Empirical Analysis of Long and Short Run Relationship among Macroeconomic Variables and Karachi Stock Market: An Auto Regressive Distributive Lag (ARDL) Approach

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Abstract  
This study analyzes the long and short run relationship between the Karachi stock market index and a set of macro-economic variables using the data from 2003 to date of inflation, exchange rate and interest rates; the Auto Regressive Distributed Lag technique is used to find the long-run Co-integration relationship of the model and Ordinary Least Square and Vector Error Correction techniques are applied for the analysis of the long and short-run relationship between the Macroeconomic variables and Karachi Stock Market, the Co-integration and granger casualty test is used to verify the results. Detailed analysis show that long run Co-integration relationship does exist between stock prices and the macro-economic variables in the Karachi stock market (evidence from the significance of Wald test. While by applying the Error Correction Model the stock market has short run relationship with interest rates and exchange rates. These results confirm that the investor can predict the future behavior of the stock market by analyzing the trends and behavior of these macroeconomic variables. And in future Pakistan’s economy will be going through struggling times that will eventually affect the stock market, to retain the investor’s confidence. In this major part of the financial sector, government policies regarding the interest rates and controlling the inflation would be of immense importance.

Keywords: Stock Market; ARDL; Bound Testing Approach; Macroeconomics
I. Introduction

In the overall economic activity, the role of the financial sector cannot be neglected, which acts as a catalyst in boosting the economic activity in a country. The financial sector has two major sub sectors: one is the banking sector and the other is the money market, which include the stock market, bond market, money market, etc., all of them are included in the broader stock market.

Several studies have been conducted to enhance the efficiency of the stock market and then its inter relationship with the real economic activity such as (Levine & Zervos, 1996) and (Fama, 1981, 1990), who examined the relationship between the stock market and its effect on the overall economic activity, but most of these studies are conducted on the developed markets where all aspects are more efficient, and well connected with the overall economy. The total market capitalization is 90 to more than 100% of the Gross Domestic Product (GDP) of the countries. There are very few studies analyze the relationship in the developing and emerging markets.

Stock markets add up to the liquidity of the financial system, while providing an alternative. It also diversifies the risk of an investor, the risk is even more diversify when the stock market is internationally integrated, it mobilizes the savings and is a major source of information about the companies listed in the stock market, in addition to that the stock market development can be judged by different factors, its total market capitalization relative to the GDP, the total value of the trade to the GDP, its international integration and the stock market indices which combines all the above measures. The mentioned measures always rise and fall due to the movement in the fundamentals of the market as well as some external macro-economic variables.

The stock market in Pakistan is still in the stage of development and had to grow even further to play its due role in influencing the real economic activity in Pakistan. According to Hussain (2006) the stock market in Pakistan cannot be characterized as the leading indicator of the economic activity. The study clearly specifies that it lags economic activity. It seems that the phenomenal growth in stock market variables like market capitalization, trading volume, the market index, etc., do not seem to influence the economy of Pakistan.

This paper examines the long-term as well as the short run relationship between the macroeconomic variables and the Karachi stock market indices. The objective of the study is to analyze that whether changes in the macroeconomic environment or its variables brings fluctuations in the stock market and whether there is a relationship between them. In this study this index is compared and its relation with different macro-economic variables, that include exchange rates, Inflation and Interest Rates.

II. Literature Review

Numerous studies have analyzed how stock prices react to changes in macro-economic variables. Fama (1981) examined the impact of individual factors such as inflation, real activity and interest rates on stock prices, the study also finds a strong positive correlation between common stock returns and real variables (i.e. industrial production, GNP, the money supply, lagged inflation and the interest rate) by investigates the relationships between stock prices and real activity, inflation, and money. Fama (1990) argued that stock price reflects expectations of earnings, dividends, interest rates,
and information about future real economic activity may be reflected in the stock price before it occurs. Moreover, stock returns will affect the wealth of investors which in turn affect the level of consumption and investment.

The relationship between stock market and economic growth has been studied by Levine (1991), and Levine and Zervos (1996), these studies have suggested that stock market development affect economic growth in developing countries. According to Levine and Zeros (1996) the stock Market effect the economic growth in different ways, which includes, liquidity, risk diversification, information acquisition about firms, corporate control, and savings mobilization. Thus, some theories provide a conceptual basis for believing that larger, more liquid, more efficient stock markets boost economic growth.

