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Relationship between Stock Prices and Exchange Rate: A Bivariate and Multivariate Analysis from Pakistan's Economy

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Abstract

This research aims to find the relationship between stock prices and macroeconomic variables i.e. exchange rate, money supply, reserves, interest rate and inflation using data set of KSE100 from June, 1996 to December, 2010. Two measures of exchange rate are being used i.e. real effective exchange rate and nominal effective exchange rate. With Johansen co-integration test, FMOLS and Granger Causality tests as econometric techniques. No evidence of long-run relationship between stock price and exchange rate in bivariate models have been observed but in case of multivariate structure of model, stable long-run co-integration is being observed between stock prices and macroeconomic variables. Results indicate that exchange rate, money supply and interest rate are positive determinants of stock prices in Pakistan whereas negative impact of reserves and inflation is being found for stock price. In both cases bivariate and multivariate models, evidence of unidirectional causality from exchange rate to stock price has been observed. But the direction of macroeconomic variables gets differ in like unidirectional causal relationship is found between stock prices and inflation that runs from inflation to stock prices, from money supply to real effective exchange rate, consumer price index to real effective exchange rate, real effective exchange rate to Total reserve, Consumer price index to Total reserve, and Total reserves to Bank rate. However interest rate and reserves fails to establish any causal linkage with stock prices. Furthermore, unidirectional causality found that is running
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1: Introduction

Stock market in developing countries is becoming an attractive place for international investors, owing to growing trade and financial liberalization. In past most of the research work was done on developed countries with a very less attention on developing and emerging economies. Stock market plays an important role in country's development, therefore, researchers, policy makers and investors have mold the way of their studies towards financial markets. Exploring linkage between stock and exchange rate markets has received a massive attention by the researchers. Theoretically, it is very difficult to find any combined opinion regarding the relationship between stock prices and exchange rate. This linkage can be viewed from different perspectives and approaches like, Stock-Oriented approach, Flow-Oriented Approach, and Asset Market Approach. Brief description of these approaches is given here under. Portfolio approach postulate negative relationship between stock price and exchange rate and it defines a change in stock price that leads to a change in exchange rate. Proponents of stock oriented approach states that exchange rate is determined by the forces of demand and supply of assets like in equities and bond markets, e.g. decrease in a stock price causes wealth of a domestic investor to fall which ends up with lower demand for money, lower money demand leads to lower interest rate. When there is low interest rate in the market investors are not interested in investments, so there are less capital inflows which in turns leads to depreciation in currency. Main focus of flow oriented model of exchange rate is based on country's current account balances or trade balances. Followers of this model state that exchange rate changes affect trade balances and international competitiveness and thus affect real income and input prices. According to this approach exchange rate and stock prices have positive relationship and change in exchange rate brings a change in stock price. For instance, if the value of home currency in terms of foreign currency depreciates, the volume of export increases as product of country become cheap in the world market. Higher volumes of exports wins back higher cash flows, profits and stock prices of local companies because the stock prices are evaluated as the present value of future cash flows of the firm. Under Asset Market approach exchange rate is a price of an asset and price of exchange rate is determined by expected future exchange rates like other assets. Any factor e.g. future interest rate differential between the countries, terms of trade, economic conditions, political conditions etc that induces change in expected future exchange rate will definitely affect today's spot exchange rate. The factors that brings change in exchange rate may be different from the factors that cause changes in stock indexes. Under this situation there should not exists any association between stock index and exchange rate. Consequently, the outcome of the argument from above mentioned approaches suggests that no theoretical consensus has been reached concerning the interactions between exchange rate and stock markets.

In literature few number of studies have made empirical attempt to explore the impact of exchange rate changes on stock prices. Results of researches absolutely depends upon the methodologies, data series, and period used. However, literature regarding the linkage between stock index and exchange rate is inconclusive.

Since independence, a lot of hurdles stood in the way of economic growth of Pakistan some of them are still persisting like violence of law, political instability, unproductive tax system, tax aversion, nonpayment of custom duties etc. All such problems adversely affect the foreign investment. Liberalization of Stock markets has taken place along with other reforms in 1991 and foreign investors were allowed to invest in stock exchange. These reforms led positive impact on stock market index. Now days, stock market achieves a huge attraction from researchers and investors. Stock market plays an important role in transferring of funds from borrowers to investors that is very useful for economic growth. A number of factors can influence stock markets in multivariate framework. Variables in said model are money supply, inflation, reserves, and interest rates, casted along with stock prices and exchange rate. Stock market plays a vital role in economy which is involved in, expansion of corporate sector (with listed companies), growing trade, etc. Stock markets of emerging countries like, Pakistan show more volatility as compared to that of developed economies. Stock markets in Pakistan are sensitive to changes in exchange rate policies, monetary policies, variations in political environment, structural changes etc. Foreign cash flows from international investors are of pivotal importance in the growth of Pakistani economy; therefore, a sound equity market is a need of time. A sound and efficient market leads towards economic growth and prosperity. Such market stabilize financial sector and provide attractive investment opportunities and also attract domestic and foreign capital flow.

Pakistan has three stock markets, namely Karachi stock exchange (KSE), Lahore stock exchange (LSE) and Islamabad stock market (ISE). Pakistan established her first stock market in 1947 i.e. Karachi stock exchange. In 2002 Karachi stock market got a declaration of best performing Stock market of the World (Business Week and USA Today (2002)) but due to domestic puzzles and global crisis it has undergone a hefty down swing. Pakistani stock markets are still developing and their role is not conducive to economic development.

Stock markets are not only affected by global factors but domestic factors have more power to induce changes in this market. This research will consider the long term impact of macroeconomic variables on the stock market. For the soundness of stock market it is essential to discover the factors with positive and negative influence. A sound equity market attracts cash flows that give a pull to business activities which leads to higher income (GDP), an indicator of economic growth.

2: Literature Review

Relationship between stock market and macroeconomic variables is of utmost importance. A number of researchers and practitioners have studied it to investigate the long-run relationship and causality. These studies have been conducted in the framework of time series and cross sectional datasets. The findings of researchers are given as under:

Granger et al (2000) examined causal association between stock prices and exchange rate markets. The study revolves around, whether stock price drives exchange rate or exchange rate drives stock price or both drive each other? Researcher used Stock price and exchange rate proxies on nine economies. Researcher applied Gregory and Hansen co-integration test, Granger causality test and impulse response (IR) function. Study found that null hypothesis of no co-integration between stock prices and exchange rate cannot be rejected in Asian markets.

Neih and Lee (2001) empirically investigated dynamic linkage between stock price and exchange rate in Canada, France, Germany, Italy, Japan, US and UK. Researchers used Engle and Granger (EG) two step methodology, Johansen Multivariate Maximum Likelihood co-integration test and Vector Error Correction Model (VECM) to find association. Results of EG test disclosed no long- run co-integration among variables except in Germany that had weak relationship. Results of Johansen test exhibited that no co-integration was found between stock price and exchange rate for G-7 countries.

Apergis and Eleftheriou (2002) investigated relationship among stock price (General Price index), inflation (CPI) and interest rate (3 Month T-Bills) in Greece on monthly data over the period 1988 to 1996. The main purpose of this study was to find out whether inflation or interest rate brings a change in stock price. When stock prices were regressed on inflation, interest rate and income it observed that coefficient of interest rate was statistically insignificant while coefficient value of inflation was negative and significant.

Smyth and Nandha (2003) explored relationship between stock price and exchange rates in India, Pakistan, Bangladesh, and Sri Lanka. Authors used monthly data for both variables (exchange rate and stock price). Researchers applied Engle and Granger two step and Johansen co-integration methodologies and found that there was no long-run co-integration. They applied Granger causality test that discovered, in India and Sri Lanka Exchange rates led stock prices whereas no causal relationship was found between exchange rate and stock price in Pakistan and Bangladesh.

Nishat and Shaheen (2004) empirically analyzed long run equilibrium association between stock market and macroeconomic variables. Co-integration results suggested that there is a long-run relationship among the variables. Main findings were, a positive impact of industrial production on stock prices, whereas negative impact of CPI on stock price index.

Phylaktis and Rvazzolo (2005) analyzed long-run and short-run linkage between stock price and exchange rate in Hong Kong, Malaysia, Philippines, Singapore, and Thailand. Results disclosed strong positive linkage between domestic stock market and exchange rate markets. US stock market had acted as a channel through which both exchange rate and stock markets were linked.

Mehrara (2006) probed causal relationship between stock prices and macroeconomic variables (money supply, trade balances and industrial production) in Iran. Toda and Yamanoto test was applied to explore the causal relationship. Results suggested unidirectional causality between stock prices and macroeconomic variables. All the macroeconomic variables led stock prices.

Pan et al (2007) investigated dynamic relation between stock markets and exchange markets in Hong Kong, Japan, Korea, Malaysia, Singapore, Taiwan, and Thailand. Sample consists of newly industrialized countries except Japan. ADF, Johansen co-integration test, Granger Causality test, Variance decomposition and impulse response analysis were Econometric methodologies. The results showed that there existed a causal relationship between stock price and exchange rate before Asian financial crisis.

