MACROECONOMIC VARIABLES AND STOCK MARKET PERFORMANCE: TESTING FOR DYNAMIC LINKAGES WITH A KNOWN STRUCTURAL BREAK

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Abstract

This paper investigates the dynamic interactions between four macroeconomic variables and stock prices in Pakistan, using cointegration and Granger causality tests that are robust to structural breaks. The results strongly suggest cointegration between the stock prices and macroeconomic variables viz. consumer prices, industrial production, exchange rate and the market rate of interest. Estimates of bivariate error-correction models reveal that there is long-run bidirectional causation between the stock prices and all the said macroeconomic variables with the exception of consumer prices that only lead to stock prices. The results also provide some evidence that the stock prices are Granger-caused by changes in interest rates in the short run. However, the analysis is unable to explore any short-run causation between the stock prices and the remaining three macroeconomic variables. It may therefore be stated that the association between the health of the stock market in the sense of rising share prices and the health of the economy is only a long-run phenomenon.

JEL Classification: C22, C32, G15

Keywords: Stock Returns; Exchange Rates; Interest Rates; Industrial Output; Prices; Economic Activity; Structural Breaks; Additive-Outlier Model

1. INTRODUCTION

The equity market is a market where the shares in publicly owned companies are traded. The equity market, like many other financial intermediaries, facilitates transfer of funds from surplus spenders (savers) to deficit spending (investors). Thus, the equity market mobilizes and channels idle resources in

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the economy to most productive use, leading to efficient allocation of capital. Debt was the preferable source of finance for industrial enterprises in the past; however, today, equity and quasi-equity are attractive instruments of finance. A stable and well-regulated equity market is necessary to enhance activities among financial elements. If equity market is efficient, firms can easily raise funds by issuing securities. Stock exchange is expected to accelerate economic growth by increasing liquidity of financial assets, making global risk diversification easier for investors, promoting wiser investment decisions based on available information, forcing corporate managers to work harder to increase the wealth of shareholders, attracting foreign portfolio investment and channeling more savings to corporations in a more effective way.

An efficient and well functioning equity market may facilitate the economic growth and development process in an economy through the following means: (1) Augmentation of household saving, (2) Efficient allocation of investment resources, and (3) Alluring foreign portfolio investment. The stock market encourages households to save and invest in financial instruments on one hand and, on the other hand, it provides easy financing to those firms who need long-term capital for investment projects. The stock market rallies both the players providing the facilities for trading of stocks. The stock market thus channels funds from savers to investors with higher efficiency. Similarly, a well-established equity market attracts foreign investors. Foreign portfolio investment inflows raise share prices up and reduce the cost of capital to corporations of the domestic country by lowering the price-earning ratio.

Moreover, an efficient pricing process rewards well-managed and profitable firms by highly valuing their shares. It lowers the cost of capital for such firms. A reduction in the cost of capital leads to great and better allocation of resources in the economy and a canalization of funds to well-managed and profitable firms instead of unprofitable and unsuccessful firms. The stock market is thus the focus of researchers and policy makers because of the perceived benefits it provides the economy.

The issue whether the stock market performance leads or follows economic activity is now becoming very controversial in Pakistan as the stock market has gained much attraction in the last few years. Almost all the indicators such as market capitalization, trading volume, total turnover and the market index have shown tremendous growth. These developments are often claimed by the authorities to be an indication of economic progress of the country. It would be useful to examine whether these developments have influence the health of the economy.

This study attempts to examine whether there are long-run and short-run dynamic interactions between stock prices and some important macroeconomic variables namely industrial production, consumer prices, exchange rates and interest rates, for Pakistan using cointegration and the Granger causality procedures, which are robust to structural breaks in both the deterministic and cointegration vector. The study also explores the direction of causation in case a long/short-run association is found. If stock prices and macroeconomic variables are significantly related and the causation runs from macroeconomic variables to stock prices, then crises in stock markets can be prevented by controlling fluctuations in macroeconomic variables (specifically, controlling exchange rates and interest rates movements). The government can focus on domestic economic policies to stabilize the stock market during any financial crisis.

Moreover, authorities in developing countries can exploit such a link to attract/stimulate foreign portfolio investment in their own countries by making returns to investment in one's own country more attractive to foreign investors[1]. Finally, if the stock market and macroeconomic variables are associated, speculators can use this information to predict the behavior of the stock market using the information on macroeconomic variables[2]. On the other hand, if the causation runs from the stock market to macroeconomic variables then the speed of the economic activities (and hence economic growth) can be boosted by taking some measures that are necessary for a stable and well-regulated equity market.

Most of the empirical literature that has examined the stock price-macroeconomic variables relationship has focused on only three macroeconomic variables such as exchange rates, interest rates, and prices. The results of these studies are, however, inconclusive. A large number of studies have failed to establish any well-defined association between the stock market and macroeconomic variables owing more to the lack of econometrics accuracy rather than to any economic inefficiency. For example, the studies by Nishat and Saghir (1991) and Ahmed (1999) reported a unidirectional causality from stock prices to consumption expenditure for Pakistan and Bangladesh respectively, whereas Mookerjee (1988) observed the opposite case in India. Likewise, Mookerjee (1988) and Ahmed (1999) reported a unidirectional causality from stock prices to investment spending for India and Bangladesh respectively, whereas the opposite case is reported by Nishat and Saghir (1991) for Pakistan.

Regarding the causal relationship between stock prices and economic ac-

[1] Total returns to foreign investors include return in the foreign exchange market as well, i.e., buying and selling of foreign currency.

[2] Investors can use this information for speculation and to hedge their return on foreign investment.

tivities, Mookerjee (1988) found evidence that GDP leads stock prices in India whereas Nishat and Saghir (1991) reported the opposite evidence for Pakistan. On the other hand, Ahmed (1999) found proof that the Index of Industrial Production (IIP) leads stock prices in Bangladesh. Similarly, another study by Husain and Mahmood (2001) reported that stock prices lag economic activity and thus cannot be characterized as the leading indicator of the economy in Pakistan.

