

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

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## **Abstract**

*This paper examines the effects of selected macroeconomic variables on the stock market index in Iran. Using quarterly data, we examine the relationships between the Tehran Stock Index (TSI) and five macroeconomic variables which consist of gross domestic product, nominal effective exchange rate, money supply, gold coin price and investment in housing sector from 1996:1 to 2008:1. 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 index is positively influenced by the growth rate of the GDP, the money supply and negatively affected by the gold prices, the private sector investment in housing sector and the nominal effective exchange rate.*

**Key words:** *stock market, macroeconomic variables, co-integration.*

**JEL Classification:** *E44, G10, G12*

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## 1. Introduction

The stock market is a market where business firms papers are bought and sold. The well-organized stock market mobilizes the savings and activates of the investment projects, which lead to economic activities in a country. The stock market mobilizes savings from a large pool of small savers and channelizes these funds into investments. The preferences of the lenders and borrowers are harmonized through stock market operation. The stock market also supports reallocation of funds among corporations and sectors. It also provides liquidity for domestic expansion and credit growth (Sohail et al., 2009). A well functioning stock market may help the economic growth and development process in an economy through the following means:

- س Growth of savings
- س Efficient allocation of resources
- س Attracting foreign portfolio investment

So, a clear understanding of stock market determinants is vital for investors, regulators, and academic researchers. In general, effective elements on stock price can be categorized in two categories:

- 1) Micro elements: a number of the elements are related to single corporation decisions and operations such as Dividend per Share (DPS), Price to Earnings ratio (P/E),
- 2) Macro elements: the elements don't affect individuals and have wide impacts so that the whole market may be affected by them.

These elements divide in two subsections:

- a) Political elements, for example campaign, peace, sanction, presidential election.
- b) Economical elements, for example GNP, exchange rate, money supply.

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 Present

Value Model and the portfolio theory together. In this way, gold coin price and investment in housing has been added as new macroeconomic variables to the model.

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 sources of data and model specification. Section 5 describes methodology and techniques of analysis. Empirical results are discussed in section 6, while the summary and conclusion are contained in section 7.

## 2. Literature Review

The relationship between stock markets and macroeconomic forces has been widely debated in the finance and macroeconomic literature ( for example: Mukherjee and Naka ,1995; Cheung and Ng ,1998; Kwon and Shin,1999; Mohammadi and Taghavi ,1999; Maysami and Koh ,2000; Nishat and Shaheen, 2004; Maysami et al., ,2005; Gan et al., ,2006; Mehrara, 2007; Sohail and Hussain, 2009; Pilinkus, (2009); Mohammad et al.,2009; Humpe and Macmillan ,2009; Alavi Rad, 2011; Hsing, 2011; Singh et al., 2011; Asaolu and Ogunmuyiwa, 2011).

Mukherjee and Naka (1995) applied Johansen s VECM to analyze Japanese Stock Market. They concluded that a co integrating equation exists between assumed variables. Cheung and Ng (1998), concluded that there are long term co-movements between the national stock index and macroeconomic variables in Canada, Germany, Italy, Japan and US, and Kwon and Shin (1999) found that the Korean stock markets are co-integrated with the production index, exchange rate, trade balance and money supply. Mayasmai and Koh (2000) found that inflation, money supply growth, changes in short- and long-term interest rate and variations in exchange rate formed a co-integrating relation with changes in Singapore s stock market levels. Nishat and Shaheen (2004) employed a vector error correction model and their results indicated that industrial

production is the largest positive determinant of Pakistani stock prices, while inflation is the largest negative determinant of stock prices in Pakistan. Maysami et al., (2005) proved the existence of the long-term equilibrium relationships between macroeconomic variables and the Singapore stock market index (STI), with various Singapore Exchange Sector indices the finance index, the property index, and the hotel index. Gan et al., (2006) examined the relationships between the New Zealand Stock Index (NZSE40) and macroeconomic variables. Humpe and Macmillan (2009), within the framework of a standard discounted value model examined a number of macroeconomic variables affecting stock prices in the US and Japan. Sohail and Hussain (2009) studied long-run and short-run relationship between Lahore Stock Exchange and macroeconomic variables in Pakistan. Pilinkus (2009) analyzed relationships between 40 macroeconomic variables and the Lithuanian stock market index, i.e. OMX Vilnius index. Using Granger causality tests revealed that some macroeconomic variables may serve as a leading indicator for stock market returns in Lithuania. Mohammad et al., (2009) investigated the relation among the macroeconomic variables share prices of KSE (Karachi Stock Exchange) in context of Pakistan. The results showed that exchange rate and exchange reserve highly affect the stock prices. Hsing (2011) examined the impacts of the macroeconomics variables in South Africa using EGARCH Singh et al., (2011) studied the casual relationship between stock index returns and certain macroeconomic variable. The analysis was based on stock portfolios. Empirical findings revealed that exchange rate and GDP seem to affect returns of all portfolios positively. Asaolu and Ogunmuyiwa (2011) investigated the impacts of the macroeconomic variables on Average Share Price (ASP) in Nigeria. The results revealed that ASP is not a leading indicator of macroeconomic variables in Nigeria and that movements in stock prices can not actually be explained by macroeconomic factors.

