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Original Research

Applying the ELECTRE Method to Determine the Effects of Calendar Anomalies on the Index Returns of Banks Listed on the Tehran Stock Exchange

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ABSTRACT

In today's world, financial markets, as the main arteries of any country's economic system, have created an attractive environment for investors, and therefore it is necessary to identify the behavior of investors in this space and variables affecting prices and stock returns in these markets. The purpose of this study is to use the method of random dominance analysis and electrification technique as a new method in financial research to investigate the effect of calendar anomalies on the index returns of banks listed on the Tehran Stock Exchange in the period 2016-2020. Findings show that according to the three main hypotheses that there is a significant difference between the returns of the banking industry index on Saturdays to Wednesdays, in the first, second, third and fourth weeks of each month and in the months of April to March based on accuracy Market efficiency assumptions were formulated, all three hypotheses were rejected. It was also found that Wednesdays and the second weeks of each month are the best time to invest in the banking sector. In addition, June is the best and March is the most unsuitable month of the year to invest in this field.

1 Introduction

Capital markets as one of the parts of the financial system cause productive and profitable pricing and as a result, optimal allocation of community resources and better market efficiency. Since our country has been involved in inflation in recent years, so many people, with the aim of maintaining the value of their money and capital, seek to invest in various areas suitable for this market, which has a high return and the lowest risk, Is, have taken; However, risk and return are two inseparable parameters. Investors are not only looking for why and how the current markets work, but also to understand their future status Studies show that one of the most important causes of inconsistent results is due to the existence of calendar anomalies that undermine the efficient market hypothesis and form a kind of anomaly [1].

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These anomalies are widespread in the stock market as well as in other markets, it enables investors to make a profit by designing business strategies and calculating such predictable patterns in the market.Empirical evidence suggests that market performance is favorable in the first month of the year (Farvardin or January). This effect is a clear deviation from the weak form of the efficient market. Because being aware of this pattern leads to buying stocks at the end of the year and earning abnormal returns. Also, after the weekend, the market prices are mainly to open at lower levels. Awareness of this situation also leads to the sales strategy on the last day of the previous week and the purchase on the morning of the beginning of the week [2]. So far, various scientific research has examined the effect of the presence or absence of seasonal and calendar patterns such as the effect of the end of the year, the effect of days of the week, etc. in efficient markets at weak and semi-strong levels. Proponents of the efficient market hypothesis expect the stock market to adjust rapidly under the above conditions so that high returns cannot be achieved after the official release of any important information about each share[3]. In Iran, a review of research shows that there is an unusual pattern of returns in the Tehran Stock Exchange and this effect is different in different years and periods [1,4]. This means that the market on Saturdays has a positive and significant total return and on Sundays has a negative and significant total return and there is no significant return on other days of the week. Therefore, market experts suggested selling stocks on Saturdays and buying stocks on Sundays. Also, a comparison of Iran's findings with other emerging markets shows that the effect of weekdays on the Tehran Stock Exchange is different from other emerging markets[4]. Because by determining the calendar effects on stock returns and industry index, it is possible to estimate how much stock returns in a particular day, week, or month, Also, if there is an effect of weekdays on the Tehran Stock Exchange, it can be used to plan the purchase and sale of shares. Based on the above explanations and considering the existence of an unusual pattern of returns in the Tehran Stock Exchange, the effect of which is different in different years and periods; Also, the behavior of Tehran Stock Exchange regarding the effect of days of the week is different from that of other emerging markets and taking into account the fact that calendar anomalies are among the factors affecting the capital markets that lead to investment uncertainty, but in researches, its effect on the index is less such as risk and stock returns have been discussed; Therefore, in this research, an attempt was made to use the Electra technique as a new technique in financial research to answer the question of how variables influence each other in the Tehran Stock Exchange despite its different characteristics compared to other emerging financial markets. Is? Certainly, the answer to this question can lead to a deeper understanding and different analysis of efficient market theory based on the conditions of the Iranian stock market. For this purpose, the Electra method was used, which is the same matrixized form of random dominance analysis method. This method allows the researcher to observe three basic principles in decision-making, which are: insatiability, risk aversion and absolute risk reduction. In this method, the distribution of yield and risk of one-time period was compared with other time periods and their superiority or non-superiority was investigated. Also, recognizing the difference in the yield distribution of different time periods can guide investors and market participants in the timing of entering and exiting the market.

2 Literature Review and Hypotheses Development

2.1 Theoretical Foundations of Research

Nowadays, financial psychologists have paid special attention to exploring the factors influencing investor and investment decisions. In this context, behavioral finance is a field that examines the behavioral orientations of investors or financial analysts using the science of psychology and seeks to understand why people buy or sell stocks in the stock market and therefore helps to Explain why and how markets may be inefficient [6]. In fact, behavioral financial knowledge significantly emphasizes the behavior of investors,

and from the study of these behaviors, many anomalies have been achieved. [7]. In this regard, despite strong initial evidence at the beginning of the decade of market efficiency, subsequent studies showed anomalies during the long-term review of market data, and these findings contradicted the concepts of an efficient market. In the financial literature, these findings, which violate efficient market theory, are referred to as anomalies. Anomalies are events that cannot be explained by the prevailing theory. In the case of stock markets, anomalies are confronted with efficient market theory. So that if there are predetermined patterns, it provides the conditions for a stock trading strategy with additional returns[8]. Anomalies expressed in efficient market theory include two categories of anomalous calendar anomalies and other (non-calendar) anomalies. Existence of calendar anomalies and non-calendar anomalies all indicate the existence of a clear pattern and predictable trend in stock price behavior that questions the basis of efficient market theory[8]. Numerous scientific and research works and articles in the field of these two types of anomalies have been done in developed stock exchanges and emerging stock exchanges, which provides the ground for re-examining efficient market theory.

Anomalies that cannot be classified as seasonal irregularities and call into question efficient market theory are called non-calendar anomalies[9]. In these anomalies, the two factors of time and time period do not undermine the theory of efficient market, but the content factors of the market, lead to the formation of such uncoordinated phenomena [10]. Non-calendar anomalies can be divided into two groups: fundamental anomalies and technical anomalies. Investing in underlying financial assets is the most common fundamental anomaly and is often cited by researchers as the best strategy for investing. There is ample documentary evidence that investors are overestimating or overestimating the value of companies.[11], They concluded that the strategy of investing in underlying financial assets could generate additional returns due to investor errors in estimating underlying value. Fundamental anomalies include the following: Low ratio of price to book value: In Fama and French's study on stock performance with low to high book value ratio in years 1 to 4, it was found that a set with a low ratio, returns higher than a set with a price ratio It has more book value, it has created, while the low-ratio collection has less risk. These results contradict the foundations of efficient market theory and serve as an anomaly against this theory.

