Exchange rates or stock prices, what causes what: A firm level empirical investigation

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Abstract

The study employs cointegration, the standard Granger causality tests and vector error correction modeling technique to investigate the cause-effect association between exchange rates and stock prices for Pakistan. It uses weekly data for 70 individual securities and the trade-weighted exchange rate over the span from January 1, 1999 to March 31, 2004. The results of cointegration tests show that there is no co-movement between the said variables for most of the examined firms. On the issue of causation, the evidences are mixed. In some cases causation runs from stock prices to exchange rate whereas for some firms' stock prices are affected by the changes in trade-weighted exchange rate. However, the analysis findings are generally supporting the asset market approach to exchange rate determination that reports no link between the said variables.

JEL Classification: G15, C32

I. INTRODUCTION

This study examines whether there is a long run and short-run dynamic relationship between the stock prices and exchange rate in Pakistan. The study also explores the direction of causation if a long/short-run association is found. These issues (association and causation) have received considerable attention after the East Asian crises. During the crises the countries affected saw turbulence 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 rate movements. 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 their countries more appealing to foreign investors[1]. On the other hand, if the causation runs from stock prices to exchange rates then authorities can focus on domestic economic policies to stabilize the stock market during the times of any financial crises. If the two markets/prices are related then investors can use this information to predict the behavior of one market using the information on other market[2]. Additionally, firms can hedge themselves from adverse movements of exchange rates if their values or competitiveness are affected by exchange rate fluctuations.

Most of the empirical literature that has examined the stock prices-exchange rate relationship has focused on examining this relationship for the developed countries with very little attention on the developing countries. The results of these studies are, however, inconclusive. Some studies have found a significant positive relationship between stock

[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.

prices and exchange rates (for instance Smith (1992), Solnik (1987), and Aggarwal (1981)) while others have reported a significant negative relationship between the two (e.g., Soenen and Hennigar (1998)). On the other hand, there are some studies that have found very weak or no association between stock prices and exchange rates (for instance, Franck and Young (1972), Bartov and Gordon (1994)).

On the issue of causation, the evidence is also mixed. Some studies (for instance, Abdalla and Murinde (1997)) have found causation runs from exchange rates to stock prices while other reported a reverse causation (e.g., Ajayi and Mougoue (1996)). Bahmani-Oskooee and Sohrabian (1992), however, claim there is a bi-directional causality between stock prices and exchange rates in the short-run but not in the long run.

On the theoretical side there is no consensus on the relationship between stock prices and exchange rates either. For instance, portfolio balance models of exchange rate determination postulate a negative relationship between stock prices and exchange rates and that the causation runs from stock prices to exchange rates. In these models individuals hold domestic and foreign assets, including currencies, in their portfolio. Exchange rates play the role of balancing the demand for and supply of assets. An increase in domestic stock prices lead individuals to demand more domestic assets. To buy more domestic assets local investors would sell foreign assets (they are relatively less attractive now), causing local currency appreciation[3]. 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.

In contrast, a positive relationship between stock prices and exchange rates with direction of causation running from exchange rates to stock prices can be explained as follows: domestic currency depreciation makes local firms more competitive, leading to an increase in their exports. This in turn raises their stock prices[4]. However, according to asset market approach there is no link between the said variables.

From the above discussion, it is clear that there is no empirical or theoretical consensus on the issue of whether stock prices and exchange rates are related and the direction of causation if they are related. This study provides further empirical evidence on the above two issues (i.e., relationship and causation) using Pakistani data.

Our empirical findings about the long-run and short-run causal relationship between stock prices and exchange rates have a number of meaningful implications not only for

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[3] Here exchange rate is defined as the price of one unit of foreign currency in local currency terms. Thus currency appreciation means lowering/decrease in exchange rate. Hence, the relationship between stock prices and exchange rates is negative.

[4] The relationship would be negative if many firms use lots of imported inputs in their production. Increase in their cost of production due to currency depreciation might reduce firms' sales and profits that might lead to a fall in their stock prices.

investors and policy makers, but also for exporter, importer, domestic and multinational firms. If any association between stock prices and exchange rate exists then foreign investors can hedge their portfolios from adverse movements of exchange rate or can increase their portfolio investment in Pakistan if they observe favorable movements of exchange rate. Therefore, prior information on the link between the two variables would be helpful in designing their investment strategy in Pakistan. Moreover, two markets are associated and foreign exchange market precedes the stock exchange then the policy maker can use exchange rate as a policy instrument to stimulate foreign portfolio investment and may be able to prevent stock market crash by controlling exchange rate.

On the contrary, if causation runs from stock prices to exchange rates then the government can stabilize the currency value by controlling the fluctuations in stock prices. In the absence of any stock price-exchange rate link, financial authorities should use some other variables (say interest rate etc.) to avoid stock market crash. For importing firms[5], if stock prices and exchange rate are associated and foreign exchange market leads (with negative sign) the stock prices. This implies that a depreciation of currency value raises the cost of firm and this adversely affects the value of the import firm (or its stock price). In such cases, the firm can reduced the exchange rate exposure using foreign currency derivatives (forward contracts, future contracts or options). However, if stock prices and exchange rates are independent (i.e., there is absence of cointegration and Granger causality) then exchange rate movements have no impact on firm's value.

For exporter or multinational firms, the causation from exchange rate to stock prices suggests that a depreciation of exchange rate is beneficial and the firm can increase its profit (firm value) by increasing its volume of exports. On the other hand, the firm can produce goods for the foreign market in a foreign country to avoid the risk of changes in exchange rate. However, in case where causation runs from stock prices to exchange rate, the higher stock price stimulates foreign portfolio investment both in existing and new issue stocks. Thus, the firm can easily raise more capital through equity to expand its production.

Domestic firms are those that do not export as well as do not use-imported inputs. This type firms have little foreign competition. However, the value of these firms may significantly be affected by exchange rate fluctuations, if firms' inputs as well as output prices are influenced by currency movements (Adler and Dums, (1984)).

The remainder of this paper is organized as follows. Section II presents the theoretical discussion on exchange rates and stock prices association. The empirical model, which is employed to explore the said linkages, is also the part of the section. Section III presents the literature survey. Empirical methodology and the data sources are discussed in Section IV. Section V presents the empirical results and discusses the policy implications derived from these results. Final section summarizes and concludes the study.

[5] The importing firms are those that import a significant amount of their inputs.

II. THEORETICAL FRAMEWORK

At micro level, it is argued that the change in exchange rate influences the value of a firm in the following three ways[6]:

1. If the real exchange rate changes, firm's cost of inputs, and demand for its outputs are also changes. Hence, the level of output and firm's profit will be changed. Therefore, firm changes the amount of dividend that it will give to shareholders. The announcement of dividend causes change in a firm's share prices.

2. The changes in exchange rates affect the balance sheet of the firm through firm's foreign operations. So, the value of the firm changes which causes changes in a firm's stock prices.

3. Changes in exchange rate affect the value of a firm through its hedging position. By hedging, firm can increase debt capacity and therefore firm value (see for details, Ross (1997); Leland (1998))[7]. Changes in current exchange rates influence the hedging position of the firm. Resulting from that firm's value will be changing which causes change in share prices.

However, the impact of exchange rate fluctuations will be different for domestic firms and for multinational firms. For multinational firms, a change in exchange rates could have direct impact on the value of a firm. Aggarwal (1981) has reported that the stock prices of a multinational firm changes due to a change in exchange rate[8].

In case of a domestic firm, an increase in exchange rates has either negative or positive impact on a firm's stock price depending upon whether that firm is an exporting firm or it is a user of imported inputs. If, it is involved in both activities, its stock prices may be positive or negative affected by devaluation depending on the price elasticity of exports and imports.

Many open economy macroeconomic models also explain the co-fluctuations of the said variables. In particular, "Flow-oriented" models (Dornbusch and Fisher (1980)) of exchange rates suggest a negative association that runs from currency value to stock prices. Currency movements affect the international competitiveness of firms, which in turn affect output, real income, and eventually stock prices. Similarly, "Stock-oriented" models (Frankel (1983)) of exchange rates describe causality from exchange rate to stock prices. In contrast, according to portfolio balance (asset) models to exchange rate determination, it is argued that a change in stock prices could also have an impact on

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[6] Some firms and industries have ability to pass through exchange rate changes into product prices and thereby reduce their exchange rate exposure (see for details, Bodnar, Dumas and Marston (1998)). Another possibility is that the firms are not exposed to exchange rate changes, i.e. they have hedged currency risk by diversifying the sources of supply and the market where they sell.

[7] Graham and Doniel (2002) have been indicated that firm's hedge to increase debt capacity, with increased tax benefits averaging 1.1 percent of firm value.

[8] All other factors are held constant and only output price is affected due to rupee depreciation.

currency value (see for example, Calvo and Rodriguez (1977), and Driskill (1980)). Therefore, stock price innovations may affect or affected by the exchange rate dynamics.

Moreover, exchange rates may have a positive or negative impact on stock prices depending upon the nature of the economy. In export-oriented economy, a rise in exchange rates makes local firms more competitive, stimulating to exports and increases the profit of the exporting industries. Higher profit news has an incentive for the investors; therefore, the average level of the stock price will increase[9]. Under such scenario, the direction of causation runs from exchange rate to stock prices.

According to the Arbitrage theory, a rise in real interest rate reduces the present value of a firm's future cash flows and causes stock prices to fall. But at the same time, a higher interest rate stimulates the capital inflow, and therefore exchange rate falls. So the real interest rate disturbance may be a factor of a positive relationship between the average level of stock prices and exchange rates. The results of the empirical studies (e.g., Smith (1992) and Solnik (1987)) verify the above macroeconomics theory.

Conversely, in import-oriented economy, a negative association runs from exchange rates to stock prices. Many firms use lots of imported inputs in their production. Hence currency depreciation increases their cost of production that may reduce firms' output and profits. Since, lower profit leads to a fall in their stock prices.

An inflationary disturbance may be another factor which is the responsible for the negative relationship between the exchange rates and the over all stock prices. When inflation increases, the exchange rate rises because the domestic currency losses its value not only in terms of goods and services but also in terms of foreign currency, a higher inflation expectation leads investors to demand a higher risk premium and demand a higher rate of return so that stock prices decreases.

The exogenous increase in domestic stock prices simply influences the exchange rate in the following ways: On the one hand, the increase in 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 rates. Resulting from a higher interest rate, the capital inflows will increase that cause appreciation of domestic currency. On the other hand, higher stock prices attract foreign investors for investment in that stock market. For this purpose, foreign investors increase the demand for domestic currency. This will result in an appreciation of domestic currency.

A weaker or no association between stock prices and exchange rates can also be hypothesized. The asset market approach to exchange rate determination treats exchange rate to be the price of an asset (price of one unit of foreign currency). Therefore, like price of other assets the exchange rate is determined by expected future exchange rates. Any news or factors that affect future values of exchange rate will affect today's exchange rate. The factors or news that cause changes in exchange rates may be different

[9] The higher profit leads to increase in dividend share as well as stock prices.

from the factors that cause changes in stock prices. Under such scenario, there should be no link between the said variables[10].

Empirical Model

The empirical model followed in this study is similar to that of past research. We are testing the link between stock prices and exchange rates by using bivariate model. Specifically, the model is:

$$SP_{it} = \alpha_i + \beta_i EX_t + \varepsilon_{it} \qquad \{1\}$$

where SP_{it} is the stock price of stock i, EX_t is the exchange rate measured in units of the domestic currency per unit of the foreign currency. We examine the stock price-exchange link using the co-integration methodology. Specifically, we examine whether the variables in {1} are co-integrated. If they are co-integrated, this provides evidence in support of the portfolio balance model of exchange rate determination as well as traditional models. In contrast, if the said variables are independent (co-integration does not exist), this verifies the asset market approach to exchange rate determination. The error-correction form of above the model is also employed to examine the causality between stock prices and exchange rates[11]. The causation from exchange rates to stock prices supports the "Flow-oriented" models (Dornbusch and Fisher (1980)) while a reverse causation verifies the "Stock-oriented" models (Frankel (1983)).

III. LITERATURE REVIEW

Franck and Young (1972) was the first study that uses a simple OLS regression to examine the link between stock prices and exchange rates. They employed six different exchange rates and found no relationship between these two financial variables.

Aggarwal (1981) examined the relationship between changes in the dollar exchange rates and change in indices of stock price under the floating exchange rate regime. He uses monthly U.S. stock price data and effective exchange rate for the period 1974-1978. His findings, which were based on simple OLS regressions, showed that stock prices and the value of the U.S. dollar is positively correlated and this relationship is stronger in the short-run as compare to in the long-run.

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[10] If there are some common factors that affect both stock prices and exchange rates (for instance interest rates) then we might expect an association between these two financial variables. No association can also be explained as follows: domestic currency depreciation raises the stock prices of those firms that export goods to other countries, but if these firms import many of its inputs from abroad, the stock prices may not rise, as the cost of production will increase making these firms less competitive. On the other hand, firms not exporting their products to other countries but importing raw materials may find a fall in their stock prices as currency depreciation may cause their sales/profits to decline.

[11] This approach of examine causality is superior to the standard Granger-causality tests, particularly if the variables involved are co-integrated.

Solnik (1987) estimated multivariate regressions by maximum likelihood approach to investigate the relationship between exchange rates, monetary shock, and economic activities using real stock returns as a proxy for changes in expected economic activities. The study uses the monthly and quarterly data from the eight major western markets (U.S., Japan, Germany, U.K., France, Canada, Netherlands, and Switzerland) over the period from July 1973 to 1983. He found that after October 1979, real exchange rate was strongly affected by changes in the interest rate differentials (that is, domestic interest rate minus foreign interest rate), however, this was not the case prior to October 1979. In addition, a weak positive relationship was found between real stock returns differentials and changes in the real exchange rate, especially in the second period: October 1979 to December 1983 for all examined markets. Finally, he reported that depreciation to have a positive but insignificant influence on the U.S. stock market prices compared to change in inflationary expectation and interest rates.

Soenen and Hanniger (1988) examined the relationship between stock prices and effective exchange rates for the U.S. using simple OLS regression for the period 1980 to 1986. They discovered that there is a strong negative relationship between the value of the USA dollar and the change in stock prices. However, when they analyzed the above relationship for a different period, they found a statistical significant negative impact of revaluation on stock prices.

