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The Effect of Macroeconomic Variables on Stock Portfolio Performance Based on Traditional and Modern Network

Yadegar Mohammadi[a], Esfandiar Mohammadi*[b], Gharibeh Esmaeli Kia[a]

[a]Department of Management, Ilam Branch, Islamic Azad University, Ilam, Iran
[b]Department of Management, ilam University, ilam, Iran

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ABSTRACT

Assessing the performance of stock portfolio is among the most important issues of the capital market and the stock investment management. To evaluate the performance of the portfolio appropriately, identifying affecting factors is essential. Macroeconomic variables are important effective factors due to their effect on the systematic risk of companies. In this study, using the ordinary least squares (OLS) method, the effect of macroeconomic variables including inflation, interest rate, liquidity growth rate, oil price and exchange rate (Rial equity versus dollar) on the performance of stock portfolio based on the theory of the traditional and modern network was investigated. The performance of portfolios including growth, growth-value, value, offensive, indifferent, and defensive portfolios was measured based on seasonal data from 2006 to 2016 using the Treynor ratio. The results showed that macroeconomic variables affected the performance of both traditional and modern networks at the 5% error level. However, the Akaike criterion value for modern network model is less than the traditional network. It indicated that the interpretation of macroeconomic variables in the portfolio of the modern network was better than that of the traditional network. Also, the effect of the macroeconomic variables on the performance of the six portfolios was different.

1 Introduction

One of the most important decision-making criteria in any investment is the level of risk and return on investment and a proportion between them. Identifying the factors that increase or decrease the risk is crucial. Various theories, including modern portfolio theory and Arbitrage pricing theory, have proven that macroeconomic variables affect the stock returns [29]. A deep link between economic boom and market returns causes macroeconomic shocks to affect the market returns. Hence, investors are always at risk in earning returns. According to William Sharp's model, stock returns are affected by micro and macro factors. Micro factors refer to issues within companies that are generally under the control of managers [15]. At the macro level, economic, political, social, and cultural factors that are not in the control of management, result in the creation and increase of the systematic risk of the company, and consequently, affect the returns of companies. Each of these micro and macro factors has compo-

* Corresponding author. Tel.: +989183410847
E-mail address: *e.mohamadi@ilam.ac.ir*

nents that any change in them would affect the economic environment and it is clear that these volatilities do not have the same effect on different industries and companies. According to Rule 1 of Markowitz theory (the principle of investment diversification), one way to control and reduce the risk for investors is to invest in a portfolio of financial assets rather than investing in a financial asset (securities). Sharing investment risk across different assets, portfolio will reduce the likelihood of loss [11], and consequently, will lead to a better performance of an investment portfolio. One of the newest active portfolio management strategies is the strategy of stock grouping in the form of network matrix, company size, and company type (growth, value, and growth-value). It is known as the traditional model of network analysis. In addition, modern models of network analysis are presented based on the type of stock (defensive, offensive and indifferent) and market type (symmetric and asymmetric). In the traditional stock network, they are divided into three groups of growth, value, and growth-value according to the P / E ratio, and in the modern network, they are divided into three groups of defensive, offensive and indifferent. Each of the six groups can form a portfolio. Changes in macroeconomic variables will create a risk for portfolios created in both traditional and modern networks and affect the performance of these portfolios, although these effects are not the same due to the different characteristics of these companies and this causes that the real return on the portfolio to be different from the expected return on investors. Therefore, these changes seem to affect the performance of all portfolios and the type and level of its effect on economic volatility differs from other portfolios because each portfolio has specific characteristics. This study sought to investigate the effect of changes in macroeconomic variables such as interest rate, exchange rate (Rials versus US dollar), inflation rate, oil price and liquidity volume on the performance of 6 portfolio based on traditional network model (including growth, value, growth-value) and the modern network (including defensive, offensive and indifferent). Investigating the volatility of systematic risks was another part of this article that had a significant contribution to the literature of stock portfolio performance. In this study, the negative effects of volatility on macroeconomic were controlled for better use of the positive effects of these factors to generate higher returns and better performance.

2 Theoretical Principles and Review of Literature

Several studies have been conducted in recent decades to indicate the effect of economic forces on stock returns in different countries. For example, Arbitrage pricing theory was used by Chen et al. [17] to describe the effect of some macroeconomic variables on stock returns in US capital markets [24]. In the arbitrage theory, the factors outside the market are considered. For this reason, in this model, the relationship of risk with stock has been derived from two sources. The first source of risk is macroeconomic factors that affect all securities. The effect of these factors on all assets is distributed in the market and it cannot be eliminated by diversity in stock. The second source of risk is the element of individual characteristics. This element is unique to each of the securities and based on the arbitrage theory, the second part of risk can be eliminated in a portfolio by diversifying. Hence, in an efficient market, the risk is merely related to systematic (macroeconomic) factors (Hamao, [21]). Based on the capital asset pricing model (CAPM), investors select and form the most diversified portfolio of assets (market portfolio) to reduce risk. Based on this model, the rate of return on investors is obtained from the following relationship. Asset risk premium + risk-free nominal return rate = investor's expected return rate. Thus, in this model, the investor can minimize the non-systematic risk of each asset by maximizing the diversification of its portfolio. However, it is not possible to eliminate

the risk systematically due to external factors such as macroeconomic factors outside the scope of company management. Therefore, risk premium is the reward resulting from systematic risk-taking. Macroeconomic factors affect the price and return on the stock of firms that have different systematic risk characteristics (β) and ratio of profit to equity (P / E) by affecting the future cash flows of an investment and other factors affecting the expected rate of return on investors. Hence, they will affect the performance of a portfolio consisting of a specific segment of the stock and it will be different from other portfolios. To calculate investment portfolio performance, different criteria have been proposed by researchers (Tripat et al. [28], Wanjiku et al., [29], Rahnemay-e Roodposhti et al. [11]). Among them, Treynor ratio obtained from dividing degree of return volatility ($\bar{r}_p - \bar{r}_f$) by portfolio risk (β) was used in this study. The reason to select it was the presence of three parameters of portfolio return, risk-free return, and systematic portfolio risk in this criterion. Also, all of these parameters are influenced by environmental factors of the company including economic factors, confirming the results of the research conducted by Rahnemay-e Roodposhti et al. [11]. The Treynor ratio is more appropriate to assess the performance of companies.

2.1 Effect of Macro Variables on The Capital Market

Interest rate as a key economic indicator plays a key role in business firms since money plays the key role in managers' decision-making. Interest rate changes are crucial in this regard. An increase in interest rates, due to the effect on financing costs on the one hand and an increase in the investors' expected rate of return on the other hand, can have a negative impact on stock returns. In general, changes in interest rate affect all financing decisions, so that an increase in interest rate will increase the creditors' expected rate of return. It increases risk-free interest rate, which will affect financing of the company. With a negative shock, interest rate (an increase in real interest rate), the risk and rate of return on certain investments and the earnings of a company tend to decrease. It may eventually lead to reduced company's stock value. Therefore, there is a significant relationship between the increase in interest rate and the performance of stock portfolios, and this relationship is different for each portfolio. A growth in the general level of prices, referred to as inflation, is one of the most important characteristics of an economy, since all economic activities are regulated by considering the general growth of prices. In fact, market theory is based on a price system. Therefore, changes in the general level of prices will affect their returns by creating inflation risk for companies. Inflation, as one of the most important economic variables affecting stock prices, has been considered for several years. The relationship between the inflation and stock returns is one of the most controversial issues among the researchers. Market equilibrium is not achieved based on nominal values and investors regard inflation as one of the most important macroeconomic variables affecting the decision on an investment. Roll and Ross also found a negative relationship between the weighted mean return of the New York Stock Exchange and expected and unexpected inflation. With increasing the inflation, investors' expected returns also increase, so discount rate of cash flows and the lost opportunity costs of money also increase. The results of the empirical studies conducted by Chen et al. [17] indicated that inflation had a negative impact on the capital market, so there is a significant relationship between interest rate and stock portfolio performance. However, this relationship is not the same for six portfolios.

