shall finalize the trading activities based on the orders given by the investor. The power to order and decide on all these works belongs to the portfolio owner. Routine works such as the collection of dividends and interests and the timely collection of the costs of the redeemed bonds are made without giving orders by the manager. There may be some drawbacks to this type of management. As is known, large changes, ups and downs can occur in the financial markets in a very short period of time. The timing error can, therefore, be made, especially as assessing opportunities or reducing losses depends on the investor's own order (Jafari et al., 2005).

2. The second application in portfolio management is the full authorization of the portfolio manager on securities. In this case, the portfolio has no real owner. However, the manager may act as the owner of the portfolio, even though it is not legal. The relations between the owner and the manager are regulated by a contract to be made between them. It is possible to give the manager all kinds of authority by contract. In this case, a manager sells the securities he wishes in the portfolio. The administrator uses or sells portfolio securities rights. Briefly, the manager can perform all transactions related to the portfolio, such as the actual owner of the portfolio with a contract.

This second type of portfolio management has great benefits in terms of ensuring the speed of buying and selling. In any case, this type of management is more effective because it is a remedy for the first type of practice's shortcomings. Evaluating market trends, the opportunities brought by timely trading are often important. In the first case, however, it is always possible to lose the appropriate time or lose income. When the investor is faced with losses in the face of negative developments, the manager cannot be claimed to have failed. As stated earlier, it is the investor who gives the order and the failed one is the investor himself (Tehrani and Nourbakhsh, 2005).

The portfolio management process consists of five steps:

- Planning
- İnvestment analysis
- Portfolio Selection
- Portfolio Implementation
- Performance Evaluation

2.2. Planning

The primary stage of portfolio management involves transactions such as determining investor status, determining investment professionals and portfolio managers status, and identifying investment criteria that guide portfolio managers on behalf of investors [23].

An investigation of the investor's situation requires disclosure of the investment period, the designation of the investor's wishes and goals, and estimation of the fund's movements during the investment period. When evaluating the status of a portfolio manager, you should investigate factors such as getting better results than what you can get in a portfolio created by investors, or getting better results than what you get with a proven investment method. For investors, the responsibilities and duties of the portfolio manager become clear. The final step in portfolio planning is to determine the investor's investment criteria and the investment criteria the portfolio manager wants to achieve on behalf of the investor (Tehrani and Nourbakhsh, 2005).

2.3. Investment analysis

The second part of portfolio management is the investment analysis phase. Investment analysis is an analysis of the securities qualifications to be involved in the portfolio and a quantitative estimation of what the performance of various securities could be within a certain time period. In this analysis, it is not only the analysis and evaluation of past performances of financial assets that can be invested. In addition, it is necessary to make clear and mathematical predictions prospectively by using different information. (1) economic analysis, (2) sector analysis, (3) securities selection and (4) forecast analysis, respectively.

In economic analysis, economic conjuncture, inflation, money supply, increase in influence, unemployment and the effects of these indicators are investigated.

In arrange to form rational decisions, it is necessary to scrutinize the sector in which the company is operating, and the situation in the sector. Therefore, sector analysis is the main area of interest in securities analysis. Because of the economic fluctuations, the degree of impact of the sectors is different. For example, some sectors such as automotive and construction are very sensitive to economic fluctuations, while some sectors such as pharmaceuticals and food are not sensitive to cyclical fluctuations.

When making the first election among the securities, the securities which can be a candidate for entering the portfolio are determined in the economy and sector analysis. Securities can be selected qualitatively by taking advantage of the personal information and experience of portfolio managers and by selecting a number of quantitative data. For example; the first distinction can be made by looking at the variables such as the turnover of many enterprises, annual profits and changes in the last few years' profits. The computer could be used to make the first selection due to a large number of securities on the market and a large number of comparisons.

An investment expert is attempting to make quantitative estimates of a security's performance at the final stage of the investment analysis. The expert's estimates can be as follows:

- Estimates of profit, dividend, interest and market values at the end of each year.
- Possible deviations from these estimates and relations between securities. (Rakhneh Roodpashti, 2005).

2.4. portfolio selection

In portfolio selection, the asset for which the portfolio is to be constructed is determined. In other words, the general composition of the portfolio is determined. After that, it is about securities selection. At this point, the funds apportioned to each group will be determined in what proportion they will be allocated to the first separated asset. This choice is a significant step forward. Because investment analysis, economic analysis, sector analysis, primary distinction, inference analysis and general composition decisions are preliminary studies of this election (Mulla'i and Khadamoradi, 2011).

