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The Impact of Macroeconomic Variables on Stock Prices index: The Case of Tehran Stock Exchange

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ABSTRACT

This paper examines the effects of macroeconomic variables like currency rate, inflation rate, real interest rate, gross domestic product and liquidity on the stock market index in Tehran Stock exchange during 1985 to 2015. Various econometric analyses such as Co-integration and Vector Error Correction Method (VECM) are employed on time series data. It finds that Iran's stock market is positively influenced by the inflation and currency rates and negatively affected by the liquidity. On the other hand the relationship between real interest rates and stock price is positive but not significant.

1. Introduction

Stock is one of the most sensitive assets to economic condition. Any aggressive change in stock prices can have negative implications for an economy, which makes the causal relationship between macroeconomic variables and stock returns one of the most debated topics in finance in the past few decades (Ozbay, 2009). The attention that the stock market attracted was not only limited to policy makers and researchers, rather the relationship between macroeconomic variables and stock market also attracted the attention of economists and financial investors because of three reasons. First, policy makers would be able to predict the full effect of current and upcoming policies and regulations. Second, investors can make more informed decision when they fully understand this relation and thus decrease their exposure to risk. Third, if the public are aware of the changes that might happen in the economy or the financial market, the shock factor will be reduced and the public will be able to take protective measures (Abu-Libdeh & Harasheh, 2011).

The purpose of this paper is to examine the impacts of selected economic elements, actually macroeconomic variables on the stock market for Iran. For investigating this relationship, we mix The Impact of Macroeconomic Variables on Value Model and the portfolio theory together. The rest of the paper is organized as follows: Section 2 and 3 provide the literature review and the theoretical underpinnings. Section 4, covers the model, and describes methodology of analysis. Empirical results are discussed in section 5, while the summary and conclusion are contained in section 6.

2. Literature review

Several researchers have focused their empirical studies on the relationship between stock market movement and macroeconomic variables and this has been intensively examined in both emerging and developed capital markets. Many other early studies of Lintner (1973), Jaffe and Mandelker (1977) and Fama and Schwert (1977) examine the relationship between inflation and stock prices. Most of these studies test the Fisher hypothesis which predicts a positive relationship between expected nominal returns and expected inflation and their findings are inconsistent with the Fisher hypothesis. They all report a negative linkage between stock returns and inflation. However, Firth (1979) observes a positive relationship between nominal stock returns and inflation when studying the relationship between stock market returns and rates of inflation in the United Kingdom.

Bhattacharya et al. (2001) analyzed the causal relationship between the stock Market and three macroeconomic variables in India`s case using the Granger causality test. These macroeconomic variables are: exchange rate, foreign exchange reserves and trade balance. The results suggest that there is no causal linkage between stock prices and the three variables under consideration.

Doong et al. (2005) investigated the relationship between stocks and exchange rates by using Granger causality test. According to their results, there is a significantly negative relation between the stock returns and change in the exchange rates for all the included countries except one.

Gay (2008) investigated the relationship between stock price index and the macroeconomic variables like exchange rate and oil price for emerging countries (Brazil, Russia, India, and China) using ARIMA model. He finds no significant relationship between respective exchange rate and oil price on the stock market index prices in any of the emerging countries. He concludes that this result suggests that the markets of Brazil, Russia, India, and China exhibit the weak-form of market efficiency.

Raymond (2009) examined the relationship between stock price index and monetary variables in Jamaica" by using vector error correction method during the period (1990-2009). Based on the results, there is a long-term relationship between stock price index with monetary variables. According to the study, stock price index has positive relationship with inflation rate and liquidity but it negatively associated with exchange rate and interest rates.

Subair and Salihu (2010) used GARCH model to evaluate the effects of exchange rate fluctuations on Nigeria's stock

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market. The results showed that exchange rate fluctuations have significant negative effect on Nigeria's stock market.