The strategy of this study is as follows. Section one contains the introduction. The second section attempts to explain the theoretical links between stock market and macroeconomic variables. The empirical model is also the part of this section. Section three briefly reviews the previous empirical work. The limitations of the previous studies in this area are given in Sub-section 3.1. Section four outlines the estimation techniques. Section five covers estimation. Finally, key findings and concluding remarks follow in section six.

2. THEORETICAL BACKGROUND

In this section, the study provides a theoretically justification for the link between the stock market and macroeconomic variables. It is stated that an exogenous increase in stock prices causes an increase in consumption expenditures and an output through an increase in wealth and investment. Then, the study explains the channels through which exogenous changes in macroeconomic variables affect stock prices. Finally, a graphical example illustrates the association between stock prices and macroeconomic variables.

2.1 The Effect of the Stock Market on Macroeconomic Variables

The effect of an increase in stock prices on expenditures (and, hence prices) is explained by Mishkin (2001) as follows. On one hand, an exogenous increase in stock prices leads to increased investments by firms. The value of a firm's equity increases its stocks prices while the prices of new equipment remain unchanged in the short run. As a result, investment becomes relatively cheaper and companies will tend to invest more. Hence, investment is a function of stock prices:

Investment = f (borrowing/lending rate, stock price)

here stock prices have a positive while the borrowing/lending interest rate has a negative impact on investment because a rise in interest makes investment funding more costly. On the other hand, an increase in stock prices will affect positively the value of financial assets held by households, leading to an increase in household wealth and therefore consumption. Thus,

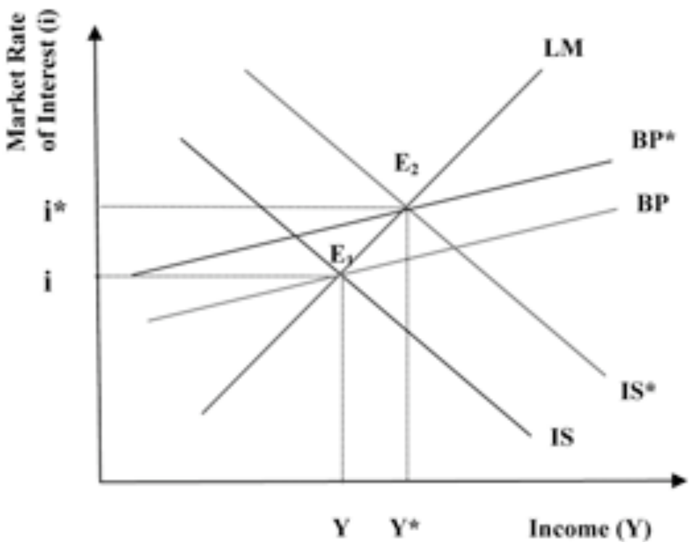
$$C = f\,(\lambda(Y - T),\, W(SP))$$

where C is consumption expenditures, Y is gross domestic income, SP is stock prices, T is taxes, W is households' wealth, and λ is the marginal propensity to consume.

Regarding foreign exchange and interest rates, the effect of stock prices may be hypothesized as follows. The exogenous increase in domestic stock prices leads to an increase in the domestic investors' wealth. According to portfolio theory, a higher domestic wealth stimulates the demand for money that will result in an increase in domestic interest rate. Resulting from a higher interest rate, the capital inflows will be increased and more capital inflows definitely do appreciation of domestic currency (a decrease in exchange rate).

The association between stock prices and macroeconomic variables is illustrated in more detail using the open economy Mundell-Fleming framework as follows (see Figure 1). The BP curve represents the accounting identity of the balance of payments account. If a country has negative trade balance (current account), it has essentially borrowed money from abroad, which would be consistent with a positive capital account. Since it is assumed high but imperfect capital mobility, the BP schedule thus is sloping upward.

Figure 1: Response to a Stock Market Shock



The liquidity for money (LM) curve shows all possible combinations of domestic income and market rate of interest at which money market is in equilibrium. It reflects the idea that a rise in domestic income raises the demand for money balance. For a fixed money supply, the money market will therefore be at a new equilibrium point with a higher inertest rate. Hence, the LM curve is sloping upward. The investment-saving (IS) locus represents the goods market equilibrium (savings equals to investment). The IS curve is sloping downward because a lower market rate of interest makes borrowing relatively cheaper, so firms invest more, and hence expenditure and output (both are equal in equilibrium) are higher. All three markets are in equilibrium at point E_1.

An exogenous increase in stock prices shifts the IS curve rightward (upwards) by increasing the level of expenditure for a given interest rate. The LM schedule is not affected by a change in stock prices. Thus, owing to a positive shock to stock prices, the new domestic equilibrium is at point E_2, higher output and higher interest rates. This new equilibrium point is above the BP schedule, which indicates that for a given output level (Y), the interest rate at point E_2 is higher than the one consistent with a balanced account. A higher interest rate leads to a rise in capital inflows, which results in a surplus in the balance of payments account because the adjustment in imports takes time.

For a given level of prices, the capital inflows, however, cause appreciation of domestic currency. An appreciation of domestic currency definitely raises the currency account disparities and thus the balance of payments is restored back to zero. An increase in value of domestic currency (a decrease in exchange rate) is consistent with an upward shit of the BP schedule (see in the figure – BP to BP*). The new equilibrium at point E_2 is consistent with a higher expenditure level, higher interest rates, lower domestic exchange rate and higher stock prices.

2.2 The Effect of Macroeconomic Variables on the Stock Market

The health of the economy can affect the stock market performance in several ways. For example, the Arbitrage Pricing Theory attempts to establish a link between risks associated with a particular macroeconomic variable and expected asset returns. Economic forces affect the discount rates, the ability of firms to generate cash flows and future dividend payments. It is through this mechanism that macroeconomic variables become part of risk factors in the equity market. An increase in output is seen as an indicator of a booming economy by investors and tends to boost investment. A higher demand for loan able funds results in a rise in the real interest rate, which reduces the present value of a firm's future cash flows and causes stock prices to fall. Likewise, "Flow-oriented" models hypothesize a positive association between output and stock prices via exchange rate.