2.5. Portfolio Implementation

Portfolio implementation is the process of assessing portfolio performance against risks and returns over a chosen time period. This includes quantitative measures of return on investment and risks from the investment horizon. The results should be compared with objective measures to evaluate the portfolio's relative performance. Alternative performance measures have also been developed for use by investors and portfolio managers.

Portfolio assessment is also useful in other areas. Define investment process weaknesses and provide a mechanism to develop these vulnerable areas. This provides feedback on the whole process of portfolio management.

2.6. Portfolio Evaluation

After the Portfolio Revision, which is the final stage of portfolio management, portfolio performance measures will be determined, the action to be taken and the necessary changes will be made. A portfolio review is aimed at optimizing portfolio returns at specific risk levels. Investors who create the most appropriate portfolios must continually monitor their portfolio to ensure optimal continuity of the portfolio. The situation can alter time over in past attractive securities and new high - yield, low - risk new securities due to the dynamic nature of the economic and financial markets. In this case, the investor must modify his portfolio in light of market developments. Some new securities will be purchased with this amendment and some securities will be sold in the portfolio. The portfolio mix of securities and weights is changing at the end of the revision.

Portfolio analysis may also be necessary for investor-related changes such as additional savings opportunities, changes in risk behaviour, and the need for cash for other alternative uses. Whatever the cause, the portfolio analysis must be scientific and objective to ensure the suitability of the portfolio. That is, portfolio revision is not an arbitrary process that is implemented carelessly and is as important as analysis and selection within the portfolio management process.

2.7. Dynamic optimization

In this research, dynamic methods are used to optimize, which means that after optimization of each sub problem, its answer is used to find the optimal solution under the next problem, and this goes back to the point where the whole larger problem Cover. In fact, dynamic programming is a method used to solve complex problems in mathematics, computer science, economics, and so on. This method first divides the problem into a simpler problem and uses the overlapping property of the submillages to determine the optimal value for the submids. The main idea of dynamic optimization is simple ideas, so that to solve a problem, we first solve the different parts of the problem, and in the next step, the answers of the subfields are combined to provide a comprehensive and comprehensive answer to the whole problem. In simpler ways, usually submillals are often made up, and each one is solved more often. But in this way, only one problem is solved once, and the overlapping property of the sub-systems is used to prevent them from resolving them again, thus reducing the volume of computations. The response of each subsystem or sub-problem is stored and used in the next step, which is the same as the general answer to the problem. This method will have a high efficiency in cases where the number of sub-months increases exponentially. In fact, the dynamic programming algorithm examines all possible paths for problem solving and ultimately selects the most appropriate path (Bench, 2016).

2.8. History of research

Redkear and Vendrelich (2018) made portfolios optimization under dynamic risk constraints for continuous investment against time-varying investment. They have obtained dynamic programming equations for random optimal control problems and solved them numerically. These numerical results show that the loss of portfolio returns is not very large, while value at risk is significantly reduced. It then examines the effects of time fragmentation that the results indicate that the loss of portfolio performance from imposing a limit value on risk is usually greater than the loss from investing.

Zhang et al. (2017) have optimized the dynamics of portfolios with the liquidity index and the market effects with the simulation and regression approach. They validated numerical methods by solving a cash portfolio and a real stock with a critique model. It also determines the amount of definitive losses associated with ignoring liquidity effects and shows how it protects the dynamic allocation of capital in market conditions. Finally, under different liquidity conditions, they analyzed the definitive return sensitivity and optimal allocation with respect to volume of transactions, stock price fluctuations, initial capital amount, probable error rate, and investment horizon.

Daimant and Somont (2017) examined the dynamics of portfolios using simulation and regression. The results showed that in both cases, for example, the two methods can yield accurate results, but the type of the inverse weighting of the portfolio yields more accurate results for a similar level of computational complexity, especially for high-level problems The term and high levels of risk appetite.

Lyon Yu and his colleagues (2017) presented a model for selecting the optimal stock portfolio. In this model, the problem of choosing a basket of shares is solved by the neural network and by balancing the mean-variance and scalability criteria. The results of the research indicate the model's power in solving the problem of portfolio selection.

Ley et al. (2016) identified the criteria for determining the share price in a research entitled Combining Multi-Criteria Decision-Making Techniques for Choosing Stock Based on the Gordon Model. In this research, they extracted the criteria that influenced the three key elements of Gordon's model, according to the literature review literature.