Morley (2007) probed relationship between stock prices and exchange rate and investigated the effect of stock price in monetary exchange rate model. Author used ARDL bound testing approach in monetary exchange model that includes money supply (M1 for US and M2 for UK, real income (GDP), real interest rate (T-Bills rate), real stock prices and exchange rate. Results suggested that stock price had power to affect exchange rate in a short run.

Rantanapakorn and Sharma (2007) investigated long and short-run linkage between stock prices and macroeconomic variables in USA on Monthly data for the period ranging from Jan 1975 to April, 1999. Two co-integrating vectors were found by applying from Johansen co-integration econometric technique. Furthermore, results suggest that stock prices negatively associate with long-run interest rate (Government Bond Yield) whereas positive association was observed for money supply, industrial production, inflation (CPI), exchange rate and short-run interest rate (T-bills). Granger causality concluded that macroeconomic variables cause stock prices in a short run but stock price was not caused by any variable in a long-run.

Humpe and Macmillan (2009) empirically employed Johansen co-integration test to investigate impact of industrial production, inflation (CPI), money supply (M1) and interest rate on stock prices in USA and Japan. In USA Co-integration results suggested that long-run relationship was observed. Result confirmed long-run relationship among the variables in Japan.

Katechos (2011) probed relationship between stock returns and exchange rates to investigated financial markets relationship. Maximum Likelihood Regressions technique with GARCH was applied to found the linkage. This study found positive relationship between global stock market returns and exchange rates but the sign of the relationship hinge on the nature of the currencies used. Results further revealed that the relationship between stock returns and exchange rate were stronger when interest rate differential was high and vice versa.

Hsing and Hsieh (2011) probed effect of macroeconomic variables on stock market index in Poland. Quarterly data was used covering period from 2000 to 2010 on nine variables and GARCH model was employed. Results of estimated regression depicts that Stock market index in Poland showed positive association with Industrial production and foreign stock market index whereas negative association was observed with government borrowings, real interest rate and expected inflation.

Ray (2012) probed impact of macroeconomic variables on stock prices. Study concluded no causal relationship between stock price index and interest rate. Absence of causality was also found for stock prices and industrial production. Unidirectional causality was observed from exchange rate and gross domestic product to stock prices. Unidirectional causality was also observed form stock price to inflation, foreign direct investment and gross fixed capital formation respectively. Exchange rate, inflation rate, foreign direct investment and wholesale price index failed to influence stock price.

Khan and Zaman (2012) had analyzed annual data to find the variations in stock price index due to changes in macroeconomic variables in Pakistan. Regression results found that exchange rate and Gross domestic product had positive effect on stock price index. However negative effect of Consumer price index was observed on stock prices. Moreover Exports, oil prices, money supply, and foreign direct investment fails to show any significant linkage with stock prices.

3. HYPOTHESES

Hypothesis of co-integration in bivariate model

H_1= co-integration between stock prices and exchange rate.

Hypothesis of co-integration in multivariate model

H_2= co-integration between stock prices and macroeconomic variables.

4. METHODOLOGY

This chapter explained the source of time series data, definitions of the variables used, hypothesized relationship between stock prices and macroeconomic variables and methodologies of unit root test, Johansen co-integration test, fully modified ordinary least square (FMOLS), and Granger causality test.

4.1. Models of Stock Price and Macroeconomic Variables

This study constructed four models i.e. two bivariate and two multivariate to probe the linkage between stock prices and macroeconomic variables. The relationship between stock prices and exchange rate is viewed from four different angles in this paper. Models are given as under:

4.1.1: Bivariate Models

Both bivariate models are constructed to find the long-run relationship between stock prices and exchange rates.

1st model

$$lKSE_t = \alpha_0 + \alpha_1 lREER_t + \mu_t \qquad 1$$

Where, KSE_t is a stock price index. $REER_t$ denotes real effective exchange rate and μt is a white noise error term. Choice of Real Effective Exchange Rate (REER) is bedded on the fact that, it measures relative competitiveness of the country in international goods and services markets.

In the second model I used Nominal Effective Exchange Rate (NEER) in place of Real Effective Exchange Rate. I use two exchange rate measures to explore the relationship between stock price and exchange rate. Many other studies used different measures of exchange in a single study to discover linkage between stock price and exchange rate.

2nd model

$$lKSE_t = \alpha_0 + \alpha_1 lNEER_t + \varepsilon_t \qquad 2$$

Here above in equation 2 KSE_t is the stock price index (KSE100), $NEER_t$ is a Nominal Effective Exchange rate and ε_t is an error term. Nominal and Real Effective Exchange Rate are commonly used as measures of exchange rate in Pakistan.

4.1.2: Multivariate Models

I have constructed two multivariate models for this study, these are

3rd Model

$$lKSE_t = \alpha_0 + \alpha_1 lREER_t + \alpha_2 lM2_t + \alpha_3 lTR_t + \alpha_4 lBR_t + \alpha_5 lCPI_t + v_t \qquad 3$$

In the above equation 3 KSE_t is a stock price index (KSE100), $REER_t$ represents Exchange rate (REER), $M2_t$ stands for Money supply (M2), TR_t is a Total Reserves minus Gold and BR_t is a Bank/Discount rate a proxy of interest rate and, CPI_t represents Consumer Price Index (CPI) proxy of inflation. v_t is a white noise term.

4th model

$$lKSE_t = \pi_0 + \pi_1 lNEER_t + \pi_2 lM2_t + \pi_3 lTR_t + \pi_4 lBR_t + \pi_5 lCPI_t + x_t \qquad 4$$

In a model KSE_t is stock price index (KSE100), $NEER_t$ is Nominal Effective Exchange Rate, $M2_t$ is broad money Supply , TR_t is Total Reserves minus Gold, BR_t is Bank/Discount rate, proxy of interest rate and CPI_t is Consumer price index, proxy of inflation whereas x_t is white noise term. "l" with all variables denotes logarithm form.

4.2. Unit root test

Most of financial time series shows non-stationary behavior. These types of properties are commonly found in financial time series like stock indexes, exchange rate etc. Test of unit root is necessary; if we run the regression on non-stationary variables it will yield un-reliable/spurious results even in the presence of high value of R square. A non-stationary time series invalidate the normal statistical test because of time varying variance. In order to avoid spurious regression series should be stationary. Series is said to be stationary if it has constant mean, constant variance and constant auto-covariance for each given lag. Granger and Newbold (1974) were first pointed out that use of non-stationary macroeconomic variables lead toward spurious regression in. Later Engle and Granger (1987) come up with prove that most of macroeconomic variables and specially a financial time series are non stationary at their level. Greater parts of time series econometric techniques are bedded upon that time series variables are stationary. So a unit root test should precede every empirical research that casted macroeconomic variables. Different approaches can be used to find the stationarity properties of a time series data but most well-liked techniques are Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS, 1992) tests. However, in this study, Augmented Dickey Fuller test and Phillips-Perron tests and and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS, 1992) tests are used to check the stationarity of variables. All the six variables i.e Stock price index (KSE100), Exchange rate (REER,NEER) Money supply (M2), Inflation (CPI),Interest rate (Discount/Bank rate) and Total reserves minus Gold shall be tested for checking stationarity/non stationarity of data series. All the said variables are transformed into Logarithm form before proceeding for empirical analysis. The methodology of unit root is given as under:

4.2.1: Augmented Dickey-Fuller (ADF) or Said-Dickey test:

Dickey and Fuller (1976, 1979) were the persons who developed the Augmented Dickey-Fuller test. Augmented Dickey-Fuller test is an Augmented version of Dickey-Fuller test. This test is conducted where time series models are bigger and complex or order of co-integration is higher. For this unit root test three versions can be used.

Test for a unit root

$$\Delta Z_t = \alpha^* Z_{t-1} + \sum_{i=1}^{p-1} \alpha_i \Delta Z_{t-i} + ?_t$$

Test for a unit root with intercept

$$\Delta Z_t = \pi^0 + \alpha^* Z_{t-1} + \sum_{i=1}^{p-1} \alpha_i \Delta Z_{t-i} + ?_t$$

Test for a unit root with intercept and trend.

$$\Delta Z_t = \pi^0 + \beta_{1t} + \alpha^* Z_{t-1} + \sum_{i=1}^{p-1} \alpha_i \Delta Z_{t-i} + ?_t$$

In the above equations ΔZ_t is a macroeconomic variable in a time period t and π^0 is a constant term ΔZ_t = Z_t - Z_{t-1}. t is a trend variable and μ_t µt is white noise error term. The basic purpose of this test is to check the Null and Alternative hypothesis, these are

H0: α* = 0 Non Stationary

H1: α* < 0 Stationary

The null hypothesis (H0) for ADF test is same as for Dickey-Fuller test i.e. series has a unit root and alternative hypothesis (H1) is that data series is stationary. To check the existence of unit root problem, t-statistics is computed and then compared with critical values at different levels of significance, if the calculated values of test statistics are greater than the critical values then we cannot reject null hypothesis of non stationarity. Critical values for this test are provided by MacKinnon (1999) and these values are different for each version. If the series is stationary at level it is called I (0) and if it is stationary at first difference it is called I (1).