Jorion (1990) examined the exposure of U.S. multinationals to foreign currency risk through simple OLS regression analysis. He uses monthly data on stock returns and trade-weighted exchange rate. His sample period starts in January 1974 and ends in December 1987. He also considers three sub-periods, 1971-75, 1976-80, and 1981-87. His results provided evidence that the relationship between stock returns and trade-weighted exchange rate differs systematically across multinationals. He also found that the co-movements between stock returns and the value of the dollar to be positively related to the percentage of foreign operations of U.S. multinationals. Finally, his analysis points out firms with no foreign operations exhibit in practice little measurable difference in exchange-rate exposure.

Bahmani-Oskooee and Sohrabian (1992) analyzed the long-run association between stock market prices and exchange rates using cointegration as well as short-run casual relationship between the said variables by using the standard Granger causality test. They employed monthly data on S&P 500 index and effective exchange rate for the period 1973-1988. They concluded that there is a twofold causal (case-effect) relationship between the stock market prices and effective exchange rate, at least in the short-run. But they were unable to find any long-run relationship between these financial variables.

Baily and Chung (1995) examined the impact of exchange rate fluctuations and political risk on the risk premiums reflected in cross-sections of individual equity retunes from Mexico. They employed monthly data from January 1986 to June 1994 on stock prices, percent change in the official pesos per U.S. dollar foreign exchange and change in the free market premium for dollars. They also, used some information variables (such as lagged exchange rate and yield spread between one-month Mexican and U.S. own-currency Treasury bills). They were unable to find any evidence of unconditional equity market premiums for the currency and political risks reflected in proxy variables. But they found that there are significant associations between expected equity market premiums for risks and related premiums from the currency and sovereign debt markets.

Ajayi and Mougoue (1996) show that an increase in aggregate domestic stock price level has a negative short-run effect on domestic currency value but in the long-run increases in stock prices have a positive effect on domestic currency value. However, currency depreciation has a negative short-run effect on the stock market.

Qiao (1997) employed daily stock price indices and spot exchange rates obtained from the financial markets of Hong Kong, Tokyo, and Singapore over the period from January 3, 1983 to June 15, 1994 to explore the possible interaction between these financial variables. His results, based on the standard Granger causality test, show that the changes in stock prices are caused by changes in exchange rates in Tokyo and Hong-Kong markets. However, he was unable to find any such causation for the Singapore financial market. On the reverse causality from stock prices to exchange rates, his results show such causation for only Tokyo market. Therefore, for Tokyo market there is a bi-directional causal relationship between stock returns and changes in exchange rates. He also used vector autoregressive model to analyze a long-run stable relationship between stock prices and exchange rates in the above Asian financial markets. His results found a strong long-run stable relationship between stock prices and exchange rates on levels for all three markets.

Abdalla and Victor Murinde (1997) applied cointegration approach to examine the long-run relation between IFC stock price index and the real effective exchange rate for Pakistan, Korea, India and the Philippines. They use monthly data that span January 1985 to July 1994. Their study found no long-run relationship for Pakistan and Korea but did find a long-run relationship for India and the Philippines. They also examine the issue of causation between stock prices and exchange rates. Using the standard Granger causality tests they found a unidirectional causality from exchange rates to stock prices for both Pakistan and Korea. Since a long-run association was found for India and the Philippines. They use an error-correction modeling approach to examine the causality for India and the Philippines. The results show a unidirectional causality from exchange rates to stock prices for India but for the Philippines the reverse causation from stock prices to exchange rates was found.

Chow, Lee, and Solt (1997) examined the exchange-rate risk exposure of U.S. stocks and bonds from March 1977 to December 1989 over 1- to 48-month horizons. They employed the method of White (980) and Hansen (1982) to adjust the variance-covariance matrix for general conditional heteroscedasticity and autocorrelation in the error terms. They also used a vector autoregressive (VAR) model of changes in annual earnings per share and real exchange rates to investigate the effect of a shock in real exchange rates on current and future annual earnings per share. The analysis results reveal that bonds are positively exposed to exchange-rate changes across all horizons while stocks are positively exposed only for longer horizons. In addition, they found that, on average, the effect of unanticipated changes in the real exchange rate on earning is negative over short horizons but positive over long horizons.

He and Ng (1998) investigated whether the value of a Japanese multinational corporation is affected by exchange-rate changes and whether lagged exchange-rate changes have any explanatory power for current stock returns. They tested this relationship by regressing stock returns against both contemporaneous and lagged exchange-rate changes[12]. The study uses daily data over the period from January 1979 to December 1993. They found that about 25 percent (43 of 171) of the firms experienced economically significant positive exposure effects for the entire sample period of January 1979 to December 1993. Their findings indicate that exchange-rate exposure is positive related to a firm's export ratio and foreign activities and negative related to a firm's hedging. In addition, as reported by authors, firms with low short-run liquidity or with high financial leverage are less exposed to fluctuations in exchange rates; however, foreign exchange-rate exposure increases with firm size.

Granger, Huang and Yang (1998) examine the causality issue using Granger causality tests and Impulse response function for nine Asian countries. They used daily data for the period January 3, 1986 to November 14, 1997. The countries included in their study were: Hong Kong, Indonesia, Japan, South Korea, Malaysia, the Philippines, Singapore, Thailand and Taiwan. For Thailand and Japan they found that exchange rate leads stock market prices with positive correlation. In contrast, the data from Taiwan suggests stock market prices lead exchange rate with negative correlation. They found exchange rate leads stock prices with positive correlation from Japan and Thailand data. They also discovered that there is a strong bi-directional causality (feedback relationship) between stock prices and exchange rates in Indonesia, Korea, Malaysia and the Philippines and no relationship were found for Singapore, Hong Kong and South Korea.

Ong and Izan (1999) used the Nonlinear Least Square method to examine the association between stock prices and exchange rates. They employed weekly data consist of spot and 90-day forward exchange rate for Australia and the Group of Seven countries and spot and 90-day futures equity prices for Australia, Britain, France and the U.S. The study covers the period from 1 October 1986 to 16 December 1992. They found that U.S share price returns fully reflect information conveyed by movements in both the Japanese yen and the French France after four weeks. Their results, however, suggest a very weak relationship between the U.S. equity and exchange rates. They concluded that depreciation in a country's currency would cause its share market returns to rise, while an appreciation would have the opposite effect.

Ibrahim (2000) examined the relationship between exchange rate and stock prices for Malaysia using a cointegration framework. The period covered is January 1979 to June 1996, with monthly data. Three different exchange rates were used for the analysis, the real effective exchange rate, the nominal effective exchange rate, and the nominal exchange rate. He employed both bivariate and multivariate cointegration techniques. He

[12] Significance of the coefficient of lagged exchange-rate changes implies that stock return can be predicted by lagged exchange-rate fluctuations.

found no long run equilibrium relationship between a composite measure of stock market returns and any of the exchange rates. However, when he employed multivariate tests with additional variables like money supply and reserves, he found unidirectional causality from the stock market to exchange rates. Also, he found evidence of causality from the nominal exchange rate to stock prices. He concluded that the Malaysian stock market is inefficient.

Amare and Mohsin (2000) examine the long-run association between stock prices and exchange rates for nine Asian countries (Japan, Hong Kong, Taiwan, Singapore, Thailand, Malaysia, Korea, Indonesia, and the Philippines). They used monthly data from January 1980 to June 1998 and employed cointegration technique to examine the said relationship. The long-run relationship between stock prices and exchange rates was found only for Singapore and the Philippines. They attributed this lack of cointegration between the said variables to the bias created by the "omission of important variables". When interest rate variable was included in their cointegrating equation, they found cointegration between stock prices, exchange rates and interest rate for six of the nine countries.

Wu (2000) employed the Johansen (1991, 1995) co-integration technique to find the long-run equilibrium relationship between stock market prices and exchange rates. He employed weekly data for the Singapore financial market for the period-April 3, 1991 to May 31, 2000. He found the inflationary shocks have played a more significant role than real interest rate shocks in the determination of the relationship between stock market prices and the Singapore dollar-ringed exchange rate. He also analyzed the Granger causality runs only one way from exchange rates to stock market prices.

Ramasay and Yeung (2001) employed the standard Granger causality test to research the causality between the foreign exchange market and stock market for nine East Asian economies (Hong Kong, Indonesia, South Korea, the Philippines, Malaysia, Japan, Thailand, Singapore, and Taiwan). They used the daily exchange rate and stock price indices from 1st January 1997 to 31st December 2000. A bi-directional causality between stock prices and exchange rates was found only for Hong Kong. For Malaysia, Singapore, Thailand, Taiwan and Japan they found that a unidirectional causality runs from stock prices to exchange rates. On the other side, they found that a unidirectional causality from exchange rates to stock prices exists in South Korea and the Philippines economies.

Hatemi-J and Irandous (2002) applied a new Granger non-causality testing procedure developed by Toda and Yamamoto (1995) to examine a link between exchange rates and stock prices in Sweden. They also employed a vector autoregression (VAR) model to explore a possible causal relation between said variables. Their results show that the Granger causality is unidirectional running from stock prices to effective exchange rates. They also found that an increase in Swedish stock market prices is associated with an appreciation of the Swedish domestic currency (Krona).

Muhammad and Abdul (2003) employed cointegration, vector error correction modeling technique, and the standard Granger causality tests to investigate the long-run and short-run linkages between stock prices and exchange rates. They used monthly data on four South Asian countries, including Pakistan, India, Sri-Lanka, and Bangladesh, over the period from January 1994 to December 2000. Their results indicate that there is no short-run association between stock prices and exchange rates for all four countries. They failed to find any long-run relationship between the said variables for Pakistan and Indian. For Sri-Lanka and Bangladesh, however, they reported a bi-directional causality between these two financial variables.

The Limitations of the Previous Studies

Based on the above literature review one may conclude that empirical evidence on the relationship between stock prices and exchange rate is not rich enough and conclusive. Many of the studies above are subject to serious criticisms. For instant, only a few studies have examined the time-series properties of the variables involved[13]. Moreover, most studies have employed residual based cointegration tests (e.g., Engle and Granger, 1987) to examine the above relationship. The recent development in the time series literature criticized this two-stage residual based cointegration technique and advocates the use of cointegration test developed by Johansen and Juselius (1990, 1992). Due to these methodological weaknesses, many of these above studies have failed to examine the true relationship between stock prices and exchange rates.

Additionally, some of the studies have employed monthly data when examining this relationship. It has been argued in finance literature that most of the financial variables are dynamic. The use of the monthly observations may not be able to capture these dynamics. Hence, they fail to explore the link between stock prices and exchange rates. Another problem associated with some studies is that of coverage. Majority of these studies have focused on examining the said relationship at the macro level and not at the industry or firm level. Only two studies have examined the said relationship for Pakistan (Abdalla and Murinda (1997) and Muhammad and Abdul (2002)) both at the macro level. They have, however, failed to find any long-run and short-run association between stock prices and exchange rates perhaps due to the limitations cited above.

The Main Differences between the Present Study and the Previous Studies

The present study differs from the previous studies in the following ways:

1. We examine the above relationship using firm level data[14]. This is for the following reason; there may not be any relationship between the two variables at

[13] The presence of nonstationary variables in an econometric model may have serious consequences on both the estimation method and the statistical properties of the commonly used estimators such as OLS.
[14] We employ stock price data for different types of firms; multinationals, exporting and importing firms and firms employing local inputs and serve only local markets.

the aggregate level. But for some firms there may exists a long-run (or short-run or both) relationship between the two variables[15].

2. Most of the studies in the literature employed a bilateral exchange rate (in term of dollar) to examine the relationship between exchange rate and stock prices. The problem with using a bilateral exchange rate is that the results may be biased if firms' foreign operations are significantly influenced by more than one currency value (if they are exporting or importing from several countries). To avoid this problem, we employ a trade-weighted exchange rate to examine the said relationship.

3. As mention earlier, a large number of empirical studies have used annual or monthly data to explore the stock price-exchange rate relationship. Against this, the present study analyzes the said relationship using weekly data.

4. The present study examines the time-series properties of the variables involved and employs multiple Cointegration and Error-Correction Modeling techniques.

IV. EMPIRICAL FRAMEWORK

The classical or conventional non-stationarity test procedures (such as Augmented Dickey-Fuller and Phillips-Perron tests) consider the presence of a unit root as the null hypothesis and the alternative is stationarity. A number of the empirical studies (For example, Delong et al. (1989), Diedbold and Rudebusch (1990), Kwiatkowski et al. (1992), etc) have reported that standard unit root tests (DF, ADF and PP tests) are not very powerful against relevant alternatives. Delong et al. (1989) found that the Dickey-Fuller tests are not able to reject a unit root null hypothesis against stable autoregressive alternatives with roots close to unity. Similarly, Diebold and Rudebusch (1990) provided empirical evidence that standard unit root tests also have low power against fractionally integrated alternatives.

To avoid this problem we use the KPSS (Kwiatowski et al. (1992)) methodology (the LM statistic) to test for the stationarity as well ADF test. Under this method the null hypothesis is stationarity and the alternative is the presence of a unit root. This ensures that the alternative will be accepted (null rejected) only when there is strong evidence for (against) it. A brief discussion regarding this test is as follow.

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[15] Firms within an industry may not be homogeneous. Thus, the nature of stock price-exchange rate linkages may be different for different firms. One problem at the industry and market level study is that one cannot say which firms are more or less likely be exposed by exchange rate movements. Moreover, almost all industry stock price indices and market stock price indices are value weighted so that the bigger firms in the industry are given the greatest weight in the index. Therefore, a firm level study is necessary to understand whether or why individual firms display varying sensitively to exchange fluctuations.

Let R_t, $t = 1,2,\ldots,T$, be the time series for which we would like to test stationarity hypothesis. According to Kwiatkowski et al. (1992), a time series can be decomposed into three components a deterministic trend, a random walk, and a stationary error. This could be expressed as follows:

$$R_t = \Psi t + Z_t + \xi_t \qquad \{2\}$$

Here Z_t is a random walk:

$$Z_t = Z_{t-1} + u_t \qquad \{3\}$$

where the u_t are $iid\ N(0,\delta_u^2)$. The first value Z_0 is treaded as constant and serves the role of an intercept. The null hypothesis of stationarity simply assumes that the variance of residual in equation {3} is equal to zero (i.e., $\delta_u^2 = 0$). As ξ_t is supposed to be stationary, under the null hypothesis R_t is trend-stationary. Further, we can also consider the special case of the model {2} when $\Psi = 0$, in which case under the null hypothesis R_t is stationary around a level (say R_0) rather than around the trend.