Mohammad (2011) uses Multivariate Regression Model computed on Standard OLS formula and Granger causality test to model the impact of changes in selected microeconomic and macroeconomic variables on stock returns in Bangladesh. He examines monthly data for all the variables under study covering the period from July 2002 to December 2009. The study finds a negative relationship between stock returns and inflation as well as foreign remittance while market Price/Earnings and growth in market capitalization have a positive influence on stock returns. However, no unidirectional Granger Causality is found between stock returns and any of the independent variables and the lack of Granger Causality reveals the evidence of an informally inefficient market.

Saeed Akhtar (2012) studied "The effect of macroeconomic variables on banks stock indexes in Pakistan" by using quarterly data (2010-2000) and ordinary least squares method. The exchange rate, Long-term interest rates and oil prices had a positive effect on the stock price index but the money supply, short-term interest rate and industrial production had a negative effect on it.

Inside of Iran, some studies have been conducted. Mehrara (2007) tested the causal relationship between Tehran Exchange Price Index (TEPIX) and three macroeconomic variables namely money supply, value of trade balance, and industrial production using Granger causality test. In general, the findings implied that macroeconomic variables are significant in predicting changes in stock prices.

Abbasian et al. (2008) examined the macroeconomic variables' effect on TSE. Their result exhibited significant effect from money supply, consumer price index, exchange rate and trade balance on TSE.

Nasrollahi et al. (2012) have reviewed the relationship between economy macro variables and stock price index in Iran by using vector error correction model in 1991-2006 periods. The result showed stock price index has been influenced by stock price index in prior periods, exchange rates and value added of the industrial sector in the short-term. But in the long term, gold price index, housing price index, the consumer price index, exchange rates, value added of industries influence on it.

karimzadeh et al. (2014) analyzed the relationship between macroeconomic variables with price index of banks by using vector error correction in the period of 2004 to 2012. Their results showed that stock index have a negative effect on inflation and exchange rates and there are positive effects between deposit interest rate and GDP with stock index.

3. Theoretical review

There are a majority of economic factors which can influence stock markets. One way of linking macroeconomic variables and stock market returns is through arbitrage pricing theory (APT) (Ross, 1976), where multiple risk factors can explain asset returns. While early empirical papers on APT focused on individual security returns, it may also be used in an aggregate stock market framework, where a change in a given macroeconomic variable could be seen as reflecting a change in an underlying systematic risk factor influencing future returns. Most of the empirical studies based on APT theory, linking the state of the macro economy to stock market returns, are characterized by modeling a short run relationship between macroeconomic variables and the stock price in terms of first differences, assuming trend stationary. For a selection of relevant studies see Fama (1981, 1990), Fama and French (1989), Schwert (1990), Ferson and Harvey (1991) and Black, Fraser and MacDonald (1997). Another approach is the discounted cash flow or Present Value Model (PVM). This approach relates the stock price to future expected cash flows thus, the PVM can be used to focus on the long run relationship between the stock market and macroeconomic variables. Moreover, we can explain some economic variables effects on stock market based on portfolio theory where assets are substitute for each other and whenever change in one asset price has direct and indirect impact on other assets.

In this section, we express the relationship between selected macroeconomic variables including exchange rates, inflation, GDP, liquidity, long term interest rate of bank deposits and stock market index for Iran. For understanding the theorem, two aspects are considered in explaining supposition relationships.

3.1. Currency rate and Stock Price

There is a big puzzle about the stock prices and exchange rate interplay. Interrelationship between them can be investigated from two different directions. On one hand, when the domestic currency depreciates against foreign currencies, export product prices will decrease for foreigners and, consequently, the volume of the country's exports will increase (Fama, 1981). On the other hand, currency depreciation can increase imported inputs prices for domestic firms which in turn decreases expected cash flow and stock prices. So, net effect of exchange rate variation on stock prices is not clear.