Levine and Zevos (1988) reported a very strong and positive correlation between stock market development and economic growth. Levine and Zevos (1995) have suggested that stock market development affect economic growth in developing countries. As the economy grows, economic development should result in stock market development and banking sector development and the banking and equity sectors, in the long run, become complementary sources of finance (Spyrou and Kassimatis, 1994). Big liquid and well-functioning markets foster growth and profit incentives, enhance corporate governance and facilitate risk management. The World Bank (2001) provides a comprehensive summary of the available evidence, which also reaches similar conclusions. It argues strongly that the evidence should be interpreted as clearly suggesting that “both development of banking and financial markets help economic growth: each can complement the other (Arestis et al. 2005).

The Effect of Exchange Rates

The impact of exchange rate changes on the economy will depend to a large extent on the level of international trade and the trade balance. Hence the impact will be determined by the relative dominance of import and export sectors of the economy (Mayasami et al. 2004).

The issue of whether stock prices and exchange rates are related or not have received considerable attention after the East Asian crises. During the crises the countries affected saw turmoil in both currency and stock markets. If stock prices and exchange rates are related and the causation runs from exchange rates to stock prices then crises in the stock markets can be prevented by controlling the exchange rates (Muhammad and Rasheed, 2001).

Exchange rate movement affects the value of a firm’s real assets, regardless whether it has any foreign operations. According to Fama (1981) Exchange rate has a double-edged sword effect. A devaluation of the currency against foreign currencies increases export as the exporting products would become cheaper and increase their demand, hence improves cash flow and dividend payoff for firms that rely on exports. On the other hand, a depreciation of domestic currency increases the cost of imported goods and decreases cash flow and dividend payoff for firms that rely on imports. The relationship between stock prices and value of the domestic currency for these firms should be positive. Hence, the relationship between exchange rate and stock prices is an empirical one (Hua, Liu and Shrestha, 2008).
According to Aliyu et al. (2009), an increase in domestic stock prices lead individuals to demand more domestic assets. To buy more domestic assets local investors would dispose foreign assets, which are relatively less attractive now, causing local currency appreciation. Equally, an increase in wealth due to a rise in domestic asset prices will also lead investors to increase their demand for money, which in turn raises domestic interest rates. This again leads to appreciation of domestic currency by attracting foreign capital. Another channel for the same negative relationship is increase in foreign demand for domestic assets due to stock price increase. This would also cause a domestic currency appreciation. Changes in exchange rates affect international competitiveness and trade balance, thereby influencing real economic variables such as real income and output. Thus a given domestic currency depreciation makes local firms more competitive internationally, leading to an increase in their exports. A rise in the foreign exchange inflow – income, in turn raises their stock prices. In the same way studies proved that exchange rate is non-significant factor in explaining development of stock prices (Liu and Shrestha, 2008).

The Effect of Interest Rates

Several studies have established the fact that the interest and the stock prices are closely related. According to Nishat and Shaheen (2004) any increment in the interest rate would cause a substitution in the stocks and the interest bearing security and the investor would shift from stocks to the interest bearing securities and this change would cause a change in the cash flow of the asset thus decreasing the demand for the stocks, while on the other hand a change in the required rate of return would certainly have an inverse effect on the stock market, thus a change in the nominal interest rate would the stock prices in the opposite direction.

Mayasami et al. (2004) in their study based on the Singapore stock market suggested that (1) interest rates can influence the level of corporate profits which in turn influence the price that investors are willing to pay for the stock through expectations of higher future dividends payment. Most companies finance their capital equipment and inventories through borrowings. A reduction in interest rates reduces the costs of borrowing and thus serves as an incentive for expansion. This will have a positive effect on future expected returns for the firm; (2) as substantial amount of stocks are purchased with borrowed money, hence an increase in interest rates would make stock transactions more costly. Investors will require a higher rate of return before investing. This will reduce demand and lead to a price depreciation.

The businesses enjoy the ability to finance expansion at a cheaper rate, thereby increasing their future earnings potential which intern leads to higher stock prices (Deimante et al. 2008). A decrease in the interest rates means that those people who wants to borrow enjoys an interest rate cut. But this also means that those who are lending money, or buying securities such as bonds, have a decrease opportunity to make income from interest. If we assume the investors as rational, a decrease in interest rates prompts investors to move money away from the bond market to the equity market (Walti, 2005).