For the trend-stationary case, the model is exactly as in equation {2}, so that the residuals ξ_t are from a regression of R_t on intercept and trend, and S_t is the partial sum process of the ξ_t; that is defined as $S_t = \sum_{i=1}^{t} \xi_i \quad t = 1,2,..,T$. Thus KSPP test statistic to testing the trend-stationary null hypothesis is defined as follows:

$$\hat{\eta}_\tau = T^{-2} \sum \frac{S_t^2}{s^2(l)} \qquad \{4\}$$

here the subscript τ indicates that we extracted a mean and a trend from R, where $s^2(l)$ is a consistent estimator of δ^2 which can be constructed from the residuals ξ_t, that is defined as follows:

$$s^2(l) = T^{-1} \sum_{t=1}^{T} \xi_t^2 + 2T^{-1} \sum_{m=1}^{l} w(m,l) \sum_{t=m+l}^{T} \xi_t \xi_{t-s}$$

here $w(m,l)$ is an optional weighting function; this is, $w(m,l) = 1 - m/(1+l)$, where l is the maximum lag.

The procedure of testing the level-stationary hypothesis is very similar to that of the trend-stationary case. The model is now as in equation {2} with Ψ set equal to zero. Thus, the residuals ξ_t are from a regression of R_t on intercept only. The test statistic denoted by η_u, where the subscript u indicating that we have extracted a mean but not a trend from R. The estimated test statistic is

$$\hat{\eta}_u = T^{-2} \sum \frac{S_t^2}{s^2(l)} \qquad \{5\}$$

If the estimated test statistic, in each case, is greater than the critical values, we reject the null of stationarity in favor of the alternative of unit roots.

The Long-Run Relationship between Stock Prices and Exchange Rates

We employ cointegration methodology to examine the long-run equilibrium relationship between stock prices and exchange rates. Consider an m-dimensional Vector Autoregressive (VAR) process, with and without trend, is employed to perform the Johansen (1988) test.

$$Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \ldots + A_m Y_{t-m} + BZ_t + \psi_t \qquad \{6\}$$

$$Y_t = \sum_{i=1}^{m} A_i Y_{t-i} + BZ_t + \psi_t \qquad \{7\}$$

where Y_t is a k-vector (n × 1) of I(1) variables[16], Z_t is a d-vector (n × 1) of deterministic variables, the matrix B contains the exogenous variables that are excluded from the cointegration space, m is the maximum lag, ψ_t is assumed to be k-vector (n × 1) of Gaussian error term, and A_i's are (n × n) matrices of coefficients to be estimated. The above vector autoregressive process can be reformulated into a vector-error-correction form:

$$\Delta Y_t = \Pi Y_{t-1} + \Gamma_1 \Delta Y_{t-1} + \Gamma_2 \Delta Y_{t-2} + \ldots + \Gamma_m \Delta Y_{t-m+1} + BZ_t + \psi_t \qquad \{8\}$$

where $\Pi = -[I - A_1 - A_2 - \ldots - A_m]$, $\Gamma_i = -[I - A_1 - A_2 - \ldots - A_i]$, and $(i = 1,2,\ldots,m-1)$. The principal difference between equation {7} and equation {4.16} is that the time paths of cointegrated variables are influenced by the extent of any deviation from long-run equilibrium as well as by their separate self-feedback pattern plus stochastic shocks and exogenous variables. According to the Granger representation theorem, if Π has a reduced rank $r < k$, then there exist $r \times k$ matrices such that $\Pi = \alpha\beta'$, where α represents the speed of adjustment to disequilibrium while β is a matrix of long-run coefficients. Thus, the term $\beta' Y_{t-1}$ is equivalent to the error-correction term.

Johansen's test for cointegration centers on estimating the matrix Π in an unrestricted form and then testing whether Π has less than full rank. The number of the independent cointegrating vectors depends on the rank of Π. Johansen's approach for testing the null

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[16] In our study Y_t contains stock prices and exchange rates, i.e. $Y_t = \begin{bmatrix} SP_t \\ EX_t \end{bmatrix}$.

hypothesis of no cointegration depends on two likelihood ratios, the trace $\{\lambda_{trace}\}$ and maximum $\{\lambda_{\max}\}$ Eigenvalue statistics.

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

where T is the number of useable observations, r = 0, 1,…,k – 1, and $\hat{\lambda}_i$ is the i-th largest eigenvalue.

Granger Causality

The Granger (1969) definition for causality of two stationary time series SP_t and EX_t is defined in general form as follows. Let $P_r(SP_t^m \mid I_{t-1})$ be the conditional probability distribution of SP_t^m given the bi-variate information set I_{t-1} consisting of a k-length vector of SP_t (SP_t^{-k}), and $P_r(SP_t^m \mid I_{t-1}, EX_t^{-k})$ is the conditional probability distribution of SP_t^m given the information set I_{t-1} and EX_t^{-k}. For all m > 0, the time series EX_t does not strictly Granger-cause SP_t time series if:

$$P_r(SP_t^m \mid SP_t^{-k}) = P_r(SP_t^m \mid SP_t^{-k}, EX_t^{-k}) \qquad \{9\}$$

where, Pr(•) denotes conditional probability,

$$SP_t^m \equiv (SP_t, SP_{t+1}, \cdots, SP_{t+m-1}) \qquad m = 1,2,\ldots, \quad t = 1,2,\ldots,$$
$$SP_t^{-k} \equiv (SP_{t-1}, SP_{t-2}, \cdots, SP_{t-k}) \qquad k = 1,2,\ldots, \quad t = 1,2,\ldots,$$
$$EX_t^{-k} \equiv (EX_{t-1}, EX_{t-2}, \ldots, EX_{t-k}) \qquad k = 1, 2,\ldots, \quad t = 1,2,\ldots,$$

If the equality in equation {9} does not hold, then information of past exchange rate values helps to predict current and future stock price values, then exchange rate said to be Granger-cause stock prices. Similarly, the Granger causality does not exist from exchange rate to stock prices if:

$$P_r(SP_t^m \mid SP_t^{-k}) = P_r(SP_t^m \mid SP_t^{-k}, EX_t^{-k}) \qquad \{10\}$$

where, EX_t is the current value of exchange rate. If the equality in equation {10} does not hold, then exchange rate is said to Granger-cause stock price.

We are using the fundamental Granger method in our study to test for causality between stock prices (SP_t) and exchange rate (EX_t). To be specific suppose SP_t and EX_t have a vector autoregressive representation (VAR) in which SP_t depends upon lags itself and lagged values of EX_t and symmetrically EX_t depends upon lagged values of it and lagged values of SP_t . For notational simplicity a common lag length of m is assumed, but this is not necessary in an empirical application.

$$SP_t = \xi_o + \partial_1 SP_{t-1} + \ldots + \partial_m SP_{t-m} + \beta_1 EX_{t-1} + \ldots + \beta_m EX_{t-m} + \varepsilon_{sp,t} \qquad \{11\}$$

$$EX_t = \xi_1 + \theta_1 SP_{t-1} + \ldots + \theta_m SP_{t-m} + \delta 1\, EX_{t-1} + \ldots + \delta_m EX_{t-m} + \varepsilon_{ex,t} \qquad \{12\}$$

where ξ_o and ξ_1 are constant, $\partial_1, \ldots, \partial_m, \ldots, \beta_1, \ldots, \beta_m, \theta_1, \ldots, \theta_m,$ and $\delta_1, \ldots, \delta_m$ are parameters, and $\varepsilon_{sp,t}$ and $\varepsilon_{ex,t}$ are disturbance terms.

If we reject both null hypotheses[17], there is a bi-directional causality (cause-effect relation) between said variables. All possible associations between exchange rates and stock prices in various categories are hypothesized below.

	Foreign Competition	**Stronger Economy**		
Firms	**EX_t cause to SP_t**	**EX_t cause to SP_t**	**SP_t cause to EX_t**	**Causation Direction**
Importers	Yes	Yes	Yes	Bi-directional
Domestic	No	Yes	Yes	Bi-directional or unidirectional
Exporters	Yes	No	Yes	Bi-directional or unidirectional

Error Correction Model (ECM)

Engle and Granger (1987) also show that if two (or more) variables, Y_t and X_t, are cointegrated then there exists an error-correction representation of the form:

$$\Delta Y_t = \Psi_0 + \lambda_0 B_{t-1} + \sum_{i=1}^{p} \beta_{0i} \Delta Y_{t-i} + \sum_{i=1}^{k} \eta_{0t} \Delta X_{t-i} + \zeta_{0t} \qquad \{13\}$$

$$\Delta X_t = \Psi_1 + \lambda_1 B^*_{t-1} + \sum_{i=1}^{p} \beta_{1i} \Delta X_{t-i} + \sum_{i=1}^{k} \eta_{1t} \Delta Y_{t-i} + \zeta_{1t} \qquad \{14\}$$

where Δ is the first difference operator (i.e., $\Delta Y_t = Y_t - Y_{t-1}$), 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 following cointegration regression,

[17] Two well-known tests, F-test and χ^2-test {likelihood ratio (LLR) test} can be used to test the Granger-causality hypothesis

$$Y_t = \alpha_0 + b_0 X_t + B_t \qquad \{15\}$$

$$X_t = \alpha_1 + b_1 Y_t + B_t^* \qquad \{16\}$$

Error-correction models, i.e., equations {13} and {14}, can also be used to draw inferences about causality between economic variables. In equation {13}, X cause Y if λ_0 is statistically significant (the long-run causality) or the η_{0i}'s are jointly significant (short-run causality). If both λ_0 and λ_1 are statistically significant, this indicates bi-directional long-run causality[18].

The Data

To investigate the stock price-exchange rate association at firm level, we use the weekly stock prices for individual securities and the trade-weighted exchange rate[19] over the period from January 1, 1999 to March 31, 2004 with a total of 270 weekly observations. This study includes a sample of 70 firms/stocks that are included to compose the KSE-100 Index. The data on exchange rates is taken from various issues of the Monthly Statistical Bulletin of the State Bank of Pakistan. The data on weekly stock prices for individual firms, however, manually collected from the weekly Pakistan & Gulf Economist.

V. EMPIRICAL RESULTS

Empirical Evidence from the KSPP Test

Table 1 (column 2-5) reports the η_u statistics at the values of lag (l) from 1 through 4. The choice of four as the maximum value l is based on wisdom that the autocorrelations in weekly stock price series has considerably died at l = 4.

Insert Table 1 about here

Since the estimated test statistic, η_u, is greater than the critical values (at all lag examined lag values) for all said series expect for three series at l = 4, therefore, we reject the null of stationarity in favor of the alternative of unit roots, that is, all series have unit roots. However, if the deterministic trends are present in the series then the rejections of the hypothesis of level stationarity are not considered reliable. We therefore proceed to test

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[18] If $\lambda_0 = \lambda_1 = 0$, the Error-Correction Model (ECM) reduces to traditional Granger causality test.

[19] The trade-weighted exchange rate is calculated by using the five pairs of nominal exchange rate series namely, Pak rupee/U.S. dollar, Pak rupee/Japanese yen, Pak rupee/ British pound, Pak rupee Deutsche mark, and Pak rupee/ French franc. Exchange rate is defined as the domestic currency price of one unit of foreign currency so that a positive nominal/real exchange rate variations implies domestic currency depreciation. The weight of each currency depends on the volume of trade (exports plus imports) in 2000 that was traded with the country which holds corresponding currency.

the null hypothesis of stationarity around a deterministic linear trend, for which $\hat{\eta}_\tau$ is the appropriate statistics. The estimated $\hat{\eta}_\tau$ statistics of lag 1 to 4 are reported in column 6-7 of Table 1. The table provides evidence that the calculated test statistics are greater than critical values. In light of this empirical evidence, we can say that the individual firms' stock price and trade-weighted exchange rate series follow unit roots (non-stationary) both around a level and around a linear trend in their levels.

Insert Table 2 about here

To examine whether the first differences of the said series is stationarity (with and without a time trend) we employ the test statistics η_u and $\hat{\eta}_\tau$ (these are given in Table 2) on their first differences. The both estimated test statistics do not follow any persistent pattern as l increases. The table reveals that the estimated test statistic η_u is less than critical value at 5% level for 67 out of the 71 series. The test statistic $\hat{\eta}_\tau$, however, is less than critical value at the same level of significance for almost all 71 series. This is implying we are not able to reject the null hypothesis of stationarity both with and without a linear trend. The overall evidence from the KSPP test statistics (η_u and $\hat{\eta}_\tau$) are strongly supportive of the ADF and PP tests results.

The next step to carry on the cointegration testing procedure is to determine the autoregressive order (k) of the corresponding model (equation {6}). The prime objective here is to choose the optimal lag-length (k) that eliminates any autocorrelation present in the residuals. Cheuny and Lai (1993) suggest that autocorrelation is a serious problem for the Johansen approach. In this study, we employ the Akaike's Information Criteria (AIC) and Schwarz Information Criteria (SIC) to select the appropriate lag length, which is required in cointegration test[20].

To find whether there is a long-run equilibrium relationship between stock prices and the trade-weighted exchange rate series we employ the Johansen cointegration tests using the maximum statistic ($\lambda_{\max}$) and the trace statistic (λ_{trace}), the latter is corrected for degrees of freedom. Table 3 reports the results of the pair wise cointegration tests with 1 through lag 4 orders[21]. However, bold lags are optimal. Furthermore, we report the results of these tests with including trend variable if the trend in equation {3.1} was found to be significant. Otherwise, we report the results without trend variable.

Insert Table 3 about here

A perusal of the table reveals that the null hypothesis of no cointegration between stock prices and the trade-weighted exchange rate based on the trace statistic (λ_{trace}) cannot be

[20] The results of these tests are not reported here but are available from author at request.

[21] The results of the cointegration tests can be sensitive to the choice of lag order; therefore, we report the cointegration tests for lag order one to four to examine whether the cointegration results are robust to the choice of lag order.

rejected for 65 out of the 70 individual firms. This implies that there is no long-run equilibrium relationship between the trade-weighted exchange rate and the stock prices for about 86% examined firms. The results for four individual firms namely Adamjee Insurance, East West Insurance, KESC, and General Tyre, show a long-run association for all examined lag-length. The null hypothesis of no cointegration for Pakistan Oilfields, however, is rejected only for lag 4. Hence cointegration tests are found to be sensitive to the choice of lag order for this unique firm. A possible explanation of this finding is that these five firms are relatively large firms (three importing and two financial firms). All three importing firms, Pakistan Oilfields, KESC and General Tyre, are significantly involved in trade activities. Higher profit (which raises stock prices) definitely is the result of higher production by using higher level of imported inputs. Of course, higher imports lead to an increase in the demand for foreign currency which depreciates local currency. Remaining two financial firms may have relatively more foreign assets, thereby, they significantly affected by the adverse/favorable movements of exchange rates.