While conducting this test it is important to pay attention on the selection of lag length. If we select less lags it will increase the power of test to reject null hypothesis but if we include more lags the power of the test to reject null hypothesis will be reduced. I have used Schwartz Bayesian Criterion (SBC) for lag selection as it gives correct model with small no of lag lengths as compared to Akaike Information Criterion.

4.2.2: Phillip Peron Test

Phillips (1987), Phillip and Perron (1988) proposed this non parametric test of unit root, to test the stationarity properties of a series. Null hypothesis of Phillip Perron test is series have a unit root and alternative hypothesis denied from the existence of unit root. Phillip Perron test is different (advantage over ADF test) from the Augmented Dickey-Fuller test in the sense that it can correct any serial autocorrelation and heteroscedasticity of covariance in error terms. Davidson and MacKinnon (1993) and Monte Carlo's experiments on the Phillip Perron test provide an evidence that Phillip Perron test has more power as compared to Augmented Dickey-Fuller test. One important edge of Phillip Perron test over Augmented Dickey-Fuller test is: no issue of lag length selection while running test regression. Phillip Perron Test is widely used where normality and Hetroscedasticity or autocorrelation problems are significant in the equation. As, null and alternative hypothesis of this test is same as of Augmented Dickey-Fuller test in the like manner, interpretation of results of both tests is also same. Phillip Perron test is non-parametric as compared to Augmented Dickey-Fuller Test. Regression of Phillip Perron test is:

$$\Delta Y\tau = \Phi Y\tau - 1 + \alpha + \mu\tau$$

In the above equation Δ is a first difference operator.

4.2.3: Kwiatkowski-Phillip-Schmidt-Shin Test

Kwiatkowski-Phillip-Schmidt-Shin (1992) proposed the stationary test under the null hypothesis i.e. data is stationary at level. This test is based on Lagrange Multiplier Test with hypothesis that random walk has a "0" variance and can be computed by regressing the dependent variables (Yt) on constant and on constant and deterministic time trend t. After regressing dependent variable second step is to save Ordinary Least Square's residuals vt. After that partial sums Qt = $\sum_{i=1}^{t} v$i for all t are computed. Verbook (2004) given the test statistics of KPPS test are given as under:

$$KPSS - LM = \sum_{i=1}^{T} \frac{S}{\hat{\sigma}_{\varepsilon}^{2}}$$

Where Qt = $\sum_{i=1}^{t} v$i and ($\hat{\sigma}_{\varepsilon}^{2}$) is the estimated error variance from the regression.

Yt = α + εt or Yt = α + βt + εt

Unlike the Augmented Dickey-Fuller Test (ADF) and Phillip Perron test, Kwiatkowski-Phillip-Schmidt-Shin (KPSS) has a Null Hypothesis of Stationarity. So in this study I use unit root test and stationarity test jointly. If conflict arises between the results of Augmented Dickey-Fuller test, Phillip Perron test and KPSS test then the results of KPSS tests will be preferred.

4.3: Co-integration Test

Before application of co-integration test I conducted a lag specification test to determine the appropriate lag length. I have used Schwarz Information Criteria for the selection of lag length. Schwarz Information Criteria is a better criterion as compared to other criteria's like Akaike Information Criteria, Final Prediction Criteria, Hannan-Quinn information Criteria etc. In the previous section I have discussed the methodology of unit root. In this section I will explain the methodology for co-integration test. Co-integration concept was developed by Engle and Granger. Co-integration test examine the long-run relationship among the variables under integrated series. When co-integration exists between the variables it means that there is a linear relationship among the variables. For co-integration two commonly used methodologies are Engle and Granger two steps test (used in a bivariate model) and Johansen co-integration technique. I used Johansen co-integration techniques to test whether the financial series Stock price index (KSE100), Exchange rate (REER, NEER) Money supply (M2), Inflation (CPI), Interest rate (Discount/Bank rate) and Total reserves minus Gold exhibited a long-run linear relationship between them. Johansen co-integration technique reports the presence of no co-integrating equations.

4.3.1: Johansen Co-integrating Test

To circumvent the co-integration I applied johansen co-integration test. This multivariate co-integration technique was developed by Johansen (1988) and Johansen and Juselius (1990).This test defines the number of co-integrating vectors among the variables. This technique is bedded upon two Likelihood- ratio test statistics, first is Trace Statistics and second is Maximum Eigen-value statistics. This VAR based test is better than regression based Engle and Granger test (1987) as it pick up the full elementary properties of data, it furnish estimates of all diverse co-integrating vectors that may subsist and produce test statistics with exact distributions for the number of co-integrating equations. Johansen test has an advantage as it let direct hypothesis testing on the coefficients entering the co-integration vector so in this test restrictions can be imposed on the model. I have used this test to detect long-run co-integration both in a bivariate as well as in multivariate models. The Trace statistics and Maximum Eigen-value statistics works under the rank of matrix. Trace test statistics are with a Null Hypothesis that there are at most 'r' co-integrating equations and Alternative Hypothesis that there are 'r' or more co-integrating vectors. For Maximum Eigen-value test statistics null hypothesis is the existence of 'n' co-integrating vectors against the alternative hypothesis of n +1 co-integrating vectors. When there is conflict between Trace statistics and Maximum Eigen-value statistics then trace test statistics shows most robust results to both Skewness and Kurtosis in innovations (Cheung and Lai [1993]). Johansen and Juselius (1990) are also in favor, to rely on the Trace Test statistics in case conflict arises between the two statistics.

I have used Schwarz Baysian Information Criteria (SBC)to find the optimum lag length in VAR structure, as Johasen based co-integration results are sensitive to the selection of lag length in VAR [Cheung and Lai, 1993]. Therefore, before estimating results of Johansen we proceed to test lag length selection.

The specific VAR model is given as follows

$$\Delta Z_t = \beta_1 \Delta Z_{t-1} + K + \beta_{t-k-1} + \beta_k \Delta Z_{t-k} + \mu + \varepsilon_t$$

Where

Z_t = A n x1 vector of the variables.

β = A n x n coefficient matrix.

μ = A n x 1 constant vector; and

ε_t =An n x 1 vector of white noise with a mean of zero and a finite variance.

Trace Statistic is a Likelihood ratio with the Null Hypothesis that is at most r co-integration vectors.

$$\lambda_{trace}(r) = -T\sum_{r+1}^{n}\ln(1-\hat{\lambda}_i)$$

In the above trace statistics T represents sample size and $\hat{\lambda}_i$ estimates characteristic root. The equation for maximum Eigen-value is given as under.

$$\lambda_{\max}(r, r+1) = -T\ln(1-\hat{\lambda}_{r+1})$$

In Johansen Juselius test, the Null and alternative hypothesis in trace statics are as under

$$H_0 : rank(\pi) \le r(\text{at most r integrated vector})$$

and

$$H_1 : rank(\pi) > r(\text{at least r+1 integrated vector})$$

If test rejects Null hypothesis i.e. H_0 it means that there exists at least r+1 long term integrated relationship among the variables.

Whereas the specific form of Null and alternative hypothesis in maximum eigenvalue is as

$$H_0 : rank(\pi) \le r(\text{at most r integrated vector})$$

and

$$H_1 : rank(\pi) > r(\text{at least r+1 integrated vector})$$

Test statistics of both (Trace statistics and Maximum Eigen-value Statistics) Likelihood ratios are compared against the critical values of Mackinnion.

4.4: Fully Modified Ordinary Least Square

In the previous pages we elaborate the methodologies of unit root and co-integration. Long-run elasticities can be estimated through Fully Modified Ordinary Least Square (FMOLS). FMOLS method was originated by Phillips and Hansen (1990). The prerequisite to apply the FMOLS is that there must be a co-integration relationship among the variables. Fully Modified Ordinary Least Square method is more reliable to account for, potential endogeneity problems, serial correlation and multicollinearity problems by modifying the least square, so this technique is more preferable over Simple Ordinary Least. Succinct contour of the Fully Modified Ordinary Least Square method is as under. Take in to the account a linear regression

$$y_t = \beta_0 + \beta_1 x_1 + u_1 \quad \text{...........(f)}$$

In above equation y_t is a vector of dependent variable and x_1 is (k x_1) vector of covariance. Both y_t and x_1 are assumed to have a 1(1) relationship. Let $\Delta x_1 = \mu + w_1$; where μ is a (k x_1) vector of drift parameters and w_1 is (k x_1) vector of stationary variables. Define the consistent estimates of u_1 and w_1 as $\hat{\xi} = (\mu_t w_t)'$.The long run variance-covariance of $\hat{\xi}$ ($\hat{V}$) is

$$\hat{V} = \hat{\Gamma} + \hat{\phi} + \hat{\phi}' = \begin{pmatrix} \hat{v}_{11} & \hat{v}_{12} \\ \hat{v}_{21} & \hat{v}_{22} \end{pmatrix}$$