The role of the exchange rate in economic systems, especially in undeveloped countries, is undeniable, since undeveloped countries depend on industrialized countries in most of their economic sectors and require more currency for importing. Most manufacturing companies import raw materials, technology and machinery. If the exchange rate increases as a result of economic changes and other fac-

tors, business firms will have to pay more money for imports. Increasing the exchange rate will increase the amount of debt, and consequently, increase the cost of paid interest and increase the cost of capital of the company [23]. Thus, there is a significant relationship between increased exchange rate and the performance of stock portfolios. Tehran Stock Exchange is considered as one of the centers for attracting and directing liquidity to the production of goods and services` sector. With increasing the volume of liquidity, some part of it is expected to flow to the stock market and affect the stock return by affecting the financing of listed companies in Tehran Stock Exchange. The effect of money supply on stock prices has been widely discussed in the economic literature. Money supply affects the current value of cash flows through discount rates. Although there is a strong relationship between money supply and prices in the stock market, the effect of changes in the money supply on the stock market is still controversial. Some of the researchers argued that there is no answer to the questions of what the effect of money on the stock market is and how the effects of money are measured. Money supply increases the real interest rate, which finally, increases the discount rate, which in turn reduces the value of the stock. As a result, the economic activities will be at lower levels, resulting in potentially reduced earnings of companies. In that case, investors will demand higher share of risk. Thus, there is a significant relationship between the growth rate of liquidity and the performance of stock portfolios.

As one of the main sources in the economy of oil-rich countries, including Iran, is the revenue resulting from the sale of crude oil, changes in oil prices can lead into changes in the cost of production of companies and the total cost of the product will affect the financial resources operating in the economy of a country which can affect the stock returns. Although an increase in oil prices increases oil revenues of a country, an increase in oil price leads to an increase in the cost of raw materials needed by companies, which also leads to increased debts of companies, resulting from the purchase of raw materials. Also, the stock price is the discounted future cash flow value. The stock price can be affected by changes in macroeconomic variables. The crude oil prices could affect the discount rate of this event and increase the expected rate of return through affecting the cash flows. Therefore, there is a positive relationship between an increase in oil price and stock portfolio performance.

2.2 Research Conducted on Modern and Traditional Portfolio Performance

Fama and Eugene [19] conducted a study on value and growth stock in 12 major international markets and in the US market from 1975 to 1995. They selected the M / B (market value to book value) and E / P (earnings to price) and C / P and D / P ratios as value indices and formed equal port folios based on these ratios at the beginning of each year and calculated the returns of these portfolios. Their research results showed that value stock had higher returns than growth stock in 12 of the 13 studied countries. Rahnemay-e Roudposhti & Mirghaffari [10] evaluated the performance of the portfolio in Tehran Stock Exchange using the Sharp Index and Revised-Sharp index based on the value at risk (VAR) from 2006 to 2009. After calculating VAR through Risk Metric method, they calculated Sharp index and revised Sharp index. The results showed differences on the ways of evaluating performance and ranking of these two indices. Therefore, the ranking of the two methods was evaluated by Wilcoxon nonparametric test and the results of these tests showed no significant differences in the ranking of these two indices. Rahnemay-e Roudposhti [9] evaluated the performance of portfolio performance based on network matrix using Sharp index and optimal potential ratio in National Development of Investment Company from 2006 to 2009. Portfolios were grouped based on growth, value,

growth-value companies as well as offensive, defensive and indifferent companies. The results indicated that portfolio consisting of offensive, defensive and indifferent companies had a higher ability to explain than portfolio of growth, value, growth-value companies. Also, none of the obtained portfolios showed better performance than market portfolios. The objective of this study was to evaluate the portfolio performance assessing indices such as Sharp index and optimal potential ratio and to compare the efficiency of these indices. In the literature some researchers investigated the performance of investment strategies in Tehran Stock Exchange during 2002-2008 and examined the appropriate strategy for investing based on behavioral characteristics of stock such as growth or value and size. In this regard, they used a three-factor model of Fama and Eugene [19] to compare the returns of the groups and finally concluded that the growth investment strategy had a higher return than the value strategy.

Halit and Karan [20] investigated the performance of value and growth stock in Istanbul Stock Exchange from 1993 to 1998. Growth and value portfolios were formed based on the M / B ratio of listed companies in the Istanbul Stock Exchange. The results showed that growth portfolios performed better than value portfolios. Hence, they were not in line with the results of developed and emerging countries. Using risk-return analysis, relative performance index (RPI) of Treynor Ratio, Sharp Index, Fama and Eugene [19] analyzed the performance of Indian joint investment funds and their return with an index portfolio. Considering the limitations of using each of these evaluation criteria, they applied the appropriate criterion for fund evaluation and ultimately concluded that most funds could meet investor expectations. Accordingly, they obtained returns higher than expected returns for both systemic and total risk criteria. Artikis [14] evaluated the performance of ten domestic financial companies operating in the financial markets since 1995 to 1998 in Greece based on three indices of Sharp, Treynor and Jensen. The results showed the similarity of the rankings based on the Treynor and Jensen indices and a difference between two mentioned indices and the Sharp index. Also, they considered smaller beta in all of these companies as a sign of their defensive investment policy.

2.3 Researches Conducted on The Effect of Macro Variables on The Stock Market

Asgharian et al. [15] investigated the effect of macroeconomic uncertainty on volatility of US stock and bond markets. Using seasonal data of 1986 to 2016 and the GARCH model, they showed that uncertainty of macroeconomic variables had a significant effect on the volatility of the two financial markets and the rate of the effect increased over time. Emenike & Okwuchukw [18] investigated the relationship between macroeconomic variables and stock market volatility in Nigeria. X GARCH and money supply variables of consumer price index, credits granted to private sector, dollar exchange rate and net foreign assets were used. Using monthly data of 1996-2013, the model has shown that inflation and money supply had a positive effect on the volatility of stock returns. The net effect of foreign assets on the volatility of stock returns was negative and non-significant, and the other two variables had a significant and negative effect on the volatility of stock returns. Tripathi and Seth [28] investigated stock market performance and macroeconomic variables in the stock market. Stock market performance includes total market index, current stock market value and volume of transactions of stock market and macroeconomic variables include interest rate, inflation rate, exchange rate, money supply, world oil price and industrial production index.