Many studies have concluded that low-price-to-sell stocks generate more returns than high-price-to-sell stocks, and Shaunsey writes in his book What's on the Wall Street goes on to argue that this ratio is one of the strongest examples of over-efficiency and over-normalization. Numerous studies have shown that stocks with a low price-to-earnings ratio generate additional returns over stocks with a price-to-earnings ratio. Lost stocks is a strategy used by people who are looking at price trends and trying to buy at low prices. Ariel [3] examined the ratio of companies into excellent and non-excellent categories. The findings showed that in the long run, excellent and non-excellent companies tend to achieve their average level of return in the long run, and in this regard, excellent companies can show better returns than excellent companies.

International Value Studies: In a study by Capaul, Rowley and Sharp, they examined US financial markets from January 1981 to June و and found that value stocks generated higher returns internationally than growth stocks. These findings were strongly like the results of studies on the value and growth of companies internationally. Technical analysis, also called technical analysis, is a method of forecasting prices in markets, based on the study of price history and trading volume in that market, and tries to predict future trends and prices by examining past prices. Nose. The main question in the topic under discussion is whether there is an investment strategy that can predict future prices of financial assets based on past prices? The existence of such strategies and techniques used by analysts is inconsistent with the efficient market hypothesis and is considered an anomaly. Moving Average: Buy and sell signals are generated by moving

the moving average in the short and long term. The researchers tested the mean of the 1, 2, and 2-day moving averages over the 4, 2, and 2-day periods, and all the signals given were positive and the results were remarkably impressive.

Breaking the trading range (resistance and support): The buy signal will be when the prices reach the resistance point and the sell signal will be when the prices reach their support point. Technicians believe that investors buy all the support points and sell all the resistance points. They determine the resistance and support lines based on the 4, 2 and 4-day prices and calculate a 2-day price range for buying and selling. Here, too, it is observed that, contrary to efficient market theory, there are tools and techniques that can predict future prices and create excessive and excessive returns, Hence, the mentioned cases are referred to as technical anomalies. Calendar anomalies are stock price irregularities in an efficient market that always change randomly. The reason is the price response to information that is randomly published over time. Now, if time itself is a factor that changes the price, so that during a certain period, in addition to the information provided (randomly), time also affects the change in stock prices and changes the nature of random market behavior, this Such patterns undermine the efficient market hypothesis and form a kind of anomaly, such effects are called calendar effects or calendar anomalies[12]. Effect of political rotation, effect of summer, effect of holidays or effect before holidays, effect of weekends, effect of moon rotation, effect of special months of the year, effect of end of year (effect of January and effect of December), effect of special lunar months and effect Ramadan are examples of these calendar irregularities that play an effective role in changing stock prices[13].Calendar irregularities, which confirm the existence of certain patterns of return at different times of the year, month, week, and day, are examples of violations of efficient market theory, which implies that between returns in calendar periods There is a heterogeneity in terms of returns and stock returns are higher in some calendar periods than in other calendar periods. Therefore, through long-term review of prices and calendar periods, patterns can be designed and based on these patterns, strategies to create additional returns for investors can be created[14]. Cross [15] is the first person to confirm that the distribution of stock price changes according to the day of the week changes using US data [15]. It pays attention to the distribution of prices on Friday versus Monday, where stock prices are usually higher on Friday and lower on Monday than other days of the week. Fortune using the S&P 500 index found statistically significant negative returns over the weekend, before and after 1987. In Brazil, Madureira and Lille [16] found that the effect of the day of the week on investors influences portfolio selection decisions, earnings management, and overall investment strategy[17]. Laconishak and Smith [16] found that the cumulative returns between the last day of the month and the next three days of the following month were higher than the returns over the entire month. In a broader study, Kunkel et al. [18] examined stock market indices in 19 countries for the period 1988 to 2000 and found that four days a month accounted for 87% of monthly returns[18]. This was found in an average of 16 stock markets. Ariel [3] observed that stock market advisors claim that the monthly pattern exists. That's why consultants are asking clients to make stock purchases before the calendar months begin and to postpone sales until after mid-month to return to higher normal returns. Rosef and Kinney [18] were the first to show that January yields were unusually high compared to the rest of the year. Goltkin [19] showed higher-than-normal stock returns in January in 16 countries. The most well-known calendar anomalies that challenged efficient market theory are as follows[19]: The effect of January is very tempting, because even though this effect has been identified for two decades and the public is aware of it, it does not disappear and still stands. Historical data show that stocks in general and stocks of small companies generate abnormally high returns in January. According to studies by Hagen et al. [20], the January effect is perhaps the best example of a calendar anomaly in behavioral finance. Some believe that due to the emergence of investment funds and their fiscal year ending in December and November, the effect has been shifted to November and December, although the effect of January in many overseas markets. The United States has also been observed, as have the United Kingdom and Australia[20].

The most complete explanation for the year-end and January effect is the capital gains tax debate, which is true in most countries. Another explanation is that in January, investable funds as well as post-transaction funds are determined[21]. Effect of Month Change: Stocks consistently have higher returns on the last trading day of the month and the first four days of each month than on other days of the month. Russell examined the performance of the S&P index over a period of 65 years and found that companies with large capital offer higher returns on changing days of the month. Hansel and Zimbba [22], in justifying this phenomenon, referring to the cash flow theory at the end of the month, calculated and paid salaries and financial expenses at the end of each month and its effect on the change of the month.Monday effect: According to this effect, Monday is the worst day for investors. The first documentary about the weekend work was published by Fields in the Journal of Commerce in 1995. Fields also found out in 1995 that the Dow Jones Industrial Average was growing the day before the holiday. Several other studies have shown that Monday yields are worse than other days of the week. Harris's studies also show that the weekend effect occurs in the first 5 minutes of the market.The effect of the days of the week indicates the existence of patterns in stock returns in the past. This return is related to the special days of the week. Or the specific positive return is determined, while Monday, the first trading day of the week, is characterized by lower returns than other days and even negative returns.The effect of the vacation makes the returns in the days before and after the vacation different. Experimental evidence shows that yields are higher than normal on the day before the holidays, while yields are lower than normal on the day after the holidays. This effect is also examined by assigning imaginary variables to before and after the holidays. Empirical evidence has attributed the high pre-holiday productivity to high activity and rising activity levels and cited lower-than-normal post-holiday productivity in the accumulation of information these days. Since the late 1990s, numerous studies have been conducted on the effect of appropriate holidays in various stock exchanges around the world [22].The effect of returns before and after major events: Some research has provided evidence of changes in return behavior before and after a major event. For example, Plastun et al. [28] in a comprehensive review of the evolution of various monthly anomalies such as the January effect, the December effect and the Mark Twain effect in the US stock market, using the statistical techniques of mean analysis, Student's test, ANOVA, Mann test -Whitney and a trading simulation method concluded that the January effect was more prevalent in the United States and that the December effect and the Mark Twain effect were never prevalent in the United States. Also, the January effect was more popular in the middle of the 20th century, but has since disappeared. Jami et al. [32] in the study of the relationship between weekday calendar events and stock returns in 60 companies admitted to the Tehran Stock Exchange between 2013 and 2015 found that there is no relationship between calendar events except Tuesday and stock returns. There is no significance, but the effect of Tuesday is significant.

