"Linkage between Stock Market Prices and Exchange Rate: A Causality Analysis for Pakistan."

Tahir. M. F[1]
Wong Wing Keung[2]

1. Introduction

Stock markets of emerging economies have recently been of vital importance to global investment community. The capitalizations, returns and volatility have increased dramatically in these markets. Since emerging markets are more volatile than the well-developed stock markets, therefore, the emerging markets tend to be unrelated with one another and with the developed markets. Numerous investors worldwide select to diversify their funds across the emerging markets in order to minimize portfolio risk. In recent years financial crises stemming from sudden and unexpected oscillation in stock and foreign exchange markets has become a common phenomenon in emerging economies. This realization prods the researches to investigate the relationship between stock market performance and exchange rate. Bahmani-Oskooee (1992) is among the first to use cointegration and Granger causality to explain direction of movement between exchange rate and stock prices. Abdalla and Murinde (1997) finds out that for India, Korea and Pakistan, exchange rate Granger cause stock prices. Yu (1997) analyzes this relationship for Hong Kong, Tokyo and Singapore. Amare and Mohsin (2000) examines this association between exchange rates and stock prices for nine Asian countries. Makurjee and Naka (1995) and Ajay and Mougouge (1996) show that stock market prices are cointegrated with exchange rates in eight industrial economies. Koutoulas and Kryzanowski (1996) furnishes evidence that stock market volatility significantly responds to exchange rate volatility in Canada. Kearney (1988) discovers similar results for Ireland. Behmani-Oskooee and Sohrabian (1992) points out that there is two-way relationship between US stock market and exchange rate. Smith (1992) demonstrates that stock returns have significant influence on exchange rate in Germany. Fang (2000) gets a negative depreciation effect in the stock return process in Taiwan over Asian crisis. Most of research on stock prices and exchange rate concentrates on developed markets.

Our aim in this paper is to complement the existing literature by examining the linkage between stock prices and exchange rates in emerging Pakistan stock market. Pakistan provides an interesting arena to investigate interrelations between stock and exchange markets for three reasons. First Karachi Stock Exchange (KSE) is one of the faster growing emerging markets in the region as well as in the emerging economies. Market capitalization has increased in recent years. In January 1993, according to KSE, the market capitalization value was Rs 206247.2 millions while at the end of 2003; on the

1 Mohammad Tahir Farooq is Senior Subject Specialist in Economics, Department of Education Government of NWFP
2 Dr. Wong Wing Keung is Associate Professor, Department of Economics National University of Singapore

other hand the market capitalization has increased to Rs 921932 millions. An increase of 347% is witnessed in market capitalization during the period of this study. Secondly, Pakistan's economy observed financial crises in recent years. The stock and foreign exchange markets suffered fluctuations from the financial crisis, which broke out in 1998 due to nuclear detonation and East Asian financial crises. For example, stock general index dropped from 161.58 at the beginning of July 1997 to 97.65 at the end of August 1998. Surprisingly rare empirical research has examined the interaction between stock and exchange markets in Pakistan. Although a few studies investigate Karachi stock market under the ambit of cross country analysis. None of them exclusively examined the causality relationship between stock prices and exchange rates for Karachi Stock Exchange. Thirdly, this paper investigate, for the first time, the relationship between stock prices and exchange rate by decomposing Karachi Stock Exchange Index into three sub-sectors.

The phenomenon of stock market and exchange rate nexus received substantial attention after East Asian financial crises. Theoretically, if there is any linkage between both of the variables then the crises can be averted either by managing exchange rate or by adopting indigenous policies to stable the stock market. Moreover the investors can utilize this relationship between stock prices and exchange rate to predict the behavior of these variables.