These models posit that currency movements affect international competitiveness of firms and trade balance, which in turn affect output, real income, and eventually stock prices. An exogenous increase in another macrocosmic variable, namely consumption, has a negative impact on stock prices via an upward change in prices. Expectations of inflation affect stock prices negatively because investors take it as bad news. Based on the theoretical discussion above, the factors that influence stock prices can be identified as follows:

$$Stock\ \mathrm{Prices} = f\,(\underset{+}{output},\ \underset{-}{exchanger\ rate},\ \underset{-}{\mathrm{int}erest\ rate},\ \underset{+/-}{\mathrm{inf}lation})$$

Based on the theoretical background outlined in this section, the next section derives an empirical model to examine links between stock market and the key macroeconomic variables.

2.3 Empirical Model

As mentioned by well knows theories[3], stock prices are influenced simultaneously by output, interest rates, price level, and exchange rates. Thus, the model is specified as follows:

$$GSPI_t = \beta_0 + \beta_1 NEX_t + \beta_2 MIR_t + \beta_3 MOI_t + \beta_4 CPI_t + e_t \qquad (1)$$

where β_0, β_1, β_2, β_3 and β_4, are parameters and e_t is a random perturbation with zero mean and constant variance. *GSPI* is the General Share Price Index, *NEX* is the nominal exchange rate measured in units of the domestic currency per unit of the foreign currency, *MIR* is the market rate of interest, *MOI* is the Manufacturing Output Index and *CPI* is the Consumer Price Index. The core objective of the study is to examine whether the variables in (1) are co-integrated. If they are co-integrated, this provides evidence in support of the as-

[3] These variables are included in the model based on the well-known theory viz. the arbitrage theory, portfolio theory, flow-oriented models to exchange rate determination, etc. Industrial production is used as a proxy for output. Some studies (for example, Dimitrova (2005) and Naka, Mukherjee and Tufte (2001)) also included money supply along with theses variables, however, this study does not include money supply as an explanatory variable in model specification to avoid the multicollinearity. Nevertheless, its effect is already captured by money market rate.

sociation between the stock market and the said macroeconomic variables. The error-correction form of the above model is employed to examine the bivariate causality between stock prices and macroeconomic variables.

3. REVIEW OF LITERATURE

Dimitrova (2005) uses a multivariate, open-economy, short-run model to test the hypothesis that in the short-run, un upward trend in the stock market may cause currency depreciation, whereas weak currency may cause decline in the stock market. His study included stock prices, exchange rates, domestic output, interest rates, current account balance, oil prices and foreign output in model specification. The study uses monthly data from the United States and the United Kingdom over the period from January 1990 to August 2004. Using OLS regression analysis, the author found a positive link between stock prices and exchange rates when stock prices are the lead variable, and likely negative, when exchange rates are the lead variable. His results provided evidence that stock prices have a positive impact on domestic output and that inflation rate is negatively associated with stock prices.

Hsing (2004) adopts a structural VAR model originally proposed by Sims (1986) to study how fluctuations of macroeconomic indicators affect stock prices in Brazil. The author finds that there is a negative relationship between stock prices and output in the short run, which turns into an unambiguous positive relationship in the long run.

Ibrahim and Aziz (2003) estimated a vector auto-regression model to explore the dynamic links between stock prices and four macroeconomic variables for the case of Malaysia. Empirical results of the analysis suggested the presence of a long-run relationship between these variables and the stock prices and substantial short-run interactions among them. They also stated that the stock market is playing a somewhat predictive role for macroeconomic variables.

Hondroyiannis and Papapetrou (2001) estimated multivariate VAR model to test whether movements in the indicators of economic health affect the performance of the stock market for Greece. Their study covers the period from January 1984 to September 1999 with monthly observations. They used five variables as indicator of economic activity, i.e., industrial production as a proxy for output, real oil prices, money market rate, exchange rate, and the performance of the foreign stock market (difference between the continuously compounded return on S&P 500 Index and the USA inflation rate).

The major finding of the study is that domestic economic activity affects the performance of domestic stock market. The study carried out the Impulse response analysis to examine the response of the stock market performance to change the domestic economic activity. The results provided evidence that all the said macroeconomic variables are important in explaining stock price movements. Growth in industrial production responds negatively to real stock return shocks. Finally, they reported that real stock returns respond negatively to interest rate shocks, while a depreciation of the currency leads to higher real stock market returns.

Naka et al. (2001) examined the long run equilibrium relationship among selected macroeconomic variables and the Bombay Stock Exchange index. The study uses data for the period 1960:1 to 1995:4 for India on the following macroeconomic variables; namely, the industrial output, prices, money supply and the money market rate in the Bombay inter bank market. They found that the said five variables are cointegrated and there exists three long-term equilibrium relationships among theses variables. Moreover, the authors reported that inflation is the most severe deterrent to Indian stock market performance.

Soenen and Johanson (2001) investigated the effects of changes in the consumer price index on industrial production and stock market returns for China. Six different types of Chinese shares are examined for the period 1994-1998. Their results provided evidence that there is a very significant positive relationship between inflation and real output. A positive and significant association is found between stock returns and real output in current periods. Moreover, they found that Inflation has no significant impact on Chinese real stock returns.

Habibullah and Baharumshah (2000) used Toda and Yamamoto (1995) methodology to establish the lead and lag relationship between the Malaysian stock market and macroeconomic variables. The study used quarterly data for the sample period 1981:1 to 1994:4. Their study includes five macroeconomic variables namely money supply, gross national product, price level (Consumer Price Index), interest rate (3-month Treasury bill rate) and exchange rate (real effective exchange rate). The results of the analysis indicates that stock prices lead nominal income, the price level and the exchange rate, but money supply and interest rate lead stock prices.

3.1 The Limitations of the Previous Studies

Based on the above literature review, one may conclude that empirical evidences on the relationship between stock prices and macroeconomic variables are not rich enough as well as conclusive. Many of the studies are subject to serious criticism. For instant, only a few studies have examined the time-series properties of the variables involved[4]. Moreover, most studies have employed OLS regression analysis to examine the above relationship. Recent development in the time series literature has criticized this technique and suggested the use of cointegration tests. Due to these methodological weaknesses, a large number of previous studies have failed to examine the true relationship between stock prices and exchange rates.