Changes in the interest rate affect the investors required rate of return, i.e. the discount rate, and therefore stock prices. Because of this relationship, it is expected that interest rate and stock prices should have a negative relationship. Furthermore, changes in
both short-term and long-term rates are expected to affect the discount rate in the same
direction (Liu and Shrestha, 2008).

The Effect of Inflation

The relationship between stock return and inflation has inspired both theoretical
and empirical studies. The study conducted by (Merikas and Merika, 2006) suggesting
that an increase in the employment forecasts inflation which is expected to erodes firms
profits, this is expressed through falling stock prices (a case of German stock market),
while GDP has positive coefficient with high economic as well as statistical significance.
An expanding economy strengthens expectations about firm profitability and increases
stock returns, investment exerts a negative influence on stock returns through an increase
in aggregate demand and the consequent expected inflationary pressures.

The presence of co-integration between stock prices and macroeconomic variables
indicate long-run predictability of the Malaysian equity prices. In other words, at least in
the long run, movements in the Malaysian equity market are tied to its economic
fundamentals. Moreover, the dynamic responses of the stock prices to changes in
macroeconomic variables especially its lagged responses to real economic activity spell
inefficiency in the Malaysian equity market (Ibrahim and Aziz, 2003). Among the most
important determinants of the conditional volatility of the Australian stock market are
found to be the conditional volatilities of inflation and interest rates which are directly
associated with stock market volatility, and the conditional volatilities of industrial
production, the current account deficit and the money supply which are indirectly
associated with stock market conditional volatility (Kearney and Daly, 1998).

According to Naceur et al. (2005) in their study of twelve MENA region countries
examines the impact of financial intermediary development on stock market
capitalization. They found that saving rate, financial intermediary (especially credit to
private sector), stock market liquidity (especially the ration of value traded to GDP) and
the stabilization variable (inflation change) are the important determinants of stock
market development, while income as well as investment does not prove to be significant.
In addition, we find that financial intermediaries and stock markets are complements
rather than substitutes in the growth process.

III. Research Methodology

The Data

The data used in the research covers the time span from January 2003 to April
2009 monthly data. The data is obtained from the publications and reports of the state
bank of Pakistan, the bureau of statistics, International Financial Statistics published by
International Monetary Fund, publications of the world bank and web site of trading
economics while the data on the Karachi Stock Market 100 Index (KSE 100) is obtained
by the publications and reports of Karachi Stock Market. The macro economic variables
used for the study are the Interest Rates (IR), Inflation (Consumer Price Index CPI) and
exchange rates.

Methodology

To examine the relationships between focused variables study employs the
autoregressive distributed lag model (ARDL) suggested by Pesaran et al. (2001) for co-
integration investigation (time series data) and error correction (short run) analysis. One
of the advantages of using this technique is that it does not consider the problems arising from the different order of integration of the variables. We use variables in natural logarithm form to assess the significance of the relationship among the macroeconomic variables and the stock market of Pakistan. To investigate the relationship between Karachi Stock market and the three Macroeconomic variables, the following equation is modeled.

\[
\ln(KSE) = \alpha + \beta \ln(H) + \delta \ln(INF) + \gamma LN(ER) + \mu_t
\]  

(1)

**Testing for Stationary**

As most of the economic time series exhibit non-stationary and the using regression analysis give us spurious and unreliable estimates, for that reason first we have to make the series stationary of the same order, if the series are not integrated at the same level then it’s justified to use the ARDL methodology for the long-run estimation. The testing procedure for the ADF test is applied to the model.

\[
\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \ldots + \delta_p \Delta y_{t-p+1} + \epsilon_t
\]  

(2)

The unit root test is then carried out under the null hypothesis \( \gamma = 0 \) against the alternative hypothesis of \( \gamma < 0 \).

**Bound Testing Approach**

The use of the bounds technique is based on three validations. First, Pesaran et al. (2001) advocated the use of the ARDL model for the estimation of level relationships because the model suggests that once the order of the ARDL has been recognized, the relationship can be estimated by OLS. Second, the bounds test allows a mixture of I(1) and I(0) variables as regressors, that is, the order of integration of appropriate variables may not necessarily be the same. Therefore, the ARDL technique has the advantage of not requiring a specific identification of the order of the underlying data. Third, this technique is suitable for small or finite sample size (Pesaran et al., 2001).