Abdol-Alizadeh Shahir and Eshghi (2016) used a special model of genetic algorithm to solve the stock selection problem. In this model, first, using a genetic algorithm, the best stocks are selected in terms of return, risk and correlation coefficient with other stocks, and then obtained by another genetic algorithm for optimal weight for each selected share.

Khodabashhishi and Fallah (2015) compared the efficiency of the Risk Model and the GARCH econometric model to predict the return on shares of the firms accepted in the Tehran Securities Exchange. The results showed that the GARCH model has the ability to predict transaction value. Based on the values obtained, all coefficients are significant. That is, it is possible to predict future stock returns using the risk model and GARCH econometric model in the firms accepted in Tehran Securities Exchange. In the second hypothesis, for comparing the power of GARCH model and the risk assessment model using criteria, it can be said that in all three criteria, the GARCH model has lower values, which indicates the greater accuracy of the GARCH model. In other words, we can say that the power of GARCH model estimation and prediction is higher than the risk assessment model.

Conla & Claozo (2015), based on the choleness criterion, used a polynomial objective plan to provide optimal stock portfolios in emerging markets. His research results showed the effectiveness of the criterion of skidding in solving stock selection issues.

Thai Liu (2014) in his article discussed the issue of optimal fuzzy portfolio. In his model, he considered the returns of assets as fuzzy numbers. The result of his research was the confirmation of the financial and economic idea that as much as the investor would accept higher risk, the potential for returns would be higher.

Thomas Bjork et al. [5]investigated portfolio optimization by combining the average risk-aversion variance model. They pointed out in their research that modern portfolio theory is limited by risks and returns that can not always reflect the realities of investment markets. (Modern portfolio theory (medium-variance method), risk is calculated based on variance or rotational criterion (standard deviation)).

Petkova et al. (2010) in a research entitled ”Time Risk Changes in the Criticism of Growth and Value Shares”. The effect of time variations on liquidity risk on growth and value has been investigated. They found that, at times of downturn, value-added shares risk higher liquidity than boom times. While rising stocks are on the opposite, in times of boom, risk has a higher liquidity than the times of recession. On the other hand, in times of downturn, small value stocks have more liquidity than small growth stocks. While during the flourishing period, small growth stocks have more liquidity than small value stocks. Their research showed that, at a time of recession, investors would sell value stocks more strongly to growth stocks, and this activity would have more relative effects on the illiquidity of value-added shares.

China et al. (2009), in their study of the choice of stock firms, adopted two mathematical approaches using a combination of DEA and AHP. The DEA and AHP approach is to build a framework for stock selection from 31 US Internet firms. The experimental results of this study confirm the usefulness of the combination method, which includes performance analysis and structural decision making.

3. Methodology of research

The statistical population of the study consisted of all firms listed in Tehran Stock Exchange during the period 2014 to 2018. The selection of the five-year period has been done because it is assumed that long-term investors on the Tehran Stock Exchange hold their portfolios for more than a year. The sample will also be selected through a simple systematic elimination of the statistical community, so that the sample consists of all the firms in the statistical society that meet the following criteria:

The statistical population of this study includes more active firms. So that the number of trades is more than 50% of the average transaction, which has the following conditions:

1. In order to compare the information, the end of the fiscal year of the firms will be March 20th.
2. During the period of research they are traded on their daily basis.
3. Information about the variables selected is available in this study.
4. Detailed information about the annual financial statements of each of the firms, along with the market share price at the end of the respective period, is available at the Tehran Stock Exchange and the Codal System in the period under review.

By applying the above conditions, 27 firms were selected as the sample of this study.

The dynamic dynamic optimization model is used when the analyst follows a response that can behave for all possible values for the parameter with good uncertainty. Unlike stochastic programming that treats parameter uncertainty based on probability theory, this approach gives equal importance to all possible values for the parameter with uncertainty. The uncertainty of the model parameters is explained by the set of uncertainties, which includes all possible values for the model parameters.

In this study, the portfolio return maximization model, as a model whose input parameters (asset return, liquidity) have uncertainty, is investigated with a dynamic optimization approach.

$$\begin{aligned} &\max \overline{r_p} \\ &S.t. \\ &\sum_{j=1}^{n} w_j = 1 \\ &w_j \geq 0 \end{aligned}$$

$$LIQ = \sum_{j=1}^{n} w_j * liq_j \geq 0$$

The above limit is to examine the liquidity assets in the return on investment portfolio.

$$ILLIQ = \sum_{j=1}^{n} w_j * illiq_j \geq 0$$

The top limitation is to examine the existence of liquid assets in the return on investment portfolio.