3 Research Background

Kinatder and Papavasilio [33], examining the calendar effects on bitcoin returns and volatility from 2013 to 2019, using the Garch model, concluded that investing in bitcoin at the weekend is less risky and at the beginning the week is associated with higher risk. Also, the effect of January on bitcoin returns is the opposite of what is in the stock market, and the investment risk in this month is lower than in other months of the year. In the research of Vahabi et al. [34], that the use of the Electre technique to investigate the effects of irregular calendar rules of the day, week and month, with the help of returns and unsystematic risk, in chemical companies admitted to the Tehran Stock Exchange, in the period of 2015 to 2019 has investigated, the findings show that Monday has the highest and Tuesday the lowest return for investing in

the Tehran Stock Exchange. Also, the best time to invest is from May to the end of summer, especially August, and the worst time is February and December. In addition to these findings, investing in the second week of every month is a more suitable opportunity than other weeks. Zhaun et al. found that by performing four calendar effects on the Chinese stock market as well as constructing investment strategies based on calendar effects, the performance of calendar anomalies at different times had different effects on additional returns on investment in the Chinese market[17]. has it.

Also, Jami et al. [32] in examining the relationship between calendar occasions of the week and stock returns in 60 companies listed on the Tehran Stock Exchange during the period 1393 to 1395 found that between calendar occasions except Tuesday with stock returns, the relationship There is no meaning, but the effect of Tuesday is significant. Architectural findings regarding the effect of days of the week on the return of mutual funds in the Tehran Stock Exchange show that there is a significant relationship between the days of the week and the return of mutual funds. Also, Wednesdays have the highest returns and Sundays have the lowest returns during the week. Kalantarian [35] in a study entitled "Study of the effect of the holy month of Ramadan on the return, risk and liquidity in the Tehran Stock Exchange" found that the holy month of Ramadan has no significant effect on the return of the total index but its effect on the financial index is significant, and the volatility of the total index yield has a negative and significant effect. Hosseini et al. [36] in a study entitled "Study of the effect of Ramadan and Muharram months on the risk and return of mutual funds in the Iranian capital market", found that unreasonable returns that have a significant effect on the return and risk of capital funds Joint laying is not observed in the months of Ramadan and Muharram. One of the basic criteria for deciding on a stock exchange is stock returns. Stock returns alone have information content, and most actual and potential investors use it in financial analysis and forecasting [23]. At present, investors can predict stock returns to some extent by creating a bridge between stock returns and other financial and non-financial information [24].

All investors who intend to invest in the stock market should first examine the factors affecting the stock price and the behavior of the stock market and buy and sell stocks taking into account these factors. According to William Sharp model, the factors affecting the stock price index can be classified into two general categories: 1. Internal factors (micro factors): include those factors that are related to the company's operations and decisions made. 2. External factors (macro factors): Includes those effective factors that are beyond the authority of the company's management and in some way affect the company's activities. These factors can be studied in the form of political and economic factors [25]. Another factor influencing the price of a share is its intrinsic value, which is based on an examination of all aspects of the business in question, including financial statements and in terms of tangible and intangible assets, and is independent of its market price. One of the main and important indicators in determining the intrinsic value of companies' shares is the analysis of the industrial situation to which the company belongs. In fact, an industry that has a comparative advantage will have higher returns than other industries. Therefore, determining the position of industries in financial markets contributes to the diversity and adequacy of information to make the capital market more efficient[26].

The theoretical foundations and research conducted in this field show that the current research is important because by determining the calendar effects on stock returns and the banking industry index, it can be estimated that the return on a particular day, week or month How much will it be and can it be used to plan the purchase and sale of shares [37]. On the other hand, the absence of these works indicates the efficiency of the weak level of the market, which means that it is not possible to predict the price performance of a particular day using periodic price data. Therefore, examining these works can open the way for buyers and sellers of stocks in Tehran Stock Exchange. Also, investigating and testing the irregularities discovered in

the Tehran Stock Exchange can be very useful for retail investors, institutional investors, portfolio managers and securities issuers to analyze and make decisions.

4 Methods

This research is applied in terms of purpose and correlational in nature, according to which the relationship and the effect of several variables on each other are examined. Also, in terms of execution time, it is retrospective research and in terms of logic, it is an inductive type, according to which an attempt is made to generalize to the whole society based on limited observations (sample) of the result.

4.1 Data Collection

The statistical population of the study is the banks listed on the Tehran Stock Exchange and the study period from 2016 to 2020 is considered. Based on the results, the market value and number of banks studied are shown in Table 1.

Table 1: Market Value and Number of Banks Examined in the Research

Market value (billion Rials)	Number
3747092	11

The data in this study were collected through the website of the Financial Information Processing Center of Iran and the documented statistics of the Exchange Organization on the indices of the banks listed on the Exchange, in the desired period, were collected and compared with each other to ensure more confidence. Is. The collected information was categorized in Excel software, then the required statistics were extracted using SPSS software, and finally data analysis was performed using MATLAB software. Regarding the validity (validity) of the data collection tool because this study uses completely real data without manipulation, it has the necessary validity and reliability. Also, since the index of banks listed on the Tehran Stock Exchange has been tested, according to Shariat Panahi's research (2009), it is reliable.

4.2 Data Preprocessing and Feature Engineering

According to the research records and the existing problems caused by two regression methods with virtual variables and GARCH model, to achieve more realistic results about the effect of calendar irregularities, the research is based on a randomized dominance analysis method and the electre technique, which is a new method in financial research, has been performed more precisely. According to the research model presented in Figure 1, the work steps include 5 steps of data entry, calculation of efficiency, initial analysis, randomized mastery analysis and then presenting the results of each analysis to reach the final comparison matrix.

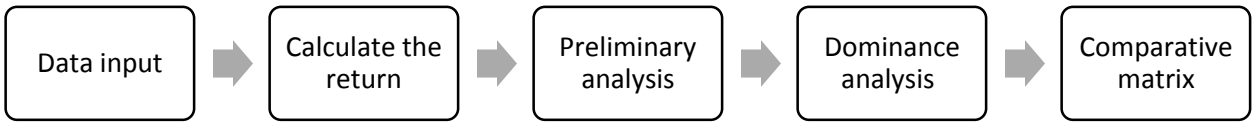

Fig.1: Workflow of the Experiment

- **Variables**

In this study, the dependent variable is a function of the distribution of returns for time periods and at the relative level, which according to Walter et al. it will be counted:

$$TRI_t = \left(\frac{IV_{t+1} - IV_t}{IV_t}\right) \times 100 \quad (1)$$

TRIt (index efficiency) is obtained from the difference IV (index value) of the industry at the beginning and end of the period.

Another dependent variable in this study is non-systematic investment risk, which is measured following Tehrani (2007) research according to Equation (2).