Further $$\hat{\Delta} = \hat{\Gamma} + \hat{\phi} = \begin{pmatrix} \square_{11} & \square_{12} \\ \square_{21} & \square_{22} \end{pmatrix}$$

$$\hat{Z} = \square_{21} - \square_{22}\hat{v}_{22}^{-1}\hat{v}_{21}$$

Where $\widehat{\Gamma}=\dfrac{1}{T^{-1}}\sum_{t=2}^{T}\widehat{\xi}_t\widehat{\xi}_{t;}\widehat{\phi}=\sum_{s=1}^{m}w(s,m)\widehat{\Gamma}_s;\widehat{\Gamma}s=\Gamma^{-1}\sum_{t=1}^{t-s}\widehat{\xi}_t\widehat{\xi}_{1+s}$, w(s, m) is the lag transaction window. The Fully Modified OLS (FMOLS) shall be

$$\widehat{\beta}_{fmols}=(w'w)^{-1}(w'\widehat{y}^{*})-TD\widehat{Z}$$

Where, $\widehat{y}_{i^*}=y_t-\widehat{v}_{12}v_{22}^{-1}\widehat{w};\widehat{y}=(\widehat{y}_{t*,}\widehat{y}_{2*},...,\widehat{y}_{t*})$; D=$\left[0_{1XK}\,I_K\right]'$ and W_{txk} is a matrix of all covariate including a constant term. The variance co-variance matrix (Ψ) is $\Psi(\widehat{\beta}_{fmols})=K_{11.2}=\widehat{v}_{11}-\widehat{v}_{12}\widehat{v}_{22}^{-1}\widehat{v}_{21}$.

If the error term gained through Fully Modified Ordinary Least Square (FMOLS) is stationary, then regressand and regressors variables in the equation are co-integrated in the equation (f). In this study I assumed that y is Stock price and x is the Exchange rate, Money supply, Total reserve, Inflation, Interest rate.

4.4. Granger Causality Test

In the previous section we highlighted the methodology for co-integration, which tells us about the presence of long-run relationship; it does not give the direction of causation. This test is a feedback concept as it tells that whether one variable is significant in forecasting the other variable or not. Granger (1969) and Sim (1972) were the former of this causality concept in economics. Granger explained that statistically if co-integration is discovered then it rules out the non-causality between the variables. Miller (1990) and Miller and Russek (1990) contends that if two variables are co-integrated, then there must be a temporal causality between them in at least one direction in the Granger sense. Granger Causality test (1988) circumvent that whether change in the past value of one variable can bring a change in another variable or not. The specific equations for the Granger causality for a bivariate are given as under:

Bivariate Granger Causality Equations for Model 1and Model 2 are given below:

Model:1

$$\Delta KSE_t=\alpha_1+\sum_{j=1}^{n}\beta_{1,j}\Delta KSE_{t-j}+\sum_{j=1}^{n}\gamma_{1-j}\Delta REER_{t-j}+\varepsilon_{1,t}..........1$$

$$\Delta REER_t=\alpha_2+\sum_{j=1}^{n}\beta_{2,j}\Delta REER_{t-j}+\sum_{j=1}^{n}\gamma_{2-j}\Delta KSE_{t-j}+\varepsilon_{2,t}.......2$$

Model:2

$$\Delta KSE_t=\alpha_3+\sum_{j=1}^{n}\beta_{3,j}\Delta KSE_{t-j}+\sum_{j=1}^{n}\gamma_{3-j}\Delta NEER_{t-j}+\varepsilon_{3,t}..........1$$

$$\Delta NEER=\alpha_4+\sum_{j=1}^{n}\beta_{4,j}\Delta NEER_{t-j}+\sum_{j=1}^{n}\gamma_{4-j}\Delta KSE_{t-j}+\varepsilon_{4,t}.......2$$

In above bivariate equations KSE is a Karachi Stock Index a proxy of Stock prices, REER stands for Real Effective Exchange Rate, NEER represents Nominal Effective Exchange Rate, and ε_t represents white noise error term.

If co-integration was found than we shall run the Granger Causality Test under the Vector Error Correction Model framework. According to Granger (1988), Vector Error Correction framework endow us with two conduits to spot causality like explanatory variables Granger cause to dependent variable and 2nd channel is Dependent variable (stock prices) Granger cause to explanatory variables (Real effective exchange rate, Nominal effective exchange rate, money supply, Reserves, Interest rate and

Multivariate Granger Causality equations for Model 3 are given as under

$$\Delta KSE_t = \alpha_1 + \sum_{j=1}^{n} \beta_{1,j} \Delta KSE_{t-j} + \sum_{j=1}^{n} \gamma_{1,j} \Delta REER_{t-j} + \sum_{j=1}^{n} \phi_{1,j} \Delta M_{t-j} + \sum_{j=1}^{n} \delta_{1,j} \Delta TR_{t-j} + \sum_{j=1}^{n} \lambda_{1,j} \Delta BR_{t-j} +$$

$$\sum_{j=1}^{n} \sigma_{1,j} \Delta CPI_{t-j} + \pi_{1,j} ECT_{t-j} + \varepsilon_{1,t} \ldots\ldots 1$$

$$\Delta REER_t = \alpha_2 + \sum_{j=1}^{n} \beta_{2,j} \Delta REER_{t-j} + \sum_{j=1}^{n} \gamma_{2,j} \Delta KSE_{t-j} + \sum_{j=1}^{n} \phi_{2,j} \Delta M_{t-j} + \sum_{j=1}^{n} \delta_{2,j} \Delta TR_{t-j} + \sum_{j=1}^{n} \lambda_{2,j} \Delta BR_{t-j} +$$

$$\sum_{j=1}^{n} \sigma_{2,j} \Delta CPI_{t-j} + \pi_{1,j} ECT_{t-j} + \varepsilon_{2,t} \ldots\ldots 2$$

$$\Delta M_t = \alpha_3 + \sum_{j=1}^{n} \beta_{3,j} \Delta M_{t-j} + \sum_{j=1}^{n} \gamma_{3,j} \Delta KSE_{t-j} + \sum_{j=1}^{n} \phi_{3,j} \Delta REER_{t-j} + \sum_{j=1}^{n} \delta_{3,j} \Delta TR_{t-j} + \sum_{j=1}^{n} \lambda_{3,j} \Delta BR_{t-j} +$$

$$\sum_{j=1}^{n} \sigma_{3,j} \Delta CPI_{t-j} + \pi_{3,j} ECT_{t-j} + \varepsilon_{3,t} \ldots\ldots 3$$

$$\Delta TR_t = \alpha_4 + \sum_{j=1}^{n} \beta_{4,j} \Delta TR_{t-j} + \sum_{j=1}^{n} \gamma_{4,j} \Delta KSE_{t-j} + \sum_{j=1}^{n} \phi_{4,j} \Delta REER_{t-j} + \sum_{j=1}^{n} \delta_{4,j} \Delta M_{t-j} + \sum_{j=1}^{n} \lambda_{4,j} \Delta BR_{t-j} +$$

$$\sum_{j=1}^{n} \sigma_{4,j} \Delta CPI_{t-j} + \pi_{4,j} ECT_{t-j} + \varepsilon_{4,t} \ldots\ldots 4$$

$$\Delta BR_t = \alpha_5 + \sum_{j=1}^{n} \beta_{5,j} \Delta BR_{t-j} + \sum_{j=1}^{n} \gamma_{5,j} \Delta KSE_{t-j} + \sum_{j=1}^{n} \phi_{5,j} \Delta REER_{t-j} + \sum_{j=1}^{n} \delta_{5,j} \Delta M_{t-j} + \sum_{j=1}^{n} \lambda_{5,j} \Delta TR_{t-j} +$$

$$\sum_{j=1}^{n} \sigma_{5,j} \Delta CPI_{t-j} + \pi_{5,j} ECT_{t-j} + \varepsilon_{5,t} \ldots\ldots 5$$

$$\Delta CPI_t = \alpha_6 + \sum_{j=1}^{n} \beta_{6,j} \Delta CPI_{t-j} + \sum_{j=1}^{n} \gamma_{6,j} \Delta KSE_{t-j} + \sum_{j=1}^{n} \phi_{6,j} \Delta REER_{t-j} + \sum_{j=1}^{n} \delta_{6,j} \Delta M_{t-j} + \sum_{j=1}^{n} \lambda_{6,j} \Delta TR_{t-j} +$$

$$\sum_{j=1}^{n} \sigma_{6,j} \Delta BR_{t-j} + \pi_{6,j} ECT_{t-j} + \varepsilon_{6,t} \ldots\ldots 6$$