However, the null hypotheses of no cointegration are rejected for further four firms (Hub Power Co, Grindlsys Motor, Shell, and Attock Refinery) by the maximum statistic ($\lambda_{\max}$). But, due to its low significance level of the test, the maximum statistic ($\lambda_{\max}$) is less dependable than the trace (λ_{trace}) test statistic. In light of these results we can conclude that in the statistical sense there is no co-movement between the said variables over time for most of the examined individual firms. The interpretation in our context is that investors cannot use information obtained from one market (say foreign exchange market) to foresee the behavior of other market (stock market) for long time interval. Moreover, the financial authority in Pakistan cannot use exchange rate as a policy tool to control the collapse in stock market. Our results from Johansen cointegration tests clearly support the results of Abdalla and Murinde (1997), and Muhammad and Abdul (2003), who have also been concluded that there is no long-run equilibrium association between stock prices and exchange rates. The significance of our results, however, could possibly be improved upon by employing multivariate model (including interest rate, commodity price index, inflation, rate of dividend, dummies for law and order, sectoral output indices, etc) and/or applying daily data.

Table 4 presents the standard Granger causality tests results (i.e., F-statistics). The stationary first differences forms of both stock prices and the trade-weighted exchange rate were used in the autoregressive (AR). For each individual firm, first row reports the F-statistics for testing the null hypothesis that change in stock prices does not (in Granger sense) cause change in trade-weighted exchange rate. Corresponding second row represents the F-statistics for reversed null hypothesis that change in stock prices are not caused by change in trade-weighted exchange rate. The lag orders are varied from 1 to 4.

Insert Table 4 about here

The results of Granger causality tests (reported in Table 4) give some fascinating information about short-run association between stock prices and the trade-weighted exchange rate. It can be observed from the table that there is no short-run association between the trade-weighted exchange rate and the stock prices for most of the examined firms. Neither stock prices lead (Granger cause) trade-weighted exchange rate nor exchange rate precede stock prices for 47 of the 65 individual firms (about 72 percent) examined in this study. These results are robust to the choice of lag order.

Despite above finding for a large number of examined firms, we are nevertheless able to explore link between stock prices and the trade-weighted exchange rate in some cases. As it can be observed from the table that the null hypothesis of changes in stock prices does not (in Granger sense) cause changes in exchange rate is rejected for 5 individual firms. This rejection is very sensitive to the choice of lag order. However, the null hypothesis of changes in stock prices are not caused by changes in exchange rate is not rejected. This implies a unidirectional causation that runs from stock prices to exchange rate. The interpretation in our context is that initial changes in stock prices lead changes in trade-weighted exchange rate. Therefore, an investor or a trader can use information about stock prices for these stocks to foresee the future changes in exchange rates. Moreover, the causation from stock prices to exchange rate clearly indicates that authorities can focus on domestic economic policies to control the collapse in prices of these stocks.

Quite the opposite, the null hypothesis of changes in stock prices are not Granger caused by changes in trade-weighted exchange rate is rejected at the 5 percent significance level for 10 individual firms. Whereas the results for the exchange rate equation fail to reject the null hypothesis of changes in stock prices do not lead (Granger cause) changes in exchange rates. This evidence supports the existence of unidirectional causality from the changes in trade-weighted exchange rate to changes in stock prices. Thus, exchange rate movements have massive implications for these firms. A simple explanation is that an increase in exchange rate (depreciation of domestic currency) or a fall in exchange rate (appreciation of domestic currency) affects the performance of firms not only in domestic but also in international markets, and this in turn affects the share prices of corresponding firms. This finding is very useful for investors as well as for policy makers. For example, an investor can apply information on exchange rate movements to anticipate the changes in stock prices for relevant firms. Policy makers can stabilize the prices of these stocks and stimulate foreign investment in these stocks by reducing the intensity of the adverse movements of exchange rate. Moreover, this discovery suggests that the management authorities in these firms can eliminate (fully or partially) the risk about foreign and even domestic operations by using currency derivatives (swap, future, and forward options).

Finally, Table 4 provides evidence with respect to only three firms (namely, Sapphire Textile, Cresent Textile, and Service Industry). The evidence shows that there is a bi-directional causation between stock prices and the trade-weighed exchange rate. This result is similar to those of Bahamani-Oskooee and Sohrahian (1992) and Abdalla and Murinde (1997) who reported unidirectional as well as feedback granger causality between stock prices and exchange rates. However, the results on bi-directional causality are consistent with the choice of lag order for only one of the three cases.

Results from Error-Correction Models

As discussed earlier, if two (or more) variables are cointegrated, then error correction method is robust than the standard Granger causality test to analysis the causal relationship. Our findings based on the Johansen cointegration test indicate that the trade-weighted exchange rate and the stock prices are cointegrated for five individual firms. Therefore, to examine the direction of the causation, we use the error-correction models.

Long-Run Granger Causality

Table 6.6 presents the estimates of the error-correction terms i.e., the estimates of λ_0 and λ_1 along with their t-statistics. As it can be observed from the table that λ_0 is statistically significant at the one percent level of significance for all five examined firms, whereas λ_1 is statistically significant at the 5 percent significance level for all firms except East West Insurance.

Insert Table 5 about here

Hence, the statistical significance of the estimates of the error-correction terms implies that there is a bi-directional causation (in the Granger sense) between the trade-weighted exchange rate and stock prices for 4 of the 5 examined firms. These are Adamjee Insurance, KESC, Pakistan Oilfields, and General Tyre. For East West Insurance the unidirectional causation runs from the trade-weighted exchange rate to the stock prices as suggested by the traditional models. For all of examined firms, this finding is robust to the number of lags employed in the error-correction models. The optimal lag orders are selected by the Akaike Information Criterion (AIC) and the Schwartz Information Criterion (SIC).

Short-Run Granger Causality

To analyze the short-run causal relationship between stock prices and the trade-weighted exchange rate we employ an F-test. If the η_{0i} 's are jointly significant using an F-test, this means that there is a short-run causation (in Granger sense) from trade-weighted exchange rate to stock prices, whereas significance of η_{1i},s indicates a reverse causation. The results are given in Table 6.

Insert Table 6 about here

As it can be observed from the table, results for the short-run causation are robust to the choice of lag order in case of all examined companies except for East West Insurance. The calculated F-statistics are less than critical values at any common level of significance for 4 out of the 5 individual firms. Therefore, we are neither able to reject the null hypothesis that η_{0i} 's are jointly equal to zero nor the null hypothesis of η_{1i},s as jointly equal to zero. This implies that there is no short-run causation in either direction between the two above-mentioned variables. For East West Insurance, however, there is a unidirectional short-run causation that runs from the trade-weighted exchange rate to stock prices for lag order 4.

The above discussion indicates that there is no (for most of the examined cases) short-run or long-run Granger causality between stock prices and the trade-weighted exchange rate. Our results confirm the finding of Muhammad and Abdul (2003) for Pakistan. Their study also finds (at macro level) neither short-run nor log-run Granger causation for Pakistan using monthly data for the sample period January 1994 through December 2000.

VI. CONCLUSION

To examine the said relationship for individual firms, we employed the Johansen' cointegration approach. Based on this methodology, we explored some fascinating information about the long-run association between stock prices and exchange rates. For 65 of the 70 firms, we accepted the null hypothesis of no cointegration. This is indicating that there is no long-run equilibrium relationship between the trade-weighted exchange rate and the stock prices for about 86% examined firms. However, we found that, for only five firms in our sample, there is a long-run stable relationship between stock prices and exchange rates.

The explanation of the absence of any long-run interaction is as follows. Stock market in Pakistan is not so tightly linked with real economy and does not efficiently reflect company's actual and expected performance. As reported by Husain (2001), the stock market in Pakistan does not lead to macro variables namely consumption expenditure, investment spending, and economic activity (measured by GDP) however, according to author fluctuations in these variables cause changes in stock prices. This may be a reason for nonexistence of any co-movement of stock prices and exchange rates. In past years, Pakistan economy has experienced high inflation (for example, it was 12.4% in 1995, 10.4% in 1996 and 11.3% in 1997)[22], in inflationary environment, nominal profits rise equally with inflation and therefore stock prices will also increase but returns in real term may remain same. Moreover, Pakistan pursued a dual exchange rate system from July 22, 1998 to May 19, 1999. Under such scenarios, it is very hard to record any long-run or short-run association between stock prices and exchange rates.

Similarly, Pakistan's economy has small volume of foreign portfolio investment. At the end of fiscal year 1998-99, it was $ 27.3 million. However, during the fiscal years 2000-01 and 2001-02, foreign portfolio investment was -140.4 and -10.0 million US dollars respectively (source: Pakistan Economic Survey)[23]. Therefore, Pakistani stock market plays somewhat regional role and does not considerably influence the behavior of foreign investors. Moreover, freezing of foreign currency account, unresolved dispute with the

[22] Source: International Financial Statistics (various issues)

[23] Some authors have been reported a long-run association between stock prices and exchange rates for UK, and U. S. A. (see for details, Aggarwal, (1981), Solnik (1987), and He & Ng (1998)) because stock markets of these countries belong to the prestigious group of the most efficient and developed markets with the largest turnover and market capitalization and they play a leading role and attract domestic as well as global investors.

Independent Power Projects (IPPs) might reduce dynamic linkages between exchange rates and stock prices. Thus, all of these factors are in line with our findings that there is no relationship between stock prices and exchange rates. However, the absence of co-movement between the said variables has a number of meaningful implications for both policy makers and practitioners.

Based on the standard Granger causality test, we found that, for 47 of the 65 individual firms, there is no short-run association between stock prices and the trade-weighted exchange rate. Despite of this finding for a large number of examined firms, we provided evidence:

1. For five firms, unidirectional causality runs from changes in stock prices to changes in exchange rate
2. For ten firms, unidirectional causality runs from changes in exchange rate to changes in stock prices.
3. For three firms, there is a bi-directional causation between stock prices and exchange rates.

This finding suggests that authorities in Pakistan cannot use exchange rate as a policy tool to attract foreign investment; rather they should use some other means to do this (for example, use interest rate, reduce political uncertainty, improve law and order situation, produce conducive investment climate etc.). Moreover, this finding is indicating that crises in the stock market cannot be prevented by controlling the exchange rate movements. Under this scenario, there should be focus on domestic economic policies to stabilize the stock market during the times of any financial crises.

The absence of long-run association implies that the competitiveness of a firm is not affected by appreciation/depreciation of domestic currency. Thus, exchange rate movements have no impact on firm’s value. This suggests that firms have no need to hedge themselves from adverse movements of exchange rates. This discovery also is implying that international investors cannot get effective help in designing their investment strategy based on information about exchange rates fluctuations.

The absence of any short-run relationship (causation) suggests that investors cannot predict the behavior of one market using the information on other markets. Moreover, higher stock prices may not stimulates/attracts foreign portfolio investment both in existing and new issue stock. Therefore, firm can not easily raise more capital through equity to expand its production. Our results, however, clearly rejected the portfolio balance models of exchange rates determination and the Arbitrage theory, whereas; strongly support the asset market approach to exchange rate determination that refutes any link between the stock prices and exchange rates.

Table 1

$\hat{\eta}_u$ and $\hat{\eta}_\tau$ Tests for Level and Trend Stationarity Applied to Firms' Weekly Observations

Company	Lag Truncation Parameter (l)							
	1	2	3	4	1	2	3	4
	η_u: 5% critical value is 0.463				η_τ: 5% critical value is 0.146			
ICP SEMF	9.287	6.289	4.816	3.931	2.348	1.602	1.245	1.031
Grindlays Modar.	12.293	8.281	6.284	5.094	2.298	1.592	1.238	1.040
Orix Leasing	3.434	2.473	2.016	1.739	0.837	0.614	0.510	0.448
P. I. C. I. C	7.615	5.253	4.072	3.371	1.869	1.304	1.019	0.854
Askari Bank	8.430	5.745	4.410	3.607	2.571	1.759	1.35	1.113
Bank-al-Habib	6.062	4.189	3.273	2.728	2.654	1.841	1.444	1.207
Bank of Punjab	1.904	1.334	1.334	1.054	1.925	1.347	1.063	0.898
Faysal Bank	6.946	4.736	3.623	2.960	2.519	1.727	1.324	1.085
MCB	5.762	3.980	3.088	2.552	1.702	1.188	0.928	0.773
Metropolitan Bank	6.875	4.743	3.691	3.072	2.533	1.761	1.384	1.164
Soneri Bank	7.578	5.345	4.248	3.574	1.596	1.159	0.953	0.823
Union Bank	3.828	2.637	2.062	1.718	2.612	1.797	1.405	1.169
Adamjee Insur.	1.063	0.739	0.585	0.498	0.819	0.571	0.52	0.386
E. W. Insurance	3.117	2.168	1.707	1.441	1.091	0.760	0.600	0.508
Gadoon Textile	7.749	5.341	4.152	3.435	0.822	0.581	0.463	0.391
Kohinoor Weaving	11.678	7.903	6.028	4.905	0.586	0.413	0.332	0.285
Crescent Textile	7.081	4.894	3.830	3.179	0.653	0.463	0.374	0.318
Gul Ahmed Textile	11.457	7.734	5.885	4.775	0.744	0.525	0.418	0.353
Nishat Mills	2.608	1.791	1.389	1.152	1.149	0.789	0.612	0.507
Sapphire Fibres	4.078	2.803	2.174	1.805	1.089	0.753	0.586	0.489
Sapphire Tex	1.056	0.733	0.566	0.466	1.113	0.772	0.596	0.491
Dewan Salman	6.268	4.268	3.278	2.688	1.331	0.925	0.727	0.612
Gatron Industry	10.537	7.165	5.481	4.471	2.734	1.893	1.476	1.224
Ibrahim Fibers	8.30	5.674	4.375	3.593	1.489	1.025	0.798	0.659
Rupali Polyester	9.080	6.261	4.828	3.987	0.645	0.466	0.372	0.320
Thal Jute	8.458	5.773	4.421	3.609	2.478	1.700	1.307	1.069
Chakwal Cement	6.943	4.779	3.702	3.032	1.908	1.332	1.047	0.861
Cherat Cement	8.212	5.599	4.293	3.514	1.889	1.296	0.998	0.820
D. G. Khan	7.695	5.233	3.998	3.259	2.280	1.554	1.188	0.968
Lucky Cement	8.040	5.492	4.212	3.455	1.858	1.277	0.982	0.808
Maple Leaf	7.031	4.799	3.701	3.049	1.956	1.337	1.035	0.856
Lackson Tobacco	8.626	5.930	4.626	3.831	1.561	1.103	0.898	0.767
Pakistan Tobacco	6.217	4.268	3.307	2.734	1.512	1.046	0.817	0.680
Attock Refinery	5.079	3.577	2.845	2.427	1.219	0.873	0.708	0.619
Hub Power Co.	9.353	6.363	4.900	4.036	1.796	1.244	0.988	0.481
KESC	6.033	4.139	3.206	2.644	1.407	0.983	0.778	0.656
Mari Gas	10.797	7.298	5.557	4.521	2.693	1.843	1.425	1.181
National Refinery	8.868	6.073	4.692	3.865	2.354	1.632	1.279	1.066