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

In this relation, σ is the deviation of the actual return or risk, r¯is the average return, r_i is the actual return, and n is the number of periods[27].

The independent variables in this research are days of the week, weeks of the month and months of the year. These variables are nominal variables. The control variables of the research also include the value of industry (Cap), age (Age), value of trades (Val) and volume of trades (Vol), which according to the existing constraints, especially time constraints, the amount of control variables is assumed to be constant. Their impact is not examined.

According to the theoretical foundations, the research hypotheses are formulated as follows:

H1: There is a significant difference between the returns of the index of banks listed on the stock exchange on Saturdays to Wednesdays.

H2: There is a significant difference between the index returns of listed banks in the first to fourth weeks of each month.

H3: There is a significant difference between the returns of the index of banks listed on the stock exchange in the months of April to March.

4.3 Classification Models

In this study, considering that in addition to profit, return of return and risk of different time periods are also considered, the model of Plaston et al. (2019) has been used[28]. To test the first hypothesis, according to Equation (6), 10 sub-hypotheses should be set to compare the productivity of weekdays on a pair-to-pair basis, meaning that Saturday to Sunday, Saturday to Monday, Saturday to Tuesday, Saturday to Wednesday, Sunday with Monday and until the end to compare and determine the superiority of each over the other to be determined, Thursdays and Fridays are not considered.

H0: F (i) X ≤ F (i) Y, for some x ε [a; b], (x, y) = {days of the week}

To test the second hypothesis, according to Equation (7), 6 sub-hypotheses should be set to compare the productivity of the weeks of the month, meaning that the first week with the second week, the first week with the third week, the first week with the fourth week, the second week is compared with the third week of the last governor and the superiority of each over the other is determined.

H0: F (i) X ≤ F (i) Y, for some x ε [a; b], (x, y) = {months of year}

The statistical method used in this research is random dominance analysis. In stochastic dominance analysis, arbitrage is assumed to be superior in decision-making and recognition, because everyone can shape his or her desirability function and include arbitrage opportunities in his or her desirability function [29]. The rule of dominance analysis in mathematical language is presented as relation (9):

F (K) X, N ≤ Y (K) Y, N for all x ε R

If the above condition holds for any K belonging to the set of arithmetic and positive numbers, it can be said that the dominance conditions of the X distribution over the Y distribution are established and there is an SDk relation. If K is equal to 1, this predominance is of type 1. In fact, for every K added, an integration step must be added to the distributions, and this can be continued to the nth stage in computational power.

4.4 Prediction Models

Considering the existing problems caused by the two regression methods with Dummy Variable Regression and the Garch model, in order to achieve more realistic results about the effect of calendar irregularities, the research is based on the random dominance analysis method and, more precisely, the Electra technique, which is a new method. In financial research, it has been done [12]. According to the records of the research conducted in Iran, it is clear that the analysis method of this research is mainly through regression with virtual variables and in a few cases using the GARCH model [35]. Investigations show that in the research conducted on market efficiency, it is not clear that the parameters estimated by regression can describe the random process well. Regarding the Garch model, it should be said that this model analyzes stock returns based on the following assumptions: 1- All yields are a function of time and have characteristics and conditions of distribution heterogeneity. 2- The measurement of the variance parameter is obtained by the linear logarithmic function of the past standardized returns. Although the GARCH model is much improved compared to regression, it is ambiguous in the definition of parameters related to external clusters and non-parametric tests. Therefore, according to the drawbacks of the regression method and the Garch model, the necessity of conducting progressive research based on the random dominance analysis method and more specifically the Electra technique, which is a new method in financial research, is well felt. It can provide more realistic results about the effect of calendar irregularities [36]. Also the Electre method, better known as the random dominance method, is one of the most widely used methods in solving decision-making problems with multiple criteria. Is used [30]. In this method, all options are evaluated using non-rank comparisons and pairwise comparisons are tested based on the degree of agreement of weights and the degree of difference of values [31].

Steps of the algorithm to solve decision problems of the ELECTRE method:

Step 1: Forming a decision matrix: According to the criteria and the number of options and the evaluated values of the options for different criteria, the decision matrix is formed as an Equation (3):

$$X = \begin{bmatrix} r_{11} & \cdots & r_{1n} \\ \vdots & \ddots & \vdots \\ r_{m1} & \cdots & r_{mn} \end{bmatrix} \quad (3)$$

Where Xij is the function of the i-th option in relation to the j-th criterion.

Step 2: De-scaling the decision matrix: In this step, we try to convert the criteria with different dimensions into dimensionless criteria. Equation (4-1) is used to un-scale:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \tag{4-1}$$

Step 3: Determining the weight matrix of criteria: In this step, according to the coefficients of importance of different criteria in decision making, the coefficient of importance of the criteria is determined. The weight of the criteria can be determined by methods such as AHP or Shannon entropy.

Step 4: Determine the normalized weighted decision matrix: The weighted decision matrix is obtained by multiplying the unmeasured decision matrix in the weighted vector of criteria as Equation (4-2).

$$v_{ij} = w_{ij} \times r_{ij} \tag{4-2}$$

Step 5: Form a set of pros and cons: For each pair of options k and e, the set of criteria is divided into two subsets of pros and cons. Agree set (Ske) is a set of criteria in which option is preferred to option and its complementary set is the opposite set (Dke). The set of agreeable criteria for positive and negative criteria is defined as Equation (5), respectively.

$$\begin{aligned} S_{ke} &= \{j | v_{kj} \geq v_{ej}\} \\ S_{ke} &= \{j | v_{kj} \leq v_{ej}\} \end{aligned} \tag{5}$$

The set of opposite criteria for positive and negative is defined as Equation (6), respectively:

$$\begin{aligned} D_{ke} &= \{j | v_{kj} < v_{ej}\} = J - S_{ke} \\ D_{ke} &= \{j | v_{kj} > v_{ej}\} = J - S_{ke} \end{aligned} \tag{6}$$

Step 6: Forming the Agreement Matrix: The agreement matrix is a square matrix followed by the number of options. Each element of this matrix is called the agreement index between the two options. To calculate the agreement index (Cke), option k and option e must be compared, and its value can be obtained from the sum of the criteria that option k prefers over option e. In mathematical language, the agreement index is calculated from Equation (7).

$$C_{ke} = \sum_{j \in S_{ke}} W_j \tag{7}$$

The agreement index indicates the degree of superiority of option k over option e and its value varies from zero to one.