4. ECONOMETRIC METHODOLOGIES AND DATA

4.1 Unit Root Tests with Structural Breaks

Some shocks at macro and even at micro level have permanent effects and there is no tendency to return to a stable value. Thus, if a series characterized by stationary fluctuations with a one-time permanent change in level, the usual tests for a unit root are biased and provide misleading results. To avoid this problem, Perron (1990) propose a number of statistics to test the unit-root hypothesis allowing for possible presence of a one-time change in mean. He reports that if the breaks are known, the Augmented Ducky-Fuller (ADF) test could be adjusted by including dummy variables in ADF regression.

The sample period for this study, which was selected to investigate the association between stock prices and exchange rates, has a structure break on May 28, 1998 when Pakistan conducted a nuclear test. The performance of stock market and the health of the economy were unsympathetically affected by this nuclear test. Therefore, there is possibility a one-time permanent change in mean of the stock price and the macroeconomic variables series. In such scenario, the Additive-Outlier method developed by Perron-Vogelsang (1992) is employed to test the unit root hypothesis for the said variables. Below we briefly discuss the Additive-Outlier test statistic.

The Additive-Outlier Model

Let a univariate time series denoted by X_t, $t = 1, 2, \ldots, T$ which has a shift in mean at time T_b, $1 < T_b < T$ and can be described by:

[4] The presence of nonstationary variables in an econometric model may have serious consequences on both the estimation method and the statistical properties of commonly used estimators such as OLS.

$X_t - \mu_1 = \beta_1(X_{t-1} - \mu_1) + \xi_t$ when $t \leq T_b$, and

$X_t - (\mu_1 + \mu_2) = \beta_1(X_{t-1} - (\mu_1 + \mu_2)) + \xi_t$ when $t > T_b$

where ξ_t is a error term with zero mean and a constant variance. The parameter β_1 is assumed to be the same in all sub-samples. Under this model, the change is assumed to take effect instantaneously. Thus, the model above is formulated conditionally on the first observations of each sub-sample: X_t and X_{t+1}. When $|\beta_1|<1$ and by $(\mu_1 + \mu_2)$ for $t > T_b$. Under the null hypothesis of a unit root, this model can be rewritten as:

$$X_t = \beta_1(X_{t-1} - (\mu_1 + \mu_2 D_{t-1})) + (\mu_1 + \mu_2 D_t)\ \xi_t \tag{2}$$

where $D_t = 0$ if $t \leq T_b$ and $D_t = 1$ if $t > T_b$. After rearranging, we get the following equation:

$$\Delta X_t = \rho_1 X_{t-1} - \rho_1\mu_1 - \rho_1\mu_2 D_{t-1} + \mu_2\Delta D_t + \xi_t \tag{3}$$

Since $\Delta D_t = 0$ if $t \leq T_b$ or if $t > T_b + 1$, and $\Delta D_t = 1$ if $t = T_b + 1$, the effect of ΔD_t corresponding to the observation X_{T_1+1} is to render the associated residual zero given the initial value in the second sub-sample. Finally, to control the autocorrelation, the test regression (3) should also include both the lags of the first difference of the dependent variable and the lags of the first difference of the intervention dummy.

$$\Delta X_t = \rho_1 X_{t-1} - \rho_1\mu_1 - \rho_1\mu_2 D_{t-1} + \mu_2\Delta D_t + \sum_{i=1}^{m}\eta_1\Delta X_{t-1} + \sum_{i=1}^{m}\gamma_1\Delta D_{t-1} + \xi_t \tag{4}$$

Perron (1990) and Perron and Vogelsang (1992) tabulate the asymptotic distribution of the t-statistic of the estimated coefficient of X_{t-1}, $\hat{\rho}_1$, the null of unit root.

4.2 Cointegration with Structural Breaks

As reported by Park (1990), in the presence of a structural break, the definition of cointegration under consideration falls into the classification of deterministic and stochastic cointegration. Thus, standard cointegration tests (Engle and Granger (1987), Johansen (1988, 1991, 1995), Phillips and Ouliaris (1990), Perron and Campbell (1993), etc) fail to explore any possible cointegration. Hao (1996) generalizes the test of Kwiatkowski et al. (1992) to allow for structural break that shifts the independent term of the cointegration vector. In the present study, I employ the Carrion-i-Silvestre et al. cointegration procedure. Carrion-i-Silvestre et al. (2005) propose a LM-Type statistic to test the null of cointegration allowing for the possibility of a structural break in both the parameters of the deterministic components and the parameters of the stochastic components. Below I briefly discuss this test.

The proposed statistic tests the null hypothesis of cointegration in the model that is a multivariate extension of the one specified by Kwiatkowski et al. (1992), where the deterministic and/or stochastic components are allowed to change at a point of time. According to time series literature, structural change models are of two types: First, the structural changes models, where only the deterministic (intercept) component is allowed to shift. These types of models are called 'the change in mean models'. The second type structural change models are known as the change in regime models. The change in regime models are those where both the deterministic (intercept term) and stochastic (slope term) components suffer change at a particular time (T_b). The dada generating process (DGP) is of the form:

$$X_t = \lambda_t + \Psi t + Z_t^{/}\beta_1 + \xi_t \tag{5}$$

$$Z_t = Z_{t-1} = \xi_t \tag{6}$$

$$\lambda_t = f(t) + \lambda_{t-1} + \eta_t \tag{7}$$

where $\eta_t \sim iid(0,\sigma_\eta^2)$, Z_t is a k-vector of $I(1)$ of regressors. The first value λ_0 is treaded as constant and serves the role of an intercept. Here $f(t)$ as a function collection the set of deterministic and/or stochastic components. The different models under consideration are specified through the definition of the function $f(t)$.

The Change in Mean Models

The change in mean models (only consider the change in deterministic component) are given as follows:

- **Model (A)**, where $\Psi = 0$ and $f(t) = \theta D(T_b)_t$
- **Model (B)**, where $\Psi \neq 0$ and $f(t) = \theta D(T_b)_t$
- **Model (C),** where $\Psi \neq 0$ and $f(t) = \theta D(T_b)_t + \phi DU_t$

where $D(T_b)_t = 1$ for $t = T_b$ and 0 otherwise, $DU_t = 1$ for $t > T_b$ and 0 otherwise, with $T_b = \hbar T, 0 < \hbar > 1$, indicating the date break. As reported by Perron (1998, 1990), the error term series in Model (A) to Model (C) is taken to be of the ARMA(p, q) type with the orders p and q possibly unknown. Thus, under the null hypothesis of cointegration that is $\sigma_\eta^2 = 0$, the model given by (5), (6) and (7) transforms to:

$$X_t = q_i\,(t) + Z_t^{/}\beta_1 + e_t \tag{8}$$

where $q_i\,(t)$, $i = \{A, B, C\}$, denotes the deterministic function under the null hypothesis.