There is lack of theoretical consensus on the relationship between exchange rate and stock prices. The portfolio balance approach of exchange rate determination and stock prices, furnishes both positive and negative relationships between stock prices and exchange rate because exchange rate play key role in balancing the demand and supply of assets. The causation between the two variables may be uni-directional or bi-directional. In this model individuals hold domestic and foreign assets in their portfolios. While on the other hand the asset market approach postulates weak or no association between stock prices and exchange rate because this approach treats the exchange rate like the price of an asset, the exchange rate is determined by expected future exchange rate. So it is clear that there is lack of theoretical and empirical consensus on this relationship and the direction of causation. However, the linkage between the two markets is important. This paper provides empirical evidence between stock indices and exchange rate for Karachi Stock Market, using monthly data by employing co-integration approach to examine the relationship.

The rest of the paper is organized as follow: in the next section the time series method is briefly presented. Section three describes the data and provides the empirical analysis. Last section contain conclusion.

2. Time Series Method.

To analyze the relationship between stock indices and exchange rate, this paper focuses on causality among these variables using the method adapted by Granger (1969). Formally a time series x_t Granger causes another time series y_t can be predicted better

by using past values of $(X_{t,}\, Y_t)$ than by using only the lag values of Y_t. In other words, X_t fails to Granger-cause Y_t if all $m>0$ the conditional probability distribution of Y_{t+m} given $Y_t, Y_{t-1.}.....)$ is the same as the conditional probability distribution of Y_{t+m} given both $(Y_{t,}\, Y_{t-1,}.....)$ and $(X_{t,}\, X_{t-1,}.....)$. That is, X_t does not Granger-cause if

$$\Pr(Y_{t+m} \mid \psi_t = \Pr(Y_{t+m} \mid \Omega_t) \qquad (1)$$

where $\Pr(\bullet)$ denotes conditional probability, ψ_t is the information set at time t on past values of Y_t and Ω_t is the information set containing values of both X_t and Y_t upto time t

Testing causality between two stationary series X_t and Y_t can be based on the following bivariate autoregression:

$$Y_t = \alpha_0 + \sum_{k=1}^{p} \alpha_k Y_{t-k} + \sum_{k=1}^{p} \beta_k X_{t-k} + u_t \qquad (2)$$

$$X_t = \varphi_0 + \sum_{k=1}^{p} \varphi_k Y_{t-k} + \sum_{k=1}^{p} \Phi_k X_{t-k} + v_t \qquad (3)$$

where p is a suitably chosen positive integer; $\alpha_k's$ and $\beta_k's$, $k=0,1,....., p$ are constants; and u_t and v_t is usual disturbance terms with zero means and finite variances. The null hypothesis that X_t does not Granger-cause Y_t is rejected if the $\beta_{k'}$s, k>0 in Eq.2 are jointly significantly different from zero using a standard joint test (e. g., an F test). Similarly Y_t Granger-causes X_t if the φ_k's, k>0 coefficient in Eq. 3 are jointly different from zero. A bi-directional causality relation exist if both $\beta_{k'}$ s and $\varphi_{k'}$ s, k>0 are jointly different from zero. It may be mentioned that above test is applicable to stationary series. So, in reality the series under analysis may not be stationary. In such cases one has to transform the original series into stationary series and causality test would be performed based on transformed-stationary series. A special case of non-stationary process is the I (1) process, that is, possessing a unit root. An I (1) may be converted into stationary one by taking first order differencing. Thus dealing with two I (1) process for causality, Eq. 2 and Eq. 3 must be expressed in term of differenced-series. However, if underlying I (1) processes are cointegrated, the specifications so obtained must be modified by inserting the lagged value of cointegration relation (error correction term) as an extra explanatory variable, that is, Eq. 1 and Eq. 2 should be modified as follow:

$$\Delta Y_t = \alpha_0 + \sum_{k=1}^{p} \alpha_k \Delta Y_{t-k} + \sum_{k=1}^{p} \beta_k \Delta x_{t-k} + \delta\, ECT_{\,t-1}\, u_t \qquad (4)$$

$$\Delta X_t = \varphi_0 + \sum_{k=1}^{p} \varphi_k \Delta Y_{t-k} + \sum_{k=1}^{p} \Phi_k \Delta X_{t-k} + \eta\, ECT_{\,t-1} + v_t \qquad (5)$$

where Δ is the difference operator and ECT_{t-1} represent an error correction term derived from the long run cointegration relationship between the I(1) processes X_t and Y_t. This term can be estimated by using residual from a cointegration regression.

