IMPACT OF MACROECONOMIC VARIABLES ON STOCK RETURNS: A STUDY OF ISLAMABAD STOCK EXCHANGE

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Abstract

This study tries to explore short run association and long run relationships between ISE10 index and five macroeconomic variables i.e. Inflation, GDP, Exchange Rate, Money Supply, and Rate of Interest. In order to explore the long run and short run relationships Johansen cointegration technique and VECM was applied. The monthly data from July 2004 to June 2008 was used for analyzing ISE10 index. Three long run relationships were found between macroeconomic variables and stock prices. The results showed that ISE10 index was negatively related with Inflation, Exchange rate and Money Supply while positively related GDP and Rate of Interest bill rate in the long run. The VECM analysis and the results of vector error correction model (VECM) depicted that the adjustments in ISE10 were due to all three error correction terms i.e. ecm1, ecm2, and ecm3. The ISE10 index was relatively more exogenous in relation to other variables because 69 percent of its variance was explained by its own shock even after 24 months.

Key words: Stock prices, Cointegration, VECM, Macroeconomic variables, Variance decompositions.

Introduction

The managed and well structured stock markets encourage and mobilize the savings and activate the investment projects which lead to economic activities in a country. Islamabad Stock Exchange (ISE) became fully operational in August, 1992. It is one of the three exchanges of Pakistani stock market. ISE10 index of Islamabad stock exchange was introduced in July, 2004. There were 248 listed companies and the market capitalization was Rs.1943.65 billions on December 16, 2008. ISE10 index which reflects overall performance of listed companies started with 2716.0 points in July, 2007 and reached all time heights of 3334.38 points on April17, 2008 and declined to 2749.64 points (Annual Report, Islamabad stock exchange, 2008).

Mandelker and Tandon (1985), Groenewold et al. (1997), Chatrath et al. (1997), Alagidede (2008), Ratanapakorn and Sharma (2007), and Humpe and Macmillan (2009) investigated the relationship between inflation and stock returns.

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Mandelker and Tandon (1985) explored relationship between stock prices and anticipated inflation, and unanticipated inflation and discovered that relationship between stock prices and anticipated inflation was negatively related. Chatrath et al. (1997), found negative impact of inflation stock prices on Indian economy. Groenewold et al. (1997) explored association between stock returns and expected inflation in Australian economy which was found negative in previous studies. The results demonstrated an indirect relationship between inflation and stock prices. Alagidede (2008) investigated whether stock market provided hedge against inflation for South Africa, Nigeria, Egypt, Morocco, Tunisia, and Kenya because this issue got great consideration in the economics and finance. The author tested Fisher' Hypothesis[1] for these countries. In Kenya only, the Fisherian hypothesis was not rejected. Ratanapakorn and Sharma (2007) reported a positive impact of inflation on stock returns in US while Humpe and Macmillan (2009), explored negative relationship between stock prices and inflation.

Some studies explored impact of economic growth on stock prices and found that oscillation in stock prices usually imitate true economic activities (Fama, 1981; Nishat and Shaheen, 2004; Ratanapakorn and Sharma, 2007; Cook, 2007; Shabaz et al., 2008; Humpe and Macmillan, 2009 ;). Fama (1981) studied the connection between real output and stock returns and explored immense association between stock returns and gross national product, and stock returns and industrial production. Chen et al. (1986) found a powerful affiliation among the economic activity and the stock market.

Nishat and Shaheen (2004) found that there was a positive and strong impact of industrial production on stock prices in Pakistan. Granger causality test showed stock price affected industrial production. Ratanapakorn and Sharma (2007) investigated the connections between industrial production and US stock returns in the long run. The authors found that stock prices were perhaps influenced by change in output level via impact of output on profitability. Shabaz et al. (2008) analyzed

[1] *According to Fisher's Hypothesis, the market interest rate consists of anticipated real interest rate and anticipated inflation (Fisher, 1930). As nominal interest rate and inflation moved one-to-one, then, real rate of interest was not affected by a permanent change in inflation rate in long run. Thus, it was concluded that stock returns and rate of inflation moved in the same direction. Hence, real assets such as shares perhaps provide hedge against inflation.*

whether there existed a relationship economic growth between and development of stock market in case of developing economy such as Pakistan. Humpe and Macmillan (2009) explored long run association between industrial production and stock returns by using cointegration technique and found in US stock returns were positively affected by the industrial production.