ARDL approach for Co-integration is preferable to other conventional Co-integration techniques such as that of Engle and Granger (1987) and Gregory and Hansen (1996). One of the reasons for preferring the ARDL is that it is applicable irrespective of whether the underlying regressors are purely I(0), I(1), or mutually co-integrated. The statistic underlying this procedure is the familiar Wald or F-statistics in a generalized Dickey-Fuller type regression, which is used to test the significance of the lagged levels of the variables under consideration in a conditional Unrestricted Equilibrium Error Correction Model (UECM) (Pesaran et al., 2001). The model used for the testing the long-run relationship of the model is given as:

\[
\Delta \ln(KSE) = \beta_0 + \sum_{p} \beta_{1p} \Delta \ln(KSE)_{t-p} + \sum_{p} \beta_{2p} \Delta \ln(H)_{t-p} + \sum_{p} \beta_{3p} \Delta \ln(INF)_{t-p} + \sum_{p} \gamma p \Delta \ln(ER)_{t-p} + \sum_{p} \mu_{p} \Delta \epsilon_{t-p} + \epsilon_t
\]  

(3)

After regression of Equation (3), the Wald test \( (F\text{-statistic}) \) was computed to differentiate the long-run relationship between the concerned variables. The Wald test
can be carry out by imposing restrictions on the estimated long-run coefficients. The null and alternative hypotheses are as follows:

\[ H_0 = \beta_1 = \beta_2 = \beta_3 = 0 \text{ (no long-run relationship)} \]

Against the alternative hypothesis
\[ H_0 \neq \beta_1 \neq \beta_2 \neq \beta_3 \neq 0 \text{ (a long-run relationship exists)} \]

The computed \( F \)-statistic value will be evaluated with the critical values. The lower bound critical values assumed that the explanatory variables \( x_t \) are integrated of order zero, or I(0), while the upper bound critical values assumed that \( x_t \) are integrated of order one, or I(1). The model is further tested for the diagnostic tests of Serial Autocorrelation, Heteroskedasticity, and Stability.

**Testing for long and short run coefficients**

The ECM version of modified ARDL is used to investigate the short run dynamic relationships. All this will be done through the ECM (Error Correction Mechanism) applied through the Ordinary Least Square (OLS) method. The lagged value of first difference of KSE, inflation, Exchange rates and interest rates on lagged values are our explanatory variable of KSE with error correction variable at first difference as follow.

\[
\Delta(\ln\text{KSE})_{t} = \alpha + \sum_{i=1}^{r} \beta_i \Delta(\ln\text{KSE})_{t-i} + \sum_{i=1}^{r} \gamma_i \Delta(\ln\text{INF})_{t-i} + \sum_{i=1}^{r} \delta_i \Delta(\ln\text{ER})_{t-i} + \sum_{i=1}^{r} \zeta_i \Delta(\ln\text{IR})_{t-i} + \text{ECT}_{t-1}
\]

The same equation is also estimated to test the short-run relationship though the VECM from the VAR estimation technique. While the long-run coefficients are estimated through the OLS equation given by:

\[
\ln(\text{KSE}) = \alpha + \beta_1 \ln(\text{IR}) + \beta_2 \ln(\text{INF}) + \beta_3 \ln(\text{ER}) + \beta_4 \ln(\text{ER}) + \mu
\]

**Diagnostic tests**

The model that has been used for testing the long-run relationship and coefficients is further tested with the diagnostic tests of Serial Autocorrelation, Heteroskedasticity and any model misspecifications.

**Stability tests**

The stability of the model and the coefficients are checked through the CUSUM and CUSUM-Q, while the graphical presentation of the recursive coefficients is used to judge the stability of the coefficients.

**Robustness check**

To check the robustness of the obtained results from the above mentioned techniques, Co-integration and granger are used to analyze the long and short-run relationship among the variables these are the alternatives to test the relationship, and the significance in these results will justify and validate the results of our analysis.

**IV. Empirical Results and Discussion**

The results of the analysis are organized in a sequential order as first some important descriptive stats are presented second the test of Stationarity is applied through
ADF and PP; we have to check for the lag selection criteria; and in the end we examine the long-run relationship of the model through ARDL and short run relationship of the variables through ECM through OLS and VECM, giving both long and short-run coefficients.

**Descriptive Statistics**

Table 1 presents the descriptive state of the initial data used for the analysis; the data is slightly skewed for the KSE and the inflation while positively skewed for the rest of the two variables. While the data for the inflation is normal while for the rest of the variables it is non-normal.