For Model (A), $q_A(t) = \lambda + \theta DU_t$

For Model (B), $q_B(t) = \lambda + \theta DU_t + \Psi t$

For Model (C), $q_C(t) = \lambda + \theta DU_t + \Psi t + hDT_t^*$

where $DT_t^* = (t - T_b)$ for $t > T_b$ and 0 otherwise

The Change in Regime Models

To explore the long-run equilibrium relationship between stock prices and exchange rates, when both the deterministic and the stochastic components suffer a change due to a specific structural break, the study employed the following two models of Carrion-i-Silvestre et al. (2005).

- **Model (D)**, where and $\Psi = 0$ and $f(t) = \theta D(T_b)_t + Z^{/}\beta_2 D(T_b)_t$
- **Model (E)**, where and $\Psi \neq 0$ and $f(t) = \theta D(T_b)_t + hDU_t + Z^{/}\beta_2 D(T_b)_t$

Consequently, under the null hypothesis of cointegration that is $\sigma_\eta^2 = 0$, the model presented by (5), (6) and (7) converts to:

$$X_t = q_i\,(t) + Z_t^{/}\beta_1 + Z_t^{/}\beta_2\, DU_t + e_t \tag{9}$$

where $i = \{D, E\}$, and $q_i\,(t)$ is the deterministic function under the null hypothesis. For model D, $q_D(t) = \lambda + \theta DU_t$ and $q_E(t) = \lambda + \theta DU_t + \Psi t + hDT_t^*$ for model E. As given by Carrion-i-Silvestre et al. (2005), the following steps are involved to test the null of cointegration with alternative no cointegration in the case where the regressors are non strictly exogenous.

1. Estimate

$$X_t = q_i\,(t) + Z_t^{/}\beta_1 + \Delta Z_t^{/}\delta + \sum_{j=-k}^{k} \Delta Z_{t-1}^{/}\gamma_j + e_t \text{ if } i = \{A, B, C\}, \text{ or} \tag{10}$$

$$X_t = q_i\,(t) + Z_t^{/}\beta_1 + Z_t^{/}\beta_2 DU_t + \Delta Z_t^{/}\delta + \sum_{j=-k}^{k} \Delta Z_{t-j}^{/}\gamma_j + e_t \tag{11}$$

when $i = \{D, E\}$, and store the estimated residuals $\hat{e}_{i,t}$, $i = \{A, B, C, D, E\}$.

2. Compute the test statistics as:

$$SC_i^*(\hbar) = \frac{\sum_{t=1}^{T} (S_{i,t}^*)^2}{T^2 \hat{w}_{1.2}^2}$$

where $\hat{w}_1^2$ is a consistent estimator of the long-run variance of $\{e_t\}$ conditioned and $S_{i,t}^* = \sum_{j=1}^{t} \hat{e}_{i,t}^*$, $i = \{A, B, C, D, E\}$[5].

Error Correction Model (ECM)

To test the Granger causality in the presence of structural breaks the study follows the Change and Ho (2002) procedure. A dummy variable is simply included in the standard vector error correction model to capture the impact of a known structural break.

$$\Delta Y_t = \Psi_0 + \lambda_0 B_{t-1} + \sum_{i=1}^{p} \beta_{0i} \Delta Y_{t-1} + \sum_{i=1}^{k} \eta_{0t} \Delta X_{t-1} + \gamma_0 DU_t + \zeta_{0t} \quad (12)$$

$$\Delta X_t = \Psi_1 + \lambda_1 B_{t-1}^* + \sum_{i=1}^{p} \beta_{1i} \Delta X_{t-1} + \sum_{i=1}^{k} \eta_{1t} \Delta Y_{t-1} + \gamma_1 DU_t + \zeta_{1t} \quad (13)$$

where Δ is the first difference operator (i.e., $\Delta Y_t = Y_t - Y_{t-1}$), DU_t is a dummy variable, equals to one for $t > T_b$ (structural break) and 0 otherwise, ζ_{it} is i.i.d with zero mean and finite variance, and B_{t-1} and B_{t-1}^* are lagged residuals obtained from the cointegration regression (eqs. (8) and (9)).

Error-correction models, i.e., equations (12) and (13), can also be used to draw inferences about causality between economic variables. In equation (12), X cause Y if λ_0 is statistically significant (the long-run causality) or the 's are jointly significant (short-run causality). If both λ_0 and λ_1 are statistically significant, this indicates bi-directional long-run causality.

Variable Description and Sample Period

To explore the linkages among stock prices and macroeconomic variables for Pakistan, monthly data is used for the period from June 1994 to March

[5] The critical values for this statistic, which depend on the number of regressors and the break fraction, are provided by Carrion-i-Silvestre et al. (2005)

2005 with a total of 130 observations. The natural logarithm form of General Share Price Index, nominal exchange rate between the Pak rupee and the U.S. dollar, the market rate of interest, the Manufacturing Output Index, and the Consumer Price Index are employed to examine the said relationship. All the indices are based on the year 2000 and are denominated in local currency. All the variables apart from the General Share Price Index are obtained from various issues of International Financial Statistics (IFS) developed by the International Monetary Fund (IFM). The General Share Price Index, however, is attained from various issues of Index Number of Stock Exchange Securities organized by the State Bank of Pakistan (SBP).

5. EMPIRICAL RESULTS

This section is constructed as follows: first the descriptive statistics and the correlation are discussed; next, the time series properties of the data are examined; finally, the cointegration and Granger causality tests are estimated to explore the causal linkages among stock prices and macroeconomic variables.

