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The Macroeconomic Variables and Stock Returns in Pakistan: The Case of KSE 100 Index

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Abstract

The stock market is a barometer of a country's economy. The stock market of Pakistan was initiated in the year 1947 at Karachi and KSE100 index was introduced in 1991. The intent of this study was to explore long run, and short run dynamics relationships between KSE100 index and five macroeconomic variables. In order to investigate the long run and short run relationships. Johansen cointegration technique and VECM was applied. The study used monthly data for analyzing KSE100 index. The results revealed that in the long run, there was a positive impact of inflation, GDP growth, and exchange rate on KSE100 index, , while money supply and three months treasury bills rate had negative impact on the stock returns. The VECM demonstrated that it takes more than four months for the adjustment of disequilibrium of the previous period. The results of variance decompositions exposed that among the macroeconomic variables inflation explained more variance of forecast error.

Keywords: Stock returns, Cointegration, Macroeconomic variables, Variance decompositions , VECM

1. Introduction

The stock market is a mirror of an economy. The Karachi stock exchange (KSE) was established in 1947. The KSE100 Index was introduced in November, 1991. The KSE100 Index consists of 100 companies. These companies are selected on the basis of market capitalization and sector representation. These companies encompass nearly 80 percent of the total market capitalization at Karachi Stock Exchange. The Karachi stock market remained very impulsive for the last sixty months. In this period, three financial disasters were observed. First, KSE100 index dropped nearly fourteen hundred points in the first quarter of the year 2005. Secondly, stock market was crashed in June 2006 when KSE100 index loosed fifteen hundred points. In the last nine months of the year 2008, highly intensive crash was observed. In this period, KSE100 index lost ten thousand points. The Board of Directors of Karachi stock exchange decided to place a floor in August 2008 which was removed in December, 2008. The major source of this volatility was political uncertainty and instability for this disaster in the stock market. Hold of speculators and bad governance in the stock market played vital role in first two crises. Hence, it was necessary to determine the economic factors by studying the behavior of stock market to plan a strategy that could protect the investors of stock markets

Varying evidences of relationship between macroeconomic variables and stock returns widely documented in the existing literature. Several studies explored the predictability of many macroeconomic variables such as exchange rate, inflation, foreign direct investment, real output, money supply, foreign reserves, prices of real estate, terms of trade, and value of trade balance on stock prices. Due to variations in results, it was found difficult to determine which specific macroeconomic variable could be consistent indicator of stock returns.

In the past, several studies were conducted using different macroeconomic variables. The studies inter alia included Bhattacharya and Mukherjee (2003), Smyth and Nandha (2003), Aquino (2004), Homma et al. (2005), Aquino (2005), Hartmann and Pierdzioch (2007), Dogan and Yalcin (2007), Ratanapakorn and Sharma (2007), Cook (2007), Shabaz et al. (2008), Alagidede (2008), and Humpe and Macmillan (2009). All the studies found contrasting results about macroeconomic indicators. Very few studies such as Farooq and Keung (2004), Nishat and Shaheen (2004) were conducted in Pakistan. It is therefore, seemed important to under take such a study keeping in view of the volatility of KSE. The intent of the paper was to explore long run and short run relationships between macroeconomic variables and stock prices in Karachi Stock Exchange.

The rest of the paper is planned as follows. Section 2 demonstrates data and methodology to explorer the long run and short run relationships between macroeconomic variables and stock returns. The empirical results are discussed in section 3, and conclusion is explained in section 4.

2. Data and Methodology

Monthly data was used to discover the association between the macroeconomic variables and KSE100. The macroeconomic variables i.e. money supply (M_2), consumer price index, three-month bills rate, industrial production index, and real effective exchange rate were used in this study. The data was obtained from Annual Reports of Karachi stock exchange, monthly bulletins of State Bank of Pakistan, International Financial Statistics (IFS) and Publications of the Federal Bureau of Statistics, Islamabad. The data about the real effective exchange rate, consumer price index, and three months treasury bills rate were retrieved from IFS CD-Rom. The study used the data from November 1991 to June 2008 to discover the relationship between macroeconomic variables and KSE100 index. In this study, all variables are used in log form and the portrayals of variables were as under:

KSE100 = KSE100 index
CPI = Consumer price index
IP = Industrial production
REER =Real effective exchange rate
M_2= Money supply (Broader money)
TTBR = Three months treasury bills rate

2.1. Stationary Tests

In macroeconomics, financial economics, and monetary economics, most of the variables are non-stationary (Hill et al., 2001). If a time series is non-stationary, then mean or the variance or both depend on time. If variance depends on time, then it approaches to infinity as time approaches to infinity (Asteriou and Hall, 2006).