Continued –

Table 5.5 – (Continued)

Company	Lag Truncation Parameter (l)							
	1	2	3	4	1	2	3	4
	η_u: 5% critical value is 0.463				η_τ: 5% critical value is 0.146			
P.S.O	5.789	3.955	3.047	2.513	1.648	1.129	0.873	0.722
Pakistan oilfields	8.551	5.855	4.579	3.834	0.863	0.613	0.513	0.468
Pakistan Refinery	8.626	5.868	4.500	3.673	2.088	1.443	1.126	0.933
Shell Pak	6.427	4.369	3.347	2.738	1.521	1.038	0.799	0.657
Sui Northern	7.651	5.225	4.030	3.317	2.489	1.704	1.321	1.093
Sui Southern	5.535	3.787	2.930	2.426	1.882	1.291	1.001	0.833
General Tyre	0.735	0.539	0.446	0.402	0.703	0.514	0.427	0.384
Honda Atlas Car	10.285	6.944	5.294	4.301	2.808	1.916	1.486	1.229
Indus Motors	8.556	5.788	4.420	3.601	2.942	1.991	1.524	1.244
Pak Suzuki	8.026	5.408	4.114	3.339	3.024	2.039	1.556	1.267
Siemens Pak	11.563	7.805	5.924	4.793	2.752	1.899	1.467	1.201
PIAC	3.520	2.424	1.886	1.576	2.317	1.590	1.233	1.028
PTCL	3.349	2.286	1.786	1.459	2.091	1.425	1.099	0.905
Abbot Lab	10.285	7.162	5.609	4.676	1.607	1.183	0.980	0.874
BOC Pakistan	4.113	2.881	2.262	1.890	1.305	0.925	0.732	0.616
Dawood Hercules	6.467	4.485	3.506	2.908	2.506	1.756	1.388	1.159
Engro Chemical	1.945	1.336	1.038	0.864	1.905	1.308	1.016	0.846
Fauji Fertilizers	7.558	5.115	3.903	3.182	2.847	1.929	1.475	1.205
Glaxo Wellcome	8.456	5.793	4.477	3.684	1.449	1.016	0.808	0.682
ICI Pakistan	11.256	7.603	5.789	4.706	1.927	1.325	1.034	0.864
Parke Davis	7.854	5.314	4.058	3.306	2.059	1.406	1.088	0.899
Reckit & Colman	7.915	5.381	4.113	3.347	2.828	1.935	1.487	1.212
Sitara Chemical	9.370	6.435	4.990	4.122	1.095	0.775	0.622	0.528
Century Paper	10.425	7.076	5.403	4.407	2.765	1.900	1.465	1.211
Packages Limited	8.876	6.014	4.599	3.751	2.337	1.587	1.217	0.994
Security Paper	11.257	7.596	5.768	4.682	1.726	1.183	0.913	0.763
Service Industry	8.216	5.614	4.332	3.563	0.490	0.344	0.274	0.232
Lever Brothers	8.067	5.480	4.194	3.426	2.425	1.651	1.267	1.037
Nestle Milk Pak	6.816	4.714	3.704	3.113	2.051	1.425	1.130	0.959
CPC Rahfan	11.541	7.806	5.946	4.844	1.012	0.692	0.529	0.435
Gillette Pakistan	6.867	4.681	3.594	2.955	1.988	1.366	1.059	0.881
Pakistan Services	7.001	4.754	3.642	2.976	2.277	1.553	1.194	0.980
Trade-Weighted Exchange Rate	9.501	6.439	4.191	4.013	2.565	1.536	1.790	0.967

Note: If the calculated (tabulated) statistics > critical values, the null hypothesis of stationary is not accepted (rejected).

Table 2

$\hat{\eta}_u$ and $\hat{\eta}_\tau$ Tests for Level and Trend Stationarity
Applied in the First Differences of Firms' Weekly Observations

Company	Lag Truncation Parameter (l)							
	1	2	3	4	1	2	3	4
	η_u: 5% critical value is 0.463				η_τ: 5% critical value is 0.146			
ICP SEMF	0.123	0.075	0.116	0.092	0.042	0.025	0.039	0.031
Grindlays Modar.	0.053	0.062	0.038	0.057	0.033	0.039	0.023	0.036
Orix Leasing	0.034	0.039	0.049	0.055	0.029	0.033	0.041	0.047
P. I. C. I. C	0.368	0.525	0.314	0.309	0.071	0.103	0.061	0.061
Askari Bank	0.617	0.641	0.612	0.507	0.083	0.088	0.085	0.071
Bank-al-Habib	0.308	0.322	0.473	0.368	0.028	0.029	0.046	0.035
Bank of Punjab	0.084	0.108	0.100	0.087	0.050	0.065	0.060	0.052
Faysal Bank	0.204	0.257	0.48	0.181	0.027	0.035	0.019	0.024
MCB	0.053	0.074	0.068	0.040	0.041	0.057	0.053	0.032
Metropolitan Bank	0.311	0.316	0.290	0.427	0.019	0.019	0.018	0.028
Soneri Bank	0.101	0.096	0.192	0.117	0.032	0.031	0.062	0.037
Union Bank	0.374	0.328	0.567	0.399	0.047	0.042	0.078	0.053
Adamjee Insur.	0.065	0.062	0.057	0.062	0.064	0.061	0.056	0.061
E. W. Insurance	0.214	0.213	0.214	0.216	0.062	0.062	0.063	0.063
Gadoon Textile	0.056	0.073	0.093	0.061	0.047	0.062	0.079	0.052
Kohinoor Weaving	0.056	0.057	0.077	0.067	0.037	0.038	0.052	0.045
Crescent Textile	0.032	0.026	0.014	0.034	0.030	0.025	0.039	0.032
Gul Ahmed Textile	0.041	0.035	0.048	0.026	0.038	0.033	0.044	0.024
Nishat Mills	0.118	0.108	0.112	0.072	0.092	0.084	0.088	0.056
Sapphire Fibres	0.058	0.063	0.052	0.075	0.057	0.062	0.052	0.073
Sapphire Tex	0.041	0.054	0.040	0.031	0.040	0.053	0.039	0.031
Dewan Salman	0.125	0.118	0.126	0.098	0.122	0.115	0.124	0.096
Gatron Industry	0.406	0.392	0.780	0.694	0.030	0.029	0.062	0.056
Ibrahim Fibers	0.302	0.281	0.392	0.325	0.153	0.143	0.199	0.166
Rupali Polyester	0.049	0.069	0.044	0.034	0.034	0.047	0.030	0.023
Thal Jute	0.892	1.171	1.308	1.124	0.129	0.177	0.208	0.182
Chakwal Cement	0.117	0.113	0.294	0.074	0.034	0.033	0.086	0.021
Cherat Cement	0.313	0.314	0.282	0.275	0.095	0.095	0.085	0.084
D. G. Khan	0.505	0.928	0.739	0.347	0.092	0.177	0.141	0.064
Lucky Cement	0.363	0.464	0.302	0.233	0.112	0.145	0.094	0.072
Maple Leaf	0.762	0.644	0.829	0.611	0.163	0.139	0.189	0.137
Lackson Tobacco	0.097	0.067	0.214	0.073	0.023	0.015	0.052	0.017
Pakistan Tobacco	0.112	0.131	0.139	0.213	0.047	0.056	0.060	0.092
Attock Refinery	0.072	0.099	0.075	0.061	0.026	0.036	0.027	0.022
Hub Power Co.	0.046	0.037	0.057	0.089	0.039	0.032	0.049	0.077
KESC	0.067	0.068	0.082	0.049	0.047	0.048	0.058	0.034
Mari Gas	0.260	0.274	0.245	0.227	0.026	0.028	0.025	0.023
National Refinery	0.269	0.258	0.425	0.349	0.067	0.064	0.108	0.088

Continued –

Table 5.6 – (Continued)

Company	Lag Truncation Parameter (l)							
	1	2	3	4	1	2	3	4
	η_u : 5% critical value is 0.463				η_τ : 5% critical value is 0.146			
P.S.O	0.084	0.093	0.084	0.086	0.074	0.082	0.075	0.076
Pakistan Oilfields	0.023	0.013	0.018	0.016	0.021	0.012	0.016	0.015
Pakistan Refinery	0.087	0.131	0.284	0.147	0.036	0.054	0.118	0.061
Shell Pak	0.071	0.079	0.080	0.056	0.072	0.081	0.081	0.057
Sui Northern	0.684	0.567	0.633	0.562	0.125	0.105	0.119	0.108
Sui Southern	0.157	0.151	0.134	0.140	0.073	0.070	0.063	0.065
General Tyre	0.061	0.075	0.063	0.075	0.032	0.039	0.033	0.040
Honda Atlas Car	0.271	0.222	0.274	0.423	0.026	0.022	0.027	0.043
Indus Motors	0.589	0.383	0.456	0.886	0.066	0.043	0.052	0.109
Pak Suzuki	0.637	0.349	0.509	0.556	0.062	0.034	0.052	0.058
Siemens Pak	0.145	0.206	0.233	0.122	0.020	0.029	0.033	0.017
PIAC	0.337	0.308	0.270	0.292	0.138	0.127	0.112	0.121
PTCL	0.268	0.211	0.387	0.204	0.108	0.085	0.158	0.082
Abbot Lab	0.228	0.280	0.199	0.235	0.033	0.041	0.029	0.035
BOC Pakistan	0.039	0.060	0.048	0.042	0.033	0.050	0.041	0.036
Dawood Hercules	0.074	0.069	0.105	0.091	0.022	0.020	0.031	0.027
Engro Chemical	0.134	0.125	0.119	0.159	0.037	0.034	0.033	0.044
Fauji Fertilizers	0.422	0.337	0.362	0.386	0.061	0.049	0.053	0.057
Glaxo Wellcome	0.107	0.105	0.233	0.460	0.039	0.038	0.086	0.175
ICI Pakistan	0.208	0.181	0.216	0.197	0.031	0.027	0.033	0.030
Parke Davis	0.154	0.138	0.225	0.134	0.046	0.042	0.068	0.040
Reckit & Colman	0.367	0.597	1.409	0.347	0.027	0.045	0.121	0.026
Sitara Chemical	0.069	0.073	0.111	0.055	0.056	0.059	0.090	0.044
Century Paper	0.349	0.453	0.234	0.239	0.027	0.036	0.018	0.019
Packages Limited	0.274	0.235	0.398	0.341	0.089	0.077	0.133	0.115
Security Paper	0.106	0.105	0.061	0.131	0.043	0.043	0.025	0.054
Service Industry	0.040	0.045	0.058	0.057	0.037	0.042	0.054	0.052
Lever Brothers	0.154	0.156	0.186	0.176	0.084	0.086	0.102	0.097
Nestle Milk Pak	0.349	0.269	0.359	0.307	0.106	0.082	0.112	0.095
CPC Rahfan	0.110	0.138	0.077	0.092	0.094	0.118	0.066	0.076
Gillette Pakistan	0.092	0.102	0.075	0.083	0.037	0.041	0.030	0.034
Pakistan Services	0.311	0.373	0.513	0.373	0.048	0.059	0.084	0.061
Trade-Weighted Exchange Rate	0.195	0.204	0.229	0.170	0.059	0.061	0.069	0.051

Note: If the calculated (tabulated) statistics > critical values, the null hypothesis of stationary is not accepted (rejected).

Table 3

Results of the Johansen Cointegration Test for Individual Firms,
Weekly Data; January 1, 1999 through March 31, 2004; 270 observations

Company	Hypothesis		Test Statistics at Different Lag-values			
	Ho	**H_A**	**k =1**	**k = 2**	**k = 3**	**k = 4**
ICP SEMF (1)						
λ_{trace} test	$r=0$	$r>0$	16.145	14.112	16.789	17.734
	$r\leq1$	$r>1$	4.365	4.171	4.356	4.459
$\lambda_{\max}$ test	$r=0$	$r=1$	11.824	10.016	12.572	13.475
	$r=1$	$r=2$	4.382	4.202	4.405	4.526
Grindlays. M (1)						
λ_{trace} test	$r=0$	$r>0$	17.139	18.213	17.958	20.659
	$r\leq1$	$r>1$	4.431	4.443	4.564	4.654
$\lambda_{\max}$ test	$r=0$	$r=1$	12.755	13.872	13.544	16.246**
	$r=1$	$r=2$	4.448	4.476	4.615	4.724
Orix Leasing (1)						
λ_{trace} test	$r=0$	$r>0$	17.605	18.845	18.136	15.966
	$r\leq1$	$r>1$	4.605	4.894	4.877	5.039
$\lambda_{\max}$ test	$r=0$	$r=1$	13.049	14.055	13.408	11.092
	$r=1$	$r=2$	4.622	4.930	4.932	5.115
P. I. C. I. C. (1)						
λ_{trace} test	$r=0$	$r>0$	11.172	10.838	11.286	11.119
	$r\leq1$	$r>1$	4.761	5.205	5.232	5.240
$\lambda_{\max}$ test	$r=0$	$r=1$	6.434	5.675	6.122	5.967
	$r=1$	$r=2$	4.779	5.244	5.290	5.319
Askari Bank (1)						
λ_{trace} test	$r=0$	$r>0$	12.499	11.640	12.638	13.407
	$r\leq1$	$r>1$	4.820	5.193	5.504	5.520
$\lambda_{\max}$ test	$r=0$	$r=1$	7.707	6.494	7.213	8.005
	$r=1$	$r=2$	4.838	5.232	5.566	5.603
Bank-al-Habib (1)						
λ_{trace} test	$r=0$	$r>0$	11.637	13.874	14.120	12.812
	$r\leq1$	$r>1$	5.595	5.453	5.501	4.983
$\lambda_{\max}$ test	$r=0$	$r=1$	6.064	8.483	8.715	7.946
	$r=1$	$r=2$	5.616	5.494	5.563	5.058
Bank of Punjab (1)						
λ_{trace} test	$r=0$	$r>0$	12.792	14.474	13.971	14.581
	$r\leq1$	$r>1$	3.577	4.022	3.481	3.788
$\lambda_{\max}$ test	$r=0$	$r=1$	9.249	10.530	10.608	10.955
	$r=1$	$r=2$	3.590	4.052	3.520	3.845