<table>
<thead>
<tr>
<th>Variable</th>
<th>KSE</th>
<th>Interest rate</th>
<th>Exchange rates</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>8.95</td>
<td>2.21</td>
<td>4.14</td>
<td>2.09</td>
</tr>
<tr>
<td>Median</td>
<td>9.07</td>
<td>2.20</td>
<td>4.10</td>
<td>2.13</td>
</tr>
<tr>
<td>Maximum</td>
<td>9.64</td>
<td>2.71</td>
<td>4.40</td>
<td>3.23</td>
</tr>
<tr>
<td>Minimum</td>
<td>7.81</td>
<td>2.02</td>
<td>4.08</td>
<td>0.34</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>0.48</td>
<td>0.21</td>
<td>0.09</td>
<td>0.64</td>
</tr>
<tr>
<td>Jarque-Bera (Probability)</td>
<td>5.51</td>
<td>10.70</td>
<td>76.90</td>
<td>2.92</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables</th>
<th>ADF without trend</th>
<th>ADF with trend</th>
<th>PP without trend</th>
<th>PP with trend</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test Statistic</td>
<td>Test Statistic</td>
<td>Test Statistic</td>
<td>Test Statistic</td>
</tr>
<tr>
<td></td>
<td>At level</td>
<td>1st difference</td>
<td>At level</td>
<td>1st difference</td>
</tr>
<tr>
<td>KSE</td>
<td>-0.42</td>
<td>-9.94***</td>
<td>-2.43</td>
<td>-10.40***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-2.19</td>
<td>-10.91***</td>
<td></td>
</tr>
<tr>
<td>Exchange Rates</td>
<td>-3.85***</td>
<td>-5.78***</td>
<td>-2.03</td>
<td>-6.47***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-1.99</td>
<td>-6.59***</td>
<td></td>
</tr>
<tr>
<td>Interest Rates</td>
<td>-1.83</td>
<td>-9.43***</td>
<td>-1.65</td>
<td>-9.79***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-1.57</td>
<td>-9.95***</td>
<td></td>
</tr>
<tr>
<td>Inflation</td>
<td>-1.07</td>
<td>-7.13***</td>
<td>-1.79</td>
<td>-7.09***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-2.10</td>
<td>-7.07***</td>
<td></td>
</tr>
</tbody>
</table>

*represents significant level of .10(10%), ** significance level of .05(5%) and *** as the significance level of .01(1%). ADF and PP represents the Augmented Dickey Fuller and Phillip Peron tests for stationary with and without trend at level and first difference.
**Bound Testing**

Before applying the method of bound testing for the Wald statistics the regression based on equation 3 is run shown in table 3 by taking the difference or the change in the variables the change in the lag value and the lag value of the of all the variables and keeping the difference of KSE as dependent variable. After that we put restriction on the coefficients of the lag values shown in table 4. The results of the regression run for the purpose of bound testing are given in table 3, while the Wald and the F-statistic for the ARDL are given in table 4. Through the results it is clear that both the statistics are significant and are indicative of the long run relationship in the model. ARDL F-statistics and Wald-statistics push to accept the hypothesis of Co-integration in the model.

**Table 3: Estimation of the Model ARDL**

<table>
<thead>
<tr>
<th>Dependent Variable: Δ(KSE), Method: Least Squares</th>
<th>Coefficient</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>103.89</td>
<td>2.386</td>
<td>0.020</td>
</tr>
<tr>
<td>Δ(KSE)</td>
<td>-0.132</td>
<td>-1.129</td>
<td>0.263</td>
</tr>
<tr>
<td>Δ(INF)</td>
<td>-73.95</td>
<td>-0.66167</td>
<td>0.517</td>
</tr>
<tr>
<td>Δ(INF)</td>
<td>-18.587</td>
<td>-0.177</td>
<td>0.860</td>
</tr>
<tr>
<td>Δ(IR)</td>
<td>-13.56</td>
<td>-0.347</td>
<td>0.730</td>
</tr>
<tr>
<td>Δ(IR)</td>
<td>-61.02</td>
<td>-1.795</td>
<td>0.077</td>
</tr>
<tr>
<td>Δ(ER)</td>
<td>-15.74</td>
<td>-0.934</td>
<td>0.354</td>
</tr>
<tr>
<td>(KSE)</td>
<td>17.358</td>
<td>0.101</td>
<td>0.920</td>
</tr>
<tr>
<td>(INF)</td>
<td>-0.243</td>
<td>-3.393</td>
<td>0.001</td>
</tr>
<tr>
<td>(IR)</td>
<td>74.282</td>
<td>1.306</td>
<td>0.197</td>
</tr>
<tr>
<td>(ER)</td>
<td>75.96</td>
<td>2.827</td>
<td>0.006</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.189</td>
<td>F-statistic</td>
<td>2.551</td>
</tr>
<tr>
<td>Durbin-Watson stat</td>
<td>2.134</td>
<td>Prob(F-statistic)</td>
<td>0.009</td>
</tr>
</tbody>
</table>