Multivariate Granger Causality equations for Model 4 are as fallows

$$\Delta KSE_t = \alpha_1 + \sum_{j=1}^{n} \beta_{1,j} \Delta KSE_{t-j} + \sum_{j=1}^{n} \gamma_{1,j} \Delta NEER_{t-j} + \sum_{j=1}^{n} \phi_{1,j} \Delta M_{t-j} + \sum_{j=1}^{n} \delta_{1,j} \Delta TR_{t-j} + \sum_{j=1}^{n} \lambda_{1,j} \Delta BR_{t-j} +$$

$$\sum_{j=1}^{n} \sigma_{1,j} \Delta CPI_{t-j} + \pi_{1,j} ECT_{t-j} + \varepsilon_{1,t} \ldots\ldots 1$$

$$\Delta NEER_t = \alpha_2 + \sum_{j=1}^{n} \beta_{2,j} \Delta NEER_{t-j} + \sum_{j=1}^{n} \gamma_{2,j} \Delta KSE_{t-j} + \sum_{j=1}^{n} \phi_{2,j} \Delta M_{t-j} + \sum_{j=1}^{n} \delta_{2,j} \Delta TR_{t-j} + \sum_{j=1}^{n} \lambda_{2,j} \Delta BR_{t-j} +$$

$$\sum_{j=1}^{n} \sigma_{2,j} \Delta CPI_{t-j} + \pi_{1,j} ECT_{t-j} + \varepsilon_{2,t} \ldots\ldots 2$$

$$\Delta M_t = \alpha_3 + \sum_{j=1}^{n}\beta_{3,j}\Delta M_{t-j} + \sum_{j=1}^{n}\gamma_{3,j}\Delta KSE_{t-j} + \sum_{j=1}^{n}\phi_{3,j}\Delta NEER_{t-j} + \sum_{j=1}^{n}\delta_{3,j}\Delta TR_{t-j} + \sum_{j=1}^{n}\lambda_{3,j}\Delta BR_{t-j} + \sum_{j=1}^{n}\sigma_{3,j}\Delta CPI_{t-j} + \pi_{3,j}ECT_{t-j} + \varepsilon_{3,t} \quad \text{.........} 3$$

$$\Delta TR_t = \alpha_4 + \sum_{j=1}^{n}\beta_{4,j}\Delta TR_{t-j} + \sum_{j=1}^{n}\gamma_{4,j}\Delta KSE_{t-j} + \sum_{j=1}^{n}\phi_{4,j}\Delta NEER_{t-j} + \sum_{j=1}^{n}\delta_{4,j}\Delta M_{t-j} + \sum_{j=1}^{n}\lambda_{4,j}\Delta BR_{t-j} + \sum_{j=1}^{n}\sigma_{4,j}\Delta CPI_{t-j} + \pi_{4,j}ECT_{t-j} + \varepsilon_{4,t} \quad \text{.........} 4$$

$$\Delta BR_t = \alpha_5 + \sum_{j=1}^{n}\beta_{5,j}\Delta BR_{t-j} + \sum_{j=1}^{n}\gamma_{5,j}\Delta KSE_{t-j} + \sum_{j=1}^{n}\phi_{5,j}\Delta NEER_{t-j} + \sum_{j=1}^{n}\delta_{5,j}\Delta M_{t-j} + \sum_{j=1}^{n}\lambda_{5,j}\Delta TR_{t-j} + \sum_{j=1}^{n}\sigma_{5,j}\Delta CPI_{t-j} + \pi_{5,j}ECT_{t-j} + \varepsilon_{5,t} \quad \text{.........} 5$$

$$\Delta CPI_t = \alpha_6 + \sum_{j=1}^{n}\beta_{6,j}\Delta CPI_{t-j} + \sum_{j=1}^{n}\gamma_{6,j}\Delta KSE_{t-j} + \sum_{j=1}^{n}\phi_{6,j}\Delta NEER_{t-j} + \sum_{j=1}^{n}\delta_{6,j}\Delta M_{t-j} + \sum_{j=1}^{n}\lambda_{6,j}\Delta TR_{t-j} + \sum_{j=1}^{n}\sigma_{6,j}\Delta BR_{t-j} + \pi_{6,j}ECT_{t-j} + \varepsilon_{6,t} \quad \text{.........} 6$$

In above multivariate equations KSE is a Karachi Stock Index a proxy of Stock prices, REER stands for Real Effective Exchange Rate, NEER represents Nominal Effective Exchange Rate, M stands for money supply (M2), TR are Total Reserves minus Gold, BR is a Bank/Discount rate i.e. a proxy of interest rate. CPI is a Consumer Price Index, whereas ECT is an Error Correction Term and ε_t represents white noise error term.

5: Data and Variable source

This study used monthly data for the period of June, 1996 to December, 2010, consists of 175 observations. Data regarding Real Effective exchange rate (REER), Nominal effective exchange rate (NEER), Bank rate (proxy of interest rate), Total reserves minus Gold and Consumer Price Index (proxy of inflation) was taken from International Financial Statistics (CD ROM Nov, 2011). Whereas Money Supply (M2) data series was obtained from the statistical and data warehouse department of State Bank of Pakistan. Handbook of Statistics on Pakistan Economy 2005 is the source which provided me access to Stock Price Index (KSE100 index). Real Effective Exchange rate (REER) and Nominal Effective Exchange rate (NEER) are two important measures of exchange rate in the context of Pakistan that is why both measures are taken in this study for analysis.

5.1: Karachi Stock Index 100 (KSE100): (1991=1000)

KSE30, KSE100, LSE25, BRIndex30 and ISE10 are indexes that are used in Pakistan. . Karachi Stock index 100 is a most commonly quoted index, as it is a good indicator of Pakistan's equity market performance. Karachi Stock index 100 is a capital weighted index. It has captured about 80% to 90% of total market capitalization of firms listed on Karachi Stock Exchange.

5.2: Money Supply (M2)

Commonly money is defined as a currency in circulation and demand deposits. There are different aggregates of money stock like narrow money, broad money etc. In Pakistan three aggregates are used M1, M2 and M3. I include broad money (M2) in my study. I have taken data series of M2 from SBP's Statistical and data warehouse department. According to SBP broad money includes narrow money and scheduled banks time deposits. Narrow money again includes currency in circulation, other deposits with SBP, Scheduled bank demand deposits.

5.3: Nominal Effective Exchange Rate

Nominal Effective Exchange rate compute value of a currency in opposition to a weighted average of several foreign currencies also called trade weighted currencies. Nominal exchange rate is exchange rate that does not incorporate the price effects while calculating the index. This indicator captures economy's foreign competitiveness in comparison to its foreign exchange rate.

5.4: Real Effective Exchange rate: index, 2005=100

Real Effective Exchange rate (REER) is useful while taking into account the comparative changes in a country's real economic circumstances. Real Effective Exchange rate is a geometric weighted of the consumer prices in Pakistan relative to an index of other foreign currencies adjusted for the effects of inflation. Real Effective Exchange rate (REER) is a nominal Exchange rate with adjusted of price inflation. Data for this variable is extracted from the International Financial Statistics databases.

5.5: Bank Rate

Bank rate is also known as discount rate. It is the rate at which central bank of any country lends or discounts eligible papers for commercial banks and to deposit money banks. These figures are based on end of period. This rate usually fulfills short and medium lending terms of private sector. Bank rate is a policy instrument that augments built in stabilizers in the economy. Bank rate is usually treated as bench mark for private sector pricing.

5.6: Total Reserves

Value of total reserves is a sum of Gold, Gross reserves and Reserves including CRR. Where Gross Reserves = SBP Foreign reserves, Special Drawing Rights, Foreign currency cash holdings, and Sinking funds. But in this study total reserves have been used after excluding Gold. The said indicator is a sum of balance sheet items like Foreign Exchange value of SDR with central bank revenues. Here central banks are monetary authorities that perform numerous functions as banker's banks.

5.6: Consumer Price Index: 2005=100 (proxy of inflation)

Consumer price index is a measure that is used to examine rate of change in the weighted average cost of consumer goods and services that are bought overtime by households at retail price. Consumer Price Index is normally used to reach on an estimate of General Price Level. CPI's percentage change is a very good indicator of inflation rate due to which I have used this variable as a proxy of inflation rate. Value of year 2005 is used as base year; monthly average is taken for the calculation of Consumer Price Index. It consists of 35 major cities of Pakistan.

6: Estimation Results:

6.1: Unit Root Test

Granger (1987) states that time series data is of spurious nature and if we cannot resolve the issue of stationarity and run t-test, F-test, regression etc, it give misleading results. Before locating any co-integration among the variables I conduct a unit root test. Presence of unit root in a series can be checked through different stationarity tests but here I have used only three of them i.e. Augmented Dickey-Fuller (ADF), Phillips- Perron (PP) and Kwiatkowski-Phillip- Schmidt-Shin tests (KPSS)

