

Impact of Macroeconomic Factors on Stock Market: Evidence from Istanbul Stock Exchange

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Abstract: In contemporary economic world, financial markets in general and stock markets in particular play a vital role in financing the investments and to extent credit to the entrepreneurs. This fact has opened a new avenue of research into the relationship between stock market and macroeconomic structure that is development/reaction/impact of stock market across macroeconomic fluctuations.

This paper analyzes long-term equilibrium relationship between macroeconomic factors and Istanbul Stock Exchange (ISE) Index. The macroeconomic factors are represented by a set of variables which include interest rate, inflation (consumer price index), industrial production index, money supply (M1), growth (GDP) and real exchange rate. We employ Johansen co-integration method to explore the above mentioned relationship among these variables in a span of time between 1998:1 and 2008:12.

Keywords: Macroeconomic factors, Stock market, Istanbul Stock Exchange, VECM.

1. Introduction

The issue of finance has gained considerable importance around the world in last few decades. So the finance and banking sectors have developed rapidly and finance literature as well, both in theoretically and empirically. Causal relationship between economic growth and financial development, and impact of macroeconomic as well as catastrophic shocks on financial institutions has been investigated for the samples of developed and developing countries.

Stock markets are one of the most important components of modern economic structure. Macroeconomic condition may have significant impacts on both prices of stocks and volume traded. With this respect, understanding the interaction between stock prices and macroeconomic variables gains importance. By knowing these relationship, investors can earn profits by exploiting past information of the variables. In addition, they may be used as indicator to formulate current economic stabilization policies. Therefore, the issue of whether stock prices and macroeconomic variables are related or not have received considerable attention. Many works have been done in past few decades to examine the relationship between stock prices and financial futures as well as the currency exchange (Hen *et al.*, 2006). However, there is no empirical or theoretical consensus on the issue of whether these variables are related and the direction of causation if they are related or, at least, different studies which have been conducted for different markets may give diverse findings.

In the finance literature, asset pricing models have been developed from 1960s, such as Capital Assets Pricing Model (CAPM), multi-factors models and Arbitrage Pricing Model (APM), in order to explain the movements in prices of financial assets and hence to determine the effective factors on their returns. Factor models and APM has been developed as alternatives to CAPM which considers only one risk factor (β). Despite the its some theoretical deficiencies, it is accepted that APM is superior to CAPM due to its more realistic assumptions and taking into consideration more variables those may affect asset returns. The APT literature suggests that macroeconomic variables may proxy for pervasive risk factors.

This paper aims to shed some light on interrelation between macroeconomic variables and stock market performance through time series methods, i.e. co-integration and error correction model. The paper proceeds as follows. The next section provides an overview of the stock market development in Turkey. The

subsequent section presents the variables and data used, and empirical evidence. The final section contains concluding remarks

2. Stock Market Development in Turkey

Financial markets in Turkey were strictly regulated until a financial liberalization program which was introduced at the beginning of 1980. The program included the liberalization of the foreign exchange regime, deregulation of interest rates, and establishment of financial markets including the Istanbul Stock Exchange (ISE) which was established in 1986. ISE has gained large momentum since then and its development became highly representative of an emerging market with rapid growth in terms of market capitalization, trade volume and number of listed companies as well as high volatility in returns (Odabaşı *et al.* 2004, 510). In 1986, there were 80 listed companies in ISE and annual volume of trade was only \$ 13 million. Up to 2000 the number of listed companies steadily increased as well as the trade volume, at a great pace. Due to the consecutive financial crises on November 2000 and February 2001, general performance of the ISE halted (Tab. 1a, below).

Table 1a. Development of Istanbul Stock Exchange (in numbers).

Year	Number of companies	Volume of Trade (Million \$)		Total market capitalization
	(End of Year)	(Total)	(Daily)	(Million \$)
1986	80	13	0.05	938
1990	110	5,854	23.70	18,737
1995	205	52,357	208.59	20,782
2000	315	181,934	739.57	69,507
2001	310	80,400	323.78	47,189
2002	288	70,756	281.22	33,773
2003	285	100,165	406.89	68,624
2004	297	147,755	593.03	97,354
2005	304	201,763	794.33	161,630

Source: Odabaşı *et al.* (2004), TSI (2006).

As is seen in Tab. 1b, ISE has realized important and rapid improvements since its commencement.

Table 1b. Development of Istanbul Stock Exchange (main events).