Also, with regard to the mentioned statistical model and the stated goals of the research, the hypotheses of this research based on the research are formulated as follows:

Hypothesis 1. The existence of high liquidity stocks in investment portfolio weights based on Taylor extension of value function has a significant effect.

Hypothesis 2. The existence of low liquidity stocks in investment portfolio weights based on Taylor extension of value function has a significant effect.

Hypothesis 3. The existence of high liquidity stocks in investment portfolio return based on Taylor extension of value function has a significant effect.

Hypothesis 4. The existence of low liquidity stocks in investment portfolio return based on Taylor extension of value function has a significant effect.

Hypothesis 5. The existence of high liquidity stocks in investment portfolio risk based on Taylor extension of value function has a significant effect.

Hypothesis 6. The existence of low liquidity stocks in investment portfolio risk based on Taylor extension of value function has a significant effect.

4. Research variables

In order to examine the portfolio weight vs value function recursion issue, we use a problem similar to the one examined in van Binsbergen and Brandt (2007) and Garlappi and Skoulakis (2009) with a portfolio consisting of one risk-free asset with gross return R_f, and a single risky asset with a gross rate of return R_t^g for the time period between $t-1$ and t. The log excess return is defined as:

$$r_t \cong \ln(R_t^g) - \ln(R_f).$$

Which yields a periodic simple excess return of:

$$R_t \cong R_t^g - R_f = R_f(e^{rt} - 1)$$

It is assumed that the log excess return is predictable with a dynamics given by the following restricted vector autoregressive process

$$r_{t+1} = a_r + b_r d_t + e_{r,t+1}$$

with

$$d_{t+1} = a_d + b_d d_t + e_{d,t+1}$$

where d_t is the log dividend yield for the time period between $t-1$ and t, and where a_d, b_t, a_r, and b_d are constant parameters, with Gaussian error terms $e_{r,t+1}$ and $e_{d,t+1}$ and a constant covariance matrix $\sum$.

The investor is endowed with wealth W_0 at time $r = 0$ 0and wishes to maximize the expected utility of his terminal wealth at date T. There are no frictions: no transaction costs nor taxes, no intermediate consumption. The investor can trade the risky asset and the risk-free security at times $t = 0, 1, \cdots, T-1$. With these assumptions the investor's problem can be expressed as

$$V_0(W_0, d_0) = \max_{x_{t_{t=0}^{t-1}}} E_0[u(W_t)]$$

with the following constraints for all t:

$$W_{t+1} = W_t \cdot (x_t R_{t+1} + R_F)$$

where x_t is the proportion of his wealth invested in the risky asset at time t, E_0 denotes the expectation conditional on the information available at time $t = 0$, which is, in this problem, the initial wealth W0, and the initial dividend yield value $d0$. Here,

$$u(W_t) = \frac{W_T^{1-\gamma}}{1-\gamma}, \quad \gamma > 0$$

is the CRRA utility function.

In the present context, as it is well known from the portfolio literature (see Brandt et al. (2005) for example), the homotheticity of the CRRA utility function allows to rewrite the problem on the form of the following Bellman equation which is independent of the wealth level (note that wealth is no more an argument, hence the change in notation):

$$v_t(d_t) = \max_{x_{t_{t=0}^{t-1}}} E_t\left[(x_t R_{t+1} + R_f)^{1-\gamma} v_{t+1}(d_{t+1})\right]$$

Here, at each time point t, $v_t(d_t)$ can be interpreted as the maximum utility of wealth at T for initial wealth at t, conditional on the dividend yield value d_t.

Our simulation-and-regression algorithm uses the above formulation and, in a nutshell, works as follows.