The descriptive statistics and correlation matrices are presented in Table 1 and Table 2. It can be observed from Table 1 that the mean of all the variables are almost the same during both periods, except for the market rate of interest. The monthly average rate of interest has been decreased significantly during the post-break period. The General Share Price Index is more volatile during the post-break period than the pre-break period. Similarly, during the post-break period, the rate of interest and the index of manufacturing out are modestly volatile relative to the pre-break period. In contrast to this, standard deviation of the nominal exchange rate and the Consumer Price Index during the post-break period is smaller than the pre-break period.

Table 1. Descriptive Statistics for Stock Prices and Macro Variables*

Variables	Pre-Break Period (48 observations)					Post-Break Period (82 observations)				
	GSPI	NEX	MIR	CPI	MOI	GSPI	NEX	MIR	CPI	MOI
Mean	4.99	3.59	2.41	4.34	4.49	4.90	4.02	1.62	4.65	4.75
Std. Dev.	0.15	0.14	0.29	0.12	0.18	0.49	0.10	0.71	0.08	0.23
Skewness	0.47	0.14	-0.62	-0.16	0.50	0.89	-0.89	-0.80	0.41	0.20
Kurtosis	2.59	1.52	3.14	1.75	1.90	2.34	2.64	2.93	2.42	2.04

* All the variables are in natural logarithm form.

The size of kurtosis for all the said variables is less than three, apart from the market rate of interest during the pre-break period. During the post-break period, although the magnitude of kurtosis has significantly improved, it is less than three.

Table 2 provides some fascinating information about the relationship among the variables. The relationship has been changed considerably during the post-break period. The General Share Price Index and nominal exchange rate were negative correlated with a coefficient of -0.87 during the pre-break period. In contrast, both variables moved in same direction during the post-break period. However, the coefficient of correlation (with a magnitude 0.37) is smaller in absolute value than the pre-break period. Similarly, the General Share Price Index and the Consumer Price Index were negatively correlated during the pre-break period and are positively correlated during the post-break period. However, the General Share Price Index is negatively correlated with the rate of interest during the both periods. The correlation coefficient of the General Share Price and the Manufacturing Output Indices has been increased from 0.57 to 0.71 during the post-break period.

It is interesting to note that the correlation between price level and the rate of interest is negative during the post-break period, whereas it was positive during the pre-break period. However, the manufacturing output is positively influenced by the price level during the pre-break and the post-break period as well. It can be observed that the coefficient of correlation is higher, with a magnitude of 0.74 during the latter period, than the former. The coefficients of correlation are providing some evidence of the dynamic interactions between stock prices and the other said variables: a theme that is explored in the next section.

Table 2. Correlation Coefficients

Variables	Pre-Break Period (48 observations)				Post-Break Period (82 observations)			
	CPI	NEX	GSPI	MIR	CPI	MOI	MIR	GSPI
NEX	0.97				0.68	0.40	-0.25	0.37
GSPI	-0.92	-0.87			0.89	0.71	-0.68	
MIR	0.35	0.33	-0.37		-0.57	-0.53		
MOI	0.30	0.30	-0.28	0.57	0.74			

The first step involved in applying cointegration is to determine the order of integration of each variable/series. To do this, the study performed the Additive-Outlier model developed by Perron-Vogelsang (1992)). This method is used to test the unit root hypothesis allowing for possible presence of a one-time change in mean. This test is performed for both the levels and for the first difference of General Share Price Index, nominal exchange rate, the rate of interest, Consumer Price Index, and Manufacturing Output Index over the time span from June 1994 to March 2005 with a structural break on May 28, 1998. Test statistics were found by estimating equation (4) at different lag orders, and the results are presented in Table 3.

Table 3. Unit-Root Tests with Changing Mean: Additive-Outlier Method, Using Perron-Vogelsang Statistics, $t_{\hat{\rho}1}$ (AO,T_b,k)

Series	t-statistic, $t_{\hat{\rho}1}$					
	At Level			At First Difference		
	k = 0	k = 1	k = 2	k = 0	k = 1	k = 2
GSPI	0.287	-0.150	-0.079	-9.453*	-7.615*	-7.470*
NEX	-1.520	-1.599	-1.747	-11.591*	-8.084*	-6.344*
MIR	-5.089*	-3.511	-2.463	-16.663*	-12.436*	-9.053*
CPI	-0.649	-0.271	-0.160	-10.062*	-8.043*	-5.447*
MOI	-3.226	-3.869	-4.011**	-10.026*	-7.474*	-5.509*

The critical values (reported by Perron-Vogelsang (1992)) of the unit root test statistics, $t_{\hat{\rho}1}$ (AO,T_b,k) in the Additive-Outlier model depends on the number of observations (T), and the order of lags (k) that are included to control the autocorrelation. In our case, k = 0 to 2 and T is 130.
*, **, *** Indicate different from null of unity at, respectively the 1 per cent, 5 per cent, and 10 per cent marginal significance level.

The table depicts that the null hypothesis of a unit root in the level series cannot be rejected, in general, for all the said variables. In case of interest rate and manufacturing output, the null hypothesis is rejected at lag order zero and 2 respectively. However, these rejections are not consistent with other lag orders. The results indicate that all the variables are non-stationary in their levels.

The table also reports the results of the Additive-Outlier model for the first difference of the variables. It can be seen from the table that estimated test statistics reject the null hypothesis of non-stationary in favor of the alternative stationary with presence of one-time change in mean for all the series. Thus, the first differences of all the series appear stationary, indicating that all the said variables are integrated of order one.

To test the null hypothesis of cointegration against the alternative of no cointegration in the presence of structural breaks, the following five models are estimated: Model A allows for a change in the deterministic component (intercept) due to a struck break, Model B includes a linear trend with the same Model A, Model C considers a break in linear trend, while Model D considers a structural break in the parameters of deterministic and stochastic components, including a linear trend, and finally, Model E combines a linear trend with the same Model D. The estimated test statistics for these models are presented in Table 4 for zero to three lag orders. However, 3 and 4 lags are used to do a consistent estimation of the long-run variance of residuals.

It can be seen from Table 4 that the test statistics are less than the respective critical values for all the estimated models apart from Model A. Therefore, the null hypothesis of cointegration is not rejected for Model B, C, D, and E. This implies that there is a cointegrating vector between the said variables, therefore, these variables move together in the long run. Thereby, there is a co-movement phenomenon for these variables over the examined sample period.