1980 – 1990	<ul style="list-style-type: none"> – Launch of liberalization program, deregulation in financial structure – Inauguration of Istanbul Stock Exchange – Commencement of stock trading – Commencement of daily calculation of ISE Indices which had so far been calculated on a weekly basis – Establishment of Settlement and Custody Center
1991 – 1995	<ul style="list-style-type: none"> – Commencement of the calculation of Financials and Industrial Indices in addition to the ISE Composite Index – Initiation of the Repo/Reverse Repo Market – Extending daily trading hours to 4 hours and the commencement of stock trading in two sessions – Launch of the Regional Markets and the Wholesale Market – Establishment of the Federation of Euro-Asian Stock Exchanges with 12 members, which ISE was one of the founder members
1996 – 2000	<ul style="list-style-type: none"> – Launch of the Watch List Companies Market – ISE International Bonds and Bills Market started its operations – ISE became the project leader of Southeast European Cooperation Initiative
2001 –	<ul style="list-style-type: none"> – ISE Derivatives market was introduced – ISE Corporate Governance Index was launched – The ISE International Market and its submarkets were closed

Source: www.ise.org

Ample of empirical studies are implemented on various aspects of ISE hitherto. Odabaşı *et al.* (2004) has analyzed the evolution of prices on the ISE for the period of 1988-1999 and concluded that, as an emerging market, the ISE has shown some differences from other emerging markets. In the sample period, they found that expected returns, as approximated by sample means, have not declined and no significant change in volatility is observed during the decade. The move towards normality also seems to be more pronounced than in other countries. Odabaşı *et al.* attribute this to the unique characteristics of the ISE.

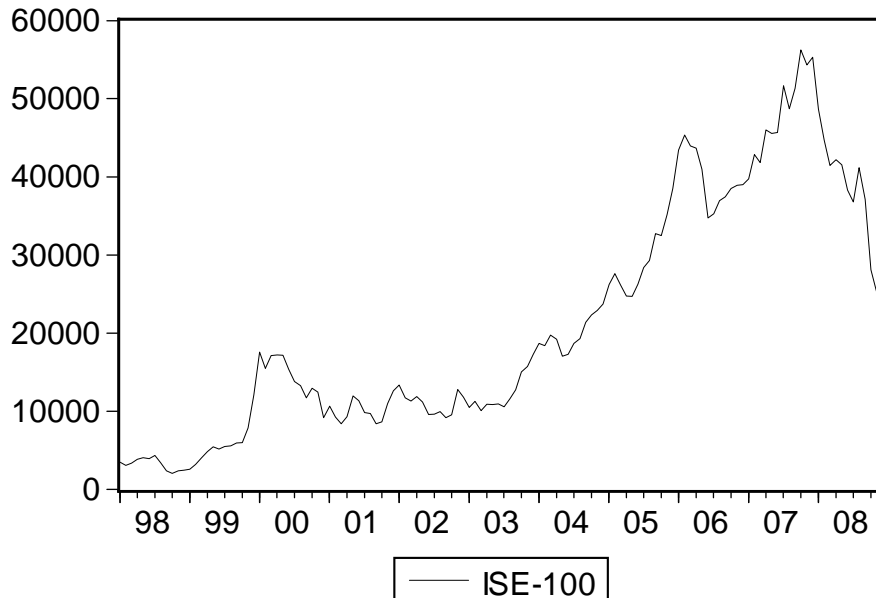


Figure 1. Development of ISE-100 index over the time.

Müslümov *et al.* (2003) tested weak-form market efficiency hypothesis in ISE using time series covering 1990-2002 years. Their findings reveal that the stock returns of the individual stocks that constitute 65% of the sample space do not show random walk behavior whilst remaining part exhibit significant random walk behavior. The findings for the ISE-100 national index provide support the evolving market efficiency hypothesis. They also found that there was no discrimination between stocks those whose returns do follow and do not follow random walk behavior. In another study, Taş and Dursunoğlu (2005) also tested the weak form efficiency of ISE using Dickey-Fuller and runs test procedures, and found out that ISE was not efficient over the period from 1995:1 to 2004:1.

Turkey has experienced severe financial crises in last two decades. In 1994 due to heavy appreciation of the currency current account a balance presented a significant deficit which created financial distress in the economy. In the year 2001, the financial crisis stemmed from the banking sector and high domestic repayment of the treasury. Political instability also contributed to deepening the crisis. Doğan and Salman (2004) examined the behavior of ISE during these financial crises using dummy variables. They found that dummies for year 2001, all for 5, 15 and 30 days before the shock, observed to be highly significant where dummies for year 1994 are not. This result implies that the 1994 crisis was unexpected. When they further examined the coefficient of year 2001 dummy, realized that coefficient gets smaller over longer horizons.