Inside of Iran, some studies have been conducted. Mohammadi and Taghavi (1999) considered macroeconomic variables such as house price index, means of transport price index, and free market exchange rate to explain the Tehran Stock Exchange (TSE) price index. Using VAR model, they found that share of these macroeconomic variables in fluctuation of stock price index are about 13 per cent. 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. Saeedi and Amiri (2010) analyzed relationships between macroeconomic variables namely consumer price index, free market exchange rate and oil price with TSE using OLS method. They couldn't find any meaningful relationship between TSE with consumer price index and free market exchange rate, while oil price had significant negative effect on TSE. Alavi Rad (2011) examined the relationship between Tehran Stock Exchange (TSE) price index and consumer prices index, free market exchange rate and liquidity using VAR model. The results revealed that share of macroeconomic variables in fluctuations of TSE price index are about 12 percent. So, he concluded macroeconomic variables don't play an important role in fluctuations of TSE price index in Iran.

### **3. Macroeconomic Variables and Stock Market**

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 stationarity. For a selection of relevant studies see inter alia 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 default relationship between selected macroeconomic variables and stock market index for Iran. For understanding the theorem, two aspects are considered in explaining supposition relationships. First, expected future cash flows and second, portfolio theory.

### **3.1. Stock Prices and Output Growth**

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).

### **3.2. Stock Prices and Money Supply**

The money supply, is likely to influence share prices through at least

three mechanisms: First, changes in the money supply may be related to unanticipated increases in inflation and future inflation uncertainty and hence negatively related to the share price; Second, changes in the money supply may positively influence the share price through its impact on economic activity; Finally, portfolio theory suggests a positive relationship, since it relates an increase in the money supply to a portfolio shift from non-interest bearing money to financial assets including equities (Humpe and Macmillan,2009). One may also add that in the case of Iran, the money stock might very well convey information about Iran s risk-free rate, which is otherwise masked by the government control of nominal interest rate in much of our study period. When the interest rate is pegged by the government, underlying pressure from agents liquidity preference which is ordinarily reflected in the interest rate is instead reflected in changes in the money stock. Since the money supply has a negative relationship with interest rates, this implies a direct relationship between the money supply and the stock price.

### **3.3. Stock Prices and Exchange Rate**

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.

### **3.4. Stock Prices and Gold Coin Prices**

Gold coin is one of the major substitute assets that investors and ordinary people hold in their portfolios in Iran. So, any changes in the gold prices

affect investors and stockholders' intention for holding stock in their portfolio. Therefore, increase in the gold prices stimulates the people to sell their shares and buy the gold coin for gaining more profits. From this point of view, we can consider stock and gold as substitute for each other and negative relationship between them.

### **3.5. Stock Prices and Investment in Housing**

Just as the gold, housing is a major substitute asset for stock in Iran's economy. So when home prices increase, for gaining more revenue, investors prefer to carry their savings to housing sector, so investment in this section arises. Similar to the gold coin, we can consider stock and gold as substitute for each other and negative relationship between them.

## **4. Data and Model**

Seeking to identify the relationship between stock prices and macroeconomic variables, a focus has been laid on evidences from Iran. The data are seasonally and are extend from the 1996:1 to 2008:1. We couldn't use recent data because GDP hasn't been published from 2008 because of non-economical reasons by central bank. Interest rate doesn't exist in Iran because of Islamic Banking System. All variables are transformed into natural logs and all of them are seasonally adjusted. A total of five macroeconomic variables and TSE are used in the analyses. The definition and resource of each variable is described in Table 1.



Table (1) Variables

VARIABLE	DESCRIPTION	Source
Share price index(SP)	Data cover all companies listed in Tehran Stock Exchange (TSE) and are produced as a Laspeyres-type index based on average daily prices.	IFS
Nominal effective exchange rate(NEER)	The total trade weights used to construct the nominal effective exchange rates. The weights take into account the relative importance of a country's trading partners	IFS
Money supply (M)	Broadly defined money supply in Iran	Iran Central Bank
Gross domestic product (GDP)	Gross domestic product	Iran Central Bank
Gold coin price (COIN)	Gold coin price, (old version)	Iran Central Bank
Housing investment(HI)	Private sector investment in Housing sector	Iran Central Bank

Using mentioned variables, we consider the below model between variables. L at the beginning of variables illustrates logarithmic form of variables.

$$LSP = (LNEER, LM, LCOIN, LGDP, LHI)$$

## 5. Methodology

This paper employs the Johansen multivariate co-integration test to determine whether selected macroeconomic variables are co-integrated with share prices in the Iran stock exchange. Furthermore, the Error Variance Decomposition analysis is used to investigate macroeconomic variables share in explaining forecast error decomposition for stock index. The Augmented Dickey-Fuller (ADF) approach is used to pre-test the order of integration for all time series variables.