Following three tests were applied to test the stationarity of the above quoted series.

2.1.1. Augmented Dickey Fuller Test

The Augmented Dickey Fuller test was commonly used because extra lagged terms of the dependent variable can be included in order to eliminate autocorrelation. On the basis of Akaike Information Criteria (AIC) or Schwartz Bayesian Criteria (SBC) decision was made that how many extra lagged dependent variables were included to capture autocorrelation. In order to test for unit root through Augmented Dickey Fuller test (ADF), the following equation was used to determine the unit root.

$$\Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + u_t \quad (1)$$

2.1.2. Phillips – Perron Test

In Phillips and Perron test (1988), a nonparametric method was used to control the higher-order serial correlation between the error terms avoiding the addition lagged difference terms. Phillips-Perron test is free from parametric errors and it allows the disturbances to be weakly dependent and heterogeneously distributed. Therefore, Phillips – Perron (PP) test (Phillips and Perron 1988) was also applied to check the stationarity. The test regression for the Phillips- Perron test was as under:

$$\Delta y_{t-1} = \alpha_0 + \gamma y_{t-1} + e_t \quad (2)$$

2.1.3. KPSS Test (Kwiatkowski, Phillips, Schmidt. and Shin, 1992)

In order to investigate the integration properties of a series, KPSS test the null hypothesis was stationary against the alternative hypothesis that data generating process (DGP) was non-stationary. If it was assumed that there is no linear trend term, the point of departure was a data generating process of the form

$$y_{t-1} = X_t + Z_t \quad (3)$$

Where; X_t is a random walk, $X_t = X_{t-1}+U_t$, U_t~ iid $(0,\sigma_u^2)$ and Z_t is a stationary process. H_0: $\sigma_u^2 = 0$ against H_1: $\sigma_u^2 > 1$. If H_0 holds, Y_t composed of constant and Z_t stationary process (Lütkepohl and Krätzig, 2004),.

2.2. Cointegration Test and Vector Error Correction Model

To explore long-run relationship between the macroeconomic variables and KSE100 Index, Johansen and Juselius (1990) cointegration techniques were used. This technique resolved the most of the problems attached with Engle and Granger technique. This technique gives maximum Eigen Value and Trace Value test statistics for determining number of cointegrating vectors. Johansen method was clarified as below:

$$x_t = A_o + \sum_{j=1}^{k} A_j x_{t-j} + \varepsilon_t \quad (4)$$

This equation was redesigned to get a vector error correction model (VECM) as under:

$$\Delta x_t = A_o + \sum_{j=1}^{k-1} \Gamma_j \Delta x_{t-j} + \Pi x_{t-k} + \varepsilon_t \quad (5)$$

Where;

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

The Trace and the Maximum Eigen Value test was used to find the number of cointegrating vectors

2.3. Variance Decomposition

To explore short run causality between macroeconomic variables and KSE100 Index, the vector autoregressive (VAR) by Sims (1980) was calculated. To explain the relationships between macroeconomic variables and KSE100 Index, variance decomposition technique was used. In this study, Bayesian VAR model specified in first differences obtained in equation (6) and (7).

$$\Delta X_t = \alpha_1 + \sum_{i=1}^{k} \alpha_{11}(i) \Delta X_{t-i} + \sum_{j=1}^{k} \alpha_{12}(j) \Delta Y_{t-j} + \varepsilon_{xt} \quad (6)$$

$$\Delta Y_t = \alpha_2 + \sum_{i=1}^{k} \alpha_{21}(i) X_{t-i} + \sum_{j=1}^{k} \alpha_{22}(j) Y_{t-j} + \varepsilon_{yt} \quad (7)$$

2.4. Model

To explore long run relationship between macro economic variables and KSE100 index, following econometric models was specified in the study.

$KSE100 = \beta_1 CPI + \beta_2 IP + \beta_3 REER + \beta_4 M_2 + \beta_5 TTBR + \varepsilon_t$

Following model was estimated to explore short-run dynamics between the variables and their long-run equilibrium relations.

$$\Delta KSE100_t = \alpha_1 + \gamma_1 U_{t-1} + \sum_{i=1}^{P} \theta_{1i} \Delta CPI_{t-1} + \sum_{i=1}^{P} \beta_{1i} \Delta IP_{t-1} + \sum_{i=1}^{P} \mu \Delta REER_{t-1} + \sum_{i=1}^{P} \eta_{1i} \Delta M2_{t-1} + \sum_{i=1}^{P} \lambda_i \Delta TTBR_{t-1} + \varepsilon_t \quad (8)$$

3. Empirical Results

3.1. Stationarity Test

In the time series analysis, it was mandatory to test the time series whether it was stationary or non-stationary. The study applied three different tests for checking the stationarity of the data. All three tests were unanimous in the results and indicated that all the series were found stationary at first difference as shown in Table 1.