The results based on factor analysis showed that three variables of inflation rate, interest rate, and exchange rate were identified as effective variables. Inflation was negatively correlated with stock market performance. Finally, there was a negative relationship between interest rate and stock market

performance. According to the Granger causality test, there is a one-way relationship from the macro variables to the stock market performance, but there is no relationship from the stock market to macro variables. According to Johansen co-integration test, there is a correlation between the index of industrial production, volume of money, and the world oil price and total stock market index. There is a co-integration between the money supply and the world oil price and volume transactions of stock market and between industrial production, volume of money, and world oil price and the current market price inflation. Previous studies were extensively being enriched by various studies investigating the relationship between macroeconomic variables and stock market indices. Accordingly, they have argued that macroeconomic variables, including GDP, price index (PI), producer price index (PPI), consumer price index (CPI) of the most extensive money supply (M1, M2, M3) and exchange rate (ER), gross domestic product (GDS), gold price (GP), oil price (OP), Federal fund rate (FFR) and INT, affect the stock market indices. They stated that macroeconomic variables affect the investors' investment decisions. However, several empirical studies investigated the relationships between macroeconomic variables and the stock market index using equilibrium time series models. To investigate the short term equilibrium relationships between macroeconomic variables and stock market indices, the VAR equilibrium time series model has been adopted by many researchers.

The results showed that macroeconomic variables are significantly affected by the stock market index. However, the VEC equilibrium time series model has been adopted by other researchers to investigate the equilibrium relationships. These studies showed that macroeconomic variables significantly changed the stock market index. Also, time series models, numerous studies using GARCH have analyzed the relationships between macroeconomic variables and the stock market index. The results also showed that conditional volatility of macroeconomic variables significantly affected stock market indices. Zakaria and Shamsueddin [30] investigated the relationship between volatility of stock market returns and five macroeconomic variables, including production, inflation, exchange rate, interest rate, and money supply in Malaysia. Using the monthly data of 2000–2012 and the GARCH model and the Granger causality test in the multivariate VAR framework, they showed little evidence of the relationship between macroeconomic volatility and stock index volatility. Extending Arbitrage Pricing Theory (APT) and applying some macroeconomic variables, Chen et al. [17] explained stock return in US stock markets. Using the data of 1959-1983 and the ordinary least squares (OLS) method, they showed that the rate of industrial production, changes in risk premium, and changes in the structure of conditions were positively correlated with expected stock returns, but both predicted inflation and unpredicted inflation had a negative relationship with expected returns of stock. In a study entitled "Analysis of factors affecting Tehran Stock Market Price Index using Co-integration method during 1991-2008", Azimi et al. [2] showed that in Tehran Stock Exchange market, dynamic and real macroeconomic variables including exchange rate, inflation rate, volume of money, short and long term interest rates and industrial production index have had a significant impact on the Tehran stock market price index, so that exchange rate, inflation rate, volume of money and industrial production index had positive effects and short and long term interest rates had a negative effect on the market price index. In this regard, inflation is the most important factor affecting the price index, and the index of industrial production and the exchange rate were ranked second and third, respectively, in this regard. Abbasian et al. [1] have evaluated the effect of macroeconomic variables on the total index of Tehran Stock Exchange using seasonal statistics and information of years 1997 to 2005. Using co-integration and error correction methods and instantaneous reaction functions, they showed that the exchange rate and trade balance had a positive effect on the stock index in the long run term and the effect of infla-

tion, liquidity, and interest rate was negative. Saeedi and Amiri [25] investigated the effect of macroeconomic variables, including general level, prices, nominal exchange rate, and oil price on the total stock index of Tehran Stock Exchange using seasonal data of 2001-2007. Using the OLS method and unit root tests, they concluded that the price index and the exchange rate had no significant effects on the total stock index and the crude oil price had a significant negative effect on the total stock index. One of the main objective of this study was to apply the OLS test method to investigate the relationships between macroeconomic variables of oil price change rate (OIL), inflation rate (INF), exchange rate (ERA), liquidity growth rate (Liq), bank interest rate (INT), and portfolio performance (growth, growth-value, value, offensive, indifferent and defensive portfolios) based on the Treynor ratio.

One difference of the present study with other studies, as mentioned in the review of literature section, was investigating the effect of macroeconomic variables on stock portfolio performance as a primary element affecting stock prices and returns and funding sources of companies, and consequently, the capital market performance. Also, in this study, macroeconomic variables including interest rate, oil price change rate, liquidity growth rate, exchange rate, and inflation rate were used, whose significant relationship with the capital market has been indicated in previous research, including the studies conducted by many authors. Thus, it is expected that the present study can enrich the existing literature in the field of capital market and help managers, investors, analysts, and other capital market actors make appropriate decisions to form stock portfolios by controlling the negative effects of economic factor volatilities on portfolio performance.

3 Data Analysis Methods and Tools

This research was a causal-analytic study in terms of method and an applied study in terms of objective and a library type of study in terms of method of collecting the information. The objective of applied research was to develop applied knowledge in a specific field. The subject area of the research was to investigate the effect of macroeconomic variables on stock portfolio performance based on traditional and modern networks. Statistics and information on the variables used in the research model were derived from seasonal time series of the central bank database and the stock exchange organization. Also, the econometric tool used in this study was EViews software and ordinary least squares method during 2006 to 2016 was used as an estimated method. The spatial score of the study was Iran. The hypotheses that are discussed through in the current paper are as follows:

Hypothesis 1: The effect of macroeconomic variables on stock portfolio performance based on traditional network model differs compared to that of the modern network model.

Hypothesis 2: Macroeconomic variables affect the stock portfolio performance based on traditional network models.

Hypothesis 2-1- Macroeconomic variables affect the stock portfolio performance based on growth model.

Hypothesis 2-2- Macroeconomic variables affect the stock portfolio performance based on growth-value model.

Hypothesis 2-3 - Macroeconomic variables affect the stock portfolio performance based on value model."

Hypothesis 3: Macroeconomic variables affect the stock portfolio performance based on the modern network model.

Hypothesis 3-1- Macroeconomic variables affect the stock portfolio performance based on the offensive model

Hypothesis 3-2- Macroeconomic variables affect the stock portfolio performance based on indifferent model.
Hypothesis 3-3- Macroeconomic variables affect the stock portfolio performance based on the defensive model.
To test the research hypotheses based on the models formulated for each stock portfolio, the reliability and co-integration between the variables of each model were tested first and the model was estimated using ordinary least squares method. Then, the classical assumptions of the model error term were examined, and if the classical assumptions were confirmed, the final model would be extracted and the results would be interpreted. The Fischer test, t-test, and adjusted coefficient of determination were also used to analyze the effects and relationships between the sample variables. The Durbin-Watson statistic was used for testing the self-correlation. The statistical population of the current study included all listed companies in Tehran Stock Exchange from 2006 to 2016. The samples were selected using the systematic elimination method. It means that all companies were considered and selected as a sample of study if they could meet all of the following criteria:
-Listed in Tehran Stock Exchange from the beginning of 2006.
- The financial period of the companies has ended on the last day of each year.
-Stock should not have had transactional lag for more than 4 months so that the stock beta could be calculated accurately.
-Companies should not be among the investment, financial intermediary, bank and insurance companies because of their different nature.
-Their financial information including financial statements and earnings per share of each company should be available.