Table 4. Estimates of the Cointegration Tests With A Structural Break at Known Date

LM-statistic to test the null of cointegration (with alternative no cointegration) allowing for the possibility of a structural break, both in the deterministic and the stochastic components. The analysis covers the sample period from June 1994 to April 2005 with a total of 130 monthly observations. A structure break exists on May 28, 1998 when Pakistan conducted a nuclear test. Here $\hbar$ (= 48/130 = 0.369) denotes the break fraction. The critical values are 0.0873, 0.0864, 0.0711, 0.0852, and 0.0570 at five percent level of significance level for Model A, B, C, D and E, respectively.

$SC_i(\hbar)$ **{LM-type} Statistics**					
LTP*	**Model A**	**Model B**	**Model C**	**Model D**	**Model E**
K = 0					
LTP = 3	0.309	0.086	0.079	0.062	0.063
LTP = 4	0.222	0.064	0.059	0.048	0.048
K = 1					
LTP = 3	0.266	0.080	0.076	0.062	0.061
LTP = 4	0.196	0.061	0.058	0.049	0.048
K = 2					
LTP = 3	0.225	0.076	0.071	0.061	0.058
LTP = 4	0.170	0.060	0.056	0.048	0.046
K = 3					
LTP = 3	0.192	0.072	0.066	0.061	0.057
LTP = 4	0.151	0.056	0.053	0.047	0.044

* Lag Truncation Parameter () is used to estimate the long-run variance of residuals.
k is the lag length used to estimate the models.

As the table shows, these results are robust because of the choice of model (excluding Model A) and lag orders. However, the value of test statistics decrease as lag order increases. As reported by Carrion-i-Silvestre et al. (2005), the rate of the divergence of the statistics depends on the spectral bandwidth that is used to choose the optional weighting function, so the optimal lag-length selection influences the power of the statistics.

The cointegration analysis with a structural change at known data clearly shows that stock prices and macroeconomic variables are cointegrated. Based on these findings, the multivariate error correction models adjusted with structural breaks are estimated in different specifications to investigate the cause-effect relationship between stock prices and macroeconomic variables. The estimated results are reported in Table 5.

Table 5. Estimates of the Error Correction Model with Known Point Structural Change for Long-run and Short-run Granger Causality

Hypothesis	Estimates of Error Correction Term	F-statistics
Only a Shift in Mean		
GSPI does not Granger cause *NEX*	-0.097*	0.755
NEX does not Granger cause *GSPI*	-0.042	0.833
GSPI does not Granger cause *MIR*	-0..418*	0.572
MIR does not Granger cause *GSPI*	-0.042	5.116*
GSPI does not Granger cause *MOI*	-0.388*	1.683
MOI does not Granger cause *GSPI*	-0.042	1.467
GSPI does not Granger cause *CPI*	-0.005	1.749
CPI does not Granger cause *GSPI*	-0.042	0.261
A Shift in Mean Including a Linear Trend		
GSPI does not Granger cause *NEX*	-0.092*	0.498
NEX does not Granger cause *GSPI*	-0.053**	0.512
GSPI does not Granger cause *MIR*	-0.419*	0.497
MIR does not Granger cause *GSPI*	-0.053**	5.174*
GSPI does not Granger cause *MOI*	-0.387*	1.637
MOI does not Granger cause *GSPI*	-0.053**	1.190
GSPI does not Granger cause *CPI*	-0.008	2.414**
CPI does not Granger cause *GSPI*	-0.053**	0.264

A Shift in both Mean and Regime		
GSPI does not Granger cause *NEX*	-0.109*	0.519
NEX does not Granger cause *GSPI*	-0.044	0.439
GSPI does not Granger cause *MIR*	-0.420*	0.243
MIR does not Granger cause *GSPI*	-0.044	2.474**
GSPI does not Granger cause *MOI*	-0.373*	0.790
MOI does not Granger cause *GSPI*	-0.044	0.815
GSPI does not Granger cause *CPI*	-0.006	1.056
CPI does not Granger cause *GSPI*	-0.044	0.746
A Shift in both Mean and Regime plus a Linear Trend		
GSPI does not Granger cause *NEX*	-0.110*	0.449
NEX does not Granger cause *GSPI*	-0.056**	0.209
GSPI does not Granger cause *MIR*	-0.421*	0.211
MIR does not Granger cause *GSPI*	-0.056**	2.551**
GSPI does not Granger cause *MOI*	-0.373*	0.708
MOI does not Granger cause *GSPI*	-0.056**	0.767
GSPI does not Granger cause *CPI*	-0.007	1.425
CPI does not Granger cause *GSPI*	-0.056**	1.159

*, ** Indicate that the null hypothesis is rejected at, respectively the 1 per cent, and 5 per cent significance level.

It can be observed from Column 2 of Table 5 the coefficients of error term appear statistically significant in the model estimated in a specification with two lags, a shift in mean plus a linear trend term. This implies that there is a long run bi-directional Granger causality between stock prices and the macroeconomic variables namely industrial production, exchange rate and the money market rate. However, a unidirectional Granger causality is found between stock prices and prices, running from consumer prices to stock prices. We observed the same findings for the model estimated in a specification with one lag (selected by AIC), shifts in both mean and regime plus a linear trend term. This evidence suggests that the collapse in the stock market can be prevented by controlling fluctuations in the macroeconomic variables. Investors can use information from macroeconomic indicators to foresee the long-run behavior of stock prices. Moreover, Pakistan's financial authority can use macroeconomic forces such as exchange rates, interest rates and domestic price level as policy tools to attract foreign portfolio investment.

However, when the error correction model is estimated using these specifications without a trend term, the results report a unidirectional long-run Granger causality that runs from stock prices to the macroeconomic variables. The coefficients on trend term are statistically significant at any reasonable critical values in both specifications[6] and it can be observed from figure 1 to 4 in appendix, that the data itself exhibits a strong lineal trend. The study therefore considers those specifications that include a trend term and conclude that there is bidirectional Granger causality between stock prices and macroeconomic forces in the long-run. It means that stock prices may affect and be affected by fluctuations in the macroeconomic variables

To assess the short-run Granger causality, the F-statistics are calculated in different specifications. The estimates indicate that stock prices and the three macroeconomic variables namely exchange rates, industrial production and domestic consumer prices are independent of each other at least in the short run. However, with regard to short run causation between stock prices and interest rate, the reported F-values in a specification with one lag, a shift in mean and with and without a trend term show that there is unidirectional causality relationship that runs from the market rate of interest to stock prices. This piece of evidence is robust to the regime shifting error correction model with, as well as without, a linear trend term.