Several economists documented the relation between foreign exchange rate on stock returns during the last two decades. Mixed results were found. Aggarwal (1981) found positive association between the exchange rate and US stock prices. Soenen and Hennigan (1988) found negative relationship between these two variables.

Mookerjee (1987) analyzed money supply and stock returns in United States, Japan, Canada, Germany, France, Italy, United Kingdom, the Netherlands, Belgium and Switzerland; and Jeng, et al. (1990) explored relationship between money supply and stock returns in United States, Belgium, France, Hungary, Japan, Poland, Sweden, Britain, Canada, Czechoslovakia, and. Nishat and Shaheen, (2004) found negative but insignificant association between money supply and stock returns and Ratanapakorn and Sharma, (2007) explored positive impact of money supply on stock prices in US. While; Humpe and Macmillan, (2009) found negative influence of money supply on NKY225 in Japan

Some studies reported positive impact of rate of interest on stock prices while; some studies explored negative relationship between these two variables e. g. Ratanapakorn and Sharma, (2007) reported positive relationship between S&P 500 and treasury bill rate in US and Humpe and Macmillan, (2009) found negative impact of treasury bill rate on SP55 in US.

The rest of the paper is as follows. In section 2 we provide source of data and methodology to explore long run and short run relations between stock prices and macroeconomic variables and section 3 gives empirical results. In the last, conclusion is explained in section 4.

Data and Methodology

Monthly time series data was examined in exploring the relationship between the macroeconomic variables such as consumer price index as a proxy for inflation, real effective exchange rate, three month bills rate as a proxy for rate of interest, industrial production index as a proxy for GDP growth rate, money supply (M_2), and ISE10 (Index relating to

Islamabad stock exchange). The main data sources were monthly bulletins of State Bank of Pakistan, Annual reports of Islamabad stock exchange, *The Business Recorder* (Pakistani financial newspaper), Publications of the Federal Bureau of Statistics, and International Financial Statistics (IFS). The study used the data from July, 2004 to June, 2008 to explore the influence of macroeconomic variables on ISE10 index. The description of variables used in this research study was given as under:

LISE10 = Log of ISE10
LCPI = Log of Consumer price index
LIP = Log of Index of industrial production
LREER = Log of Real effective exchange rate
LM_2 = Log of money supply (Broader money)
LTTBR = Log of three months treasury bills rate

Stationary Checks

Many of variables studied in macroeconomics, monetary economics and financial economics were non-stationary time series (Hill et al., 2001). If a time series was stationary, then shocks were considered transitory. On the other hand, mean or the variance or both the mean and the variance of a non-stationary time series depend on time. The variance depends on time and approach to infinity as time goes to infinity (Asteriou and Hall, 2006).

Augmented Dickey Fuller test (Dickey and Fuller, 1981), Phillips – Perron test (Phillips and Perron, 1988), and KPSS (Kwiatkowski, Phillips, Schmidt. and Shin, 1992) unit root tests were applied to test the stationarity of the above mentioned series.

Cointegration Test and Vector Error Correction Model

Cointegration test was used to identify equilibrium or a long-run association among the variables. If there was a long-run relationship between variables, then divergence from equilibrium path was bordered and the variables were co-integrated in the long-run. Johansen and Juselius (1990) procedure undertook the most of the problems of Engle and Granger approach. The Johansen and Juselius (1990) approach was based on maximum likelihood estimates and gives maximum Eigen Value and Trace Value test statistics to find the number of cointegrating relations. This procedure provides framework for cointegration test in the

context of vector autoregressive approach. Johansen method was explained as follows:

$$x_t = A_o + \sum_{j=1}^{k} A_j x_{t-j} + \varepsilon_t \quad \text{..... (1)}$$