At each time step, a simulated sample for the values appearing inside of the conditional expectation on the right hand side of the Bellman equation (5) is generated. Using this sample as a dependent variable, a regression on a basis formed with portfolio weights and dividend yields is used to obtain a conditional expected value function which is continuous in the portfolio weights. This expected value function can then be optimized for each sample path of the simulated dividend yield to obtain the optimal portfolios. With the results from these optimizations, it is then possible to perform the recursions with the optimal portfolio weights or with points on the value function. It is important to note that this simulation-and-regression method is invariant to the transformation of the value function proposed in Garlappi and Skoulakis (2009). With their method and the one used in van Binsbergen and Brandt (2007), a certainty equivalent transformation linearizing the value function provides more precise function approximations; this is linked to their use of Taylor series. For our algorithm, using their suggested transformation has no impact on the computed sample of dependant variables. More specifically, they propose using the certainty equivalent transformation

$$J_t(d_t) = u^{-1}\big(v_t(d_t)\big)$$

and

$$v_{t+1}(d_{t+1}) = \frac{1}{1-\gamma} J_{t+1}(d_{t+1})^{1-\gamma}$$

to obtain the following Bellman equation

$$\frac{1}{1-\gamma} J_t(d_t)^{1-\gamma} = \max_{x_{t\,t=0}^{\,t-1}} E_t \left[(x_t R_{t+1} + R_f)^{1-\gamma} \frac{1}{1-\gamma} J_{t+1}(d_{t+1})^{1-\gamma} \right]$$

The return on a portfolio of assets is equal to the average equilibrium of the return on each asset. The weight used for each return is a proportion of the investment made in the asset. As r_j is the return on the jth asset and w_j is the proportion of the funds invested in the asset. In this case, the total return and total risk of a portfolio are:

$$\overline{r_p} = \sum_{j=1}^{n} w_j \cdot \overline{r}_j$$

and

$$\overline{\beta_p} = \sum_{j=1}^{n} w_j \cdot \beta_j$$

assets liquidity: In this research, stock trading volume will be used as a liquidity index. Thus, if the company's stock trading volume is less than the middle of the total at the end of each month, the company is considered as low liquidity, and also if its liquidity is higher than the average, the company's stock is considered as high liquidity.

5. Research results

In the table below, central indices such as mean and dispersion indices such as standard deviation, kurtosis and skewness are calculated for average monthly return and average liquidity variables for 27 active firms during the five-year period of the research.

If the mean and median variables are close together, the distribution of variables is symmetric. This property is important because symmetry is one of the normal distribution features that will be addressed in the next section (the stroke and skewness of the normal distribution is zero). Also, the histogram diagram shows the variables of the average monthly return and average liquidity, in order to better display their information as follows:

In this study, the firms listed in the Tehran Stock Exchange, which were active since 2014, were investigated. The data were divided into two sections. The first section, which collected data monthly,

Table 1: Descriptive statistics for research variables

Variable name	Symbol	Mean	Median	Mode	Standard	Skewness	Kurtosis	Range
R	Average Monthly Return	0.2349	0.2420	0.23	0.12195	-0.798	0.467	0.45
MEANLIQ	Average liquidity	7.41755	7.45594	7.689	0.288728	-0.265	-0.509	1.112

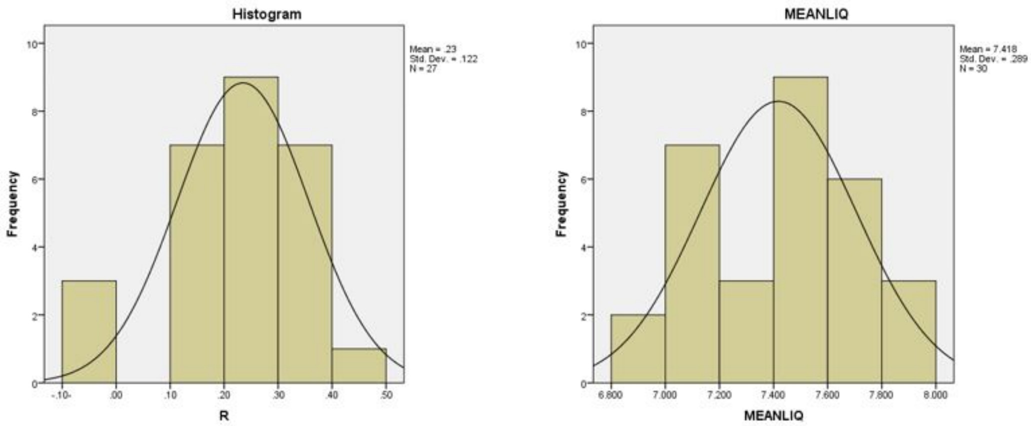

Figure 1: Histogram of the research variables

was analyzed and analyzed in the next section by means of averaging over 5 years to evaluate the efficiency of the considered models.