Table 1: Unit Root Analysis

Variables	Augmented Dickey-Fuller test statistic		Phillips-Perron Test Statistics		Kwiatkowski-Phillips-Schmidt-Shin test statistic	
	Null Hypothesis: Variable is Non-stationary		Null Hypothesis: Variable		Null Hypothesis: Variable	
	Level	First Difference	Level	First Difference	Level	First Difference
KSE100	-0.187	-14.509*	-0.175	-14.509*	1.268	0.178*
CPI	-0.148	-4.273*	-0.695	-11.291*	1.702	0.368*
IPI	2.106	-13.446*	-2.285	-21.744*	1.755	0.266*
REER	-1.904	-11.346*	-1.383	-11.233*	1.498	0.065*
M2	0.295	-3.107*	-0.734	-15.749*	1.749	0.190*
TTBR	- 2.172	-5.249*	-1.609	-10.276*	0.707	0.112*
	Test critical values (MacKinnon, 1996)					
5% Level	- 2.875		- 2.875		0.463	
10% Level	-2.574		-2.574		0.347	

3.2. Cointegration Analysis

The results of stationarity tests were exposed in the Table 1. The results depicted that the variables involved in the study were integrated of order one i.e. I(1), therefore the Johansen and Juselius (1990) technique was applied to examine the long-run associations between macroeconomic variables and KSE100 Index. In multivariate cointegration analysis using JJ technique, the first step was the appropriate lag selection for the variables. One lag length was selected equal in this study on the basis of Schwarz Bayesian Criteria (SBC) and following the study of Harris and Sollis (2003). The variables involved in the cointegration analysis were; KSE100, CPI, P, REER, M_2, and TTBR. To explore the number of cointegrating vectors Maximal Eigenvalue and Trace statistics were used. In multivariate cointegration analysis, five different models were available. These models were based upon different specifications of intercept and trend term. Using Pantula principle, the model with ‘Unrestricted intercept and no trend’ was selected. The results of Maximmum Eigenvalue and Trace statistics were shown in Table 2 and Table 3 respectively.

Table 2: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.412	**103.591**	40.078	0.000
At most 1	0.132	27.550	33.877	0.235
At most 2	0.109	22.441	27.584	0.199
At most 3	0.070	14.104	21.132	0.357
At most 4	0.055	10.946	14.265	0.157
At most 5	0.009	1.818	3.841	0.178

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 percent probability level
* denotes rejection of the hypothesis at the 0.05 percent probability level

Table 3: Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.412	180.450	95.754	0.000
At most 1 *	0.132	76.859	69.819	0.012
At most 2 *	0.109	49.309	47.856	0.036
At most 3	0.070	26.868	29.797	0.105
At most 4	0.055	12.764	15.495	0.124
At most 5	0.009	1.818	3.841	0.178

Trace test indicates 3 cointegrating eqn(s) at the 0.05 percent probability level
* denotes rejection of the hypothesis at the 0.05 percent probability level

The Trace statistic recognized three cointegrating vectors, while the Maximal Eigen statistic identified only one cointegrating vector. Because the Trace statistic was more robust than the Maximal Eigen statistics (Cheung and Lai, 1993), therefore, the study used three cointegrating vectors in order to establish the long-run relationships among the variables.

3.4. Long Run Relationships

After normalization the first cointegrating vector on KSE100, normalized cointegrating coefficients were estimated as reported in Table 4.

Table 4: Normalized cointegrating coefficients

KSE100	**CPI**	**IP**	**REER**	**M2**	**TTBR**
1	-35.567	-25.051	-10.959	26.369	2.330
S.E.	-6.140	-2.284	-5.463	-3.613	-0.511
t-value	5.793	10.966	2.006	-7.298	-4.555