4 Research Model

After calculating the stock portfolio performance using the Treynor ratio (TP), macroeconomic factors as independent variables were calculated using official data announced by the central bank. Then, using multivariate regression model based on ordinary least squares (OLS) model, the effects of macroeconomic variables such as inflation rate, exchange rate, interest rate, oil price change rate, and liquidity growth rate on the performance of stock portfolios, including offensive, indifferent, defensive, traditional, growth, growth-value and value were individually evaluated in different models using the following model in Eviews econometric software and the research hypotheses were tested.

$$T_P = f(INF_t, ERA_t, INT_t, Liq_t, Oil_t) \quad (1)$$

Where, Tp represents the p stock portfolio performance, INFt represents inflation rate at time t, ERAt represents the Iran's Rial exchange rate versus US dollar at time t, INTt represents one-year bank loan interest rate at time t, Liqt represents the rate of liquidity growth of the country at time t, and Oilt is the rate of changes in the price of oil per dollar at time t. Each of the stock portfolio performances has been included in separate equations:

$$(T_P)_N = \beta_1 + \beta_2 INF_t + \beta_3 ERA_t + \beta_4 INT_t + \beta_5 Liq_t + \beta_6 Oil_t + \varepsilon_t \quad (2)$$
$$(T_P)_O = \beta_1 + \beta_2 INF_t + \beta_3 ERA_t + \beta_4 INT_t + \beta_5 Liq_t + \beta_6 Oil_t + \varepsilon_t \quad (3)$$
$$(T_P)_I = \beta_1 + \beta_2 INF_t + \beta_3 ERA_t + \beta_4 INT_t + \beta_5 Liq_t + \beta_6 Oil_t + \varepsilon_t \quad (4)$$
$$(T_P)_D = \beta_1 + \beta_2 INF_t + \beta_3 ERA_t + \beta_4 INT_t + \beta_5 Liq_t + \beta_6 Oil_t + \varepsilon_t \quad (5)$$

$$(T_P)_T = \beta_1 + \beta_2\ INF_t + \beta_3 ERA_t + \beta_4 INT_t + \beta_5\ Liq_t\ + \beta_6 Oil_t + \varepsilon_t \quad (6)$$

$$(T_P)_G = \beta_1 + \beta_2\ INF_t + \beta_3 ERA_t + \beta_4 INT_t + \beta_5\ Liq_t\ + \beta_6 Oil_t + \varepsilon_t \quad (7)$$

$$(T_P)_{GV} = \beta_1 + \beta_2\ INF_t + \beta_3 ERA_t + \beta_4 INT_t + \beta_5\ Liq_t\ + \beta_6 Oil_t + \varepsilon_t \quad (8)$$

$$(T_P)_V = \beta_1 + \beta_2\ INF_t + \beta_3 ERA_t + \beta_4 INT_t + \beta_5\ Liq_t\ + \beta_6 Oil_t + \varepsilon_t \quad (9)$$

Where,
$(T_P)_N$: stock portfolio performance
$(T_P)_O$: Offensive portfolio performance
$(T_P)_I$: Indifferent portfolio performance
$(T_P)_D$: Defensive portfolio performance
$(T_P)_T$: Traditional portfolio performance
$(T_P)_G$: Growth portfolio performance
$(T_P)_{GV}$: Growth-value portfolio performance
$(T_P)_V$: Value portfolio performance
Also, β_1 is the intercept εt is the error term of any equation.
It should be noted that each of these functions was the mean of all listed stock companies during the period 2006-2016.

5 Proposed Research Process

The variables and the research methodology that are applied in this study are described as follows.

5.1 Variables

In simple words, a portfolio is a combination of assets that is formed by an investor for investment. This investor can be a person or an entity. Technically, a portfolio includes a set of financial or real assets investments. In other words, it can be stated that a portfolio is a set of assets of one person or one organization (Charles [3]).
The dependent variable in the present study was the performance of the six stock portfolios (growth, growth-value, value, offensive, indifferent, and defensive portfolios) based on the Treynor ratio.
In this study, macroeconomic variables were selected as independent variables due to the existence of theoretical foundations related to stock returns and affecting the capital market index and they were calculated based on data published by the Central Bank of the Islamic Republic of Iran.

5.2 Research Methodology

Growth stock is often the stock of companies that have high growth in earnings and sales and have high P / E and P / B stock versus equity value stock, which have been underpriced for some reason other than potential earnings growth and are introduced at intrinsic by analysts as stock with low P / E and P / B ratios. In some periods, value stock performs better than growth stock, and in some others, growth stock performs better than value stock (Rahnemay-e Roudposhti [9]).
The capital asset pricing model (CAPM) implies that the risk associated with an asset is its return co-variance with a portfolio of market securities called as systematic risk. A stock with low or negative systematic risk (a small positive or negative sensitivity coefficient) is called a defensive stock, since its return is not significantly affected by adverse stock market conditions. Also, defensive stock re-

turns are not expected to decline or fall further than the overall rate of market. A stock with a high systematic risk or greater than 1 is called an offensive stock. In fact, the risk of this type of stock is higher than the market, so it is expected to have a higher rate of return. There is another type of stock that has a systematic risk of 1. This stock is called indifferent stock, since they have systematic risks equal to the market (Lee et al. [5]).

The main idea of performance evaluation is to compare the returns of a portfolio with the returns of several appropriate portfolios (Rahnemay-e Roudposhti, and Mousavi Anzahabi [11]), since performance should be evaluated relatively not absolutely. One of the main problems in performance evaluation is the human tendency to focus on portfolio returns and the lack of paying sufficient attention to the risk incurred to achieve the desired return (Rahnemay-e Roudposhti, and Mousavi Anzahabi [11]). One of the criteria used for evaluating portfolio performance is the Treynor Return to Volatility Ratio. It is represented by the TP symbol. In the Treynor ratio, the stock market historical line is used to create a baseline index to evaluate the performance. In this index, the ratio of return to volatility for a portfolio is derived by dividing excess returns by systematic portfolio risk:

$$T_p = \frac{\bar{r}_p - \bar{r}_f}{\beta_p}$$

The numerator is the risk premium earned by the portfolio and the denominator is the systematic risk (beta). Therefore, the Treynor ratio represents the surplus of return earned per unit of risk. As both the return and the risk factors are affected by macroeconomic factors related to macroeconomic level, they are accepted as an appropriate criterion by researchers.

Where,

$=\bar{r}_p$ Return on stock portfolio

$\bar{r}_f$ = Risk-free return

Bp= Stock portfolio risk

Portfolio return: The mean return on stock portfolio and the sum of the weighted mean of that portfolio.

$$R_P = \sum W_i R_i$$

Wi =Percentage of investment in stock i

Ri= Seasonal return of each stock in portfolio

Portfolio Beta:

$$\beta_P = \sum W_i \beta_i$$

Wi = percentage of investment in stock i

βi =Seasonal beta of each stock in portfolio

B coefficient: Beta coefficient is the criterion for calculating systematic stock risk. It is calculated through weighted mean of their daily returns in each season of the year using the following equation.

$$\beta_i = \frac{COV(R_i, R_m)}{\sigma_{rm}^2}$$

Risk-free rate of return:

The rate of return that investors expect without the risk tolerance expected in this study using the central bank's seasonal data in terms of one-year bank interest rates.