Table: 1 UNIT ROOT TESTS

Variables	Augmented Dickey-Fuller		Phillip Perron Test		Kwiatkowski-Phillip-Schmidt-Shin tests	
	Intercept	Intercept and trend	Intercept	Intercept and trend	Intercept	Intercept and trend
lnKSE100	-0.496415 (0.8877)	-1.850794 (0.6754)	-0.775751 (0.8230)	-3.195938 (0.0887)	1.505338	0.212968
ΔlnKSE100	-9.466233* (0.0000)	9.442775* (0.0000)	-17.11682* (0.0000)	-17.07861* (0.0000)	0.143522*	0.131531
lnREER	-2.772275** (0.0644)	-2.717422 (0.2310)	-2.448505 (0.1301)	-2.390721 (0.3831)	0.897335	0.302798
Δ lnREER	-10.86167* (0.0000)	-10.91289* (0.0000)	-10.79955* (0.0000)	-10.80420* (0.0000)	0.137101	0.021514
lnNEER	-0.344018 (0.9144)	-2.304608 (0.4288)	-0.258127 (0.9271)	-2.092729 (0.5458)	1.579289	0.234333
ΔlnNEER	-10.10421* (0.0000)	-10.07985* (0.0000)	-10.08098* (0.0000)	-10.05446* (0.0000)	0.074747	0.066721
lnM2	0.654416 (0.9908)	-1.772813 (0.7137)	1.327745 (0.9987)	-2.007654 (0.5927)	1.695037	0.303509
ΔlnM2	-4.022934** (0.0017)	-4.142521** (0.0067)	-14.80436* (0.0000)	-15.16828* (0.0000)	0.273651	0.095491
lnTR	-0.879980 (0.7927)	-2.049741 (0.5696)	-0.966464 (0.7646)	-2.291775 (0.4358)	1.401886	0.269186
ΔlnTR	-11.47092* (0.0000)	-11.43668* (0.0000)	-11.40202 (0.0000)	-11.36579* (0.0000)	0.079809	0.083478
lnBR	-1.354844 (0.6033)	-0.547745 (0.9804)	-1.462428 (0.5504)	-0.782888 (0.9643)	0.695963	0.695963
ΔlnBR	-11.83987* (0.0000)	-12.01727* (0.0000)	-11.99810* (0.0000)	-12.10654* (0.0000)	0.359619	0.072845
lnCPI	3.055524 (1.0000)	0.823321 (0.9998)	2.828823 (1.0000)	0.782733 (0.9997)	1.592677	0.383983
ΔlnCPI	-9.534139* (0.0000)	-10.17669* (0.0000)	-10.10288* (0.0000)	-10.44892* (0.0000)	0.716566	0.209490

Source: Results for unit root test are computed by using E-views 7 Software.
Notes:-[* ** and *** indicates that Null Hypothesis of unit root is rejected at 1%, 5% and 10% significance level respectively. For ADF test critical values for t-statistics are taken from Mackinnon (1996).Value in the parenthesis ( ) is *p*-value. For ADF test optimal lag length are selected by SIC criteria. For KPSS the tabulated values are: For Trend 1% (0.739000), 5% (0.463000) 10% (0.347000) and for Trend and Intercept 1% (0.216000) 5% (0.146000) 10% (0.119000) respectively.

Discussion

Table: 1 gives results of Augmented Dickey-Fuller (ADF), Phillips- Perron (PP) and Kwiatkowski-Phillip-Schmidt-Shin (KPSS) unit root tests with a constant and constant & time trend. The Null Hypothesis for Augmented Dickey-Fuller and Phillips- Perron (PP) test is of non-stationary. The results of ADF test shows that variable lnKSE is insignificant at level as test statistics (-0.496415) is greater than the critical value both at 1% and 5% (at intercept). At level (intercept and trend) t-statistics (- 1.850794) of lKSE is still greater than critical values even at 1% so we cannot reject null hypothesis of unit root. Likewise lnREER, lnNEER, lnM2, lnTR, lnBR and lnCPI are also insignificant at level as test statistics are greater than their critical values at almost all level of significances, so we fail to reject null hypothesis of unit root. The Augmented Dickey Fuller test concludes that at level all the variables under study possess unit root. According to Granger the variables can get stationary if we take differenced series. So I took 1st difference of all variables under study. The results depicts that the test statistics (-9.466233 at intercept, -9.442775 at intercept and trend) of the variable lKSE is more negative than the critical values even at 1% level, the null hypothesis of a unit root is strongly rejected. In same way the t-values of lnREER, lnNEER, lnM2, lnTR, lnBR, and lnCPI are t = -10.91289, -10.07985, -4.142521, -11.43668, -12.01727 and -10.17669 respectively are less than the critical values at all levels so we can reject the null hypothesis and accept the alternative . Results drawn from Augmented Dickey Fuller unit root test are: all variables are stationary at 1st difference, So order of integration of all variables is I(1). Null hypothesis of the Phillip Perron test is same as that of Augmented Dickey-Fuller test. Results of Phillip Perrron test are not different from the Augmented Dickey-Fuller test. This test reported that all the variables contain unit root as it fails to reject the Null Hypothesis at level. Thereafter, I obtained the first difference of the series which confirms the nonexistence of unit root at 1% significance level. KPSS works under the null hypothesis of No Unit Root means that all variables are stationary at level. Results of this test depict that t-statistics (1.505338: intercept) of lnKSE are greater than the critical values at all significance levels so we can reject the null hypothesis of stationarity while null hypothesis is rejected when I take the first difference of it. After differencing the t-statistics of lnKSE get less than the critical values so we cannot reject the null hypothesis. Same is the case for all other variables. They all got stationary at first difference. All three unit root tests end up with a result that variables contain unit root at level and got stationary at first difference.

6.2. Co-integration test

After getting the level of integration for all the series, now second step is to find co-integration among the variables. Two commonly used co-integration techniques are Engle and Granger: two step method and Johansen co-integration test. For this study I have applied a very well-known test of co-integration proposed by Johansen and Juselius (1990).

H0 = No co-integration

H1 = co-integration

This test is based upon two statistics first is Trace statistics and second is Maximum Eigen-value statistics. Both statistics pinpoint the number of co-integrating vectors. I conduct co-integration test in bivariate as well as in a multivariate model. Co-integration results for bivariate models are given as under:

Table: 2 JOHANSEN CO-INTEGRATION TEST

Johansen Co-integration test for Bivariate Models						
Model 1	No of Co-integrating Equations	Trace Statistic	Eigen Value Statistic	Model 2	Trace Statistic	Eigen Value Statistic
KSE100=REER	None	11.44568 (0.1855)	9.210486 (0.2691)	**KSEI00=NEER**	5.823627 (0.7163)	5.742744 (0.6464)
	At Least 1	2.235192 (0.1349)	2.235192 (0.1349)		0.080883 (0.7761)	0.080883 (0.7761)

Discussion

Table: 2 sketches the results of Johansen co-integration for both bivariate models. Outcome for Model 1 of KSE100 index and REER, from both the Trace statistics and Maximum Eigen-Value statistics concluded that no long-run relationship is observed as values of both statistics fails to reject null hypothesis of no co-integration. Table:1 also depicts the results of Model 2 constructed between KSE100 and NEER in this case both test statistics also fails to detect any co-integrating vector. In both of the bivariate models we fail to reject the null hypothesis of no co-integration. Our findings are consistent with the findings of Granger et al (2000) who conduct a Gregory and Hansen co-integration test and found no co-integration between exchange rate and stock prices in Asian countries. Ibrahim (2000) used Johansen co-integration test for bivariate model and failed to find any relationship between two variables in Malaysian economy. Abdalla and Murinde (1997) found no linkage between stock prices and exchange rate in Korea and Pakistan. Zhao (2010) in his analysis on Chinese economy could not establish any association between two markets. Smyth and Nanda (2003) analyze the relationship between stock prices and exchange rate in Pakistan, India, Bangladesh, and Sri-Lanka but remained unsuccessful in finding co-integration. Nieh and Lee (2001) demonstrated no association among two variables. Mookerjee and Yu (1997) suggested no long-run relationship between stock market and exchange rate market in Singapore economy. Yau and Nieh (2006) also failed to demonstrate long-run association between stock market and exchange rate markets in Taiwan and Japan. Findings of this study also shows inconsistency with the results of Sim and Chang (2008) who found negative relationship, Vygodina (2006) reveled long-run relationship between two markets, Diamandis and Drakos (2011) postulate positive association among the two variables, Phylaktis and Razzolo (2005), fold up strong linkage between stock price and exchange rate. Hasing Yu and Hsieh (2012) found negative association between stock market and exchange rate. Bruce Morley (2007) suggested long-run association between stock price index and exchange rate. Aggarwal (1981) contend positive linkage between the variables. Results of this research are not so different from other studies conducted on Pakistan's economy where null hypothesis cannot be rejected. Results of multivariate co-integration test of Model3 and Model 4 are discussed in the table 3 here under:

Table: 3- JOHANSEN CO-INTEGRATION TEST

Johansen Co-integration test for multivariate Models						
Model 3	No of Co-integrating Equations	Trace Statistic	Eigen Value Statistic	**Model4**	Trace Statistic	Eigen Value Statistic
KSE100=REER,M2,TR,BR,CPI	None	128.6311* (0.0001)	53.07218* (0.0010)	**KSE100=NEER,M2,TR,BR,CPI**	130.2415* (0.0000)	52.30316* (0.0013)
	At least 1	75.55892 (0.0162)	26.88370 (0.2696)		77.93835 (0.0097)	29.80778 (0.1419)
	At least 2	48.67522** (0.0418)	25.19691*** (0.0980)		48.13057** (0.0471)	24.19705 (0.1280)
	At least 3	23.47831 (0.2234)	14.89077 (0.2966)		23.93352 (0.2033)	14.69319 (0.3110)
	At least 4	8.587537 (0.4049)	8.215672 (0.3572)		9.240323 (0.3436)	8.450266 (0.3348)
	At least 5	0.371865 (0.5420)	0.371865 (0.5420)		0.790058 (0.3741)	0.790058 (0.3741)