KSE, INF, IR and ER represent Karachi Stock Exchange, Inflation, Interest Rates and Exchange Rates while t-1 is the Lag value and Δ represents the change in the variable. The estimated model is presented by:

\[
Δ(KSE)_t = β_0 + β_1(INF)_{t-1} + β_2(IR)_{t-1} + β_3(ER)_{t-1} + \sum \beta_4 Δ(INF)_{t-2} + \sum \beta_5 Δ(IR)_{t-2} + \sum \beta_6 Δ(ER)_{t-2} + \sum \beta_7 Δ(INF)_{t-3} + \sum \beta_8 Δ(IR)_{t-3} + \sum \beta_9 Δ(ER)_{t-3} + \sum \beta_{10} Δ(INF)_{t-4} + \sum \beta_{11} Δ(IR)_{t-4} + \sum \beta_{12} Δ(ER)_{t-4} + \sum \beta_{13} Δ(INF)_{t-5} + \sum \beta_{14} Δ(IR)_{t-5} + \sum \beta_{15} Δ(ER)_{t-5}
\]

**Table 4: Bound Testing for ARDL Co-integration**

<table>
<thead>
<tr>
<th>Null Hypothesis:</th>
<th>C(8)=0, C(9)=0, C(10)=0, C(11)=0</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-statistic</td>
<td>3.46</td>
</tr>
<tr>
<td>Probability</td>
<td>0.013</td>
</tr>
<tr>
<td>Chi-square</td>
<td>13.82</td>
</tr>
<tr>
<td>Probability</td>
<td>0.008</td>
</tr>
</tbody>
</table>

The restriction was imposed on the coefficients of (KSE)_{t-1}, (INF)_{t-1}, (IR)_{t-1} and (ER)_{t-1}

**Result of Long and short-Run relationship**

To test the short-run and long-run relationship among the variables the OLS and the VECM models are estimated, the short-term ECM estimation are given in table 5, the coefficients of the exchange rates is significant while the error correction term with its lag
value is also significant and shows that 22% of the errors from the lags are absorbed in the next period which shows that there is short term error correction in the model.

The long-term relationship among the variables is estimated through the OLS the coefficients obtained from the model are all significant and shows the long-run relationship of the variables among the coefficients the exchange rates shows negative value while the rest of the two variables have positive coefficients. The model showed evidence of Autocorrelation which have been removed through adding an Autoregressive term within the model.

Table 5: OLS and ECM Estimation Results

<table>
<thead>
<tr>
<th>ECM Estimation, Dependent Variable: ∆(KSE), Method: Least Squares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
</tr>
<tr>
<td>-----------------------</td>
</tr>
<tr>
<td>C</td>
</tr>
<tr>
<td>∆(INF)</td>
</tr>
<tr>
<td>∆(IR)</td>
</tr>
<tr>
<td>∆(ER)</td>
</tr>
<tr>
<td>(ECT)_{t-1}</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
</tr>
<tr>
<td>Durbin-Watson stat</td>
</tr>
</tbody>
</table>

KSE, INF, IR and ER represent Karachi Stock Exchange, Inflation, Interest Rates and Exchange Rates while ECT is the Error Correction Term. The estimated model is presented by:

\[
\Delta(\text{KSE})_t = \beta_0 + \sum_{i=1}^{n} \beta_i \Delta(\text{KSE})_{t-i} + \sum_{i=1}^{n} \beta_i \Delta(\text{INF})_{t-i} + \sum_{i=1}^{n} \beta_i \Delta(\text{IR})_{t-i} + \sum_{i=1}^{n} \beta_i \Delta(\text{ER})_{t-i} + (\text{ECT})_{t-1} + \epsilon_t
\]