Tüzüntürk (2009) aimed to find out empirically whether there was any insider trading on ISE in 2003 using the panel data method. His estimations show that the average trade size sign is negative and the trade frequency sign is positive, the result which can be interpreted as an evidence of insider trading occurred at the ISE in 2003.

3. Review of Related Literature

A significant literature exist which investigates the relationship between stock market and a range of macroeconomic and financial variables, across a number of different markets and over a range of different time horizons. Existing financial economic theory provides various models to test this relationship. Most of the research has focused on the developed countries (see for example, Poon and Taylor, 1991; Mukherjee and Naka, 1995; Gjerde and Sættem, 1999; Hondroyiannis and Papapetrou, 2001; Chen, 2008; Bordo *et al.*, 2008).

In last decade, researchers have begun to turn their attention to examining similar relationship in developing countries.

Chen *et al.* (1986) is one of the pioneering papers to empirically investigate the impact of macroeconomic variables on stock price returns. They concluded that interest rates, inflation rates, bond yield spreads, and industrial production level have risk that is priced in the stock market.

Campbell and Ammer (1991) focus on the relationship between changes in expectations of future stock dividends, short-term real interest rate, inflation, and excess returns on stock and bonds. Using a log-linear asset pricing framework and a vector autoregression (VAR) model approach, they found that in monthly post-war U.S. data, excess returns are to be driven by news about future excess stock returns, while excess 10-year bond returns are driven largely by news about future inflation. Real interest rate changes seem have little impact on either stock or 10-year bond returns, although they do affect the short-term nominal interest rate and slope of the term structure.

Hamilton and Lin (1996) investigate the joint time series behavior of monthly stock returns and growth in industrial production and find that stock returns are well characterized by year-long episodes of high volatility separated by longer quite periods. Real output growth, on the other hand, is subject to abrupt change in the mean associated with economic recessions. They employ a bivariate model in which these two changes are driven by related unobserved variables, and conclude that economic recessions are the primary factor that derives fluctuations in the volatility of stock returns.

Sadorsky (2003) uses monthly data from July 1986 to April 1999 to investigate the macroeconomic determinants of the US technology stock price volatility. The empirical results indicate that the conditional volatilities of industrial production, oil prices, the federal funds rate, the default premium, the consumer price index, and the foreign exchange rate each have a significant effect on the conditional volatility of technology stock prices. Industrial production and the consumer price index each have the largest direct impact.

Gunasekarage *et al.* (2004) estimates an error correction model with monthly data to study the relationship between macroeconomic variables and stock market equity values, in Sri Lanka. In their analysis VECM provide some support for the argument that the lagged values of macroeconomic variables such as the consumer price index, the money supply and the treasury bill rate have a significant influence on the stock market. It was found that treasury bill rate play most important roles in affecting stock returns compared to other variables.

Maysami *et al.* (2004) investigate the relationship between macroeconomic variables and sector stock market returns, using Johansen' VECM, in the case of Singapore. They conclude that the Singapore stock market and the SES All-S Equities Property Index formed significant relationships with all macroeconomic variables identified, while the SES All-S Equities Finance Index and SES All-S Equities Hotel Index form significant relationship only with selected variables.

Nishat and Shaheen (2005) analyze long-term equilibrium relationships between a group of macroeconomic variables and the Karachi Stock Exchange Index. The macroeconomic variables are represented by the industrial production index, the consumer price index, money supply (M1), and the value of an investment earning the money market size. By employing a VECM, they examined the relationship during 1973:1 to 2004:4, and they found that these five variables are co-integrated and two long-term equilibrium relationships exist among them. Results of the analysis indicate that industrial production is the largest positive determinant of stock prices, while inflation is the largest negative determinant. They also found that while macroeconomic variables Granger-caused stock movements, the reverse causality was observed in case of industrial production and stock prices.

Padhan (2007) aims at to find out the causal linkages between stock market and economic activity in India. To this end he applies recently developed Granger non-causality tests by Toda-Yamamoto, Dolado and Lutkepohl (TYDL model). The notable finding of the paper is that both the stock price and economic activity are integrated of order one and the Johansen-Juselius co-integration tests confirm the existence of one long-run relationship. The TYDL model suggests that there is bi-directional causality between stock price and economic activity during the post-liberalization period.