Continued –

Table 3 – (Continued)

Company	Hypothesis Ho	Hypothesis H_A	k =1	k = 2	k = 3	k = 4
Faysal Bank (4)						
λ_{trace} test	$r=0$	$r>0$	14.036	14.840	14.555	11.983
	$r\leq 1$	$r>1$	4.744	5.114	5.439	5.312
$\lambda_{\max}$ test	$r=0$	$r=1$	9.326	9.798	9.218	6.771
	$r=1$	$r=2$	4.762	5.152	5.500	5.392
MCB (1)						
λ_{trace} test	$r=0$	$r>0$	15.449	15.263	14.740	15.379
	$r\leq 1$	$r>1$	4.928	5.185	4.479	4.581
$\lambda_{\max}$ test	$r=0$	$r=1$	10.560	10.154	10.376	10.961
	$r=1$	$r=2$	4.946	5.223	4.530	4.650
Metropolitan. B (1)						
λ_{trace} test	$r=0$	$r>0$	14.743	14.598	14.664	15.541
	$r\leq 1$	$r>1$	6.414	5.516	5.369	5.699
$\lambda_{\max}$ test	$r=0$	$r=1$	8.359	9.149	9.399	9.989
	$r=1$	$r=2$	6.438	5.558	5.429	5.785
Soneri Bank (1)						
λ_{trace} test	$r=0$	$r>0$	14.624	13.709	14.928	11.694
	$r\leq 1$	$r>1$	4.532	4.678	4.849	4.401
$\lambda_{\max}$ test	$r=0$	$r=1$	10.129	9.098	10.192	7.403
	$r=1$	$r=2$	4.549	4.713	4.904	4.467
Union Bank (1)						
λ_{trace} test	$r=0$	$r>0$	12.824	12.595	13.586	11.458
	$r\leq 1$	$r>1$	4.747	5.053	5.315	5.329
$\lambda_{\max}$ test	$r=0$	$r=1$	8.107	7.597	8.364	6.220
	$r=1$	$r=2$	4.764	5.091	5.374	5.409
Adamjee Ins. (1)						
λ_{trace} test	$r=0$	$r>0$	10.090	11.487	12.429	14.499
	$r\leq 1$	$r>1$	4.115**	4.486**	4.227**	4.540**
$\lambda_{\max}$ test	$r=0$	$r=1$	5.996	7.053	8.294	10.109
	$r=1$	$r=2$	4.130**	4.519**	4.274	4.608**
East West Ins. (1)						
λ_{trace} test	$r=0$	$r>0$	17.676**	19.453**	20.466*	17.883**
	$r\leq 1$	$r>1$	2.734	3.084	3.306	2.308
$\lambda_{\max}$ test	$r=0$	$r=1$	14.998**	16.492**	17.352**	15.869**
	$r=1$	$r=2$	2.744	3.107	3.343	2.351
Gadoon Textile (1)						
λ_{trace} test	$r=0$	$r>0$	11.409	13.703	12.896	12.013
	$r\leq 1$	$r>1$	4.812	4.788	4.281	3.792
$\lambda_{\max}$ test	$r=0$	$r=1$	6.620	8.980	8.712	8.344
	$r=1$	$r=2$	4.831	4.824	4.329	3.849

Continued –

Table 3 – (Continued)

Company	Hypothesis		Test Statistics at Different Lag-values			
	Ho	**H_A**	**k =1**	**k = 2**	**k = 3**	**k = 4**
Kohinoor Weav. (1)						
λ_{trace} test	$r=0$	$r>0$	12.365	15.135	16.508	15.719
	$r\leq 1$	$r>1$	4.336	4.864	5.295	5.621
$\lambda_{\max}$ test	$r=0$	$r=1$	8.058	10.347	11.34	10.25
	$r=1$	$r=2$	4.352	4.901	5.354	5.705
Crescent Textile (1)						
λ_{trace} test	$r=0$	$r>0$	17.240	15.696	17.375	22.795
	$r\leq 1$	$r>1$	4.320	4.143	3.937	8.974
$\lambda_{\max}$ test	$r=0$	$r=1$	12.968	11.639	13.59	14.576
	$r=1$	$r=2$	4.336	4.175	3.981	9.465
G. Ahmed Text. (1)						
λ_{trace} test	$r=0$	$r>0$	16.601	15.044	16.194	14.664
	$r\leq 1$	$r>1$	4.527	5.187	5.271	5.550
$\lambda_{\max}$ test	$r=0$	$r=1$	12.118	9.930	11.046	9.251
	$r=1$	$r=2$	4.544	5.226	5.330	5.634
Nishat Mills (1)						
λ_{trace} test	$r=0$	$r>0$	9.403	9.661	10.095	10.506
	$r\leq 1$	$r>1$	3.730	3.313	3.265	3.472
$\lambda_{\max}$ test	$r=0$	$r=1$	5.6945	6.3948	6.907	7.1403
	$r=1$	$r=2$	3.7443	3.3386	3.3017	3.5243
Sapphire Fibres (1)						
λ_{trace} test	$r=0$	$r>0$	13.356	13.684	13.035	12.486
	$r\leq 1$	$r>1$	5.129	4.713	4.152	16.600
$\lambda_{\max}$ test	$r=0$	$r=1$	8.258	9.037	8.983	8.386
	$r=1$	$r=2$	5.148	4.748	4.198	4.288
Sapphire Textile (1)						
λ_{trace} test	$r=0$	$r>0$	18.589	12.667	11.798	11.926
	$r\leq 1$	$r>1$	6.417	5.585	5.516	5.420
$\lambda_{\max}$ test	$r=0$	$r=1$	12.21	7.134	6.352	6.603
	$r=1$	$r=2$	6.440	5.626	5.577	5.501
Dewan Salman (1)						
λ_{trace} test	$r=0$	$r>0$	13.182	13.549	14.848	15.234
	$r\leq 1$	$r>1$	3.727	3.393	3.242	3.310
$\lambda_{\max}$ test	$r=0$	$r=1$	9.489	10.232	11.737	12.103
	$r=1$	$r=2$	3.741	3.418	3.279	3.360
Gatron Industry (1)						
λ_{trace} test	$r=0$	$r>0$	12.358	13.184	13.120	12.850
	$r\leq 1$	$r>1$	5.047	5.297	5.440	5.504
$\lambda_{\max}$ test	$r=0$	$r=1$	7.338	7.944	7.766	7.456
	$r=1$	$r=2$	5.065	5.337	5.501	5.586

Continued –

Table 3 – (Continued)

Company	Hypothesis		Test Statistics at Different Lag-values			
	Ho	**H_A**	**k =1**	**k = 2**	**k = 3**	**k = 4**
Ibrahim Fibres (1)						
λ_{trace} test	$r=0$	$r>0$	11.417	10.790	11.248	12.401
	$r\leq 1$	$r>1$	4.537	4.105	4.586	4.685
$\lambda_{\max}$ test	$r=0$	$r=1$	6.906	6.735	6.737	7.831
	$r=1$	$r=2$	4.553	4.136	4.638	4.755
Rupali Polyester (1)						
λ_{trace} test	$r=0$	$r>0$	16.569	15.855	12.886	13.312
	$r\leq 1$	$r>1$	4.632	4.828	5.003	5.152
$\lambda_{\max}$ test	$r=0$	$r=1$	11.983	11.109	7.9708	8.2824
	$r=1$	$r=2$	4.649	4.8644	5.0597	5.2297
Thal Jute (2)						
λ_{trace} test	$r=0$	$r>0$	18.171	14.043	15.603	16.648
	$r\leq 1$	$r>1$	4.713	5.092	5.214	5.259
$\lambda_{\max}$ test	$r=0$	$r=1$	13.50	9.017	10.506	11.561
	$r=1$	$r=2$	4.731	5.130	5.273	5.338
Chackwal Cem. (1)						
λ_{trace} test	$r=0$	$r>0$	16.017	14.762	14.496	12.302
	$r\leq 1$	$r>1$	4.647	4.687	4.673	4.591
$\lambda_{\max}$ test	$r=0$	$r=1$	11.412	10.150	9.932	7.826
	$r=1$	$r=2$	4.664	4.722	4.726	4.660
Cherat Cement (1)						
λ_{trace} test	$r=0$	$r>0$	10.404	10.565	10.209	9.986
	$r\leq 1$	$r>1$	4.577	4.433	4.205	4.234
$\lambda_{\max}$ test	$r=0$	$r=1$	5.849	6.177	6.072	5.838
	$r=1$	$r=2$	4.594	4.466	4.252	4.298
D. G. Cement (1)						
λ_{trace} test	$r=0$	$r>0$	12.205	11.351	13.277	13.546
	$r\leq 1$	$r>1$	4.740	4.958	5.189	5.237
$\lambda_{\max}$ test	$r=0$	$r=1$	7.492	6.441	8.178	8.434
	$r=1$	$r=2$	4.757	4.995	5.248	5.315
Lucky Cement (1)						
λ_{trace} test	$r=0$	$r>0$	10.462	10.771	11.492	10.795
	$r\leq 1$	$r>1$	4.593	4.478	4.731	4.679
$\lambda_{\max}$ test	$r=0$	$r=1$	5.890	6.340	6.836	6.207
	$r=1$	$r=2$	4.610	4.511	4.784	4.749
Maple Leaf (1)						
λ_{trace} test	$r=0$	$r>0$	14.117	14.000	12.623	13.586
	$r\leq 1$	$r>1$	4.769	5.105	5.247	5.355
$\lambda_{\max}$ test	$r=0$	$r=1$	9.381	8.961	7.459	8.355
	$r=1$	$r=2$	4.787	5.143	5.306	5.435

Continued –

Table 5.9 – (Continued)

Company	Hypothesis		Test Statistics at Different Lag-values			
	Ho	**H_A**	**k =1**	**k = 2**	**k = 3**	**k = 4**
Lackson Tobac. (1)						
λ_{trace} test	$r=0$	$r>0$	16.970	15.146	17.230	14.184
	$r\leq 1$	$r>1$	4.698	5.122	5.168	5.012
$\lambda_{\max}$ test	$r=0$	$r=1$	12.318	10.099	12.198	9.309
	$r=1$	$r=2$	4.715	5.160	5.226	5.088
Pakistan Tobac. (1)						
λ_{trace} test	$r=0$	$r>0$	13.222	14.642	14.207	14.387
	$r\leq 1$	$r>1$	3.592	3.879	4.018	3.480
$\lambda_{\max}$ test	$r=0$	$r=1$	9.666	10.843	10.304	11.071
	$r=1$	$r=2$	3.606	3.908	4.063	3.532
Attock Refinery (2)						
λ_{trace} test	$r=0$	$r>0$	16.868	23.642	20.509	25.055
	$r\leq 1$	$r>1$	4.501	4.73	4.990	5.063
$\lambda_{\max}$ test	$r=0$	$r=1$	12.412	18.808**	15.693**	20.293**
	$r=1$	$r=2$	4.518	5.010	5.046	5.139
Pakistan Refin. (3)						
λ_{trace} test	$r=0$	$r>0$	12.653	17.532	15.507	13.823
	$r\leq 1$	$r>1$	4.456	4.896	4.609	4.547
$\lambda_{\max}$ test	$r=0$	$r=1$	8.227	12.731	11.020	9.415
	$r=1$	$r=2$	4.472	4.932	4.661	4.615
National Refin. (1)						
λ_{trace} test	$r=0$	$r>0$	11.805	11.048	11.301	10.800
	$r\leq 1$	$r>1$	4.600	4.486	4.424	4.530
$\lambda_{\max}$ test	$r=0$	$r=1$	7.231	6.610	6.954	6.364
	$r=1$	$r=2$	4.617	4.520	4.474	4.598
Shell Pak (2)						
λ_{trace} test	$r=0$	$r>0$	12.322	12.755	12.860	19.910
	$r\leq 1$	$r>1$	4.469	4.320	4.092	4.336
$\lambda_{\max}$ test	$r=0$	$r=1$	7.882	8.497	8.867	16.426**
	$r=1$	$r=2$	4.485	4.353	4.138	4.574
P. S. O (1)						
λ_{trace} test	$r=0$	$r>0$	12.504	11.946	12.008	14.176
	$r\leq 1$	$r>1$	4.025	3.706	3.365	3.246
$\lambda_{\max}$ test	$r=0$	$r=1$	8.510	8.301	8.740	11.095
	$r=1$	$r=2$	4.040	3.734	3.403	3.295
Pakistan Oilfie. (2)						
λ_{trace} test	$r=0$	$r>0$	24.469	18.604	24.224	29.967**
	$r\leq 1$	$r>1$	4.812	5.299	5.276	5.303
$\lambda_{\max}$ test	$r=0$	$r=1$	19.73**	13.405	19.161**	25.035*
	$r=1$	$r=2$	4.830	5.339	5.336	5.383

Continued –

Table 3 – (Continued)