Table 6: OLS Estimation Results

<table>
<thead>
<tr>
<th>OLS Estimation, Dependent Variable: KSE, Method: Least Squares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
</tr>
<tr>
<td>-----------------------</td>
</tr>
<tr>
<td>C</td>
</tr>
<tr>
<td>INF</td>
</tr>
<tr>
<td>IR</td>
</tr>
<tr>
<td>ER</td>
</tr>
<tr>
<td>AR(1)</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
</tr>
<tr>
<td>Durbin-Watson stat</td>
</tr>
</tbody>
</table>

The model has a reliable value for the R-Squared, while the Durban-Watson showed no evidence of serial Autocorrelation, while the rest of the results are presented in the diagnostic section.

Diagnostic Tests

The diagnostic test run on the residuals of the long-run equation presented in the table 6 indicates no evidence of Serial Autocorrelation, the Breusch-Godfrey with the null hypothesis of no serial Autocorrelation is accepted, while the white test for Hetroskedasticity also indicates no evidence of Hetroskedasticity.
Table 7: Diagnostic tests based on OLS (long-run relationship) estimation

<table>
<thead>
<tr>
<th>Test</th>
<th>F-statistic</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breusch-Godfrey Serial Correlation LM Test: Serial Autocorrelation</td>
<td>2.25</td>
<td>0.11</td>
</tr>
<tr>
<td>White Heteroskedasticity Test:</td>
<td>1.30</td>
<td>0.25</td>
</tr>
<tr>
<td>Obs*R-squared</td>
<td>4.66</td>
<td>0.09</td>
</tr>
<tr>
<td>Ramsey RESET Test: Model Misspecification</td>
<td>0.84</td>
<td>0.36</td>
</tr>
<tr>
<td>Log likelihood ratio</td>
<td>0.89</td>
<td>0.35</td>
</tr>
</tbody>
</table>

The test for checking the model specification i.e. the Ramsey RESET for model specification also indicates that the model has no evidence of any misspecification.

**Stability Test**

Graphical representations of CUSUM and CUSUM square are shown in figure 1 and 2 for the long-run OLS model. According to Bahmani and Oskooee, (2004) the null hypothesis (i.e. that the regression equation is correctly specified) cannot be rejected if the plot of these statistics remains within the critical bounds of the 5% significance level.

![CUSUM Curve](image1)

**Figure 1 CUSUM Curve**

As it is clear from Fig. 1 and 2, the plots of both the CUSUM and CUSUM square within the boundaries and hence these statistics confirm the stability of the long run coefficients of regressors.

![CUSUM of Squares Curve](image2)

**Figure 2 CUSUMsq Curve**
Also from figure 3, we can judge the stability of the coefficients; it is clearly evident that the individual coefficients of the model are also stable and are within the boundary of the critical limits.

**Robustness Check**

As the long and the short-run relationship of the model and the variables are tested through the techniques of ARDL and the OLS and VECM respectively, the robustness of the results is tested through the Co-integration and the GRANGER techniques.

The test of Co-integration from table 7 indicated the presence of two Co-integration vectors in the model which is in agreement with our results obtained through the ARDL Co-integration technique which also supports the presence of long-run relationship within the model.

**Table 8: Johansen Co-integration Test**

<table>
<thead>
<tr>
<th>Eigenvalue</th>
<th>Likelihood Ratio</th>
<th>5 Percent Critical Value</th>
<th>1 Percent Critical Value</th>
<th>Hypothesized No. of CE(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.40</td>
<td>86.34</td>
<td>53.12</td>
<td>60.16</td>
<td>None **</td>
</tr>
<tr>
<td>0.26</td>
<td>48.54</td>
<td>34.91</td>
<td>41.07</td>
<td>At most 1 **</td>
</tr>
<tr>
<td>0.25</td>
<td>26.93</td>
<td>19.96</td>
<td>24.60</td>
<td>At most 2 **</td>
</tr>
<tr>
<td>0.08</td>
<td>6.38</td>
<td>9.24</td>
<td>12.97</td>
<td>At most 3</td>
</tr>
</tbody>
</table>

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 3 Co-integration equation(s) at 5% significance level
The granger test also supports the results as evident from table 8, that all the three macroeconomic variables granger causes the KSE. Inflation, interest rates and the exchange rates does have a causal relationship with the KSE which is indicative of the short-run causal relationship among the macroeconomic variables and the Stock Market.