Step 7: Determine the Opposite Matrix: The Opposite Matrix is a square matrix followed by the number of options. Each element of this matrix is called the disagreement index between the two options. The value of this index is obtained from Equation (8).

$$d_{ke} = \frac{\max\limits_{j \in D_{ke}} |v_{kj} - v_{ej}|}{\max\limits_{j \in J} |v_{kj} - v_{ej}|} \tag{8}$$

Step 8: Form the Consent Matrix: In this step, a certain value is specified for the agreement index (Cke), which is called the consent threshold and is denoted by (C). The agreement threshold is obtained by averaging the agreement indices (agreement matrix constructs). The value of the consent threshold is calculated from Equation (9).

$$\bar{C} = \sum_{k=1}^{m} \sum_{e=1}^{m} \frac{c_{ke}}{m(m-1)} \tag{9}$$

The agreement dominance matrix (F) is formed according to the value of the agreement threshold. If Cke is greater than $(C)^{-}$, the superiority of option k over option e is acceptable; otherwise, option k is not superior to option e, so the dominance matrix elements are determined according to Equation (10).

$$f_{ke} = \begin{cases} 1 \,, c_{ke} \geq \bar{c} \\ 0 \,, c_{ke} \leq \bar{c} \end{cases} \tag{10}$$

Step 9: Form the Opposite Dominance Matrix: The Opposite Dominance Matrix (G) is formed like the Agree Dominance Matrix. For this purpose, the value of the opposition threshold (D^{-}) must first be calculated from the mean of the opposition indices (opposing matrix elements). In mathematical language, the value of the opposition threshold is calculated from Equation (11).

$$\bar{D} = \sum_{k=1}^{m} \sum_{e=1}^{m} \frac{d_{ke}}{m(m-1)} \tag{11}$$

The lower the opposition index (dke), the better. Because the degree of opposition (disagreement) expresses the superiority of option k over option e. If dke is greater than (D.), The opposition is high and can not be ignored. Therefore, the properties of the opposite dominance matrix (G) are calculated as Equation (12-1).

$$g_{ke} = \begin{cases} 1 \,, d_{ke} \geq \bar{d} \\ 0 \,, d_{ke} \leq \bar{d} \end{cases} \tag{12-1}$$

Step 10: Final Matrix Mastery: The final mastery matrix (H) is obtained by multiplying each of the positive mastery matrix elements (F) by the opposite mastery matrix (G).

$$h_{ke} = f_{ke} \cdot g_{ke} \tag{12-2}$$

Step 11: Choose the best option: The final mastery matrix (H) expresses the slight preferences of the options. For example, if the value of hke is equal to one, it means that the superiority of option k over option e is acceptable in both the pros and cons (ie, its superiority is greater than the agreement threshold and its opposition or weakness is less than the opposition threshold). But option k still has a chance to be dominated

by other options. In fact, it is a preferred option over other options that have the lowest number 1 in the column, and from this point of view, the options can be ranked.

5 Experiment Results and Discussion

Descriptive Statistics

In this section, the results of descriptive statistics of the research are presented in three tables 2, 3 and 4 for days, weeks and months in the field of banking.

Table 2: Statistical characteristics and normality of the dependent variable (efficiency)

Variable	Average	Minimum	Maximum	Standard deviation	Skewness	Kurtosis	Kolmogorov-Smirnov test	Probability value
Days of the Week								
Saturday	0/20	-4/74	4/88	1/70	0/22	1/03	0/16	0/001
Sunday	0/23	-4/41	6/49	1/75	0/66	1/92	0/16	0/001
Monday	0/20	-4/53	6/11	1/63	0/22	1/74	0/17	0/001
Tuesday	0/14	-9/68	6/41	1/76	-0/23	4/93	0/18	0/001
4 Weeks Reviewed								
First Week	0/66	-9/45	16/67	4/59	0/88	3/72	0/22	0/003
Second Week	1/70	-10/45	25/61	5/45	1/52	5/71	0/18	0/022
Third Week	1/63	-8/07	19/78	5/56	1/33	4/11	0/22	0/003
Fourth Week	0/27	-17/15	22/31	6/11	0/48	1/87	0/15	0/104
12 months reviewed								
Farvardin	3/44	-8/58	19/56	11/17	0/72	-0/64	0/94	0/853
Ordibehesht	8/51	-7/59	42/86	20/72	1/57	2/16	0/82	0/147
Khordad	11/93	-2/31	49/67	21/73	1/94	3/82	0/74	0/046
Tir	10/41	-3/41	38/96	17/27	1/52	2/13	0/84	0/222
Mordad	7/96	0/57	34/53	14/86	2/23	4/96	0/59	0/005
Shahrivar	1/73	-3/74	6/01	4/08	-0/48	-1/79	0/93	0/803
Mehr	5/69	-10/47	30/93	16/10	1/09	1/10	0/91	0/652
Aban	1/74	-8/0	14/02	8/19	0/69	0/86	0/95	0/951
Azar	-0/17	-6/07	2/71	4/43	-1/83	3/70	0/79	0/101
Dey	2/55	-4/98	12/67	6/58	0/82	1/24	0/95	0/914
Bahman	1/26	-17/59	14/09	12/60	-0/73	0/16	0/91	0/618
Esfand	-1/56	-13/47	10/63	9/41	0/16	0/97	0/95	0/948

The results of Table 2 show that the highest average daily return in banks listed on the stock exchange is related to Wednesday with 0.27%. That is, the investor, if the criterion is only return, the best day of the week to invest is Wednesday, also the lowest average daily return is related to Tuesday with 0.14 percent. The average daily returns on listed banks is positive on all days of the week. Standard deviation indicates

the amount of investment risk in the desired period and according to the table above, it can be seen that the highest daily investment risk in banks listed on the stock exchange is related to Wednesday and the lowest risk is on Monday. Be. Wednesday is the most profitable as well as the riskiest day for investing in listed banks. Skewness and elongation are two statistics to check the normality of the data. In the above table, skewness is positive and to the right every day of the week except Tuesdays and Wednesdays. Elongation indicates the high concentration of data on a particular number. According to the table above, it can be seen that in the banks listed on the stock exchange, there is a stretch of charts and data distribution on all days of the week, ie the data is more focused on a certain amount and on Wednesday there is the highest amount of stretch. has it. Another method of detecting data normality is the Kolmogorov-Smirnov test. Given that the probability value of the above data is less than 0.05, it shows that the distribution of daily returns in the banks listed on the stock exchange is not normal on any day.

The results of Table 2 show that among the weeks of one month, the highest average weekly return is related to the second week with a return of 1.74% and the lowest average return is related to the fourth week with a value of 0.27. Also, the highest and lowest standard deviations, which indicate the return risk, are related to the fourth and first weeks, respectively. The first week has the least amount of risk and return. The skewness is positive on all weeks and to the right, meaning that most of the data is concentrated on the left side of the chart and most of the weekly returns are negative. Also, by performing Kolmogorov-Smirnov test and calculating the probability value, it was found that the data at the error level of 0.05%, except in the fourth week, are not normal and the probability of error is high.

Based on the findings presented in Table 2, it can be said that the only month with a negative return, December is -1.56 percent, and the highest return is in June at 11.93 percent. Also, the highest standard deviation, which indicates investment risk, occurred in June and the lowest standard deviation occurred in December. As a result, June has the highest risk and return and December has the lowest risk and return, but the negative average of December is not pleasant for the investor and will not be selected for investment. According to the table above, the amount of skewness is positive in some months and negative in others and shows that in some months the number of positive returns and in some months the number of negative returns is higher. Also, except in April and September, when the amount of elongation is negative and the graph is flat, in other months it shows positive elongation and the concentration of data on a certain number. Also, in the annual survey, because the number of data is less than 50, Shapiro-Wilk test was used to check the normality of the data and the results showed that except in June and August, with a very small difference, the probability value in all Months is more than 0.05 and data are normal.