Note: * ** and * shows 1%, 5%, and 10% significance level respectively**

The above table shows the Johansen co-integration test for the following two models

$$lKSE_t = \alpha_0 + \alpha_1 lREER_t + \alpha_2 lM2_t + \alpha_3 lTR_t + \alpha_4 lBR_t + \alpha_5 lCPI_t + v_t$$

$$lKSE_t = \pi_0 + \pi_1 lNEER_t + \pi_2 lM2_t + \pi_3 lTR_t + \pi_4 lBR_t + \pi_5 lCPI_t + x_t$$

Johansen co-integration results for 3rd model suggests that there is a long-run co-integrating relationship among the stock price and macroeconomic variables. At none both the Trace and Eigen-value statistics are significant at 1% level of significance and rejects the Null hypothesis of no co-integration. In at least 1 co-integrating relationship, the results of Trace statistics reject the Null hypothesis of no co-integration whereas the maximum Eigen-value statistics accepts the Null hypothesis. For At least 2 co-integrating equations the trace statistics again ends with the rejection of Null hypothesis at 5% significance level. Whereas the Null Hypothesis of no co-integration is rejected for at least three, four, and five co-integrating equations. Trace statistics suggests three co-integration equations whereas Eigen-value statistics suggest one co-integrating vector. When there is conflict between Trace statistics and Maximum Eigen-value statistics then Trace test statistics shows most robust results to both Skewness and Kurtosis in innovations (Cheung and Lai [1993]). Johansen and Juselius (1990) are also in favor to rely on the Trace Test statistics in case conflict arises between the two statistics. So consistent with the reason I also rely on the Trace statistics. Results of both statistics expose Long-run association among all the variables.

Johansen co-integration results for model 4 contends that there exists a long-run co-integration relationship among stock prices (KSE100), exchange rate (NEER), Money supply (M2), Total Reserves (total reserves minus gold), interest rate (Bank/Discount rate), and Inflation (CPI). At none Null hypothesis is rejected at 1% significance level in both statistics. Trace statistics also rejects the Null Hypothesis for At least 1 and 2 co-integrating equations.

So, concluding upshot of multivariate Johansen co-integration test is that there are 3 co-integrating equations that show a strong long-run association between stock prices and macroeconomic variables. It was obvious from the results that stock prices and exchange rate do not exhibit a co-integrating relationship in a bivariate structure but when other variables (M2, TR, BR and CPI) are including in the model then exchange rate variable get significant and shows a long term association with the stock prices. The absence of long-run relationship in a bivariate structure might be due to the lapse of some essential and theoretically muscular variables from the model.

Results of this study shows consistency with the findings of Ibrahim (2000) for Malaysia, Horobet (2009). Hsing (2002), Rantanapakorn and Sharma (2007), Humpe and Macmilan (2009) for Japan, Hwang (2003) Sim and Chang (2008) for China, Hye et al (2009) for Pakistan and Wongbangpo and Sharma (2002) for five Asian economies, whereas, results are inconsistent with Lin (2012) who revealed no long-run association among macroeconomic variables.

6.3: Fully Modified Ordinary Least Square

In above section long-run association has been tried to find while co-integration framework does not estimate regression coefficients. To find the log-run elasticity and to estimate the regression coefficients, Fully Modified Ordinary Least square method (FMOLS) is being used which is applied when co-integrating relationship exists among the variables. This has been applied on multivariate models as there exists a long-run relationship among the variables. Both bivariate models do not exhibit long-run association so FMOLS can not be applied on these two models. FMOLS's results are displayed in table 4 and 5.

Table: 4 FULLY MODIFIED ORDINARY LEAST SQUARE

FMOLS Results for Model 3

$$lKSE_t = \gamma + \gamma lREER_t + \gamma lM2_t + \gamma lTR_t + \gamma lBR_t + \gamma lCPI_t + v_t$$

Variables	Coefficient	t-value	p-value
REER	1.331255**	2.171252	0.0313
M2	4.717531*	15.58177	0.0000
TR	-0.334384*	-4.115692	0.0001
BR	0.031254**	2.073231	0.0397
CPI	-5.143600*	-11.32450	0.0000
C	-41.24064*	-11.09072	0.0000

Note: * ** and *** shows 1%, 5%, and 10% significance level respectively

Discussion:

Table: 4 presents the FMOLS results for the model 3 which depicts that 1% increase in Real effective exchange rate will increase Stock prices (KSE100) by 1.331255%. 1% increase in Money supply (M2) will compel the Stock prices (KSE100) to increase by 4.717531%, whereas there is a inverse relationship between Total reserves (TR) and Stock index (KSE100) as 1% increase in Total reserves will bring about a decrease in Stock price index (KSE100) by 0.334384%. Similarly Consumer price index (CPI) also shows negative relationship with KSE100 as 1% rise in CPI will bring a 5.143600% fall in KSE100. Results concluded a positive relationship between Bank/Discount rate and KSE100 as 1% increase in BR ends up with 0.031254% an increase in KSE100.

Table 5 portrays the results of Fully Modified Ordinary Least Square for Model 4.

Table: 5 FULLY MODIFIED ORDINARY LEAST SQUARE

FMOLS Results of Model 4

$$lKSE_t = \pi + \pi lNEER_t + \pi lM2_t + \pi lTR_t + \pi lBR_t + \pi lCPI_t + x_t$$

Variables	Coefficient	t-value	p-value
NEER	1.571536*	2.420602	0.0166
M2	4.408414*	14.37482	0.0000
TR	-0.349291*	-4.390673	0.0000
BR	0.025388***	1.754374	0.0812
CPI	-3.426374*	-4.420315	0.0000
C	-45.49901*	-8.737105	0.0000

Note: * ** and *** shows 1%, 5%, and 10% significance level respectively

Discussion

Results of FMOLS for model 4 are statistically significant against 1% level of significance. 1% increase in Nominal effective exchange rate (NEER) will bring 1.571536% increase in Stock index KSE100. Similarly 1% rise in Money Supply and Bank rate ends up with an increase in Stock index by 4.408414% and 0.025388% respectively. It is obvious from the results that 1% rise in Total reserves will bring 0.349291% fall in Stock price index. Likewise 1% increase in Consumer price index leads 3.426374% fall in stock price. FMOLS results concluded that in Pakistan exchange market has positive long run impact on stock price index in multivariate models. Results are consistent with the hypothesized relationship between stock price and exchange rate. This result is consistent with the findings of Khan and Zaman (2012) in Pakistan, Ratanapakorn and Sharma (2007), Aggarwal (1981), Diamandis and Drakos (2011), Phylaktis and Ravazzolo (2005) , Wongbangpo and Sharma (2002) declared positive linkage in Indonesia, Phillipines, and Malaysia, however negative relationship was observed in case of Thailand and Singapore but shows inconsistency with the findings of Hsing Yu (2002), Hsing and Hsieh (2012) in Poland and Sim and Chang (2008) they found negative alliance between stock prices and exchange rate. In Pakistan Positive and significant long-run relationship is found between stock price and money supply this result also matched with my hypothesized relationship. Positive association between stock market index and money supply shows consistency with the outcomes of Hsing Yu (2002) in South Africa, Baharumshah et.al (2009). Ratanapakorn and Sharma (2007) Choudhry (1996) in Canada and Wongbangpo and

Sharma (2002) who predicated positive impact of money supply on stock prices in Malaysia, Thailand and Singapore while negative effect was found in Phillipines and Indonesia. Findings of research are inconsistent with the results of Humpe and Macmillan (2009) in their study on USA and Canada which disclosed that money supply has no effect on the stock price index in USA while for Japanese stock price index money supply showed negative impact. Furthermore, it depicts from the results that, as study hypothesized stock prices and total reserves show a negative long-run association in the context of Pakistan. Results are consistent with the findings of Horobet Alexender (2009) in Romania who found negative relationship between stock prices and reserves. Moreover, unlike the theoretical and hypothesized relationship interest rate is positively related with stock market index which is in line with the results of Ratanapakorn and Sharma (2007), Wongbangpo and Sharma (2002) for Malaysia and Indonesia and Ray (2012) for India. Whereas results are inconsistent with the outcomes of Hsing Yu (2002), Hsing and Hsieh (2012) for Poland, Humpe and Macmillan (2009) for USA and Gjerde and Saettem (1999) they found stock prices are negatively affected by interest rates. Finally, results of FMOLS depict negative long run association among stock prices and inflation as per my hypothesized relationship. Result are consistent with the findings of Hsing Yu (2002), Khan and Zaman (2012) for Pakistan, Al-Tamimi and Rehman (2012) for UAE financial market, Hsing and Hsieh (2012) for Poland, and Humpe and Macmillan (2009) for USA. However findings are inconsistent with the outcomes of Ratanapakorn and Sharma (2007) who disclosed positive linkage between stock price index and inflation, Al-Khazali (2004) postulated positive long-run association between stock prices and inflation in nine economies moreover Ray (2012) found that inflation has failed to show any significant linkage with stock prices.