Company	Hypothesis Ho	Hypothesis H_A	Test Statistics at Different Lag-values k =1	k = 2	k = 3	k = 4
Sui Northern (1)						
λ_{trace} test	$r=0$	$r>0$	13.614	12.302	11.816	12.291
	$r\leq1$	$r>1$	5.085	5.527	5.771	5.519
$\lambda_{\max}$ test	$r=0$	$r=1$	8.561	6.825	6.112	6.873
	$r=1$	$r=2$	5.104	5.568	5.836	5.602
Sui Southern (1)						
λ_{trace} test	$r=0$	$r>0$	11.235	10.926	11.351	12.545
	$r\leq1$	$r>1$	3.811	3.423	3.638	3.943
$\lambda_{\max}$ test	$r=0$	$r=1$	7.451	7.558	7.799	8.731
	$r=1$	$r=2$	3.825	3.449	3.678	4.003
Mari Gas (1)						
λ_{trace} test	$r=0$	$r>0$	13.992	14.198	15.912	17.153
	$r\leq1$	$r>1$	4.977	5.220	5.468	5.522
$\lambda_{\max}$ test	$r=0$	$r=1$	9.049	9.044	10.562	11.806
	$r=1$	$r=2$	4.995	5.259	5.530	5.605
Hub Power Co. (1)						
λ_{trace} test	$r=0$	$r>0$	14.944	17.966	22.747	21.958
	$r\leq1$	$r>1$	3.710	3.820	4.334	4.150
$\lambda_{\max}$ test	$r=0$	$r=1$	11.275	14.251	18.619**	18.075**
	$r=1$	$r=2$	3.724	3.849	4.383	4.213
KESC (1)						
λ_{trace} test	$r=0$	$r>0$	14.874	15.845**	17.278**	16.277**
	$r\leq1$	$r>1$	3.795**	3.604	3.549	3.658
$\lambda_{\max}$ test	$r=0$	$r=1$	11.120	12.333	13.883	12.809
	$r=1$	$r=2$	3.809**	3.631	3.589	3.713
General Tyre (1)						
λ_{trace} test	$r=0$	$r>0$	20.306*	22.789*	21.118*	23.566*
	$r\leq1$	$r>1$	4.327**	4.960**	4.262**	4.584**
$\lambda_{\max}$ test	$r=0$	$r=1$	16.038**	17.962**	17.045**	19.267*
	$r=1$	$r=2$	4.344**	4.997**	4.310**	4.653**
Honda Atl. Car (1)						
λ_{trace} test	$r=0$	$r>0$	12.764	13.448	12.636	12.056
	$r\leq1$	$r>1$	4.734	5.049	5.125	5.230
$\lambda_{\max}$ test	$r=0$	$r=1$	8.060	8.461	7.595	6.928
	$r=1$	$r=2$	4.752	5.087	5.182	5.309
Indus Motors (1)						
λ_{trace} test	$r=0$	$r>0$	12.764	13.448	12.636	12.056
	$r\leq1$	$r>1$	4.734	5.049	5.125	5.230
$\lambda_{\max}$ test	$r=0$	$r=1$	8.060	8.461	7.595	6.928
	$r=1$	$r=2$	4.752	5.087	5.182	5.309

Continued –

Table 3 – (Continued)

Company	Hypothesis		Test Statistics at Different Lag-values			
	Ho	**H_A**	**k =1**	**k = 2**	**k = 3**	**k = 4**
Pak Suzuki (2)						
λ_{trace} test	$r=0$	$r>0$	13.652	16.229	15.787	15.565
	$r\leq 1$	$r>1$	4.833	5.252	5.325	5.382
$\lambda_{\max}$ test	$r=0$	$r=1$	8.851	11.059	10.579	10.336
	$r=1$	$r=2$	4.852	5.291	5.385	5.463
Siemens Pak (1)						
λ_{trace} test	$r=0$	$r>0$	19.978	19.556	18.144	16.883
	$r\leq 1$	$r>1$	5.056	5.194	5.462	5.740
$\lambda_{\max}$ test	$r=0$	$r=1$	14.469	14.469	12.825	11.311
	$r=1$	$r=2$	5.233	5.233	5.523	5.826
PTCL (3)						
λ_{trace} test	$r=0$	$r>0$	15.491	14.726	11.739	11.790
	$r\leq 1$	$r>1$	4.887	4.163	4.009	4.044
$\lambda_{\max}$ test	$r=0$	$r=1$	10.644	10.642	7.817	7.861
	$r=1$	$r=2$	4.905	4.194	4.054	4.105
PIAC (1)						
λ_{trace} test	$r=0$	$r>0$	11.978	12.090	13.651	12.920
	$r\leq 1$	$r>1$	3.897	3.853	4.041	4.156
$\lambda_{\max}$ test	$r=0$	$r=1$	8.111	8.297	9.718	8.895
	$r=1$	$r=2$	3.911	3.882	4.086	4.219
Sitara Chemical (1)						
λ_{trace} test	$r=0$	$r>0$	12.737	13.312	13.261	11.678
	$r\leq 1$	$r>1$	4.880	5.266	4.881	4.953
$\lambda_{\max}$ test	$r=0$	$r=1$	7.886	8.105	8.473	6.825
	$r=1$	$r=2$	4.898	5.306	4.936	5.028
Abbot Lab (1)						
λ_{trace} test	$r=0$	$r>0$	15.303	15.187	15.234	23.290
	$r\leq 1$	$r>1$	5.731	5.789	5.048	6.506
$\lambda_{\max}$ test	$r=0$	$r=1$	9.608	9.468	10.300	17.045**
	$r=1$	$r=2$	5.752	5.832	5.105	6.604
BOC Pakistan (3)						
λ_{trace} test	$r=0$	$r>0$	16.064	16.766	14.778	15.976
	$r\leq 1$	$r>1$	4.218	4.917	3.989	4.063
$\lambda_{\max}$ test	$r=0$	$r=1$	11.891	11.938	10.91	12.093
	$r=1$	$r=2$	4.233	4.954	4.034	4.124
Dawood Hercul. (1)						
λ_{trace} test	$r=0$	$r>0$	19.413	15.689	16.985	17.072
	$r\leq 1$	$r>1$	4.559	4.777	4.711	4.623
$\lambda_{\max}$ test	$r=0$	$r=1$	14.909	10.994	12.412	12.636
	$r=1$	$r=2$	4.576	4.813	4.764	4.692

Continued –

Table 3 – (Continued)

Company	Hypothesis Ho	H_A	k = 1	k = 2	k = 3	k = 4
Engro Chemical (1)						
λ_{trace} test	$r=0$	$r>0$	13.816	12.751	14.581	16.857
	$r\leq 1$	$r>1$	4.189	4.014	4.082	4.195
$\lambda_{\max}$ test	$r=0$	$r=1$	9.663	8.802	10.617	12.853
	$r=1$	$r=2$	4.205	4.044	4.128	4.258
Fauji Fertilizers (1)						
λ_{trace} test	$r=0$	$r>0$	13.196	11.895	12.059	13.728
	$r\leq 1$	$r>1$	5.169	4.631	4.261	4.350
$\lambda_{\max}$ test	$r=0$	$r=1$	8.056	7.318	7.885	9.518
	$r=1$	$r=2$	5.189	4.666	4.309	4.415
Glaxo Wellcome (1)						
λ_{trace} test	$r=0$	$r>0$	15.487	16.375	15.622	14.313
	$r\leq 1$	$r>1$	5.406	5.593	5.189	5.386
$\lambda_{\max}$ test	$r=0$	$r=1$	10.118	10.863	10.551	9.060
	$r=1$	$r=2$	5.426	5.635	5.247	5.467
ICI Pakistan (2)						
λ_{trace} test	$r=0$	$r>0$	17.583	15.092	16.720	17.236
	$r\leq 1$	$r>1$	5.862	5.427	5.610	5.550
$\lambda_{\max}$ test	$r=0$	$r=1$	11.765	9.737	11.235	11.862
	$r=1$	$r=2$	5.884	5.468	5.673	5.633
Parke Davis (1)						
λ_{trace} test	$r=0$	$r>0$	12.614	13.693	15.321	14.039
	$r\leq 1$	$r>1$	4.812	5.147	5.282	5.304
$\lambda_{\max}$ test	$r=0$	$r=1$	7.831	8.610	10.152	8.866
	$r=1$	$r=2$	4.830	5.185	5.342	5.384
Rectik. & Colm. (1)						
λ_{trace} test	$r=0$	$r>0$	16.061	15.858	15.205	18.528
	$r\leq 1$	$r>1$	4.824	5.072	5.219	5.318
$\lambda_{\max}$ test	$r=0$	$r=1$	11.279	10.866	11.109	13.408
	$r=1$	$r=2$	4.842	5.110	5.277	5.398
Century Paper (1)						
λ_{trace} test	$r=0$	$r>0$	13.402	13.004	12.973	19.698
	$r\leq 1$	$r>1$	4.895	5.395	5.689	8.381
$\lambda_{\max}$ test	$r=0$	$r=1$	8.538	7.665	7.365	11.936
	$r=1$	$r=2$	4.913	5.435	5.753	8.840
Pakages Limited (1)						
λ_{trace} test	$r=0$	$r>0$	11.437	12.191	12.065	12.308
	$r\leq 1$	$r>1$	4.310	4.334	4.370	4.793
$\lambda_{\max}$ test	$r=0$	$r=1$	7.153	7.915	7.780	7.628
	$r=1$	$r=2$	4.326	4.367	4.419	4.865

Continued –

Table 3 – (Continued)

Company	Hypothesis		Test Statistics at Different Lag-values			
	Ho	H_A	k =1	k = 2	k = 3	k = 4
Security Paper (1)						
λ_{trace} test	$r=0$	$r>0$	13.627	13.528	13.071	16.141
	$r\leq1$	$r>1$	4.682	5.037	5.138	5.180
$\lambda_{\max}$ test	$r=0$	$r=1$	8.978	8.554	8.021	11.126
	$r=1$	$r=2$	4.699	5.075	5.196	5.258
Service Industry (2)						
λ_{trace} test	$r=0$	$r>0$	11.428	14.094	14.727	13.740
	$r\leq1$	$r>1$	4.246	4.718	5.097	5.227
$\lambda_{\max}$ test	$r=0$	$r=1$	7.208	9.445	9.737	8.641
	$r=1$	$r=2$	4.262	4.753	5.154	5.306
Lever Brothers (2)						
λ_{trace} test	$r=0$	$r>0$	17.574	18.071	18.733	18.850
	$r\leq1$	$r>1$	3.600	4.479	4.685	4.783
$\lambda_{\max}$ test	$r=0$	$r=1$	14.026	13.694	14.206	14.279
	$r=1$	$r=2$	3.613	4.512	4.738	4.855
Nestle Milk Pak (1)						
λ_{trace} test	$r=0$	$r>0$	9.641	9.799	10.511	9.771
	$r\leq1$	$r>1$	4.162	4.072	4.089	3.721
$\lambda_{\max}$ test	$r=0$	$r=1$	5.499	5.769	6.494	6.140
	$r=1$	$r=2$	4.178	4.103	4.135	3.777
CPC Rahfan (1)						
λ_{trace} test	$r=0$	$r>0$	9.442	9.691	7.928	8.564
	$r\leq1$	$r>1$	3.097	2.648	2.103	2.724
$\lambda_{\max}$ test	$r=0$	$r=1$	6.368	7.096	5.891	5.927
	$r=1$	$r=2$	3.109	2.668	2.126	2.766
Gillette Pakistan (1)						
λ_{trace} test	$r=0$	$r>0$	15.300	16.341	17.479	19.140
	$r\leq1$	$r>1$	4.574	4.777	4.666	4.828
$\lambda_{\max}$ test	$r=0$	$r=1$	10.765	11.65	12.957	14.526
	$r=1$	$r=2$	4.591	4.813	4.719	14.526
Pakistan Serv. (1)						
λ_{trace} test	$r=0$	$r>0$	11.504	11.762	12.018	11.883
	$r\leq1$	$r>1$	4.731	5.128	5.246	5.255
$\lambda_{\max}$ test	$r=0$	$r=1$	6.798	6.683	6.848	6.727
	$r=1$	$r=2$	4.748	5.166	5.304	5.334

Note: Numbers in parentheses are the optimal lag order required in the cointegration test of Johansen and Juselius (1990). Lags were chosen based on the Akaike Information Criteria (AIC) and the Schwartz Information Criteria (SIC).
Ho: Null hypothesis
H_A: Alternative hypothesis
Critical values for the maximum eigenvalue statistic are tabulated in Osterwald-Lenum (1992) that is given in Annexure A.4. *Significant at the 1 percent level; ** Significant at the 5 percent level.

Table 4

Results of the Granger Causality Test for Individual Firms, Weekly Data; January 1, 1999 through March 31, 2004; 270 observations (bold statistics are at optimal lags)

Company	Test Statistics at Different Lag-Values			
	k =1	**k = 2**	**k = 3**	**k = 4**
ICP SEMF				
ΔSP does not Granger cause ΔEX	**0.184**	0.211	0.147	0.911
ΔEX does not Granger cause ΔSP	1.096	**0.658**	0.446	0.351
Grindlays Modaraba				
ΔSP does not Granger cause ΔEX	**0.607**	0.314	0.697	0.779
ΔEX does not Granger cause ΔSP	0.212	0.502	0.554	**0.868**
Orix Leasing				
ΔSP does not Granger cause ΔEX	**0.002**	0.152	0.252	0.218
ΔEX does not Granger cause ΔSP	0.053	0.581	1.241	**1.754**
P. I. C. I. C				
ΔSP does not Granger cause ΔEX	**0.481**	0.635	0.529	0.427
ΔEX does not Granger cause ΔSP	1.173	0.840	**0.687**	0.637
Askari Bank				
ΔSP does not Granger cause ΔEX	**0.184**	0.727	0.447	0.518
ΔEX does not Granger cause ΔSP	**5.523****	2.794**	2.035***	1.889
Bank-al-Habib				
ΔSP does not Granger cause ΔEX	**0.034**	0.177	0.136	0.139
ΔEX does not Granger cause ΔSP	1.865	1.585	**1.956**	1.450
Bank of Punjab				
ΔSP does not Granger cause ΔEX	**0.061**	0.721	0.441	0.406
ΔEX does not Granger cause ΔSP	2.069	1.073	**1.250**	1.189
Faysal Bank				
ΔSP does not Granger cause ΔEX	**0.880**	0.651	0.447	0.496
ΔEX does not Granger cause ΔSP	1.479	1.196	**4.275***	3.213**
MCB				
ΔSP does not Granger cause ΔEX	0.004	**1.223**	0.747	0.783
ΔEX does not Granger cause ΔSP	3.824**	2.581***	1.848	**1.337**
Metropolitan Bank				
ΔSP does not Granger cause ΔEX	**0.038**	0.022	0.029	0.107
ΔEX does not Granger cause ΔSP	**0.077**	0.437	0.290	0.656
Soneri Bank				
ΔSP does not Granger cause ΔEX	**0.026**	0.072	0.057	0.054
ΔEX does not Granger cause ΔSP	0.264	0.238	**0.149**	0.164
Union Bank				
ΔSP does not Granger cause ΔEX	1.395	1.439	0.933	**1.767**
ΔEX does not Granger cause ΔSP	0.820	0.314	**1.557**	1.313

Continued –

Table 4 – (Continued)