The first normalized equation was estimated as below:

$$KSE100 = 35.567CPI + 25.051IP + 10.959REER - 26.369M_2 - 2.33TTBR. \quad (9)$$

The first normalized equation, depicted that in the long run, consumer price index had an positive impact on KSE100 Index which implied that equities were hedged against inflation. The positive relation between consumer price index and stock prices was consistent with the study of Abdullah and Hayworth (1993), Ratanapakorn and Sharma (2007), and Sohail and Hussain (2010). The market rate of interest included expected inflation Fisher (1930). As the rate of inflation rises, the nominal rate of interest also goes up. Consequently, real rate of interest remained the same in the long run. Thus, it was concluded that there was a positive one-to-one relationship between rate of inflation and stock prices. Thus, equities provided hedge against inflation rate. Industrial production showed positive impact on KSE100 Index as reported in many studies (see *inter alia* Fama, 1981; Abdullah and Hayworth, 1993; Eva and Stenius, 1997; Ibrahim and Yusoff, 2001; Nishat and Shaheen, 2004; Cook, 2007; Ratanapakorn and Sharma, 2007; Liu and Sinclair, 2008; Shabaz et al., 2008; Humpe and Macmillan, 2009; Sohail and Hussain, 2010). Stock prices were also positively affected by real effective exchange rate. It interpreted that with the depreciation in domestic currency due to increase in exchange rate , exports become cheaper which resulted in increase in exports and stock prices of exporting firms. The same results were reported by Aggarwal (1981), Ratanapakorn and Sharma (2007), Sohail and Hussain (2009) and Sohail and Hussain, (2010) but Soenen and Hennigan (1988) reported negative correlation between the exchange rate and stock prices. The impact of money supply on KSE100 Index was found significantly negative. The same results were shown in the study of Humpe and Macmillan (2009) for Japan. The negative relation between stock prices and money supply was perhaps due to Keynesian liquidity trap experienced by Pakistani economy in the last nine years. The study established that there was a significant negative long run relationship between three month treasury bills and the stock prices. This finding was consistent with the previous studies (see Nishat and Shaheen, 2004; Humpe and Macmillan, (2009) but it was in contrast with the results of Ratanapakorn and Sharma, (2007) and Sohail and Hussain, (2009).

3.4. Vector Error Correction Model

In order to find the short run relationships among the variables, vector error correction mechanism was applied. The results of VECM were shown in Table 5.The coefficients of ecm1 (-1), ecm2 (-1) and ecm3 (-1) disclosed the adjustment speed and disequilibrium of the previous period. The adjustments in KSE100 Index were only due to the second error correction term (ecm2). Equation 10 showed that the coefficient of ecm2 (-1) was significant which implied that KSE100 adjusted by 23.2 percent in one month to the long run equilibrium. The results showed that it took more than four months (1/0.232= 4.31) to eliminate the disequilibrium.

DKSE100=O.008 -0.018 KSE100 (-1) +0.208DCPI (-1) +0.18DIP (-1) +0.115DREER (-1) + 0.042DM2 (-1) – 0.124DTTBR (-1) – 0.034 Vecm1 (-1) – 0.232 Vecm2 (-1) – 0.018Vecm3 (-1) (10)

Table 5: Results of Vector Error Correction Model

Variables	D(KSE100)	D(CPI)	D(IP)	D(REER)	D(M2)	D(TTBR)
Vecm1(-1)	-0.034 (-1.26)	0.006* (3.74)	0.039 (1.37)	0.016* (3.46)	0.020* (4.06)	0.037*** (1.72)
Vecm2(-1)	-0.232*** (-1.78)	0.029* (3.44)	-0.476* (-3.47)	0.050** (2.23)	0.065** (2.75)	0.187*** (1.79)
Vecm3(-1)	-0.001 (0.02)	-0.001 (-0.37)	-0.404* (-6.84)	0.011 (1.11)	-0.010 (-0.94)	0.002 (0.03)
D(KSE100(-1))	-0.018 (-0.24)	-0.001 (-0.31)	0.093 (1.18)	-0.026** (-2.1)	-0.015 (-1.09)	-0.042 (-0.7)
D(CPI(-1))	0.208 (0.16)	0.123 (1.57)	-0.502 (-0.38)	-0.240 (-1.15)	-0.233 (-1.04)	1.418 (1.43)
D(IP(-1))	0.180** (2.63)	-0.001 (-0.15)	0.148** (2.06)	0.008 (0.71)	0.030** (2.37)	-0.002 (-0.04)
D(REER(-1))	0.115 (0.28)	-0.056** (-2.15)	0.252 0.58)	0.272* (3.9)	0.094 (1.25)	-0.272 (-0.82)
D(M2(-1))	0.042 (0.11)	0.012 (0.47)	0.670*** (1.65)	0.039 (0.58)	-0.171** (-2.38)	-0.032 (-0.14)
D(TTBR(-1))	-0.124 (-1.43)	0.008 (1.49)	-0.034 (-0.37)	-0.011 (-0.73)	-0.009 (-0.57)	0.313* (4.52)
C	0.008 (0.66)	0.006* (7.08)	-0.003 (-0.24)	0.001 (0.38)	0.016* (7.18)	-0.008 (-0.84)
R-squared F-statistic	0.10 2.31	0.18 4.66	0.23 6.19	0.20 5.45	0.13 2.89	0.17 4.57

significance level at 5%l, *** shows the coefficient significant significance level at 10%