Where; A_o is an $(n \times 1)$ vector of constants, x_t is an $(n \times 1)$ vector of non stationary I(1) variables, , k is the number of lags, A_j is a $(n \times n)$ matrix of coefficients and ε_t is $(n \times 1)$ vector of error terms. The above vector autoregressive process was reformulated and turned into a vector error correction model (VECM) in order to use Johansen and Juselius test as under:

$$\Delta x_t = A_o + \sum_{j=1}^{k-1} \Gamma_j \Delta x_{t-j} + \prod x_{t-k} + \varepsilon_t \quad \text{..... (2)}$$

Where:

$$\Gamma_j = -\sum_{i=j+1}^{k} A_j \quad \text{and} \quad \prod = -I + \sum_{i=j+1}^{k} A_j$$

"I" is an $(n \times n)$ identity matrix, and Δ is the difference operator. The Trace statistics and the Maximum Eigen Value test statistics was used to identify the characteristic roots that were insignificantly different from unity.

Variance Composition

The vector autoregressive (VAR) by Sims (1980) was estimated to find short run causality between macro economic variables and stock prices. To illustrate implication of relationships among macroeconomic variables and ISE10, variance decomposition was employed. In this study, Bayesian VAR model specified in first differences obtained in equation (3) and (4).

$$\Delta X_t = \alpha_1 + \sum_{i=1}^{k} \alpha_{11}(i) \Delta X_{t-i} + \sum_{j=1}^{k} \alpha_{12}(j) \Delta Y_{t-j} + \varepsilon_{xt} \quad \text{..... (3)}$$

$$\Delta Y_t = \alpha_2 + \sum_{i=1}^{k} \alpha_{21}(i) X_{t-i} + \sum_{j=1}^{k} \alpha_{22}(j) Y_{t-j} + \varepsilon_{\gamma t} \quad \text{..... (4)}$$

Where ε's are the stochastic error terms, called innovations or shock.

Model

To explore long run association between macroeconomic variables and ISE10 index, following econometric models was specified in the study.

$$LISE10 = \beta_1 LCPI + \beta_2 LIP + \beta_3 LREER + \beta_4 LM_2 + \beta_5 LTTBR + \varepsilon_t$$

To find both the short-run and long-run relations following models were estimated.

$$\Delta LISE10_t = \alpha_1 + \gamma_1 U_{t-1} + \sum_{i=1}^{P} \theta_{1i} \Delta LCPI_{t-1} + \sum_{i=1}^{P} \beta_{1i} \Delta LIP_{t-1} + \sum_{i=1}^{P} \mu_{1i} \Delta LREER_{t-1}$$
$$+ \sum_{i=1}^{P} \eta_{1i} \Delta LM2_{t-1} + \sum_{i=1}^{P} \lambda_{1i} \Delta LTTBR_{t-1} + \varepsilon_t \quad \text{..... (5)}$$

Empirical Results

Stationarity Test

The study applied three different tests for checking the stationarity of the time series. All three tests were unanimously in the results and indicated that all the series were found non-stationary at level. But, at the first difference time series were found stationary as was shown in Table-1.

Table-1: Unit Root Analysis

Variables	ADF Test Statistic		PP Test Statistic		KPSS Test Statistic	
	Null Hypothesis: Time Series is Non-stationary		Null Hypothesis: Time Series is Non-stationary		Null Hypothesis: Time Series is Stationary	
	Level	First Difference	Level	First Difference	Level	First Difference
LISE 10	-2.43	-5-93*	-2.40	-6.80*	0.63	0.18*
LCPI	2.99	-1.08	2.44	-5.05*	0.90	0.41**
LIPI	-2.51	-5.54*	-2.53	-8.14*	0.76	0.11*
LREER	-1.76	-6.81*	-1.73	-6.81*	0.35	0.14*
LM2	-0.14	-2.68**	-0.13	-10.08*	0.91	0.02*
LTTBR	-2.47	-3.81*	-6.24	-3.66*	0.67	0.53
Test Critical Values (MacKinnon, 1996)						
5% Level	-2.925169		-2.925169		0.463000	
10% Level	-2.600658		-2.600658		0.347000	

** implies that the coefficient is significant at 0.05 percent probability level and*
*** implies significant at 0.10 percent probability level*

Cointegration Analysis

In this study, to find the long run association between the ISE10 and macroeconomic variables Johanson and Juselius (1988) cointegration technique was applied after confirming the stationarity of the series.