Inferential statistics: In this section, all the steps of performing the electrification method to check the return and daily risk in the banks listed on the stock exchange are given.

- ✓ Results of stochastic approximate dominance analysis for the first hypothesis

The first hypothesis of this research deals with the issue that there is a significant difference between the index returns of banks listed on the Tehran Stock Exchange on different days. Random approximate dominance analysis is used to perform this test. If the return and risk of one day are superior to the return and risk of another day, this advantage will be shown in the matrix and graph. In this paper, considering that Shannon entropy method is a scientific method and has superiority over experimental mode, this method has been used. The first step in creating the decision matrix shown in Table (3), using the average

return and risk with the help of the mentioned formulas, was measured, and recorded for each day. The second step is to normalize or scale

Table 3: Daily return and risk decision matrix

Day	Average return	Risk
Saturday	0/196	1/69
Sunday	0/233	1/74
Monday	0/195	1/62
Tuesday	0/144	1/75
Wednesday	0/269	1/82
Index type	Positive	Negative
Index weight	0/965	0/0347

The matrix was performed by Euclidean method with the help of the mentioned formulas and the amount of risk and return calculated in the previous section were normalized or scaled. In fact, normalization reduces the range of data changes, which further contributes to the accuracy and speed of analysis. In the third step, by multiplying the value of the index coefficient in the normalized matrix, without considering the sign, the normalized weight matrix was calculated, which is shown in Table (4).

Table 4: Normal weighted matrix of daily returns and risk

Day	Average return	Risk
Saturday	0/04007	0/0152
Sunday	0/475	0/0156
Monday	0/397	0/0147
Tuesday	0/275	0/0154
Wednesday	0/04007	0/0152

In the fourth step, the results of the coordination matrix, which represents the coordination set of daily returns and risks, were formed. As shown in Table (5), the results.

Table 5: Daily return and risk coordination set

Coordination matrix	Saturday	Sunday	Monday	Tuesday	Wednesday
Saturday	-	0/03478	0/0965	1	0/03478
Sunday	0/0965	-	0/0965	1	0/03478
Monday	0/03478	0/03478	-	1	0/03478
Tuesday	0	0	0	-	0/03478
Wednesday	0/0965	0/0965	0/0965	0/0965	-

Step 5, the matrix of coordination and inconsistency sets was formed, which shows the superiority of each option over the other. The formation of the Boolean matrix of coordination and the Boolean matrix of inconsistency were the steps of the sixth and seventh steps. The Boolean matrix of coordination and inconsistency, like the simplified form of the matrix, is a set of coordination and inconsistency in that the superiority of one option over the other is shown by the numbers zero and one, which are presented in Tables (6) and (7). Is.

Table 6: Bolini matrix Coordination of daily returns and risk

Boolean matrix of coordination	Saturday	Sunday	Monday	Tuesday	Wednesday
Saturday	-	*0/03478*	0/0965	*1*	0/03478
Sunday	*0/0965*	-	0/0965	*1*	0/03478
Monday	*0/03478*	*0/03478*	-	*1*	0/03478
Tuesday	*0*	*0*	*0*	-	0/03478
Wednesday	0/0965	0/0965	0/0965	0/0965	-

The Boolean matrix of coordination and inconsistency, like the simplified form of the matrix, is a set of coordination and inconsistency in that the superiority of one option over another is represented by the numbers zero and one.

Table 7: Bolini matrix of mismatch of daily returns and risk

Boolean matrix of coordination	Saturday	Sunday	Monday	Tuesday	Wednesday
Saturday	-	0	1	1	0
Sunday	1	-	1	1	0
Monday	0	0	-	1	0
Tuesday	0	0	0	-	0
Wednesday	1	1	1	1	-

In the eighth step, the final dominance matrix was formed, which shows the superiority of one option over the other option by considering both return (positive effect) and risk index (negative impact) and by combining two Boolean matrices, coordination and inconsistency are achieved. comes.

The last step is the step of calculating the number of dominances, the results of which are shown separately in days (weeks) and Figure (2) in Table (8). At this point, by summing the superior number of each option that is here on weekdays and arranging them, it can be concluded whether one option is more favorable to the investor than the other options. At this stage, the superiority of one option can be three more, less or equal than other options. If one option has more advantages, it is more desirable for investment and a better choice for the investor. Had.

According to the above information in the banking industry, Wednesday is the best day and Tuesday is the worst day for investment, and the assumption of uniform distribution of returns and risk is rejected. The results of random domination by electrode method in Figure 2 show that the return on Wednesday is superior to other days and Tuesday is the most unsuitable day for investing in the Tehran Stock Exchange. The superiority of one day over other days indicates that the investor prefers a particular day to invest over other days, and this is contrary to the view of market efficiency and shows that the Tehran Stock Exchange is a necessary efficiency. Does not have. Accordingly, the assumption of equal distribution of daily returns and risk in companies in banks listed on the stock exchange is rejected. Also, the investor will not be indifferent to the superiority of one day, that is, there is the superiority of the distribution of returns and daily risk of one day over another. Based on the above analysis, it can be concluded that investors are not indifferent to the different days of the week by considering the principles of insatiability and risk aversion, and in order to increase the desirability, they prefer some days over others, contrary to the first hypothesis

and violation. And specifies that there is no similarity between returns and risk on different days of the week in banks listed on the Tehran Stock Exchange.

- ✓ Review the results of weekly returns and risk

In this section, considering that the second hypothesis of the research states that there is a significant difference between the returns of the index of banks listed on the Tehran Stock Exchange in the first to fourth weeks of each month, all the results obtained from random dominance analysis and the weekly superiority of the surveyed banks was summarized in Table (9) and Figure (3) in terms of market value.