3.2. Inflation rate and Stock Prices

In the inflation condition, nominal earning of companies increases after a period of time, in fact, by inflation, profitability does not increase, but nominal earnings will increase. When nominal earnings increase, the stock prices will increase too. The other effect of inflation is reducing the intrinsic value of per share. Moreover, inflation conditions reduce the purchasing power of the people. Increase in the cost of living has reduced investment opportunities and savings and most of the revenue will consume for ongoing expenses. On the other hand less investment will lead to less demand for investments on the stock thus the stock price index will reduce.

3.3. Liquidity and Stock Prices

There are different theories about the relationship between liquidity and stock price. The quantity of money as a macro economic variables have considerable effects on interest rates and the general level of prices in the money. For example, an increase in the money supply leads to increase in the general level of prices. In addition, if increase in the quantity of money is the result of the budget deficit, it has a negative effect on stock prices. As a result, the volume of money have a positive or negative effect on the price index. Based on the opinions of some Iranian economists, Increase in the volume of money and liquidity, at least, has a negative effect on the stock market by the psychological aspects (Eslamoueyan and Zare, 2006).

3.4. Real Interest Rate and Stock Prices

Investors are looking for efficient portfolio investment. Hence, their portfolios are filled by a composition of cash, stocks, bank deposits, bonds, etc. Due to risky capital market in Iran; yields are not equal with their risks. On the other hand, the existence of long-term bank deposit interest rates without risk in Iran is a competitor for investing in the stock market. For realization of deposit interest rates, inflation rate has been

deducted from the nominal interest rate. Therefore, we expect there is negative relationship between increases in real interest rates with growth rate of stock prices.

3.5. Gross Domestic Product and Stock Prices

Gross domestic product (GDP) is a measure of overall economic activity and affects stock prices through its influence on expected future cash flows (Fama, 1990). Thus, we would expect a positive relationship between stock prices and gross domestic production (GDP).

4. Model and methodology

Seeking to identify the relationship between stock prices and macroeconomic variables, a focus has been laid on evidences from Iran. The annual data are extending from the 1985 to 2015. A total of five macroeconomic variables and TSE are used in the analyses. We consider the below model between variables by using mentioned variables:

$$\begin{bmatrix} LSP_t \\ RER_t \\ LINFR_t \\ LGDP_t \\ LLIQ_t \\ INTR_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \\ \alpha_5 \\ \alpha_6 \end{bmatrix} + \begin{bmatrix} \beta_{11,i} & \beta_{12,i} & \beta_{13,i} & \beta_{14,i} & \beta_{15,i} & \beta_{16,i} \\ \beta_{21,i} & \beta_{22,i} & \beta_{23,i} & \beta_{24,i} & \beta_{25,i} & \beta_{26,i} \\ \beta_{31,i} & \beta_{32,i} & \beta_{33,i} & \beta_{34,i} & \beta_{35,i} & \beta_{36,i} \\ \beta_{41,i} & \beta_{42,i} & \beta_{43,i} & \beta_{44,i} & \beta_{45,i} & \beta_{46,i} \\ \beta_{51,i} & \beta_{52,i} & \beta_{53,i} & \beta_{54,i} & \beta_{55,i} & \beta_{56,i} \\ \beta_{61,i} & \beta_{62,i} & \beta_{63,i} & \beta_{64,i} & \beta_{65,i} & \beta_{66,i} \end{bmatrix} \begin{bmatrix} LSP_{t-1} \\ RER_{t-1} \\ LINFR_{t-1} \\ LGDP_{t-1} \\ LLIQ_{t-1} \\ INTR_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \end{bmatrix} \quad (1$$

Which:

LSP: The logarithm of stock price, RER: real exchange rate, $LINFR$: logarithm of inflation rate, $LGDP$: logarithm of gross domestic product, $LLIQ$: logarithm of liquidity, $INTR$: interest rate.