### 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 stationarity test by using the widely acclaimed Augmented Dickey Fuller (ADF) test by Dickey and Fuller (1979) to confirm stationarity of the series.

### 5.2. Johansen Procedure

This section outlines Johansen's vector error-correction model (VECM) for testing co integration between integrated time series. In estimating the VECM we first consider whether each series is integrated with the same order, to do this we consider the standard Augmented Dickey-Fuller test. Assuming that each series contains a single unit root, and thus each series is integrated of order one, the potential for co-movements between series exists, suggesting the existence of a long-run relationship amongst these variables. Thus, we can test for co-integration that is the existence of at least one long-run stationary relationship between these series, using the method of Johansen, which involves investigation of the  $p$ -dimensional vector autoregressive process of  $k^{\text{th}}$  order:

$$\Delta Y_t = \mu + \sum_{i=1}^{k-1} \Gamma_i \Delta Y_{t-i} + \Pi Y_{t-k} + \varepsilon_t \quad (1)$$

where  $\Delta$  is the first difference lag operator,  $Y_t$  is a  $(p \times 1)$  random vector of time series variables with order of integration equal to one,  $I(1)$ ,  $\mu$  is a  $(p \times 1)$  vector of constants,  $\Gamma_i$  is  $(p \times p)$  matrices of parameters,  $\varepsilon_t$  is a sequence of zero-mean  $p$ -dimensional white noise vectors, and  $\Pi$  is a  $(p \times p)$  matrix of parameters, the rank of which contains information about long-run relationships among the variables.

Tests of the hypothesis that the number of co-integrating vectors is at most  $r$  ( $r = 1, \dots, p$ ) are conducted using the likelihood ratio (trace) test statistics for reduced rank in the context of the restrictions imposed by co-integration on the unrestricted VAR involving the series comprising  $Y_t$ .

### **5.3. Variance Decomposition**

In the usual VAR framework, the portion of the total variance of an observed variable that is due to the various structural shocks is called variance decomposition. The variance decomposition exhibits that which one of the macroeconomic factors can provide explanatory power for variation in stock prices over different periods (Lutkepohl, 2005).

## **6. Empirical Findings**

### **6.1. Unit Root Tests**

We test for unit roots in the natural logarithms of our variables using the Augmented Dickey° Fuller (ADF) test. This test considers the null hypothesis of non-stationary variables versus the alternative hypothesis of stationary variables. We employ the Schwarz information criteria (SC) to select the lag length from the ADF test.

Outcomes of the test are presented in Table 3. According to the ADF test; all variables in logarithmic form cannot be rejected at the 5 percent level, the null hypothesis that each variable contains a unit root with a constant and a trend. However, the first log difference rejects the null hypothesis at the 5 percent level, with a constant.

**Table (2) ADF unit root results**

Variable	ADF	ADF
	Level with intercept & trend	First difference with intercept
LSP	-3.22	-3.29
LNEER	-3.12	-7.15
LM	-0.52	-5.65
LCOIN	-1.48	-5.55
LGDP	-3.01	-8.32
LHI	-2.84	-2.92
Test critical values (MacKinnon, 1996)		
5% Level	-3.49	-2.92

## 6.2. 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 Hannan-Quin information criteria and Final error prediction we collect 2 lags as suitable.

## 6.3. 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 2 lags in level (one lag in differenced form), we use Johansen procedure and trace test to obtain the co-integration relationships.

When restrictions are imposed on the deterministic components of the Johansen s multivariate model to obtain co integration relationships, five possible models exist (Hansen and Juselius, 1995) In this study, we just test two models (model with intercept only) and (model with intercept and trend) restrictions to determine the number of co-integration relationships, since according to Hansen and Juselius (1995),

the other models are too restrictive or least restrictive are unlikely to occur in practice.