The results of stationarity analysis shown in the Table-1 illustrated that all the variables involved in the study were integrated of order one. Hence, the Johansen and Juselius (1990) cointegration technique was used to explore the long run relationship between the macroeconomic variables i.e. LCPI, LIP, LREER, LM_2, and LTTBR and ISE10 index. In the first step, appropriate lag length was determined by using Schwarz Bayesian Criteria (SBC) which showed that the appropriate lag length

was equal to one. In order to investigate the number of long run relations between the macroeconomic variables and ISE10 index, both Trace statistic and Maximal Eigen statistic were used. Using Pantula principle, the model with 'Unrestricted intercept and no trend' was selected. The results for both Trace statistic and Maximal Eigen statistic were shown in Table-2 and Table-3, respectively.

Table-2: Unrestricted Cointegration Rank Test (Trace)

Hypothesized		Trace Statistics	0.05 Critical Value	Probability **
No. of CE(s)	Eigen Value			
None *	0.792	187.139	95.754	0.000
At most 1 *	0.682	118.128	69.819	0.000
At most 2 *	0.567	67.721	47.856	0.000
At most 3	0.369	28.908	29.797	0.037
At most 4	0.181	10.628	15.495	0.235
At most 5	0.041	1.844	3.841	0.175
Trace test indicates 3 cointegrating equation(s) at the 0.05 percent probability level				

** denotes rejection of the hypothesis at the 0.05 percent probability level*
*** MacKinnon-Haug-Michelis (1999) p-values*

Table-3: Unrestricted Cointegration Rank Test (Maximum Eigen Value)

Hypothesized		Max-Eigen Statistics	0.05 Critical Value	Probability **
No. of CE(s)	Eigen Value			
None *	0.792	69.010	40.078	0.000
At most 1 *	0.682	50.408	33.877	0.000
At most 2 *	0.567	36.813	27.584	0.003
At most 3	0.369	20.279	21.132	0.066
At most 4	0.181	8.784	14.265	0.305
At most 5	0.041	1.844	3.841	0.175
Max-eigen value test indicates 3 cointegrating equation(s) at the 0.05 percent probability level				

** denotes rejection of the hypothesis at the 0.05 percent probability level*
*** MacKinnon-Haug-Michelis (1999) p-values*

Both tests i.e. the Trace statistic and the Maximal Eigen statistics recognized three cointegrating vectors, therefore, the study used three cointegrating vectors in order to explore the long-run association among the variables.

Long Run Relationship

After normalization the first cointegrating vector on LISE10, normalized cointegrating coefficients were estimated as reported in Table-4.

Table-4: Normalized Cointegrating Coefficients

LISE10	LCPI	LIP	LREER	LM2	LTTBR
1	4.999	-5.152	17.543	1.277	-2.562
S E	-6.548	-0.967	-3.789	-3.409	-0.616
t-value	-0.763	5.328	-4.630	-0.375	4.160

The first normalized equation was estimated as below:

$$LISE25 = -4.999LCPI + 5.152LIP - 17.543LREER - 1.277\ LM_2 + 2.562LTTBR \quad ...(6)$$

According to the first normalized equation 6, stock prices (LISE10) showed insignificantly negative relationship with consumer price index (LCPI). The negative relationship between stock returns and consumer price index was steady with the results of Humpe and Macmillan (2009) for US data. However, findings were at variance Abdullah and Hayworth (1993) and Ratanapakorn and Sharma (2007). Normalized equation depicted that there was a significant positive association between stock prices and industrial production (LIP). The similar results were reported by many researchers (*Fama*, 1981; Chen et al., 1986; Abdullah and Hayworth, 1993; Eva and Stenius, 1997; Ibrahim and Yusoff, 2001; Nishat and Shaheen, 2004; Ratanapakorn and Sharma, 2007; Cook, 2007; Shabaz et al., 2008; Humpe and Macmillan, 2009). The LISE10 index was influenced by real effective exchange rate (LREER) negatively. This implied that along with the increase in exchange rate or depreciation in domestic money, there was a negative effect on production due to increase prices of imported raw material ultimately returns of the firms decreases and stock prices were depressed. Similar finding were reported by Soenen and Hennigan (1988). The relationship between stock returns and money supply was found negative but insignificant. The negative link between the two variables was consistent with the study of Humpe and Macmillan (2009) for Japan. The study found that stock prices and three month treasury bills (LTTBR) had a positive but insignificant relation with LISE10 in the long run. The result was consistent with the study of Ratanapakorn and Sharma, (2007) for US three months treasury bills rate but contrary to the study of Humpe and Macmillan (2009) for US who found negative relationship between US stock market (S&P500) and treasury bills rate.

Vector Error Correction Model

Error correction mechanism was applied to capture the short run dynamics of the model. The results of vector error correction model were reported in Table-5.

Table-5: Vector Error Correction Estimates

Variables	D(LISE10)	D(LCPI)	D(LIP)	D(LREER)	D(LM2)	D(LTTBR)
Vecm1(-1)	-0.642 (-4.45)	0.027 (0.075)	-0.042 (-0.34)	0.012 (0.43)	0.037 (1.11)	0.154 (2.20)
CointEq2	-1.595 (-3.70)	0.105 (2.65)	-0.392 (-1.07)	0.124 (1.97)	0.136 (1.37)	0.901 (4.32)
CointEq3	0.194 (3.10)	0.003 (0.60)	-0.086 (-1.61)	0.030 (3.23)	0.001 (0.045)	0.007 (0.23)
D(LISE10(-1))	0.243 (1.48)	0.011 (0.76)	0.287 (2.06)	-0.038 (-1.59)	-0.064 (-1.69)	-0.252 (-3.18)
D(LCPI(-1))	2.369 (1.096)	0.067 (0.34)	2.349 (1.27)	-0.972 (-3.07)	-0.402 (-0.81)	-1.235 (-1.18)
D(LIP(-1))	0.179 (0.85)	-0.013 (-0.66)	-0.116 (-0.65)	-0.047 (-1.51)	0.066 (1.36)	-0.023 (-0.22)
D(LREER(-1))	0.715 (0.60)	-0.084 (-0.78)	-1.117 (-1.11)	0.246 (1.428)	-0.024 (-0.08)	1.129 (1.98)
D(LM2(-1))	-0.304 (-0.45)	0.096 (1.55)	0.147 (0.25)	-0.007 (-0.07)	-0.464 (-2.99)	-0.116 (-0.35)
D(LTTBR(-1))	-0.105 (-0.39)	-0.014 (-0.55)	0.209 (0.92)	-0.054 (-1.37)	0.010 (0.17)	-0.101 (-0.78)
C	-0.004 (-0.15)	0.007 (2.81)	-0.022 (-0.94)	0.011 (2.73)	0.023 (3.54)	0.054 (4.05)
R-squared	0.42	0.42	0.23	0.36	0.32	0.74
F-statistic	3.02	2.92	1.21	2.26	1.89	11.52

( ) shows 't' values of "t" statistics
** show the coefficient significant at 0.01 percent probability level*
*** show the coefficient significant at 0.05 percent probability level*
**** show the coefficient significant at 0.10 percent probability level*

The coefficients of ecm1 (-1), ecm2 (-1), and ecm3 (-1) showed the correction speed of the ISE 10 to the long run equilibrium position in a period. As all three error correction terms were significant, hence the outcomes of vector error correction model (VECM) depicted that the adjustments in LISE10 were due to all three error correction terms i.e. ecm1, ecm2, and ecm3.

$$DLISE10 = -0.004 + 0.243DLISE10\ (-1) + 2.369DLCPI\ (-1) + 0.1797DLIP\ (-1) + 0.715DLREER\ (-1) - 0.304DLM_2\ (-1) - 0.105DLTTBR\ (-1) - 0.642\ Vecm1\ (-1) - 1.595\ Vecm2\ (-1) + 0.194Vecm3\ (-1) \quad \ldots \quad (7)$$