Kyereboah-Coleman and Agyire-Tettey (2008) aims at examining how macroeconomic indicators affect the performance of stock markets by using the Ghana Stock Exchange as a case study. Using the quarterly time series data covering the period 1991-2005, they ascertain both short- and long-run relationships via co-integration and the error correction model techniques. Findings of the study reveal that lending rates from deposit money banks have an adverse effect on stock market performance and particularly serve as major hindrance to business growth in Ghana. Again, while inflation rate is found to have a negative effect on stock market performance, the results indicate that it takes time for this to take effect due to the presence of a lag period; and that investors benefit from exchange-rate losses as a result of domestic currency depreciation. Osei (2006) also examined the case of Ghana Stock Exchange somewhat different variable set and concluded that in terms of Efficient Market Hypothesis (EMH), the Ghana stock market is informationally inefficient particularly with respect to inflation, treasury bill rate and world gold price.

Al-Sharkas (2004) researches the impact of selected macroeconomic variables on Amman Stock Exchange. The variables are the real economic activity, money supply, inflation, and interest rate. His empirical findings reveal that the stock prices and macroeconomic variables have a long-term equilibrium relationship.

3. Empirical Analysis and Results

3.1. Variables, Data and Methodology

Engle and Granger (1987) and Johansen (1988) proposed to determine the existence of long-run equilibrium among selected variables through co-integration analysis, paving the way for a preferred approach to examining the economic variables-stock market relationship. A set of time series variables are co-integrated if they are integrated of the same order and a linear combination of them is stationary. Such linear combinations would then point to the existence of a long-term relationship between the variables. An advantage of co-integration analysis is that through building an error correction model (ECM), the dynamic co-movement among variables and the adjustment process toward long-term equilibrium can be examined (Maysami *et al.* 2004; 49).

Variables: We selected six macroeconomic variables based on their hypothesized effect on either the cash flows or the required rate of return (or both) in the basic valuation model. These variables are: stock index (represented by monthly average of daily closing value of ISE-100 index; *ISE*), exchange rate (represented by real TL/ 19 foreign currencies basket; *RDK*), inflation (represented by consumer price index; *CPI*), money supply (represented by M1; *MS*), real economic activity (represented by industrial production index; *IPI*), interest rate (represented by three month term weighted deposit interest rate; *INT*).

Inflation: A negative relation between inflation and stock prices has been hypothesized. Although real stock returns and inflation have been negatively correlated historically, the correlation is widely seen as an anomaly resulting from the simultaneous impacts of real economic activity on inflation and stock returns (Fama, 1981; Fama and Schwert, 1977). This negative relationship between stock returns and inflation is called as the *proxy hypothesis*. The proxy hypothesis refers to the fact that the negative relationship between stock returns and inflation is not direct; but rather inflation negatively impacts the real economic activity, which in turn directly impacts equity returns. In other words, real economic activity is the channel by which inflation influences stock returns in most countries. The investigation of the proxy hypothesis for emerging market economies may be especially crucial in light of high past inflation rates that most economies of that region have experienced (Adrangi *et al.*, 1999).

Exchange rate: The interaction between the exchange rate and stock prices is uncertain. When the Turkish Lira (TL) depreciates against the foreign currencies, Turkish products become cheaper in the external markets. As a result, if the demand for these goods is elastic, the volume of Turkish exports should increase, causing higher TL-denominated cash flows to Turkish companies. The opposite should hold when the TL appreciates against the foreign currencies. On the other hand, as an alternative investment instrument for Turkish investors, any depreciation in TL against foreign currencies may cause a withdrawal in stock markets.

Money supply: The effect of money supply on stock prices is an empirical question. Since the rate of inflation is positively related to money growth rates, an increase in the money supply may lead to an increase in the discount rate. The negative effects on stock prices, however, may be countered by the economic stimulus provided by money growth. Such stimulus, often referred to as a corporate earnings effect, would likely result in increased future cash flows and stock prices (Mukherjee and Naka, 1995).

Real economic activity: The level of real economic activity (proxied in this study by the Industrial Production Index), through its effect on expected future cash flows, will likely affect stock prices in the same direction. Fama (1981), Chen, Roll, and Ross (1986), and Geske and Roll (1983), among others, suggest a positive relation between stock returns and real activity.

Interest rate: Finally, changes in interest rate are expected to affect the discount rate in the same direction via their effect on the nominal risk-free rate. Therefore, we hypothesize a negative relation between these rates and stock prices.