3.5. Variance Decompositions

In order to calculate the degree of exogeneity among the variables, variance decomposition additionally provided evidence of the relationships between the variables under examination. It demonstrated the proportion of the forecast error of one variable due to the other variables. Therefore, it determines the relative importance of each variable in creating variations in the other variables (Ratanapakorn and Sharma, 2007). Table 6 showed that the KSE100 index was relatively more endogenous in relation to other variables because almost 39 percent of its variance was explained by its own shock after 24 months. Among the macroeconomic variable CPI explained 46 percent impact on stock prices. Movements in other macroeconomic variables i.e. IP, REER M2, and TTBR explained forecast variance of KSE100 0.54 percent, 5.14 percent, 7.33 percent, and 2.18 percent respectively. The value of variance forecast error explained by all macroeconomic variables increased with the passage of time except IP.

Table 6: Variance Decompositions

VDC of	Months	S.E.	KSE100	CPI	IP	REER	M2	TTBR
KSE100	1	0.10	100.00	0.00	0.00	0.00	0.00	0.00
	6	0.20	89.39	7.36	1.09	1.15	0.36	0.65
	24	0.39	38.81	46.00	0.54	5.14	7.33	2.18
CPI	1	0.01	1.77	98.23	0.00	0.00	0.00	0.00
	6	0.02	0.40	96.06	0.02	2.38	0.04	1.10
	24	0.04	12.29	81.31	0.27	1.94	1.43	2.75
IP	1	0.09	0.67	2.90	96.43	0.00	0.00	0.00
	6	0.13	1.42	13.44	78.86	1.03	3.56	1.70
	24	0.17	2.85	15.45	70.61	2.89	4.90	3.29
REER	1	0.02	0.87	2.80	0.04	96.30	0.00	0.00
	6	0.03	6.57	1.58	1.27	89.67	0.69	0.22
	24	0.04	17.83	2.75	1.78	61.48	2.10	14.06
M2	1	0.02	0.00	5.63	4.31	0.52	89.54	0.00
	6	0.03	4.41	6.65	5.58	2.11	80.25	1.00
	24	0.06	18.94	12.35	1.79	9.81	50.04	7.07
TTBR	1	0.08	3.62	0.00	0.12	0.25	0.00	96.01
	6	0.26	2.52	8.13	0.09	0.06	0.29	88.92
	24	0.50	7.61	22.88	0.07	1.42	1.32	66.70

Cholesky Ordering: KSE100, CPI, IP, REER, M2, TTBR

4. Conclusion

This study explored the impact of macroeconomic variables on KSE100 index .All the series used in this analysis were found stationary at first difference but non-stationary at levels. Three long run relationships were found between macroeconomic variables and KSE100 index. In the long run, inflation, Industrial production index, and real affective exchange rate affected stock returns positively. While, Money supply and three month treasury bill rate showed negative impact on stock returns in the long run.

The VECM analysis depicted that it took more than four months for the adjustment of disequilibrium of the previous period. The results of Variance Decomposition revealed that KSE100 index explained nearly 39 percent of its own forecast error variance while CPI, IP, REER, M2, and TTBR explained 46 percent, 0.54 percent, 5.41 percent, 7.33 percent, and 2.18 percent variance in KSE100 index respectively. Among the macroeconomic variables, inflation was showing the maximum variation.

The study proposed that by controlling inflation the volatility of the stock markets can be reduced. Therefore monetary managers should adopt appropriate monetary measures. Positive impact on KSE100 Index revealed that by raising the Industrial production the capital markets of Pakistan can be developed significantly. Thus, it was recommended that authorities should formulate such policies, which uphold stock prices through the promotion of industrial production. The long run positive impact of exchange rate on KSE100 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. The monetary authorities should take care in executing monetary policies particularly to affect movements in the stock market, because soft monetary policy elevate stock prices in the short-run leading to adverse results in the long-run. The study also recommended that three months treasury bills rate should be kept appropriately low so that it cannot affect stock returns adversely.

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