The data were used during the period from March 2014 to March 2018 in the form of monthly returns as elementary data. To select the firms, we examined 27 existing firms, which requires using these firms to have data over the interval considered in the table below the list of firms proposed. The table below lists the firms surveyed and the average monthly returns during the period under review.

5.1. portfolio Selection

Three types of approaches have been used to generate capital portfolios from ranked stocks. In the first approach, optimization of the Markowitz model and Taylor Extension of Value function model is considered as the basic model, so that it can be used as a criterion for answering the above questions.

In the second approach, the high liquidity index of assets is introduced into the model and the model is again optimized and solved. Finally, in the third approach, the index of assets low liquidity of assets was introduced into the model and again the model was optimized. After choosing the stock to form the capital portfolio to obtain the weight of each stock in the portfolio, and calculating the portfolio performance, the below fuzzy normalization relation is used the stock equity.

$$x_s = \frac{x_i - x_{\min}}{x_{\max} - x_{\min}}$$

Where x_i is the score of each share, xmin the smallest score among the stocks in the portfolio and $x_{\max}$ the highest score among the stocks present in a portfolio. The reason for using this formula is that we want to get first positive shares, and then the negative equity shares get a little less than

Table 2: firm By Case Check it out And The values of the efficiency of the Month

Symbol	Firm Name	Average Monthly Return
Khodro	Iran Khodro	0.126
Kama	Bama	0.396
Sakht	Tose Sakhteman	-0.02
Khepars	Pars Khodro	0.243
Shepaksa	PAksan	0.411
Sharak	Petroshimi Shazand	0.238
Kemase	Tamin Mase	0.289
Tayra	Teraktorsazi	0.291
Hetoka	Hamlonaghl Toka	0.232
Madaran	Dade pardazi Iran	0.334
Ketabas	Zoghal Sang Negin	0.281
Khetrak	Rikhtegari Teraktor	0.242
Khering	Ringsazi Mashhad	0.232
Khezamiya	Zamiad	0.175
Khesaipa	Saipa	0.169
Shiran	Sanaye Shimiaee Iran	-0.041
Kegol	Gol Gohar	0.395
Satran	Siman Tehran	0.184
Sedor	Siman Dorood	0.191
Sepapha	Siman Sepahan	-0.019
Seshargh	Siman Shargh	0.19
Gheshekar	Shekar Shahrood	0.318
Segharb	Siman Gharb	0.179
Ghebahonar	Mes Bahonar	0.351
Ghepino	Pars Minoo	0.383
Khemohareke	Niro Mohareke	0.327
Sefars	Omran va tose Pars	0.244

positive shares. Finally, given that the total weight assigned to the shares is equal to 3, the following equation is used.

$$w_i = \frac{x_s}{\sum_{s=1}^{n} x_s}$$

After determining the stock weight in the above mentioned portfolios, a relationship has been used to calculate the portfolio performance criterion (Treynor).

$$\beta_p = \sum_{i=1}^{n} \beta_i * w_i$$

$$R_p = \sum_{i=1}^{n} R_i * w_i$$

$$Treynor = \frac{R_p - R_f}{\beta_p}$$

β_p portfolio beta, β_i beta stock, R_p portfolio return, R_i return on equity, R_f is the neutral risk value here, equal to 0.0322 (the monthly geometric mean for a profit of %20 per year). Finally, the results are shown in the following tables for the listed portfolios.

Table 3: Portfolio results for Markowitz model

Number of Stocks		Treynor	R_p	β_p
27		0.074663	0.24282	0.439578
Trading Volume	Stock with high liquidity	-0.5909	0.1419	0.115248
	Stock with low liquidity	-0.34351	0.28443	0.308466

Table 4: Portfolio results for Taylor Extension of Value function model

Number of Stocks		Treynor	R_p	β_p
27		0.090422	0.24055	0.33785
Trading Volume	Stock with high liquidity	-1.81127	0.13455	0.041656
	Stock with low liquidity	-0.35111	0.106	0.296204

Based on the results shown in the tables above, it can be seen that the portfolio resulting from considering the regression model based on Taylor's time series compared to the Markowitz (classic) model has a higher performance criterion than other portfolios. Therefore, this portfolio is recommended as the optimal portfolio for 2019. Therefore, the portfolio resulting from the regression based on the Taylor time series is introduced as the optimal portfolio.