In This paper we employ the Johansen multivariate co-integration test to determine whether selected macroeconomic variables are co-integrated with share prices in the Tehran stock exchange. Furthermore, Generalized impulse response function (IRF) and the Error Variance Decomposition analysis are used to detect the effect of shocks in the macroeconomic factors on complete time path of stock prices and vice versa. The first requirement of estimating co-integrating vector is a test for stationary; the order of integration of the variables is required. For this purpose, The Augmented Dickey-Fuller (ADF) approach is used to pre-test the order of integration for all-time series variables and we use Schwartz Bayesian Criterion (SBC) as a leading indicator for VAR lag selection.

5. Empirical results

5.1. Unit Root Test

Many of variables studied in macroeconomics, monetary economics and financial economics are non-stationary time series (Hill et al., 2001).Time series analysis must be based on stationary data series for drawing useful inferences and avoiding spurious regressions. So, we first subject the data to stationary test by using the widely acclaimed Augmented Dickey Fuller (ADF) test by Dickey and Fuller (1979) to confirm stationary of the series. The null and alternative hypotheses are as follows:

$H_0 : \delta = 0$ Unit root [Variable is not stationary]

$H_1 : \delta < 0$ No unit root [Variable is stationary]

If the coefficient is significantly different from one (less than one) then the hypothesis that y contains a unit root is rejected. Rejection of the null hypothesis denotes stationary in the series. If we don´t reject the null hypothesis, we conclude we have a unit root. By looking at the results, it appears that the p-values of two out of six variables included in our regression are less than the critical value (5%). In other words, the p-values of RER and LINFR are less than 5%, meaning that we reject the null hypothesis and they are stationary at level. But the p-values for other variables in our research are greater than the critical value (5%). So we cannot reject the null hypothesis. Therefore we need to take the first difference of those variables before they can be run in the regression model.

Table 1. ADF test results.

	variable	ADF	t-Statistic	Conclusion
Level with intercept & trend	LGDP	-0/1084	-2/9639	non-stationary
	LSP	0/8194	-2/9639	non-stationary
	RER	-5/0113	-2/9639	stationary
	LINFR	-3/4905	-2/9639	stationary
	LLIQ	1/6224	-2/9639	non-stationary
	INTR	-2/6694	-2/9639	non-stationary
First difference with intercept	D(GDP)	-3/5970	-2/9639	stationary
	D(LSP)	-3/1308	-2/9639	stationary
	D(LLIQ)	-3/8671	-2/9639	stationary
	D(INTR)	-5/5489	-2/9639	stationary

5.2 Lag Selection

Before investigating existence of any co-integration relationship between variables, we should choose appropriate lag length in the study. So, for this purpose, we run an unrestricted vector auto-regression between variables. Using Schwarz information criteria and Final error prediction we collect 1 lags as suitable.

Table 2. Lag Selection

Lag	AIC	SC	HQ
0	19/977	20/265	20/063
1	10/762	* 12/778	11/362
2	9/813	13/557	10/926
3	* 7/361	12/832	* 8/988

5.3 Impulse Response functions

In this section impulse response functions were investigated for price index in order to see the effect of macroeconomic factors on it in terms of reaction over time. Figure 1 shows the generalized impulse response functions which trace the effects of a shock to one endogenous variable on to the other variables in the system. It should be noted that a shock to one variable does affect itself and other endogenous variables in the system due to the dynamic lag structure.