In the first step, by collecting the data of all stock companies, they were selected based on the elimination sampling method among the companies that have met the inclusion criteria of the research. These criteria were mentioned in the statistical population and sample of the research. In the second

step, the P / E, β and current value ratios of the companies were calculated and the six portfolios were formed based on the traditional and modern network model in two separate matrices. In the third step, the descriptive statistics of each portfolio, including mean returns, portfolio standard deviation, portfolio beta and quartiles to assess the risk and portfolio returns were calculated. In the fourth step, using the risk and return of each portfolio, the performance of each portfolio was calculated using the Treynor ratio. In the last step, the effect of change in macroeconomic variables on the performance of traditional and modern network portfolios was tested using the multivariate regression model.

A. Grouping in a traditional network (Growth, growth - value and value portfolios)

The P / E ratio for each company in each season was calculated using its daily value that was calculated by dividing the price of stock market in each day to the earnings of each stock and the weighted mean of P/E in total season was considered for each stock.

-The companies were ranked based on P / E values, and then, the ranks were ordered from big to small.

- Using the formula of quartiles, the companies were divided into three groups based on the ranks.

-Growth: Stock of companies that are ranked first in the quartile.

-Growth - Value: Stock of companies that are ranked second and third.

-Value: Stock of companies that are ranked fourth.

- Calculating market value of each stock

- Calculating the weight of each company in the portfolio by dividing its market value by the total portfolio value

- Calculating the beta of each portfolio

- Calculating the performance of each portfolio based on the Treynor ratio

B) Grouping in a modern network (offensive, indifferent and defensive portfolios)

- β (systematic risk criterion of company) was calculated for each company in each season

- Companies were ranked based on β values, and then, the ranks were ordered from big to small.

-Using the β value, the companies were divided into three groups.

Aggressive: The stock of companies with $\beta > 1$.

Indifferent: The stock of companies with $\beta = 1$.

Defensive: The stock of companies with $\beta < 1$

-Calculating market value of each stock

-Calculating the weight of each company in the portfolio by dividing its market value by the total value of the portfolio.

-Calculating the beta of each portfolio

-Calculating the performance of each portfolio based on the Treynor ratio

6 Obtained Results and Analysis

6.1 Descriptive Statistics of the Variables

By using descriptive statistics appropriately, it is possible to state the characteristics of a set of information and facilitate understanding of the results of a test by comparing it with other tests and observations. The descriptive statistics of the research have been presented in Table 1. The Jarque-Bera statistic with two degrees of freedom and the chi-square distribution examined the hypothesis of normal distribution. The null hypothesis of this test indicated that it was normal. Hence, if the probability was less than **0.05**, the null hypothesis would be rejected. According to the results, the variable of growth portfolio performance, inflation and oil prices had normal distribution, but other variables

were not normal. However, according to the central limit theorem, if the data volume was more than **30** samples, the normal distribution would be confirmed. Hence, according to the volume of observations of **44** samples, the variables had a normal distribution.

Table 1: Descriptive statistics of estimated variables

	Variables		Mean	Median	Max	Min	SD	Skew-ness
	Primary portfolios	Secondary portfolios						
Modern network model	Modern	-	2.61	1.72	19.15	-5.17	4.51	1.39
	-	Offensive	2.00	1.34	12.10	-4.27	3.22	1.09
	-	Indifference	3.09	2.47	30.91	-7.59	7.84	1.36
	-	Defensive	4.98	3.05	31.55	-10.56	10.90	1.05
Traditional network model	Traditional	-	4.10	1.69	33.01	-17.70	9.60	1.04
	-	Growth	3.92	2.47	25.45	-12.93	8.47	0.45
	-	Growth-value	4.26	2.89	30.15	-21.04	8.74	0.28
	-	Value	1.06	-0.11	23.98	-9.64	6.21	1.59
Macroeconomic variables	Inflation		14.82	14.78	28.05	7.22	5.52	0.62
	Interest rate (deposit interest rate)		17.31	16.00	24.00	14.00	۰۵.۳	۰۱.۱
	Liquidity growth rate		0.16	0.25	0.40	-0.99	0.37	-2.67
	Price of each barrel of oil in dollar		79.36	76.02	128.20	29.62	26.15	-0.40
	Exchange rate		20370.34	12459.85	38679.20	9153.00	11636.79	0.32
Source: research findings								

The skewness is equal to the normalized third torque. The skewness is in fact a criterion of the symmetry or asymmetry of the distribution. For a completely symmetric distribution, the skewness will take the value of zero, and for an asymmetric distribution with a kurtosis toward higher values of skewness, it will be positive, and for an asymmetric distribution with a kurtosis towards smaller values, it will be negative. The data studied in this study were skewed to the right except for the liquidity growth rate and oil price. The kurtosis was equal to normalized fourth torque. In other words, it was a criterion of sharpness of the curve at the maximum point. For example, inflation, interest rate, oil price, exchange rate had the kurtosis values of **2.69, 2.80, 1.75, and 1.25**, respectively, which were less than normal distribution kurtosis (normal distribution kurtosis is **3**) and other variables had more kurtosis than normal distribution kurtosis.

6.2 Unit Root Test Results

Before testing the model, the data were analyzed in terms of stationariness, because if non-stationary data were used in estimating econometric equations, the T and F statistics would not be valid and the estimation model would be biased and non-usable, since these data do not have stable variance and covariance over time. The Augmented Dickey-Fuller test (ADF) was used to evaluate the stationariness of the variables; the results of which have been presented in Table (**2**). Based on the results of this test, the null hypothesis on the existence of unit roots for the model variables and their non-stationariness was not rejected. Therefore, using the first-order difference form of the variables, the results of the ADF test showed that the desired series were stationary. The first-order difference of the

variables indicated that the desired series were stationary. Hence, it is observed that all the desired time series were the first order.

Table 2: The results of Augmented Dickey-Fuller test (trend and intercept mode)

Variable	Augmented Dickey-Fuller test			
	ADF statistic	10% critical value	5% critical value	1% critical value
$(T_P)_N$	-4.1451	-3.1912	-3.5207	-4.1923
$(T_P)_O$	-3.5930	-3.1897	-3.5180	-4.1864
$(T_P)_I$	-3.2048	-3.1897	-3.5180	-4.1864
$(T_P)_D$	-5.0874	-3.1897	-3.5180	-4.1864
$(T_P)_T$	-4.6266	-3.1897	-3.5180	-4.1864
$(T_P)_G$	-3.3706	-3.1897	-3.5180	-4.1864
$(T_P)_{GV}$	-3.4583	-3.1897	-3.5180	-4.1864
$(T_P)_V$	-4.8802	-3.1897	-3.5180	-4.1864
INF_t	-3.8121	-3.1897	-3.5180	-4.1864
ERA_t	-4.1113	-3.1897	-3.5180	-4.1864
INT_t	-6.3118	-3.1897	-3.5180	-4.1864
Liq_t	-8.0867	-3.1897	-3.5180	-4.1864
Oil_t	-5.7449	-3.1897	-3.5180	-4.1864

Source: research findings

The results of the stationariness tests showed that all the variables investigated in this study were at the stationary level and this stationariness has been obtained at different critical levels. In other words, the calculated statistical value for them was higher than the critical values, confirming that they were stationary and had constant mean, variance, and auto-covariance structure.