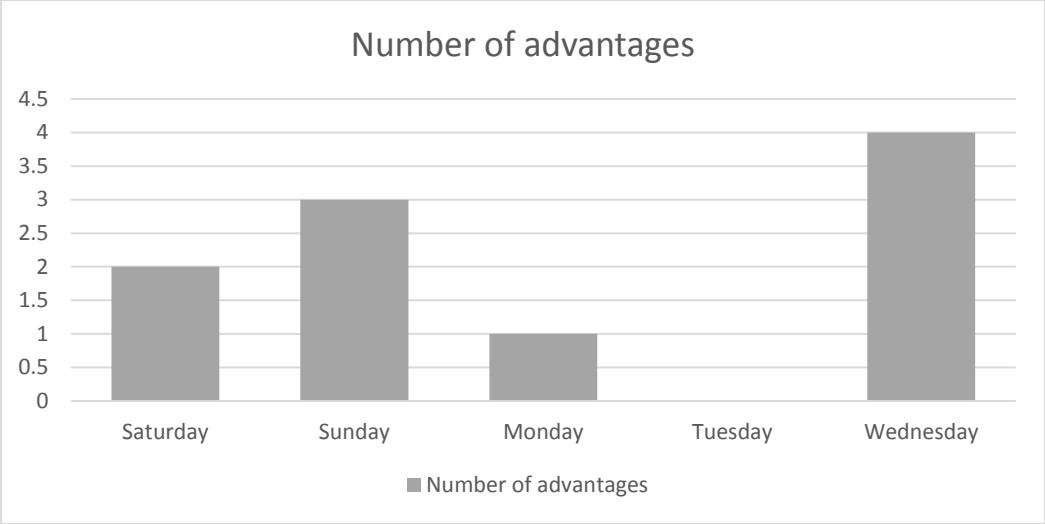

Fig.2: Daily Superiority of Returns and Risk in the Banking Industry

Table 8: The Final Dominance Matrix of Daily Returns and Risk in the Banking Industry

Boolean matrix of coordination	Saturday	Sunday	Monday	Tuesday	Wednesday
Saturday	-	0	1	1	0
Sunday	1	-	1	1	0
Monday	0	0	-	1	0
Tuesday	0	0	0	-	0
Wednesday	1	1	1	1	-

Table 9: Number of Weekly Superiority of Returns and Risk in Banks Listed on the Stock Exchange

Industry	first week	second week	Third week	fourth week
Bank	1	3	2	0

The results of electrically randomized dominance analysis show that there is a significant advantage between the distribution of returns and risk of the weeks of different months and the investor is not indifferent to choosing a week to invest.

Based on the above findings, it can be concluded that investing in the second week of each month is a better opportunity than other weeks and there is almost no significant investment preference between other weeks.

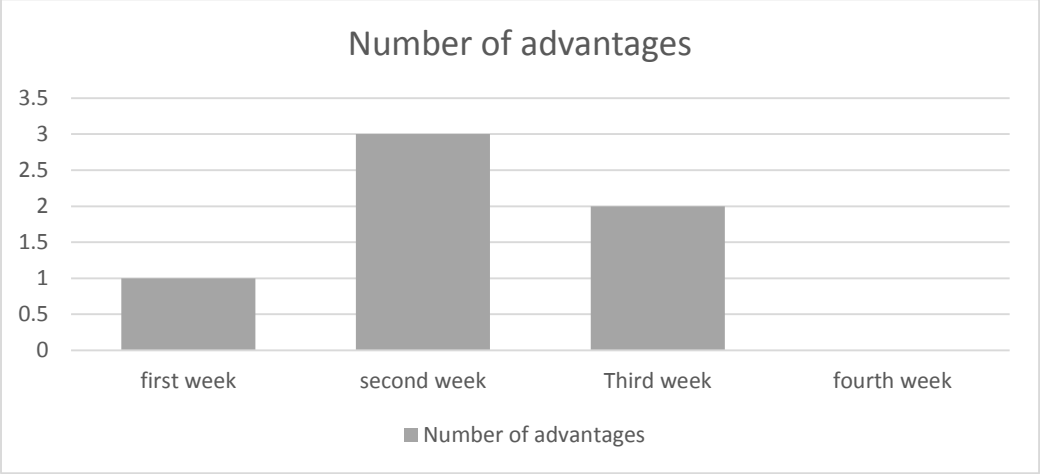

Fig.3: Weekly Superiority of Returns and Risk in the Banking Industry

In general, there is a greater proportion of the superiority of risk distribution and return functions between the weeks of the month compared to the days of the week, which is due to the smaller number of comparisons and the adjustment of data over a larger period. But the existence of even one case of superiority, which has happened much more here, makes the second hypothesis of the research rejecting the homogeneity of the distribution of returns and risk between the weeks of the month. Therefore, according to the table above, the assumption of uniform distribution of weekly returns and risk in the banking industry is rejected and the best time to invest in the banking industry is the second week.

- ✓ Review monthly return results and risk

In this section, considering that the third hypothesis of the research states that there is a significant difference between the returns of the index of banks listed on the Tehran Stock Exchange in the months of April to March of each year, all the results obtained from random dominance analysis and monthly superiority The studied banks, all the results obtained from the random dominance analysis and the superiority of the months of the year in the studied banks, in Table (10) and Figure (4), were brought together in terms of market value.

Table 10: Number of Monthly Returns and Risk in the Banking Industry

Industry	farvardin	Ordibehesht	Khordad	Tir	Mordad	Shahrivar	Mehr	Aban	Azar	Dey	Bahman	esfand
Saturday	4	8	11	10	8	3	6	3	1	4	1	0

The results of the analysis of random dominance by electro method, show that the return and risk of June is superior to other months and according to the principle of risk aversion and insatiability, investors will not be indifferent to the choice of investment time. And choosing June for investment will increase their desirability. Also, according to the table above, it can be found that the most unsuitable time to invest in the Tehran Stock Exchange is March, February, and December, followed by November and September. The result of analyzing the sub-hypotheses about the pair superiority of return and risk of the months of the year shows that in most cases it can recognize the superiority of one month over another, and this is the third hypothesis of the research on the similarity of monthly distribution of return and risk. Rejects Tehran Stock Exchange.

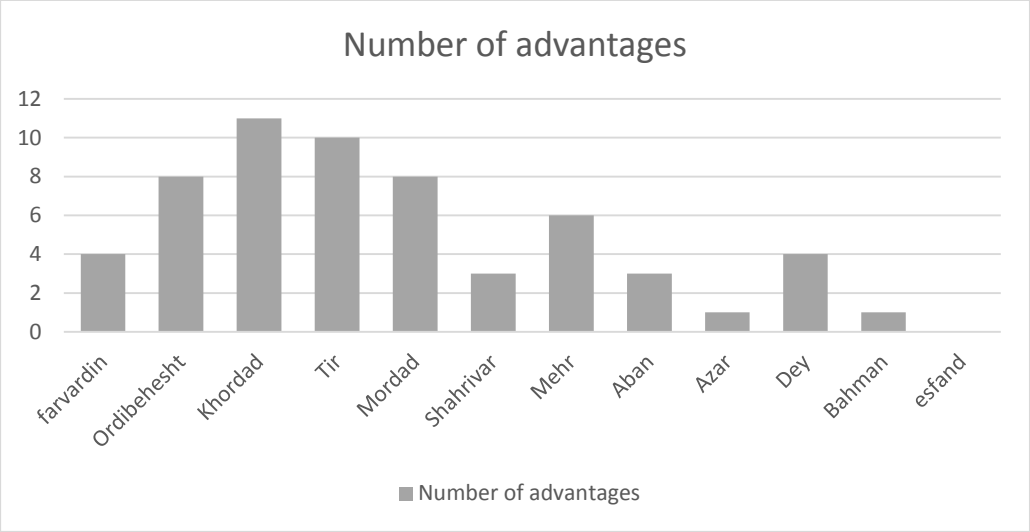

Fig.4: Superiority of Risk and Monthly Returns in the Banking Industry

According to the chart above, the best time to invest in banks listed on the stock exchange is from May to late August and the worst time is from November to late March. Also, the assumption of uniform distribution of monthly returns and risk in the banking industry is rejected.