6. CONCLUSIONS

The intention in this paper is to investigate the long-run and short-run dynamic interactions between stock prices and selected macroeconomic indicators. The study uses monthly data on five variables: the General Share Price Index, the nominal exchange rate between the U.S. dollar and the Pak rupee, the market rate of interest, the Consumer Price Index, the Manufacturing Output Index for an eleven-year period, from June 1994 to March 2005.

To assess the long-run equilibrium relationship, the study uses the LM type cointegration methodology. Both mean and regime switching models are estimated to test the null hypothesis of cointegration against alternative of no cointegration. To look at the short-run dynamics, error correction models adjusted with structural changes in different specifications are estimated. The following conclusions derive from the analysis:

[6] The results are not given here to save space, however, they are available from author on request.

First, descriptive statistics provide evidence that the General Share Price Index, the Manufacturing Output Index, and the market rate of interest are modestly volatile during the post-break period, compared to the pre-break period. The size of the Kurtosis for all the said variables, excluding the rate of interest, is less than 3 over both the examined periods. The General Share Price Index is significantly correlated not only to the nominal exchange rate but also to the Consumer Price Index, the Manufacturing Output Index, and the market rate of interest during the post-break period.

Secondly, using the Additive-Outlier model in a specification with 0 to 2 lags the analysis is unable to reject the null hypothesis of a unit root in the levels generally for all the variables with the exception of two cases; however, those rejections were not robust to other lag orders.

Thirdly, the analysis provided the evidence of a long-run relationship among the said variables in all the examined specifications apart from the model that considers only a change in level due to a structural change at known date without a trend term. These empirical findings are in contrast of the results reported by the previous studies for Pakistan in this area. The previous studies examined the said relationship by using a bivariate model of stock prices and exchange rates instead of a multivariate model including other variables that have significant impact on stock prices. The "omission of variables" from cointegrated vector may be a reason why they are unable to find any long-run association between stock prices and exchange rates rather than any economic inefficiency. Another reason of the lack of the long-run relationship is that these studies did not take into account the presence of structural break; however, as reported by the well-known literature on econometrics, the relationship between economic variables is significantly affected by the presence of structural changes in the data.

The presence of the long-run relationship between stock prices and the macroeconomic variables is supporting the hypothesis that the health of the stock market, in the sense of a rise in share prices, is a result of an improvement in the health of the economy.

Fourthly, using specifications selected by AIC with a linear trend term, it was found that in the long run, there is a two-way causal link between stock prices and the macroeconomic variables. The cause-effect relationship suggests that macroeconomic indicators can be used to judge the stock market behavior. Moreover, authorities in Pakistan can use these macroeconomic variables as policy tools to decrease the intensity of a collapse in the stock market. In sum, empirical estimations show that there is a two-way causation between stock prices and the macroeconomic variables, excluding consumer prices in all specifications, apart from Model A that only considers a shift in mean. Thus, it can be concluded that the stock market is playing some kind of role to enhance economic activities/economic growth. There are many other dimensions, however, that have to be studied before arriving at any definite conclusion about the link between the stock market performance and economic growth.

Finally, the calculated F-statistics indicate there is no short-run association between stock prices and the macroeconomic variables excluding money market rate. Neither the stock market drives (in Granger sense) the macroeconomic variables namely exchange rate, industrial production and price level nor these variables lead (in Granger sense) stock prices. Thus, it can be concluded that stock prices and the macroeconomic variable, apart from interest rate, are unrelated in the short run. These results are in agreement with the study by Naeem and Rashid (2002) which reportes that the two financial variables, namely exchange rates and stock prices, are independent of each other in the short run. Concerning stock price-interest rate short-run Granger causality, the reported F-values provide evidence that there is a unidirectional causation running from interest rates to stock prices.

In conclusion, the analysis suggests that care should be taken in designing government policies (economic liberalization, privatization, relaxation of foreign exchange control and in particular, monetary policy) since stock prices, exchange rate, interest rate and consumer prices are closely linked. On the one hand, they should agree with the requirements of the well-functioning equity market. On the other hand, they should provide a weighing scale in the financial mechanism, which would be useful in controlling any crisis (or unusual fluctuations) occurring in the financial markets, particularly in capital market. The Securities and Exchange Commission of Pakistan should start a capital market reform program at priority basis, towards the development of a modern and efficient corporate sector and capital market based on sound regulatory principles that provide momentum for high and steady economic growth. There is a need to do more in the fields of risk management (for instance, introduction and application of financial derivatives), governance, transparency and of course, in future trading mechanism.

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Résumé

Cet article analyse les interactions dynamiques entre quatre variables macroéconomiques et les prix des actions au Pakistan, en utilisant les tests de co-intégration et Granger qui sont robuste aux choc structurels. Les résultats suggèrent fortement que la co-intégration entre les prix des actions et les variables macroéconomiques : prix à la consommation, production industrielle, taux d'échange et taux d'intérêt de marché. Les estimations démontrent qu'il y a une causalité bidirectionnelle de long terme entre les prix des actions et les variables macroéconomiques susmentionnées avec l'exception des prix à la consommations. Les résultats indiquent aussi que les cours des actions are causés selon Granger par des changements des taux intérêts dans le court terme. Toutefois, l'analyse ne peut pas expliquer des relations de court terme entre les prix des actions et les autres variables macroéconomiques. On peut donc affirmer que la relation entre un état positif (augmentation des cours) du marché des actions et un état positif de l'économie est un phénomène de longue terme uniquement.

ANNEXURE

Natural Log of General Share Price Index, Nominal Exchange Rate, Consumer Price Index and Money Market Rate, June 1994 to March 2005, Shaded Area Presented the Period before Structural Break on May 28, 1998