Also, the results obtained from the trainer criterion from the above two methods indicate that the Markowitz method as well as the regression method based on the Taylor time series have the ability to select the portfolio. In order to examine the research hypotheses, we first calculate the weights obtained from the Markowitz binoculars and the Taylor time series-based regression method. The following tables show the stocks in these two portfolios along with their weight, which were implemented in MATLAB software using the frontcon function.

5.2. Testing the research hypotheses

To solve the optimized portfolio problem, In Marquette model mode, the risk of optimizing the efficient boundary portfolio was obtained as follows:

As can be seen, by increasing the minimum moratorium yield, the standard deviation of the portfolio has increased, where standard deviation is considered as a risk measure.

In order to test the research hypotheses, we use the t-test hypothesis test to compare the portfolio weights of the models from the Markowitz model and Taylor Extension of Value function model. The purpose of this test is to determine the meaning or meaning of the difference between the returns and the risks of the models. , Shows how to calculate this statistic.

$$t_{n-1} = \frac{\mu_d}{S_d/\sqrt{n}}$$

Table 5: Weights of portfolio selection

Symbol	Firm Name	Markowitz weight	Taylor Extension of Value function model
Khodro	Iran Khodro	0.05	0.05
Kama	Bama	0.05	0.01
Sakht	Tose Sakhteman	0.03	0.04
Khepars	Pars Khodro	0.02	0.06
Shepaksa	PAksan	0.03	0.05
Sharak	Petroshimi Shazand	0.05	0.02
Kemase	Tamin Mase	0.03	0.04
Tayra	Teraktorsazi	0.02	0.03
Hetoka	Hamlonaghl Toka	0.05	0.03
Madaran	Dade pardazi Iran	0.04	0.02
Ketabas	Zoghal Sang Negin	0.05	0.02
Khetrak	Rikhtegari Teraktor	0.05	0.02
Khering	Ringsazi Mashhad	0.04	0.06
Khezamiya	Zamiad	0.02	0.06
Khesaipa	Saipa	0.02	0.04
Shiran	Sanaye Shimiaee Iran	0.06	0.05
Kegol	Gol Gohar	0.04	0.04
Satran	Siman Tehran	0.02	0.04
Sedor	Siman Dorood	0.05	0.05
Sepapha	Siman Sepahan	0.03	0.02
Seshargh	Siman Shargh	0.03	0.01
Gheshekar	Shekar Shahrood	0.05	0.04
Segharb	Siman Gharb	0.04	0.05
Ghebahonar	Mes Bahonar	0.06	0.06
Ghepino	Pars Minoo	0.03	0.02
Khemohareke	Niro Mohareke	0.02	0.02
Sefars	Omran va tose Pars	0.05	0.05

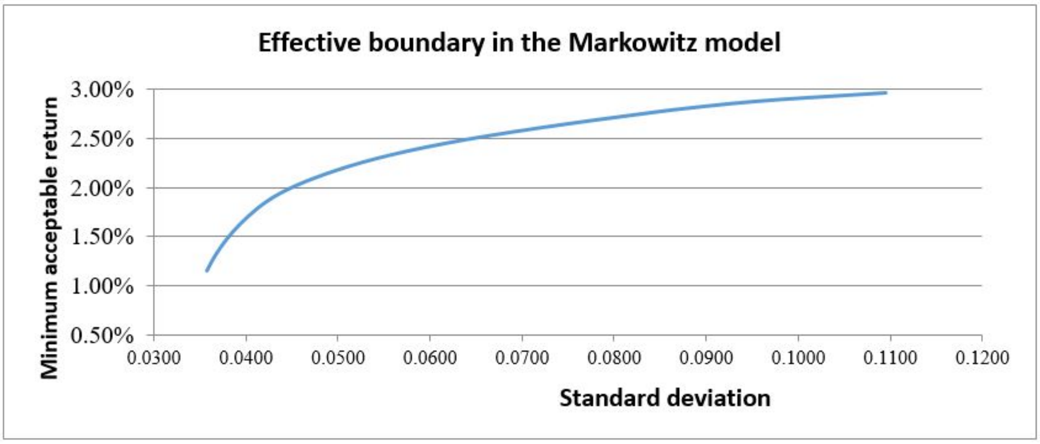

Figure 2: Effective boundary in Markowitz mode

In the above equation, μ_d indicates the mean difference of the Trynol's index in the Model Contains of Liquidity and illiquidity and Markowitz methods, S_d represents the standard deviation of this difference and n shows the sample size. This t-student distribution has a n-1 degree of freedom. This test was performed using the t-test function in MATLAB software and the results of this test are presented in the table below for a 95% confidence level.