6.3 Testing Research Hypotheses

6.3.1 Main First Hypothesis of the Research

The main hypothesis of the research has been presented as follows:
"The effect of macroeconomic variables on the stock portfolio performance based on traditional network models differs from that of modern network models".

Table 3: The Akaike criterion for modern and traditional models

		Akaike criterion	Result of hypotheses
First main hypothesis	Modern network model	5.822	Not Reject
	Traditional network model	6.724	
Sub-hypothesis on the effect of inflation rate	Modern network model	5.901	Not Reject
	Traditional network model	7.423	
Sub-hypothesis on the effect of interest rate	Modern network model	5.897	Not Reject
	Traditional network model	7.127	
Sub-hypothesis on the volume of liquidity	Modern network model	5.900	Not Reject
	Traditional network model	7.332	
Sub-hypothesis on the effect of oil price	Modern network model	5.922	Not Reject
	Traditional network model	7.423	

Source: research findings

To examine the main hypotheses and the first sub-hypothesis of the research, the Akaike criterion was utilized in all the confirmed models. Table 3 shows the values of the results of the Akaike criterion. The Akaike criterion value for the modern network model was 5.822 and it was lower than the traditional network value with 6.724. It indicated that the interpretation of macroeconomic variables in the portfolio of the modern network was better than that of the traditional one. Also, the Akaike criterion showed that the effect of economic variables on the performance of stock portfolios formed based on the modern network was different from their effect on the performance of the portfolios formed based on the traditional network.

6.3.2 Second Main Hypotheses of the Research

The second main hypothesis of the research was as follows:
"Macroeconomic variables affect the performance of stock portfolios formed based on traditional network model." After confirming the ordinary least squares model, the regression model was estimated according to the performed tests. Table 4 has presented the regression estimation of the above model. As stated before, it is necessary to test the significance of the whole model before examining the variables and conforming or rejecting the hypotheses. It is done by calculating the statistic F and the p-value of this statistic. Since the calculated p-value for this statistic was less than 0.05, the whole model can be confirmed with 95% confidence level.

Table 4: Results of estimation of coefficients of stock performance model based on traditional network model

Variable name	Coefficient	SD	Statistic t	p-value
C	-15.7342	7.7232	-2.0372	0.0486
INF	0.2920	0.1392	2.0976	0.0426
ERA	0.0006	0.0001	3.7100	0.0007
INT	-0.2379	0.4779	-0.4978	0.6215
LIQ	-4.8421	3.3073	-1.4640	0.1514
OIL	0.0973	0.0407	2.3889	0.0220
Coefficient of determination	0.5884			
Adjusted coefficient of determination	0.5342			
Durbin-Watson statistic	1.6806			
Statistic F	10.8654			
p-value of Statistic F f	0.0000			
F-Wald statistic	17.7462			
p-value of F-Wald	0.0000			

Source: research findings

The F-Wald statistic also indicated the significance of each coefficient, which was confirmed for the estimated regression considering its probability level. Durbin-Watson statistics also showed that there was no autocorrelation between the model error terms. Also, the statistics of the coefficient of determination and adjusted coefficient of determination indicated a high explaining power of the explanatory variables in the dependent variable. The adjusted coefficient of determination of the model was 0.53, which indicated that 53% of the dependent variable variations were explained by the independent variables. Therefore, it can be stated that there was a significant relationship between macroeconomic variables and the performance of the stock portfolios formed based on traditional network. Fur-

ther investigation of the model results showed a positive and significant relationship between inflation, oil price, and exchange rate and portfolio performance formed based on the traditional model, so that by increasing these economic variables, the portfolio stock performance in the traditional model increased. However, the relationship between interest rate and liquidity and the dependent variable was negative and non-significant.

Testing the Hypotheses 2-1 **of the Study:** The hypothesis2-1 of the study was presented as follows "Macroeconomic variables affect the performance of stock portfolios formed based on a growth network model." In this hypothesis, according to the results of the analysis presented in Table 5, the significance level of the regression model (p) was less than 0.05, so the whole model can be confirmed at the 95% confidence level. The F-Wald statistic also indicated the significance of each coefficient, which was confirmed by the estimated regression considering its probability level. Durbin-Watson statistics also showed that there was no autocorrelation between the model error terms. Also, the statistics of coefficient of determination and adjusted coefficient of determination and their probability indicated high explaining power of the explanatory variables in the dependent variable. Therefore, it can be stated that there was a significant relationship between the macroeconomic variables and performance of growth stock portfolios. Also, based on the results of model estimation, oil price and exchange rate had a significant and positive relationship with growth portfolio stock performance, so that by increasing these economic variables, portfolio stock performance in the growth model increased. However, the relationship of interest rate with the dependent variable was negative and significant. Also, the relationship between liquidity and inflation and the dependent variable was negative and positive, respectively. In other words, an increase in the liquidity and inflation rate of the country had no effects on the stock portfolio performance based on the growth model.

Table 5: The results of estimation of coefficients of stock performance model based on the growth model

Variable name	Coefficient	SD	Statistic t	p-value
C	0.8014	6.5372	0.1225	0.9031
INF	0.0972	0.2665	0.3646	0.7174
ERA	0.0002	0.0001	1.8626	0.0703
INT	-1.0771	0.5016	-2.1474	0.0382
LIQ	-5.3973	4.5718	-1.1797	0.2454
OIL	0.1948	0.0760	2.5617	0.0145
Coefficient of determination	0.2934			
Adjusted coefficient of determination	0.2004			
Durbin-Watson statistic	1.2811			
Statistic F	3.1566			
p-value of Statistic F f	0.0176			
F-Wald statistic	2.7800			
p-value of F-Wald	0.0309			

Source: Research Finding

Testing the Hypothesis 2-2 **of the Research:** The hypothesis 2-2 of the research was presented as follows "Macroeconomic variables affect the performance of stock portfolios formed based on growth-value network model." In this hypothesis, according to the results of the analysis presented in Table 6, the significance level of the regression model (p) was less than 0.05, so the whole model

could be confirmed at the 95% confidence level. The F-Wald statistic also indicated the significance of each coefficient, which was confirmed by the estimated regression considering its probability level. Durbin-Watson statistics also showed that there was no autocorrelation between the model error terms. Also, the statistics of coefficient of determination and adjusted coefficient of determination and their probability indicated high explaining power of the explanatory variables in the dependent variable. Therefore, it can be stated that there was a significant relationship between the macroeconomic variables and performance of growth-value stock portfolios. Also, based on the results of model estimation, oil price and exchange rate had significant and positive relationship with growth-value portfolio stock performance, so that by increasing these economic variables, portfolio stock performance in the growth-value model increased. However, the relationship of interest rate with the dependent variable was negative and significant. Also, the relationship between liquidity and dependent variable was negative and non-significant. In other words, an increase in the liquidity of the country had no effects on the stock portfolio performance based on the growth-value model.