Table 9: Granger Causality

<table>
<thead>
<tr>
<th>Pair wise Granger Causality Tests, Lags: 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Null Hypothesis: Inf Granger Cause KSE</td>
</tr>
<tr>
<td>INF does not Granger Cause KSE</td>
</tr>
<tr>
<td>Obs 14  F-Statistic 6.91  Probability 0.001</td>
</tr>
<tr>
<td>IR does not Granger Cause KSE</td>
</tr>
<tr>
<td>Obs 14  F-Statistic 6.55  Probability 0.002</td>
</tr>
<tr>
<td>ER does not Granger Cause KSE</td>
</tr>
<tr>
<td>Obs 14  F-Statistic 5.24  Probability 0.01</td>
</tr>
</tbody>
</table>

In Pakistan however the major contributor evident from the short-run estimation is the exchange rates through the VECM, which has relationship both in the long and short run, and has an inverse effect on the stock market as proved through the literature, while the stock market does exhibit causal relationship with the real economic activity, also evident from the ARDL model estimation the Stock Market has significant relationship with the lag values of the Interest Rates and the exchange rates. It shows that the long run relationship between the macro economic variables and stock market. Any news about the changes in the macroeconomic environment brings changes in the overall behavior of the stock market.

The Effect of Exchange Rates

The exchange rates has a long run relationship and in case of Pakistan it does effect the movements of the stock prices of the firms that relies on the imports, in the short run it does have an effect as was proved in the study by Muhammad and Rasheed, (2001) as the local currency depreciates against other major currencies, for the firms that rely on the imports their costs increases, which reduces their cash inflows and reduces the relative dividends, hence reduces the stock prices. As Pakistan’s currency is always under pressure from the major foreign currencies so the firms relying on the imports are under constant pressure, and heavily rely on government support and subsidies.

While the exporting firm’s does benefit from the depreciating currency. Although the increased competition and local inflationary pressure makes it difficult as the inflation rates in Pakistan is much higher and it erodes the increase in the corporate profits that the exporting firms get from the depreciating currency, which is not the case with other strong economies like the Singapore which benefits from this effect (Maysami et al. 2004).

The Effect of Inflation

The inflation has a long run effect on the stock market, the effect is increase in inflation causes a shift from investment towards consumption which puts a negative impact on the stock returns, secondly increase in inflation causes the tightening of the monetary policy, which increases the risk free and the discount rate, which causes a shift from investments in the stock market to the more safer and less riskier investments. An increase in inflation raises the nominal risk-free rate and the discount rate in the equity valuation model. The effect of a higher discount rate would be neutralized if cash flows
increase with inflation. However, cash flows may not rise as fast as inflation again putting pressure on the stock market in a negative and inverse relation.

**The effect of Interest Rates**

The interest rate is the only variables which exhibit both long and short run effect on the stock market. The relationship between the interest rates and the stock market is found to be negative. Liu & Shrestha (2008) and Adam *et al.* (2008) also found the negative relationship between stock prices and the interest rate. The interest rate affects investors’ required rate of return which is used to discount the expected future cash flows associated with holding stocks. Secondly the with the decrease in the interest rates the rate of return on the Risk Free Assets decreases, which pushes the investors to invest in the stock market which promises more returns, hence increasing the stock prices and the index. The increase in the interest rates has the opposite effect on the stock market.

**V. Conclusion and Suggestions**

This study examined the long run and short run relationship between selected macroeconomic variables and the Karachi Stock Market, using different statistical analysis of ARDL and Error Correction Model for the short-run and OLS for the long-run coefficients and confirms that there exist a relationship between different economic variables and the Stock Market, the results showed that all the macroeconomic variables i.e. exchange rates and interest rates has impact on the stock market in the short run while all the three macroeconomic variables has long-run impact on the stock market index and the Karachi Stock Market does react to the changes in the macro economic variables, despite the fact that the market is immature, a highly speculative, and has a high degree of volatility, by examining the movements in the interest rates and exchange rates in the short run and overall macroeconomic activity in the long run the investors can use the changes in the economic indicator for prediction about the movements of the market and hence formulate their strategy in accordance with those changes.

Our results prove the long and short run relationship and interconnection between macroeconomic variable and stock market. It also confirms the existence of long run relationship. The overall macroeconomic environment does effect the movement in the stock prices.

**References**