Required data have been compiled from Central Bank of the Republic of Turkey on-line database (EDDS). The sample period consist of 132 monthly observations for each variable, from January 1998 to December 2008. All variables have been expressed in their logarithms. Prior to the analysis all variables have been seasonally adjusted through the ratio to moving average method.

3.2. Examination for Stationarity Properties of the Variables

As is well known, most of the macroeconomic variables have a nonstationary nature and hence a regression relation set on them will not be far away from spuriousness. So, to ensure that the variables are stationary, and that shocks are only has temporary impact and revert to their long-run mean level, it is a standard exercise to apply an unit root test procedure.

The Augmented Dickey – Fuller (ADF) and the Phillips – Perron (PP) test are employed to determine the presence of a unit root in the series. Results of ADF and PP unit root tests show all six of the variables are nonstationary in their levels but become stationary after one time differenced (Tab. 3).

Table 3. Results of ADF and PP unit root tests.

	ADF				PP	
	lags (<i>k</i>)	Type	$\alpha(\rho)$	P	$z(t_\alpha)$	p
<i>ISE</i>	1 c+t	int. + trend	- 2.2203	0.4741	- 1.7656	0.3961
<i>IPI</i>	2 c	int.	- 0.9906	0.7554	- 1.6948	0.4315
<i>INF</i>	1 c	int.	- 0.4348	0.8986	- 1.3362	0.8744
<i>INT</i>	3 c	int.	- 1.8554	0.3524	- 1.9825	0.2943
<i>MS</i>	2 c	int.	- 1.6777	0.7556	- 1.7119	0.7407
<i>RER</i>	1 c	int.	- 1.6128	0.4731	- 1.7382	0.4097
ΔISE	0 c	int.	- 8.2771	0.0000	- 8.3247	0.0000
ΔIPI	1 c	int.	- 12.1605	0.0000	- 19.4055	0.0000
ΔINF	0 c+t	int. + trend	- 6.6728	0.0000	- 67822	0.0000
ΔINT	2 c+t	int. + trend	- 6.1104	0.0000	- 13.4762	0.0000
ΔMS	1 c+t	int. + trend	- 11.2684	0.0000	- 15.2475	0.0000
ΔRER	1 c	int.	- 8.3180	0.0000	- 7.1460	0.0000

3.3. Research for Co-integrating Relationships

In this part of the paper, co-integration relationships among variables are investigated through Johansen VAR framework. Co-integration refers to the possibility that non-stationary variables may have a linear combination that is stationary. Such a linear combination, the co-integrating vector, implies that there is a long-run equilibrium relationship among variables, i.e., variables will not wander off apart from one another over extended periods of time. Therefore, co-integration between the stock index and the macroeconomic variables implies a long-run relationship between these variables. To analyze the long-term equilibrium relationships between stock market index and macroeconomic variables, co-integration analysis is more appropriately compared to the VAR model because the co-integration method can explore the dynamic co-movements among the variables (Mukherjee and Naka, 1995).

In order to use the Johansen test, a VAR representation of a set of n variables ($n \geq 2$) which are under consideration that are $I(1)$, needs to be turned into a vector error correction model (VECM) of the form,

$$\Delta y_t = \Pi y_{t-k} + \Gamma_1 \Delta y_{t-1} + \Gamma_2 \Delta y_{t-2} + \dots + \Gamma_{k-1} \Delta y_{t-(k-1)} + u_t$$

where $\Pi = \left(\sum_{i=1}^k \beta_i\right) - I_n$ and $\Gamma = \left(\sum_{j=1}^i \beta_j\right) - I_n$

This VAR contains n variables in first differenced form and $k - 1$ lags of the dependent variables (differences), each with a Γ coefficient matrix attached to it. The test procedure centers around the examination of Π matrix. Π can be interpreted as a long-run coefficient matrix, since in equilibrium, all the Δy_{t-i} will be zero, and setting the error terms (u_t) to their expected value of zero will leave $\Pi y_{t,k} = 0$.

The test for co-integration between the y s is calculated by looking at the rank of the Π matrix via its eigenvalues (denoted λ_i). The rank of a matrix is equal to the number of its characteristic roots (eigenvalues) that are different from zero.

There are two test statistics for co-integration under the Johansen approach, which formulated as

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^n \ln(1 - \hat{\lambda}_i) \quad \text{and} \quad \lambda_{max}(r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1})$$

where r is the number of co-integrating vectors under the null hypothesis and λ_i is the estimated value for the i th ordered eigenvalue from the Π matrix. λ_{trace} is a joint test where the null is that the number of cointegrating vectors is less than or equal to r against an unspecified or general alternative that are more than r . λ_{max} conducts separate tests on each eigenvalue, and has as its null hypothesis that the number of co-integrating vectors is r against an alternative of $r + 1$ (Brooks, 2008; 350,351).