Table 6**:** The results of estimation of coefficients of stock performance model based on the growth-value model

Variable name	Coefficient	SD	Statistic t	p-value
C	-1.9202	7.2131	-0.2662	0.7915
INF	0.3359	0.1497	2.2429	0.0308
ERA	0.0006	0.0001	4.0792	0.0002
INT	-1.4986	0.5187	-2.8892	0.0063
LIQ	-3.3980	3.4808	-0.9762	0.3351
OIL	0.1812	0.0481	3.7657	0.006
Coefficient of determination	0.5162			
Adjusted coefficient of determination	0.4525			
Durbin-Watson statistic	1.3237			
Statistic F	8.1100			
p-value of Statistic F f	0.0000			
F-Wald statistic	6.4630			
p-value of F-Wald	0.0001			

Source: research findings

Testing the Hypothesis 2-3 **of the Research:** The hypothesis 2-3 of the research was presented as follows: "Macroeconomic variables affect the performance of stock portfolios formed based on the value network model." In this hypothesis, according to the results of the analysis presented in Table 7, the significance level of the regression model (p) was less than 0.05, so the whole model could be confirmed at the 95% confidence level. The F-Wald statistic also indicated the significance of each coefficient, which was confirmed by the estimated regression considering its probability level. Durbin-Watson statistics also showed that there was no autocorrelation between the model error terms. Also, the statistics of coefficient of determination and adjusted coefficient of determination and their probability indicated high explaining power of the explanatory variables in the dependent variable. Therefore, it can be stated that there was a significant relationship between the macroeconomic variables and performance of value stock portfolios. Also, based on the results of model estimation, oil price and exchange rate had significant and positive relationship with value portfolio stock performance, so that by increasing these economic variables, portfolio stock performance in the value model increased. Also, the relationship between the interest rate and dependent variable was negative and significant

and the relationship between the liquidity and inflation rate was non-significant and negative and positive, respectively. In other words, an increase in the liquidity of the country had no effects on the stock portfolio performance based on the value model.

Table 7: The results of estimation of coefficients of stock performance model based on the value model

Variable name	Coefficient	SD	Statistic t	p-value
C	8.8610	4.3302	2.0463	0.0477
INF	0.0863	0.0759	1.1366	0.2628
ERA	0.0004	0.0001	3.2232	0.0026
INT	-1.4350	0.4374	-3.2805	0.0022
LIQ	1.3529	1.2264	1.1031	0.2769
OIL	0.7930	0.0361	2.1950	0.0343
Coefficient of determination	0.3756			
Adjusted coefficient of determination	0.2934			
Durbin-Watson statistic	2.1898			
Statistic F	4.5724			
p-value of Statistic F f	0.0023			
F-Wald statistic	2.9659			
p-value of F-Wald	0.0234			

Source: research findings

6.3.3 Third Main Hypothesis

The third main research was presented as follows:
"Macroeconomic variables affect the performance of stock portfolios formed based on the modern network model." After confirming the ordinary least squares` model, the regression model was estimated. Table 8 presents the regression estimation of the above model. As stated before, it is necessary to test the significance of the whole model before examining the variables and confirming or rejecting the hypotheses. It is done by calculating the statistic F and the p-value of this statistic. Since the calculated p-value for this statistic was less than 0.05, the whole model could be confirmed at 95% confidence level.

Table 8: Estimation of coefficients of stock performance model based on the modern network model

Variable name	Coefficient	SD	Statistic t	p-value
C	7.9320	3.8816	2.0435	0.0480
INF	0.1989	0.0525	3.7883	0.0005
ERA	0.0002	0.0001	2.0936	0.0430
INT	-0.9067	0.3134	-2.8930	0.0063
LIQ	-2.8096	2.6761	-1.0498	0.3004
OIL	0.0456	0.0206	2.2112	0.0331
Coefficient of determination	0.2530			
Adjusted coefficient of determination	0.1547			
Durbin-Watson statistic	1.7855			
Statistic F	0.5741			
p-value of Statistic F f	0.0422			
F-Wald statistic	6.9063			
p-value of F-Wald	0.0001			

Source: research findings

Also, the F-Wald statistic indicated the significance of each coefficient, which this significance was confirmed for the estimated regression considering its probability level. Durbin-Watson statistics also showed that there was no autocorrelation among the model error terms. Also, the statistics of coefficient of determination and adjusted coefficient of determination and their probability indicated high explaining power of the explanatory variables in the dependent variable. Also, based on the results of model estimation, oil price and exchange rate had a significant and positive relationship with portfolio stock performance based on the modern network model, so that by increasing these economic variables, portfolio stock performance in the modern network model increased. However, the relationship of interest rate with the dependent variable was negative and significant. Also, the relationship between the interest rate and dependent variable was negative and significant and the relationship between the liquidity and dependent variable was non-significant and negative. In other words, an increase in the liquidity of the country had no effects on the stock portfolio performance based on the modern network model.

Testing the Hypotheses 3-1 **of the Research:** The hypothesis 3-2 of research was presented as follows: "Macroeconomic variables affect the performance of stock portfolios formed based on the offensive model." In this hypothesis, according to the results of the analysis presented in Table 9, the significance level of the regression model (p) was less than 0.05, so the whole model could be confirmed at the 95% confidence level. The F-Wald statistic also indicated the significance of each coefficient, which was co firmed by the estimated regression considering its probability level.

Table 9: The results of estimation of coefficients of stock performance model based on the offensive model

Variable name	Coefficient	SD	Statistic t	p-value
C	2.8461	3.1474	0.9042	0.3716
INF	0.0466	0.0551	0.8457	0.4030
ERA	0.0001	0.0006	2.9683	0.0052
INT	-0.5750	0.1988	-2.8922	0.0063
LIQ	-1.7113	1.9572	-0.8743	0.3874
OIL	0.0604	0.0174	3.4656	.0013
Coefficient of determi-	0.3384			
Adjusted coefficient of	0.2513			
Durbin-Watson statistic	1.6398			
Statistic F	3.8877			
p-value of Statistic F f	0.0060			
F-Wald statistic	6.4669			
p-value of F-Wald	0.0001			

Source: research findings

Durbin-Watson statistics also showed that there was no autocorrelation between the model error terms. Also, the statistics of coefficient of determination and adjusted coefficient of determination and their probability indicated high explaining power of the explanatory variables in the dependent variable. Therefore, it can be stated that there was a significant relationship between the macroeconomic variables and performance of the stock portfolio formed based on the offensive model. Also, based on the results of model estimation, oil price and exchange rate had a significant and positive relationship

with the performance of stock portfolio formed based on offensive model, so that by increasing these economic variables, portfolio stock performance in the offensive model increased. Also, the relationship between the interest rate and dependent variable was negative and significant and the relationship between the liquidity and inflation rate was non-significant and negative and positive, respectively. In other words, an increase in the liquidity and inflation rate of the country had no effects on the performance of stock portfolio formed based on the offensive model.

Testing the Hypotheses 3-2 **of the Research:** The hypothesis 3-2 of research was presented as follows: "Macroeconomic variables affect the performance of stock portfolios formed based on the indifferent model". In this hypothesis, according to the results of the analysis presented in Table 10, the significance level of the regression model (p) was less than 0.05, so the whole model could be confirmed at the 95% confidence level.