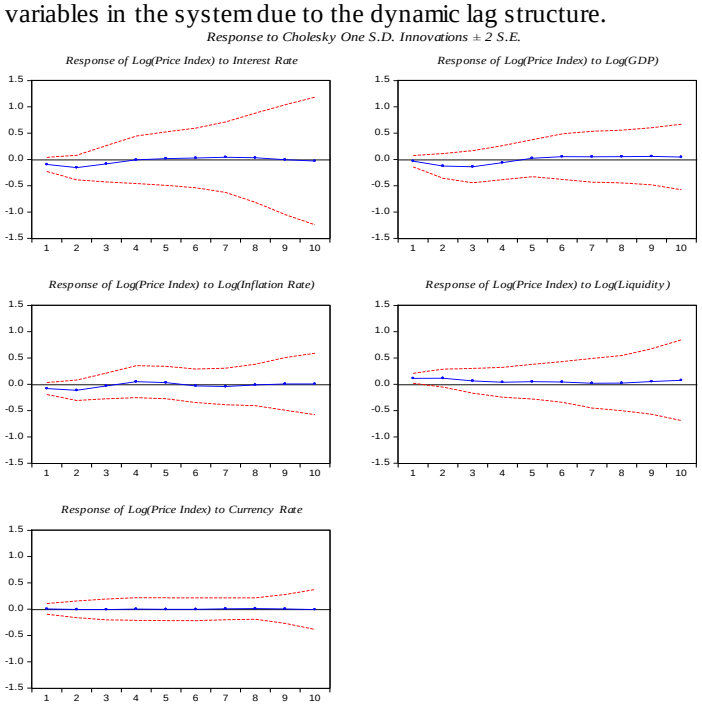

Figure 1. Impulse Response functions.

When a shock or a positive impulse has been entered on macroeconomic variables, the stock price has change a little. So that in case of shocks to the real interest rate, stock prices initially raised but in a negative trend, and this trend has continued during 10 periods. In the case of GDP shocks, similar to the interest rate, the increase in stock prices has been observed to increase by negative reaction, and then these changes declined to zero during the period. In case of inflation the effects are similar. But a shock to liquidity first has led to decline in stock prices by a positive effect but, then it changes to zero. it is important to note that in the short-term, stock prices have reacted to macroeconomic variables shocks, some of these reactions were negative, but in increasing trend. In the midterm the effects has achieved to zero But it has been anticipated that in the long-term stock price reaction to macroeconomic variables will be higher in comparison with short and medium term.

5.4. Variance Decomposition

The variance decomposition provides further evidence of relationships among the variables under investigation. The variance decomposition shows the proportion of the forecast error of one variable due to the other variables. Therefore, the variance decomposition makes possible to determine the relative importance of each variable in creating fluctuations in other variables. Variance decomposition of stock price index has been displayed at a 10-year period in the short, medium and long term in the Table3.

As you can see in the Table3, all the variables affect the stock price index in the short term and the most effective of them is stock price index. So that at the beginning of the period 61/90% of the stock price, 68/16% of the liquidity and 60/11% of the real interest rate effect on the stock price. In the medium term, the most affecting factor on the stock price index is still stock price, then GDP, real interest rate and liquidity. In the long term, stock price index has had the greatest impact on itself and then GDP, liquidity and real interest rate.

5.5. Co-integration Analysis

Most macroeconomic variables are non-stationary, with time-dependent means and variances. However, a linear combination of non-stationary variables may be stationary. If there is such a stationary linear combination, then variables are co integrated. With selection of 1 lags in level, we use Johansen procedure, trace and Maximum Eigenvalue test to obtain the co-integration relationships. When restrictions are imposed on the deterministic components of the Johansson's multivariate model to obtain co integration relationships, five possible models exist (Hansen and Juselius, 1995), In this study, we just test model with intercept and without trend restrictions to determine the number of co-integration relationships, since according to Hansen and Juselius (1995), The Impact of Macroeconomic Variables on the other models are too restrictive or least restrictive are unlikely to occur in practice.

Table 4. Trace co-integration test

H0	H1	Trace Statistic	Critical Value	Probability
$r = 0$	$r = 1$	144/7781	95/7536	0/0000
$r \leq 1$	$r = 2$	83/3830	69/8188	0/0028
$r \leq 2$	$r = 3$	47/0458	47/8561	0/0595
$r \leq 3$	$r = 4$	25/9312	29/7970	0/1308

Table 5. Maximum Eigenvalue test.