Company	Test Statistics at Different Lag-Values			
	k =1	k = 2	k = 3	k = 4
Gadoon Textile				
ΔSP does not Granger cause ΔEX	4.317**	3.373**	2.396***	**2.534****
ΔEX does not Granger cause ΔSP	0.001	0.031	**0.048**	0.034
Kohinoor Weaving				
ΔSP does not Granger cause ΔEX	**0.019**	0.372	0.475	0.392
ΔEX does not Granger cause ΔSP	**0.511**	0.467	0.346	0.559
Cresent Textile				
ΔSP does not Granger cause ΔEX	0.574	1.399	0.929	**1.996*****
ΔEX does not Granger cause ΔSP	0.127	0.199	0.752	**2.145*****
Gul Ahmed Textile				
ΔSP does not Granger cause ΔEX	**3.460*****	1.715	1.234	1.137
ΔEX does not Granger cause ΔSP	0.016	0.889	0.928	**1.293**
Nishat Mills				
ΔSP does not Granger cause ΔEX	**1.249**	1.145	0.774	1.412
ΔEX does not Granger cause	0.001	0.002	0.058	**0.034**
Sapphire Fibre				
ΔSP does not Granger cause ΔEX	**1.221**	1.271	0.881	0.715
ΔEX does not Granger cause ΔSP	**0.878**	0.629	0.841	0.856
Sapphire Textile				
ΔSP does not Granger cause ΔEX	27.712*	**12.440***	7.994*	6.112*
ΔEX does not Granger cause ΔSP	5.572*	**4.174***	2.687**	1.948***
Dewan Salman				
ΔSP does not Granger cause ΔEX	**0.136**	0.488	0.316	0.202
ΔEX does not Granger cause ΔSP	1.336	2.653***	**1.750**	1.325
Gatron Industry				
ΔSP does not Granger cause ΔEX	**0.683**	0.341	0.443	0.345
ΔEX does not Granger cause ΔSP	0.157	0.255	0.280	**0.394**
Ibrahim Fibre				
ΔSP does not Granger cause ΔEX	**0.329**	0.262	0.448	1.034
ΔEX does not Granger cause ΔSP	0.589	0.813	**0.898**	0.723
Rupali Polyester				
ΔSP does not Granger cause ΔEX	**0.591**	0.625	0.395	0.323
ΔEX does not Granger cause ΔSP	0.174	0.479	0.835	**0.846**
Thal Jute				
ΔSP does not Granger cause ΔEX	**0.499**	0.325	0.248	0.196
ΔEX does not Granger cause ΔSP	0.045	**0.135**	0.127	0.099
Chakwal Cement				
ΔSP does not Granger cause ΔEX	**1.018**	0.605	0.474	0.491
ΔEX does not Granger cause ΔSP	0.575	0.350	**0.180**	0.168
Cherat Cement				
ΔSP does not Granger cause ΔEX	**0.014**	0.258	0.199	0.224
ΔEX does not Granger cause ΔSP	**0.239**	0.505	0.413	0.324

Continued –

Table 4 – (Continued)

Company	Test Statistics at Different Lag-Values			
	k =1	**k = 2**	**k = 3**	**k = 4**
D. G. Khan Cement				
ΔSP does not Granger cause ΔEX	**0.001**	0.467	0.317	0.371
ΔEX does not Granger cause ΔSP	0.277	0.128	0.097	**0.079**
Luckey Cement				
ΔSP does not Granger cause ΔEX	**0.922**	0.961	0.709	0.705
ΔEX does not Granger cause ΔSP	0.229	0.191	0.642	**0.431**
Maple Leaf				
ΔSP does not Granger cause ΔEX	**0.209**	0.148	0.249	0.188
ΔEX does not Granger cause ΔSP	1.160	**0.634**	0.448	0.351
Lackson Tobacco				
ΔSP does not Granger cause ΔEX	**0.020**	0.016	0.028	0.342
ΔEX does not Granger cause ΔSP	0.020	0.142	**0.230**	0.186
Pakistan Tobacco				
ΔSP does not Granger cause ΔEX	**0.005**	0.077	0.084	0.074
ΔEX does not Granger cause ΔSP	0.536	0.386	0.357	**0.385**
Attock Refinery				
ΔSP does not Granger cause ΔEX	**0.009**	0.372	0.331	0.367
ΔEX does not Granger cause ΔSP	0.359	0.277	**0.193**	0.249
Hub Power Co.				
ΔSP does not Granger cause ΔEX	**0.088**	0.234	0.144	0.139
ΔEX does not Granger cause ΔSP	0.033	1.009	0.727	**0.571**
Mari Gas				
ΔSP does not Granger cause ΔEX	0.006	**1.621**	1.024	0.796
ΔEX does not Granger cause ΔSP	**2.266**	1.189	0.914	1.059
National Refinery				
ΔSP does not Granger cause ΔEX	**0.413**	0.666	0.435	0.720
ΔEX does not Granger cause ΔSP	2.257	1.206	**0.738**	0.542
P.S.O				
ΔSP does not Granger cause ΔEX	**0.738**	1.230	0.795	0.757
ΔEX does not Granger cause ΔSP	4.749**	2.349***	**1.682**	1.599
Pakistan Refinery				
ΔSP does not Granger cause ΔEX	0.032	**1.649**	1.044	0.912
ΔEX does not Granger cause ΔSP	1.426	0.624	**0.303**	0.272
Shell Pak				
ΔSP does not Granger cause ΔEX	**0.002**	0.161	0.552	0.483
ΔEX does not Granger cause ΔSP	**5.226****	2.621***	1.826	1.587
Sui Northern				
ΔSP does not Granger cause ΔEX	**0.299**	0.222	0.198	0.251
ΔEX does not Granger cause ΔSP	2.218	0.999	1.016	**1.161**
Sui Southern				
ΔSP does not Granger cause ΔEX	**0.078**	0.221	0.157	0.119
ΔEX does not Granger cause ΔSP	**4.612****	2.382***	1.666	1.289

Continued –

Table 4 – (Continued)

Company	Test Statistics at Different Lag-Values			
	k =1	k = 2	k = 3	k = 4
Honda Atlas Car				
ΔSP does not Granger cause ΔEX	**1.194**	0.595	0.549	0.400
ΔEX does not Granger cause ΔSP	0.169	0.044	0.164	**0.163**
Indust Motors				
ΔSP does not Granger cause ΔEX	**0.110**	0.064	0.125	0.224
ΔEX does not Granger cause ΔSP	1.834	0.834	0.616	**0.419**
Pak Suzuki				
ΔSP does not Granger cause ΔEX	**0.097**	0.188	0.354	0.264
ΔEX does not Granger cause ΔSP	0.211	**0.307**	0.265	0.305
Siemens Pak				
ΔSP does not Granger cause ΔEX	**3.706****	2.028	1.432	1.354
ΔEX does not Granger cause ΔSP	0.027	0.124	**0.068**	0.071
PIAC				
ΔSP does not Granger cause ΔEX	**1.616**	0.914	0.667	0.891
ΔEX does not Granger cause ΔSP	0.274	0.702	**1.051**	1.065
PTCL				
ΔSP does not Granger cause ΔEX	0.418	**0.211**	1.639	2.058***
ΔEX does not Granger cause ΔSP	0.521	0.306	**0.212**	0.194
Abbot Lab				
ΔSP does not Granger cause ΔEX	1.276	1.291	0.744	**0.776**
ΔEX does not Granger cause ΔSP	15.609*	13.047*	**10.700***	7.964*
BOC Pakistan				
ΔSP does not Granger cause ΔEX	**1.276**	1.291	0.744	0.776
ΔEX does not Granger cause ΔSP	15.609*	13.047*	**10.700***	7.964*
Dawood Hercules				
ΔSP does not Granger cause ΔEX	**0.172**	0.225	0.277	0.957
ΔEX does not Granger cause ΔSP	5.981**	3.579**	3.019**	**2.632****
Engro Chemical				
ΔSP does not Granger cause ΔEX	2.184	1.811	1.496	**1.690**
ΔEX does not Granger cause ΔSP	**2.082**	1.192	1.044	0.943
Fauji Fertilizers				
ΔSP does not Granger cause ΔEX	**1.859**	1.158	1.379	1.383
ΔEX does not Granger cause ΔSP	5.054**	2.355***	2.031	**4.183***
Abbot Lab				
ΔSP does not Granger cause ΔEX	1.276	1.291	0.744	**0.776**
ΔEX does not Granger cause ΔSP	15.609*	13.047*	**10.700***	7.964*
Glaxo Wellcome				
ΔSP does not Granger cause ΔEX	**0.003**	0.040	0.390	0.321
ΔEX does not Granger cause ΔSP	0.155	1.482	1.006	**0.761**
ICI Pakistan				
ΔSP does not Granger cause ΔEX	7.746*	3.878**	2.668**	**3.102****
ΔEX does not Granger cause ΔSP	1.168	**0.408**	0.279	0.244

Continued –

Table 4 – Continued

Company	Test Statistics at Different Lag-Values			
	k =1	**k = 2**	**k = 3**	**k = 4**
Parke Davis				
ΔSP does not Granger cause ΔEX	**0.001**	0.001	0.013	0.059
ΔEX does not Granger cause ΔSP	0.053	0.043	0.154	**0.231**
Reckit & Colman				
ΔSP does not Granger cause ΔEX	**1.168**	0.674	0.814	0.623
ΔEX does not Granger cause ΔSP	0.317	0.166	**0.053**	0.082
Sitara Chemical				
ΔSP does not Granger cause ΔEX	**0.093**	0.698	0.683	0.516
ΔEX does not Granger cause ΔSP	0.112	0.101	**0.248**	0.244
Century Paper				
ΔSP does not Granger cause ΔEX	**0.038**	0.022	0.020	0.088
ΔEX does not Granger cause ΔSP	1.127	0.661	0.573	**0.864**
Pakages Limited				
ΔSP does not Granger cause ΔEX	**0.023**	0.035	0.050	0.201
ΔEX does not Granger cause ΔSP	0.045	0.134	0.102	**0.072**
Security Paper				
ΔSP does not Granger cause ΔEX	**0.615**	0.329	0.609	0.629
ΔEX does not Granger cause ΔSP	0.428	0.639	**0.469**	0.503
Service Industry				
ΔSP does not Granger cause ΔEX	1.09	1.438	0.852	**2.058*****
ΔEX does not Granger cause ΔSP	12.149*	6.394*	4.553*	**4.037***
Lever Brothers				
ΔSP does not Granger cause ΔEX	**9.938***	5.063*	3.558*	2.589**
ΔEX does not Granger cause ΔSP	**0.398**	0.215	0.454	0.404
Nestle Milk Pak				
ΔSP does not Granger cause ΔEX	0.046	0.153	1.668	**1.668**
ΔEX does not Granger cause ΔSP	0.816	1.248	**0.965**	0.965
CPC Rahfan				
ΔSP does not Granger cause ΔEX	0.676	**5.756***	3.809*	2.879**
ΔEX does not Granger cause ΔSP	0.027	0.056	**1.094**	1.036
Gillette Pakistan				
ΔSP does not Granger cause ΔEX	0.021	**2.095**	1.458	1.052
ΔEX does not Granger cause ΔSP	0.001	**0.227**	0.176	0.257
Pakistan Services				
ΔSP does not Granger cause ΔEX	**0.580**	0.358	0.247	0.212
ΔEX does not Granger cause ΔSP	**0.116**	0.054	0.088	0.109

*Significant at the 1percent level
**Significant at the 5 percent level
***Significant at the 10 percent level.

Table 5

Estimates of the Error Correction Term in Models (13) & (14) for Individual Firms, Weekly Data; January 1, 1999 through March 31, 2004; 270 observations (bold statistics are at optimal lag)

Company	# of Lags	Model: 1.3			Model: 1.4		
		λ_0	t-stat.	p-value	λ_1	t-stat.	p-value
Adamjee Insurance	1	-0.047	**-2.605**	0.0097	-0.014	**-1.974**	0.0494
	2	-0.051	-2.801	0.0055	-0.015	-1.993	0.0473
	3	-0.057	-3.103	0.0021	-0.015	-2.016	0.0448
	4	-0.016	-3.186	0.0016	-0.016	-2.092	0.0374
East West Insurance	1	-0.069	-3.699	0.0003	-0.012	**-1.294**	0.1969
	2	-0.072	-3.751	0.0002	-0.012	-1.362	0.1743
	3	-0.072	-3.653	0.0030	-0.011	-1.273	0.2041
	4	-0.049	**-2.965**	0.0030	-0.012	-1.321	0.1878
KESC							
	1	-0.077	**-3.332**	0.0001	-0.021	**-2.021**	0.0443
	2	-0.082	-3.446	0.0007	-0.024	-2.218	0.0274
	3	-0.081	-3.289	0.0011	-0.023	-2.139	0.0334
	4	-0.089	-3.571	0.0004	-0.025	-2.174	0.0306
Pakistan Oilfields	1	-0.039	-1.956	0.0516	-0.019	**-2.316**	0.0213
	2	-0.047	**-2.393**	0.0174	-0.018	-2.262	0.0245
	3	-0.053	-2.657	0.0084	-0.019	-2.261	0.0245
	4	-0.058	-2.757	0.0063	-0.019	-2.206	0.0283
General Tyre							
	1	-0.106	**-4.162**	0.0000	-0.015	**-2.114**	0.0355
	2	-0.105	-3.967	0.0001	-0.014	-2.034	0.0429
	3	-0.115	-4.187	0.0000	-0.015	-2.088	0.0378
	4	-0.120	-4.243	0.0000	-0.017	-2.236	0.0262

Table 6

The Joint F Tests of η_{0i} 's and η_{1i} 's in Models (13) & (14) Respectively, Weekly Data: January 1, 1999 through March 31, 2004; 270 observations (bold statistics are at optimal lag-orders)

Company	F-Statistics at Different Lag-Values			
	k =1	k = 2	k = 3	k = 4
Adamjee Insurance				
η_{0i} 's	**0.574**	0.518	0.826	0.901
η_{1i} 's	**0.526**	1.259	0.929	0.689
East West Insurance				
η_{0i} 's	1.526	0.825	0.744	**36.143***
η_{1i} 's	**0.188**	0.366	1.437	1.119
KESC				
η_{0i} 's	**0.211**	0.592	0.401	0.400
η_{1i} 's	**1.559**	1.551	1.064	0.999
Pakistan Oilfields				
η_{0i} 's	0.972	**0.394**	0.425	1.000
η_{1i} 's	**1.046**	0.764	0.481	0.616
General Tyre				
η_{0i} 's	**0.357**	0.355	0.302	0.241
η_{1i} 's	**1.202**	1.945	1.357	1.428

Notes: The F-statistic = ((RRSS – URSS)/B)/(URSS/T-K)
where RRSS is the sum of residual squares obtained from the restricted model. URSS is the sum of residual squares obtained from the unrestricted model. B is the number of constraints, T is the number of observations and K is the number of parameters in the unrestricted model.
*Significant at the 1 percent level
**Significant at the 5 percent level
***Significant at the 10 percent level.

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