Table 10**:** The results of estimation of coefficients of stock performance model based on the indifferent model

Variable name	Coefficient	SD	Statistic t	p-value
C	6.8307	4.7090	1.4505	0.1551
INF	0.6107	0.1029	5.9308	0.0000
ERA	0.0002	0.0001	2.1973	0.0342
INT	-1.6402	0.3969	-4.1318	0.0002
LIQ	-3.4087	2.9955	-1.1379	0.2623
OIL	0.1282	0.0524	2.4448	0.0192
Coefficient of determina-	0.3937			
Adjusted coefficient of	0.3139			
Durbin-Watson statistic	1.5538			
Statistic F	4.9352			
p-value of Statistic F f	0.0014			
F-Wald statistic	11.2771			
p-value of F-Wald	0.0000			

Source: research findings

The F-Wald statistic also indicated the significance of each coefficient, which was confirmed by the estimated regression considering its probability level. Durbin-Watson statistics also showed that there was no autocorrelation between the model error terms. Also, the statistics of coefficient of determination and adjusted coefficient of determination and their probability indicated high explaining power of the explanatory variables in the dependent variable. Therefore, it can be stated that there was a significant relationship between the macroeconomic variables and performance of stock portfolio formed based on the indifferent model. Also, the results of model estimation on the effect of macroeconomic variables on the performance of indifferent stock portfolio showed that oil price and exchange rate had a significant and positive relationship with the performance of stock portfolio formed based on the indifferent model, so that by increasing these economic variables, portfolio stock performance in the indifferent model increased. However, the relationship between the interest rate and dependent variable was negative and significant and the relationship between the liquidity and inflation rate was non-significant and negative. In other words, an increase in the liquidity of the country had no effects on the stock portfolio performance based on the indifferent model.

Testing the Hypotheses 3-3 **of the Research:** The hypothesis 3-3 of research was presented as follows: "Macroeconomic variables affect the performance of stock portfolios formed based on the de-

fensive model." In the analysis of this hypothesis, the regression model was estimated after confirming the ordinary least squares` model.

Table 11**:** The results of estimation of coefficients of stock performance model based on the defensive model

Variable name	Coefficient	SD	Statistic t	p-value
C	5.7744	9.1875	0.6285	0.5334
INF	0.0972	0.2282	0.4262	0.6723
ERA	0.0004	0.0001	2.9779	0.0050
INT	-1.5043	0.6118	-2.4587	0.0186
LIQ	-7.1803	5.3447	-1.3434	0.1871
OIL	5.7744	9.1875	0.6285	0.5334
Coefficient of determina-	0.2513			
Adjusted coefficient of	0.1528			
Durbin-Watson statistic	1.9285			
Statistic F	2.5511			
p-value of Statistic F f	0.0433			
F-Wald statistic	5.1535			
p-value of F-Wald	0.0010			

Source: research findings

As stated before, it was necessary to test the significance of the whole model before examining the variables and confirming or rejecting the hypotheses. It was done by calculating the statistic F and the p-value of this statistic. Since the calculated p-value for this statistic was less than 0.05, the whole model could be confirmed at 95% confidence level. Also, the F-Wald statistic indicated the significance of each coefficient, which this significance was confirmed for the estimated regression considering its probability level. Durbin-Watson statistics also showed that there was no autocorrelation among the model error terms. Also, the statistics of coefficient of determination and adjusted coefficient of determination and their probability indicated high explaining power of the explanatory variables in the dependent variable.

Also, based on the results of model estimation, oil price and exchange rate had a significant and positive relationship with portfolio stock performance based on the defensive network model, so that by increasing these economic variables, portfolio stock performance in the defensive network model increased. However, the relationship of interest rate with the dependent variable was negative and significant. Also, the relationship of liquidity and the interest rate with the dependent variable was non-significant and negative, respectively. In other words, an increase in the liquidity and the interest rate of the country had no effects on the stock portfolio performance based on the defensive network model.

7 Conclusion and Recommendations

The objective of this study was to investigate the effect of macroeconomic variables on the performance of stock portfolios formed based on the traditional and modern network in Tehran Stock Exchange. It was conducted by using the ordinary least squares (OLS) method and the seasonal data of the years from 2006 to 2016. Investigations showed that macroeconomic variables affected the performance of the stock portfolios formed by both traditional and modern networks and the proposed mod-

el was significant for both traditional and modern networks. However, based on the Akaike criterion, the interpretation of macroeconomic variables in the modern network portfolio was better than that of the traditional network portfolio. Further investigation of the main hypotheses and sub-hypotheses of the study showed that interest rate and exchange rate affected the performance of all modern network portfolios, including offensive, indifferent and defensive portfolios. It was also revealed that oil price only affected the performance of offensive and indifferent portfolios. It means that there was a positive relationship between exchange rate changes and oil price and there was a negative relationship between interest rate and changes in the performance of portfolios formed based on modern network. The results were in line with those of the research conducted by Tripathi and Seth on the relationship between the stock market performance and macroeconomic variables.

Also, they were in line with the results of the study conducted by Azimi et al. on the effect of microeconomic variables on the total stock index. However, the variables of interest rate, exchange rate, and oil price affect the performance of growth, growth-value, and value portfolios, and inflation rate affected only the performance of growth-value and indifferent portfolios. Interestingly, investigations revealed the negative effect of interest rate and the positive effect of the exchange rate on the performance of all portfolios. It indicated that an increase in interest rate increased the cost of capital and reduced their profitability, leading to negative performances. Also, as majority of Tehran Stock Exchange companies are export-oriented companies, increased exchange rate would lead to higher sales, and consequently, positive performance.

Table 12: the factors affecting the performance of each portfolio in this study were as follow

Portfolio	Macroeconomic factors				
	Interest rate	Inflation rate	Exchange rate	Liquidity growth rate	Oil price
Growth	*	-	*	-	*
Growth-value	*	*	*	-	*
Value	*	-	*	-	*
Offensive	*	-	*	-	*
Indifferent	*	*	*	-	*
Defensive	*	-	*	-	-

*=Significant

Directing the micro capitals of the community into the stock market and preventing capital flows from the stock market to intermediary markets, it is necessary to reduce the volatility and risk of stock returns to achieve a more stable performance by the investors. It is achieved through two ways. First, macroeconomic policies should be formulated and planned in the form of long-term economic plans and within the framework of five-year development plans to prevent unexpected volatility of these factors to minimize the systematic risk of volatility experienced by the companies. Second, managers of investment companies should create portfolio for investors by recognizing the major factors affecting the performance of stock portfolios. It enables the companies to control the negative effects of volatility on these factors and use the positive effects of these factors to generate higher returns and better performance. Limitations of this study were as follows:

I. Since the interest rate in a free economy is determined by the supply-demand balance, the interest rate (or cost of money) is the result of the expectations of economic activists. However, in Iran, the interest rates are affected by the policies and decisions of monetary authorities such as the "Cen-

tral Bank" and the "Monetary and Credit Council". Hence, it cannot be a reflection of the production of the participants in an economic system.

II. The exchange rate determined in the market is a function of the supply and demand mechanism. In Iran, exchange rate is not a single rate and is determined by legal authorities such as the Central Bank, so it could affect the results of the research.

III. The Iran's stock market is affected by emotional and sectional behaviors. Therefore, policy-makers such as the Stock Exchange and Securities Organization try to control and manage market volatilities in order to control these emotional behaviors.

IV. In this study, the interest rate of the bonds was used. It is recommended for future studies to investigate the effect of short and long term bank deposit rates. The effect of the mean rate of bonds and the rate of deposits can be also investigated in future studies.

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