H0	H1	Max-Eigen Statistic	Critical Value	Probability
$r = 0$	$r = 1$	61/3949	40/0775	0/0001
$r \leq 1$	$r = 2$	36/3372	33/8768	0/0249
$r \leq 2$	$r = 3$	21/1145	27/5843	0/2694
$r \leq 3$	$r = 4$	18/5476	21/1316	0/1107

Both of the trace and Maximum Eigenvalue tests confirm existence of two co-integration equation in the model. Since these coefficients are meaningful in co-integration equation, we choose model with intercept and without trend. Table 6 shows this equation with corresponding standard deviations (s.d) and t-statistics.

$$LSP = 2.47\ LINF - 0.59\ LLIQ + 0.005\ RER + 0.03\ INTR \quad (2)$$

Table 6. Co-integration Equation.

Variable	LINFR	LLIQ	RER	INTR
Long time coefficient (normalized vector)	**2/4707**	**-0/5939**	**0/0057**	**0/0376**
t-statistic	**3/6387**	**-6/8738**	**4/4883**	**1/0591**

According to the results of the normal vector, a percentage increase in inflation rate will increase stock prices index 2/47 percent in the long term. Liquidity and currency rate respectively have significant positive and negative correlation with the stock price index. One percent increase in liquidity and currency rates, respectively will have significantly 0/59 decrease and 0/**0057** increase in stock prices in long-term. On the other hand the relationship between real interest rates and stock price index are positive but not significant.

Table 3. The result of FEVD for LSP

Period	INTR	LGDP	LINFR	LLIQ	RER	LSP
1	11.60123	1.380985	8.412803	16.68374	0.020147	61.90110
2	16.75001	8.364936	9.720265	13.42046	0.015392	51.72894
3	15.49995	13.94515	7.834204	11.97319	0.026775	50.72073
4	14.28470	14.15670	8.128975	11.55158	0.025640	51.85241
5	13.84334	13.83081	8.182962	12.00379	0.025285	52.11382
6	13.79242	14.47689	8.285285	12.38517	0.025393	51.03484
7	14.02206	14.92957	8.633935	12.19309	0.043077	50.17826
8	13.99258	15.49989	8.472147	12.05614	0.084592	49.89466
9	13.69074	16.22337	8.299898	12.66910	0.086593	49.03029
10	13.58408	16.42679	8.081209	14.12010	0.098058	47.68976

6. Conclusion

This paper analyzed long-term equilibrium relationships between a group of macroeconomic variables and Tehran Stock Exchange price Index. The macroeconomic variables were represented by the currency rate (CR), inflation rate (IR), gross domestic product (GDP), real interest rate (RIR), liquidity (Liq).We employed a vector error correction model to explore such relationships and found that these five variables are co-integrated and one long-term equilibrium relationship exists among these variables. First of all, we used Auto-Regressive Vector test (VAR), Impulse Response Functions and Variance Decomposition analysis to examine the effects of shocks and variables that had the greatest effects on stock index. For estimating a long-term relationship between variables and Johansson co-integration test, maximum eigenvalue and trace test was used.

Findings of this study may help stakeholders to recognize the link between macroeconomic factors and Stock Price index and to choose appropriate measures to evaluate and analyze the companies' performance. The findings suggest there are both long and short run relationship between the macroeconomic variables and stock prices. Also the impulse response results also suggest that Shocks to inflation Rate, real interest rate and GDP instantaneously affect the stock price index negatively. For liquidity, impact of the shock is negligible. Finally, the Variance results also suggest that all the variables affect the stock price index in the short, medium and long term and the most effective of them is stock price index. We found that Iran's stock market is positively influenced by the inflation and currency rates and negatively affected by the liquidity. On the other hand the relationship between real interest rates and stock price is positive but not significant.

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