To compare the existence of a high liquidity index, we use the returns of the portfolios obtained from the paired t-statistic, the results of which are shown in the table below:

Table 6: Compare portfolio model derived from the Markowitz model and Taylor Extension of Value function model

One-Sample Test						
	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Weight	11.369	26	0.000	0.03577	0.0293	0.0422
Return	107.055	1	0.006	0.10502	0.0926	0.1175
Risk	0.381	1	0.768	0.00234	-0.0756	0.0802

As can be seen in the table above, because the probability value is less than 5%, so the assumption of an acceptable one is assumed to indicate that Taylor's time series-based regression model has better weights than the Markowitz method in selecting portfolios in stocks. Therefore, the first hypothesis of the research is confirmed.

Also as can be seen in the table above, because the probability value is less than 5%, so the assumption of an acceptable one is shown, which shows that the efficiency of the portfolio resulting from the regression model based on Taylor's time series compared to the Marquises method in selecting portfolios in stocks High liquidity makes a significant difference. Therefore, the research hypothesis is confirmed.

The table above shows the results of the t-test for a 95% confidence level. As you can see in the table above, there is no significant difference between the two portfolio risk models of the Marquises models and the Taylor time series-based regression model. In other words, the research hypothesis is not confirmed.

Finally, in order to compare the existence of a liquidity and illiquidity index, we use the risk of portfolios derived from paired statistics, the results of which are shown in the table below:

Table 7: Compare portfolio model derived from the Markowitz model and Taylor Extension of Value function model

One-Sample Test						
	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Weight	11.009	26	0.000	0.03778	0.0307	0.0448
Return	0.027	1	0.983	0.00368	-1.7526	1.7600
Risk	26.989	1	0.024	0.14736	0.0780	0.2167

As can be seen in the table above, because the p-value is less than 5%, it is assumed that the regression model based on Taylor's time series has better weights than the Markowitz method in selecting the resulting portfolio. Gives. Therefore, the research hypothesis (for the case of portfolio weights) is confirmed.

As can be seen in the table above, because the probability value is more than 5%, therefore the research hypothesis is not accepted. There is no significant difference.

The table above shows the results of the t-test for a 95% confidence level. As you can see in the table above, there is a significant difference between the two portfolio risks of the models derived from the Markowitz model and the regression model based on the Taylor time series. Therefore, the research hypothesis is confirm.

6. Conclusion

Two important elements are investment, risk and returns. Investors always tend to increase their returns at a certain level of risk, or at a certain level of return, reduce their risk. By presenting its stock portfolio model, Markowitz showed that by creating a basket of financial assets, it would be possible to reduce a certain level of risk returns. Therefore, investors tend to maximize their expected returns and minimize risk by knowing and choosing the optimal combination of financial assets in their stock portfolios. One of the problems encountered in the problem of the underlying assumptions of the Markowitz model is that the return on assets is normal distribution, and the standard deviation explains the portfolio risk to the investor. One of the methods used in this field is the Dynamic Optimization Model. In which the risk criterion is considered standard deviation. In this research, the optimal investment portfolio selection based on the liquidity index of assets using dynamic model has been investigated. The suggestions based on the dynamic optimization test are as follows:

1. To capital market managers with the aim of assessing the future portfolio of investment firms to enter this market.
2. To investors with the aim of assessing the level of future investment portfolios of firms in order to obtain appropriate decisions on the purchase or sale of shares of firms
3. Directors and managers of firms with the aim of achieving a clear view of the status of their investment portfolio in order to take appropriate measures to address the problems of causing loss or loss of profit.
4. To banks and other creditors aimed at reducing risk by assessing the status of portfolios of future corporate equity and giving priority to profitable firms in providing facilities.

To senior executives and macroeconomic policy makers in order to achieve a vision of the future portfolios of firms operating in different sectors of the economy and their use in medium and long-term economic programs.

The applied proposals from the research are as follows:

1. use of other portfolio selection methods for stock portfolios.
2. Use of meta-innovative methods such as genetic algorithm and cumulative particle optimization to determine the stock weights in the portfolio and compare them with each other and with the method used in this research.
3. Using qualitative criteria such as firm management, market rumors and ... along with financial criteria for choosing portfolios.

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