6 Conclusions

The purpose of this study is to investigate the effect of calendar anomalies on returns and risk in banks listed on the Tehran Stock Exchange. For this purpose, for the first time in Iran, the effect of three groups of calendar anomalies, including Saturday to Wednesday, the first, second, third and fourth weeks of each month, from the random dominance analysis method and the electro method, which is the matrix form of the random dominance analysis method. Also, the months of April to March in the banks listed on the stock exchange in the period 1395 to 1399 were examined.

With the help of 9 steps of the Electra technique and determining suitable and unsuitable options for investing and also ranking the days based on their importance and weighting them, finally, based on the findings of the research, it was first determined which of the days of the week Which of the weeks of a month and which of the months of the year are suitable and which are unsuitable for investing in the country's banking industry. Thus, Wednesday is the best day and Tuesday is the worst day for investing in the country's banking industry, and the second week of each month is more suitable for investment than other weeks, and the fourth week of each month is less suitable than other weeks. The month is for investment. Throughout the year, June is the most suitable month for investment and March is the most unsuitable.

This method allows the researcher to observe three basic principles in decision making including insatiability, risk aversion and absolute risk reduction. In this method, the return of return and risk of one time is compared with other time periods and their superiority or non-superiority over each other is examined and with its help, market anomalies regarding returns and risk in different time periods can be detected. This issue can refute or confirm the hypothesis of market efficiency. Also, recognizing differences in the distribution of returns over different time periods can guide investors and market participants in scheduling market entry and exit.

The research findings indicate that all three research hypotheses were not accepted. The results obtained from the first hypothesis, which is based on Kara Fama market theory and tested by electro method, show

that the returns of the days of the week are not the same and the Wednesday has the highest and Tuesday the lowest returns for investing in the stock market. It has the stock of Tehran, so investors will tend to invest on certain days. Accordingly, the investor will not be indifferent to the superiority of one day, that is, there is the superiority of the distribution of returns and daily risk of one day over another. Accordingly, the assumption of equal distribution of daily returns and risk in the banking industry is rejected and this result indicates the inefficiency of the Tehran Stock Exchange. Based on the above analysis, it can be concluded that investors are not indifferent to the different days of the week by considering the principles of insatiability and risk aversion, and to increase the desirability, they prefer some days over others, contrary to the first hypothesis and violation. And indicates that there is no similarity between the returns and risk of different days of the week in the banking industry of the Tehran Stock Exchange. This result, based on the principle of market efficiency, indicates that efficient market behavior is unpredictable, and it is not possible to determine a strategy in an efficient market and achieve abnormal returns through it. Hence there is a similarity between the distribution of returns over different time periods. The superiority of the distribution of returns and risk in one day over another makes the investor choose the time in which his utility function is maximized and is indifferent to other time periods. In other words, recognizing the superiority of one day's return and risk over another day rejects the first hypothesis based on the homogeneity of return and risk distribution on weekdays. The results of this study are consistent with the findings of Patingle, Gibbon and Hess, Jami et al. and Qadan et al. [32].

The findings of the research on the second hypothesis also indicate that each month, the second week, compared to other weeks, creates a better opportunity for investors in terms of return on investment and risk, and makes investors in the period Choose times when their utility maximizes, and do not be indifferent to choosing a particular week to invest. Therefore, it can be concluded that investing in the second week of each month is a better opportunity than other weeks, and there is almost no significant investment preference between other weeks. However, in general, there is a greater proportion of the superiority of risk distribution and return functions between the weeks of the month compared to the days of the week, which is due to the smaller number of comparisons and the adjustment of data over a larger period. But the existence of even one case of superiority, which has happened much more here, and the recognition of the superiority of one week's return over another week, rejects the second hypothesis, that the return on risk and risk are the same between the weeks of the month. This result is another emphasis on the inefficiency of the Tehran Stock Exchange. The results of this hypothesis are consistent with the findings of Plaston et al., Swang et al., and Rai and Shirzadi [33].

Findings obtained from the third hypothesis to investigate the effect of calendar anomalies on the return and risk of different months showed that the return and risk of June is superior to the other eleven months, while March, February and December are the most unsuitable months for capital. Is listed on the Tehran Stock Exchange. These results are enough for investors to be indifferent to the choice of investment time according to the two principles of risk aversion and insatiability and tend to invest in months that will increase their desirability. The results of lack of consistency between months in terms of return and risk led to the rejection of the hypothesis. While emphasizing the inefficiency of the Tehran Stock Exchange. The results of this hypothesis are consistent with the findings of Hosseini et al., Rai et al. and Regalsi et al. Regarding the research findings, it should be noted that in this study, according to the definition of an efficient market at a weak level that historical information of the past cannot and should not have information content and be used in predicting the future, to evaluate the Tehran Stock Exchange It is also

addressed at a weak level. However, if it is possible to extract a specific trend and pattern in the financial markets, including the Tehran Stock Exchange, by any means from past information, and use it as a strategy to obtain additional returns, the market efficiency can be assumed by He hesitated. Because according to this research, researchers were able to extract a time strategy for investment, so the performance at a weak level of the Tehran Stock Exchange can also be challenged. Because the findings showed that, for example, and according to the findings, investors can get more additional returns by investing on Wednesday in the second week of June than on Tuesday in the fourth week of March.

Finally, since the Iranian capital market as an influential part of the financial market in recent years has tried to prove itself as a sustainable source of financing the national economy, pay attention to the existence of calendar anomalies in the capital market and achieve a pattern of anomalies. The presence of this inflammatory market with the help of new financial techniques, enables professional investors to design the appropriate business strategies to achieve the highest utility and return from this market, and these efforts will ultimately improve the position of the Iranian capital market.

In the end, financial mathematics researchers are suggested to use the results obtained from this research to model the optimal strategies when entering/exiting the market, considering the confirmation of the abnormality of stock returns in different periods of time. It is also suggested that the researchers investigate the effect of time periods on other economic indicators such as the indicators in the money, currency, commodity market and compare the results with the research done.

It should also be noted that in the course of conducting this research, researchers were faced with limitations, some of the most important of which include the following:

- The existence of the fluctuation range in Tehran Stock Exchange has caused the recognition of the superiority of yield distributions due to small daily changes to be less recognizable than other world markets and requires the need for long calculations and the use of advanced software.
- The presence of obstacles such as base volume, fluctuation range greatly reduces the severity of detection and the power of irregular periods.
- The long-term stoppage of symbols due to things such as holding a meeting and adjustment of profit, which is not common anywhere in the world.

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