**Table (3) trace co-integration test**

$H_0$	Trace Statistic (intercept)	0.05 Critical Value (intercept)	Trace Statistic (intercept and trend)	0.05 Critical Value (intercept and trend)
$r=0$	104.53	95.75	147.07	117.70
$r \leq 1$	64.99	69.81	86.87	88.80
$r \leq 2$	33.75	47.85	47.37	63.87
$r \leq 3$	17.10	29.79	27.83	42.91

In both cases, trace test confirms existence of one co-integration equation in the model. Since trend coefficient is meaningful in co-integration equation, we choose model with intercept and trend. Table 5 shows this equation with corresponding standard deviations (s.d) and t-statistics.

**Table (4) Co-integration equation**

Equation	<b>LSP = 71.8 – 2.43 LNEER + 7.06 LM – 6.01 LCOIN + 11.7 LGDP – 3.82 LHI – 0.64 TREND</b>					
<b>s.d</b>	1.005	1.5241	0.8718	1.152	0.6746	0.0789
<b>t-statistic</b>	2.42	-4.63	6.9	-10.15	5.66	8.17

$$D(LSP) = -0.0008*ECM + 0.6*D(LSP (-1)) - 0.47*D(LNEER (-1)) - 0.1*D(LM (-1)) - 0.27*D(LCOIN (-1)) + 0.18*D(LGDP (-1)) - 0.13*D(LHI (-1)) + 0.02$$

$$t: \quad 1.94 \quad 5.33 \quad -1.8 \quad -0.17 \quad -1.2 \quad 0.65 \quad -1.3 \quad 0.63$$

According to the normalized equation, stock prices show significantly negative relation with nominal effective exchange rate.

This imply that along with the decrease in nominal effective exchange rate or depreciation in domestic currency, there is a positive effect on export-oriented firms that lead to increase in returns of the firms and ultimately resulting in hike in stock prices. The relationship between stock price and money supply is found significantly positive. Changes in the money supply influence the share price through its impact on economic activity; on the other hand, upon portfolio theory, increase in the money supply to a portfolio shifts from non-interest bearing money to financial assets including equities. Also, an increase in gross domestic product that is a symbol for better economic situation has a positive effect on firms earnings and increases stock prices. Estimated negative coefficients show that the gold coin and housing sector act as suitable substitutes for stock market in Iran.

#### **6.4. Variance Decomposition**

The variance decomposition provided 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. Results show that the share of economic variables such as gross domestic product (GDP), nominal effective exchange rate (NEER), money supply (M), gold coin price (COIN) and investment in housing sector (HI) in fluctuation of TSE price index are about 15 percent after ten periods. In fact, the forecast error variance of the TSE price index is almost exclusively accounted for by own innovations (85 per cent). LNEER explained 5 percent impact on stock prices. Movements in other macroeconomic variables, i.e. LM, LCOIN, LGDP, and LHI explained forecast variance of 4.5 percent, 4 percent, 1 percent, and 0.5 percent respectively for LSP after 15 years. The result of forecast error variance decomposition (FEVD) for LSP is shown in Table 6.

Table (6) The result of FEVD for LSP

Period	S.E.	LSP	LNEER	LM	LCOIN	LGDP	LHI
1	0.0711	94.55	0.13	0.68	2.94	1.66	0.00
2	0.1375	90.72	1.52	0.48	4.33	2.49	0.44
3	0.2011	89.84	1.97	1.23	4.48	1.94	0.51
4	0.2607	88.91	2.52	2.02	4.47	1.57	0.48
5	0.3157	88.08	3.05	2.62	4.40	1.37	0.45
10	0.5315	85.83	4.49	4.03	4.11	1.09	0.42
15	0.6881	85.09	4.94	4.48	4.01	1.04	0.42

**Cholesky Ordering:** LNEER LM LCOIN LHI LGDP LSP

## 7. Conclusion

This paper analyzed long-term equilibrium relationships between a group of macroeconomic variables and the Tehran Stock Exchange Index. The macroeconomic variables were represented by the gross domestic product (GDP), nominal effective exchange rate (NEER), money supply (M), gold coin price (COIN) and investment in housing sector (HI). 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. Stock prices show significantly negative relation with nominal effective exchange rate. This implies that along with the decrease in nominal effective exchange rate or depreciation in domestic currency, there is a positive effect on export-oriented firms that lead to increase in returns of the firms and ultimately resulting in hike in stock prices. The relationship between stock price and money supply is found significantly positive. Changes in the money supply influence the share price through its impact on economic activity; on the other hand, upon portfolio theory,

increase in the money supply to a portfolio shifts from non-interest bearing money to financial assets including equities. Also, an increase in gross domestic product that is a symbol for better economic situation has a positive effect on firms' earnings and increases stock prices. Other results show that the gold coin and housing sector act as substitutes for stock market. In addition, the variance decomposition of the share of economic variables in fluctuation of TSE price index is about 15 percent after ten periods. In fact, the forecast error variance of the TSE price index is almost exclusively accounted for by own innovations (85 per cent).



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