Variance Decompositions

In order to examine the proportion of forecasting error variance in 24-months, the vector autoregressive (VAR) was estimated. The Variance decomposition confirms the relationships of the variables under study and degree of exogeneity among the variables. Table 3.6 showed that the LISE10 index was relatively more exogenous in relation to other variables i.e. LCPI, LREER, LM2, and LTTBR because 69 percent of its variance was explained by its own shock even after 24 months. LCPI explained 10.34 percent impact on stock prices. Innovations in other macroeconomic variables i.e. LIP, LEER LM_2, and LTTBR explained forecast variance 6.66 percent, 1.31 percent, 4.17 percent, and 8.44 percent respectively for LISE10. The value of variance forecast error explicated by all macroeconomic variables increased along with the passage of time. The degree of exogeneity of LCPI was greater than other variables including LISE10.

Table-6: Variance Decompositions

VDC of	Months	S.E.	LISE25	LCPI	LIP	LREER	LM2	LTTBR
LISE25	1	0.08	100.00	0.00	0.00	0.00	0.00	0.00
	12	0.10	70.05	10.46	6.65	0.87	4.06	7.91
	24	0.10	69.08	10.34	6.66	1.31	4.17	8.44
LCPI	1	0.01	2.80	97.20	0.00	0.00	0.00	0.00
	12	0.03	9.44	34.68	19.15	27.71	5.12	3.89
	24	0.07	8.70	26.07	22.61	26.48	9.12	7.02
LIP	1	0.06	0.00	6.85	93.15	0.00	0.00	0.00
	12	0.08	1.94	9.08	85.33	0.18	2.95	0.52
	24	0.08	2.49	10.15	80.74	2.64	3.24	0.73
LREER	1	0.01	0.14	3.35	11.87	84.64	0.00	0.00
	12	0.02	0.23	2.61	13.04	72.97	1.32	9.83
	24	0.02	0.84	4.56	13.46	65.89	3.57	11.68
LM2	1	0.02	2.21	8.03	2.81	6.64	80.31	0.00
	12	0.05	6.60	20.69	19.81	17.19	34.19	1.52
	24	0.10	8.16	22.73	23.12	24.81	15.56	5.63
LTTBR	1	0.05	5.31	0.00	11.03	0.64	0.44	82.57
	12	0.11	3.84	5.65	7.23	23.08	7.46	52.74
	24	0.13	5.44	10.67	13.01	28.12	6.75	36.00
Cholesky Ordering: LISE10 LCPI LIP LREER LM_2 LTTBR								

Conclusion

This study investigated long run and short run relations between ISE10 Index and five macroeconomic variables in Islamabad Stock Exchange, Pakistan. All the time series used in this analysis was found

stationary at first difference but non stationary at levels. Three long run association was found between macroeconomic variables and ISE10 index. In the long run, Industrial production index, and three month treasury bill rate affected stock returns positively. While, inflation, real affective exchange rate, money supply showed negative impact on stock returns in the long run.

As all three error correction terms were significant, hence the outcome of vector error correction model (VECM) depicted that the adjustments in LISE10 were due to all three error correction terms i.e. ecm1, ecm2, and ecm3. The results of Variance Decomposition revealed that ISE10 index explained nearly 69 percent of its own forecast error variance while CPI, IP, REER, M2, and TTBR explained 10.34 percent, 6.66 percent, 1.31 percent, 4.17 percent, and 8.44 percent respectively for LISE10.

The study proposed that appropriate monetary measures should be adopted by monetary managers to control inflation so that the volatility of the stock markets can be minimized. Increase in Industrial production can play significant positive role in development of the capital markets of Pakistan. Thus, it was recommended that authorities should formulate such a policy which supports stock prices through the promotion of industrial production. The long run positive impact of exchange rate on ISE10 index suggested that for the development of stock market in Pakistan, exchange rate should be managed carefully keeping in view the elasticities of exports and imports which will lead to stability in stock market.

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