The results of the tests which conducted based on both the λ_{trace} and λ_{max} are reported below. Examining the *trace test*, the test statistic exceeds the critical value (of 95) up to the second row which shows that there is at least two co-integration equations among the variables. The λ_{max} test, shown in the second panel, confirms that there are at least two co-integrating relationships. 128 observations are included after adjustments and quadratic deterministic trend is assumed in co-integration relations.

Table 4. Results of Johansen co-integration test.

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized	Trace	0.05		
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.
r = 0 *	0.862516	343.6881	83.93712	0.0000
r ≤ 1 *	0.332972	83.75142	60.06141	0.0002
r ≤ 2	0.134915	30.70646	40.17493	0.3186
r ≤ 3	0.049591	11.72096	24.27596	0.7281
r ≤ 4	0.034704	5.057933	12.32090	0.5595
r ≤ 5	0.003285	0.431005	4.129906	0.5749

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized	Max-Eigen	0.05		
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
r = 0 *	0.862516	259.9367	36.63019	0.0001
r ≤ 1 *	0.332972	53.04496	30.43961	0.0000
r ≤ 2	0.134915	18.98550	24.15921	0.2152
r ≤ 3	0.049591	6.663026	17.79730	0.8424
r ≤ 4	0.034704	4.626927	11.22480	0.5314
r ≤ 5	0.003285	0.431005	4.129906	0.5749

* denotes rejection of the hypothesis at the 0.05 level

Normalized co-integrating coefficients for the ISE index (*INDX*) are (standard errors in parentheses):

<i>ISE</i>	<i>INF</i>	<i>INT</i>	<i>IPI</i>	<i>MS</i>	<i>RER</i>
1.000	-3.604	2.638	-1.019	2.126	-5.436
	(1.176)	(0.345)	(1.732)	(0.981)	(1.507)

These values represent long-term elasticity at the same time, due to logarithmic transformation of the series. So, the long-run equilibrium relationship can be expressed as:

$$ISE_t = 3.604 INF_t - 2.638 INT_t + 1.019 IPI_t - 2.126 MS_t + 5.436 RER_t$$

t – statistic (3.065) (-7.646) (0.588) (-2.167) (3.607)

It appears from the results that all variables have a statistically meaningful impact on the stock index except the real economic activity (*IPI*). The empirical results suggest that the Turkish stock market prices do not rationally signal changes in the macroeconomic activity in terms of industrial production index. It also seems that inflation has a positive effect on stock prices. This result is not in line with the theoretical expectation and general finding of related literature and can be attributed to distinctive feature of the Turkish stock market which Ceylan and Başçı (2005) pointed out. The results show that interest rates (*INT*) have a negative relationship with stock prices. Money supply has also same effect on stock prices, indicating that any extending in money supply did not cause to an increase in stock prices through its demand enhancing effect. This result coincides with the finding of Akkum and Vuran (2003). The relationship between exchange rate and stock prices is expected to be positive in the literature. We have found evidences of this positive relationship, that is, real exchange rates affect the ISE index positively which means that a depreciation of the currency leads to higher real stock market returns.

4. Conclusion

Stock prices are generally believed to be determined by some fundamental macroeconomic factors. Several studies have attempted to investigate the interrelationship between economic factors and stock returns in different countries. Two methods which have been used for this purpose were capital asset pricing model and arbitrage pricing model. The development of co-integration analysis provided another tool as to examine the relationship between the macroeconomic variables and stock returns.

In this paper, we aim to shed some light on the relationship between a group of macroeconomic variables and stock market performance. To this end we have employed the index of Istanbul Stock Exchange (ISE) and macroeconomic aggregates such as CPI, interest rate, industrial production index, money supply, and real effective exchange rates. Using the Johansen VAR method, the empirical evidence we found shows that these macroeconomic variables are co-integrated i.e. there exist a long-run relationship between these variables. Further, the results reveal that all variables have a statistically meaningful impact on the stock index except the real economic activity (*IPD*). It seems that consumer prices (*INF*) has a positive effect on stock prices. The results show that interest rates (*INT*) have a negative relationship with stock prices. Money supply (*MS*) has also same effect on stock prices. Real exchange rates also affect the ISE index positively which means that a depreciation of the currency leads to higher real stock market returns.

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