6.4 Granger Causality Results

After getting the results of co-integration that suggests that no long-run co-integrating relationship exists between stock prices and exchange rate, when this relationship was investigated in a bivariate context. However, when study includes other economic variables in a model then exchange rate got significant and shows long term association with stock prices. Multivariate context help to reduce potential omitted variables bias that could have arisen in the bi-variant case. This model see the impact of exchange rate (REER, NEER), money supply (M2), Reserves, inflation and interest rate on the stock price. Using a standard Granger Causality test to find the direction of causation between stock price and exchange rate measures the results are presented in Table: 6 below.

Table: 6 GRANGER CAUSALITY TEST

Bivariate Granger Causality/ Block Exogeneity Wald test			
Model 1	$lKSE_t = \alpha + \alpha lREER_t + \mu_t$	**Model 2**	$lKSE_t = \alpha + \alpha lNEER_t + \varepsilon_t$
Null Hypothesis		**Null Hypothesis**	
REER doesn't cause KSE	18.30968 (0.0106)*	**NEER doesn't cause KSE**	15.51624 (0.0299)*
KSE doesn't cause REER	8.333053 (0.3041)	**KSE doesn't cause NEER**	9.389319 (0.2259)

Note: * ** and * shows 1%, 5%, and 10% significance level respectively**

Discussion

Results of Granger causality in both bivariate models are given above in table 6. It was observed that null hypothesis of real effective exchange rate (REER) do not Granger causes Karachi stock exchange index (KSE100) is rejected at 1% significance level whereas the Null hypothesis that KSE100 do not causes REER cannot be rejected so there was found a unidirectional causality running from REER to KSE100. The Granger results of model 2 also depict a unidirectional causal linkage that runs from Nominal effective exchange rate (NEER) to stock prices (KSE100).

Hence, it is concluded that in both bivariate models, evidence of unidirectional causality from exchange rate to stock price is being found. Results are consistent with Ray (2012 for India. Ibrahim (2000) for Malaysia and Abdalla and Murinde (1997) who found unidirectional causality that runs from exchange rate to stock prices in Korea, India, and Pakistan. Pan et al (2007) also disclosed a unidirectional causality in which exchange rate leads stock indexes for Hong Kong, Japan, Taiwan, Singapore, and Korea while causality from stock prices to exchange rate was observed in Malaysia. Symth and Nandha (2003), reveled unidirectional causality from exchange rate to stock price for India and Sri-Lanka but failed to find any causality between stock price and exchange rate in Pakistan and Bangladesh. After a univariate causal linkage we move towards a multivariate Granger causality test. Results are portrays in following

Table: 7 GRANGER CAUSALITY TEST

	KSE	REER	M2	TR	BR	CPI
Dependent variable						
KSE	-	16.10727* (0.0242)	7.519916 (0.3768)	6.803518 (0.4496)	7.149736 (0.4135)	13.58319** (0.0591)
REER	24.97514* (0.0008)	-	23.30867* (0.0015)	9.947813 (0.1916)	5.212011 0.6341	24.37977* 0.0010
M2	20.83889* (0.0040)	7.031418 (0.4256)	-	11.86272 (0.1052)	2.882182 (0.8957)	34.24618 (0.0000)
TR	10.14421 (0.1805)	13.27200** (0.0658)	2.385282 (0.9355)	-	3.297486 (0.8562)	19.20249* (0.0076)
BR	6.670964 (0.4639)	10.19981 (0.1775)	11.05645 (0.1362)	25.07745* (0.0007)	-	3.201480 (0.8658)
CPI	7.606453 (0.3686)	3.670475 (0.8169)	20.53810* (0.0045)	8.374404 (0.3007)	2.753650 (0.9068)	-
Dependent variable						
KSE	-	13.31508*** 0.0648	7.641514 0.3653	5.943501 0.5464	7.638419 0.3656	12.25516*** 0.0925
NEER	22.90701* (0.0018)	-	18.98555*** (0.0082)	5.070710 (0.6513)	4.489622 (0.7220)	23.81429* (0.0012)
M2	17.63535** (0.0137)	8.043301 (0.3288)	-	9.111959 (0.2447)	2.914913 (0.8928)	33.08036* (0.0000)
TR	9.313305 0.2309	15.55618** 0.0295	2.587822 0.9203	-	3.476679 0.8377	18.58527* 0.0096
BR	7.480747 0.3806	8.567591 0.2852	10.35516 0.1693	26.44763* 0.0004	-	2.772784 0.9052
CPI	7.847702 0.3462	2.837876 0.8996	20.27820* 0.0050	8.872555 0.2619	2.779249 0.9046	-

Note: * ** and * shows 1%, 5%, and 10% significance level respectively**

Discussion

Granger causality results for multivariate models are given in the above table. The output of the Granger Causality/ Block Exogeneity Wald test turn up that there exists a bidirectional causality between stock prices and real effective exchange rate consistent with the results of Aydemir and Demirhan (2009) for Turkey, Broome and Morley (2004) for East Asia, Lin (2012) for India, Korea, and Indonesia, Ajaiyi et al (1998) and Granger et al (2000) for Hong Kong, Malaysia, Taiwan, Thailand, and Singapore while inconsistent for South Korea (unidirectional causality from stock prices to exchange rate), Philippines (causality from exchange rate to stock prices), Indonesia (no causal linkage) and Japan (no causal linkage). Study found unidirectional causality that runs from inflation (Consumer price index) to stock price and are consistent with the outcomes of Erdem (2005), Rantanapakorn and Sharma (2007) for USA, and Apergis and Eleftheriou (2002). Result of this study shows inconsistency with the findings of Ray (2012) (who disclosed unidirectional causality running from stock price to inflation) and Wongbangpo and Sharma (2002) (find feedback causality between stock prices and inflation in Indonesia, Philippines, Singapore, Malaysia and Thailand). Unidirectional Causality from stock prices to money supply is observed which is consistent with the findings of Mookerjee and Yu (1997), whereas inconsistent with the results of Chuodhry (1996) and Ray (2012) who discovered bidirectional causal linkage between stock prices and money supply. Results are also inconsistent with Ibrahim (2000), (unidirectional causality from money supply to stock prices) and Wongbangpo and Sharma (2002) who found bidirectional causality between stock prices and money supply in case of Indonesia, Malaysia, and Thailand whereas unidirectional causality was revealed from money supply to stock prices in Philippines and Singapore. However interest rate fail to show any causal relationship with stock prices and findings are consistent with Ray (2012) for Indian economy but inconsistent with the findings of Choudhry (1996) who find bidirectional causality between interest rate and stock prices in Canada & USA and Erdem et al (2005) discovered unidirectional causality running from interest rate to stock prices. Reserves also fail to show any significant causal relationship with stock prices in Pakistan this result shows inconsistency with the findings of Ibrahim (2000) and Ray (2012) who found bidirectional causality between reserves and stock prices. Furthermore, bidirectional causal linkage is also observed between money supply and consumer price index. Unidirectional causal relationship was observed running from money supply to real effective exchange rate, consumer price index to real effective exchange rate, real effective exchange rate to Total reserve, consumer price index to total reserve, and total reserves to bank rate. Granger result for Model 4 depicts the same results as mentioned above for model 3 but differ only in their significance level.

7. Conclusions

This research sheds light on the long-run relationship between stock prices and macroeconomic variables (exchange rate, money supply, reserves, interest rate and inflation). Two measures of exchange rate were used i.e. real effective exchange rate and nominal effective exchange rate. Augmented Dickey Fuller, Phillip Perron and KPSS unit root test, Johansen co-integration test, FMOLS and Granger Causality tests are econometric techniques employed in this paper. Study did not observe long-run relationship between stock price and exchange rate in bivariate models whereas stable long-run co-integration is observed between stock prices and macroeconomic variables in multivariate structure. Results indicate that exchange rate, money supply and interest rate are positive determinants of stock prices whereas negative impact of reserves and inflation is depicted over stock price. Among the outcome of interest, bidirectional causality is exposed between exchange rate and stock prices and between consumer price index and money supply. Unidirectional causal relationship is found between stock prices and inflation that runs from inflation to stock prices whereas it is stock price that granger causes money supply. However interest rate and reserves fails to establish any causal linkage with stock prices. Furthermore, unidirectional causality found that is running from money supply to real effective exchange rate, consumer price index to real effective exchange rate, real effective exchange rate to Total reserve, Consumer price index to Total reserve, and Total reserves to Bank rate.

8. Implications of study

1. This study found a long-run relationship between macroeconomic variables and stock prices which enables the local and foreign investors to take successful investment decisions. Understanding of relationship between stock prices and macroeconomic variables will help investors to adjust or manage their portfolios in more efficient manner.
2. For the development of stock market authorities are required to follow the movements of developed Stock markets for better decisions and development of equity market.
3. Stock market authorities can closely contemplate stock market activities to avoid stock prices manipulation and encourage general public to make investment in stock market by educating them.
4. To manage the explanatory variables (exchange rate, money supply, reserves, interest rate and inflation) of stock prices that are significant, that needs optimum policy options by the policy makers.
5. The major implication of these findings in case of policy making were suggested that Governments of these emerging markets should take due care while implementing exchange rate policies that have effect on their stock markets.

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