3. Data Description and Empirical Analysis.

Our data consist of monthly prices of four aggregate indices, General 100 index, Financial Sector Index, Industrial Sector Index and Services Sector Index. General 100 index is the main index of Karachi Stock Exchange. Inclusion of Karachi Stock Exchange is because of the fact that it possesses the lion share of market capitalization (around 80%) of the total stock market business in Pakistan. The other three indices are sectoral indices. Our monthly data on General Index are obtained from Statistical Bulletin and Annual Report published by State Bank of Pakistan, Economic Survey Published by Government of Pakistan, Finance Division, and Karachi Stock Exchange Publications. Due to non-availability of data on sectoral level, the data on sectoral indices have been determined and calculated by authors. The Karachi Stock Market 100 index is divided into three main sub-sectors on the basis of market capitalization of these sectors. Data on all indices start from January 1994 to December 2003. Exchange rate is expressed in term of US dollar. Two subsets of this data set are analyzed: the full data set consisting all monthly values of market indices and RS/ US exchange rates: the subset covering period prior to stock market financial crises in 1998: and subset covering later period of the financial crises up to December 2003. We obtain similar results in two subsets, therefore, we only report the results obtained from the full data set.

Before analyzing the relationship between exchange rate and stock indices it is important to carry out univariate analysis. The stationarity of each variable is checked. Otherwise inference from the *F-statistic* might be spurious because the test statistic will have non-standard distributions. The stationarity of each series was investigated by employing Augmented Dickey-Fuller unit root test. The test consists of regressing each series on its lagged value and lagged difference terms. The number of lagged differences included is determined by the Akaike information criterion. Following the literature all data series have been transformed into natural logarithms. The equation used for conducting Augmented Dickey Fuller test has the following structure:

$$X_t = \alpha + \beta_t + \rho X_{t-1} + \sum_{k=1}^{p} \delta_k \Delta X_{t-k} + e_t \qquad (6)$$

In Eq. 6, if (i) $\beta = 0$ and $|\rho| < 1$, the series X_t is stationary; (ii) $\beta = 0$ and $\rho = 1$ then the series is an I (1) process; (iii) $\beta \neq 0$ and $|\rho| < 1$ then the series is trend stationary.

Table-1 represents the Augmented Dickey Fuller test statistics under the null hypothesis of unit root. Number of lagged difference terms included in the regression is also reported in Table-1. Null hypothesis of unit root against the stationary alternative is not rejected at 5% level of significance for exchange rates and stock indices with or with

out deterministic trends. However the first differences of theses variables are stationary under the test. Hence, we conclude that these variables are integrated of order 1.

Table 1 Unit root tests (levels)

	Exchange Rate	**KSE General Index**	**KSE Financial Index**	**KSE Industrial Index**	**KSE Services Index**
Constant ADF Test Statistic	-0.9172	-2.5790	-2.2517	-2.7115	-1.7170
Lag	1	2	1	2	4
Constant & Trend ADF Test Statistic	-1.6850	-0.4460	-2.5161	-3.0102	-2.0160
Lag	1	3	2	3	4

Note: 5% Critical value for ADF test with constant is –2.89 while it is –3.45 for the test with constant and trend.

Table 2 Unit root tests (First Difference)

	Exchange rate	**KSE General Index**	**KSE Financial Index**	**KSE Industrial Index**	**KSE Services Index**
Constant ADF Test Statistic	-7.7568	-6.7026	-7.0813	-6.3273	-8.4836
Lag	1	2	3	3	3
Constant & Trend ADF Test Statistic	-7.7623	-7.7269	-7.4097	-6.6261	-8.4329
Lag	1	2	3	3	3

Note: 5% Critical value for ADF test with constant is –2.89 while it is –3.45 for the test with constant and trend.

On the basis of above unit root tests, we performed Johansen's cointegration test to see whether any combinations of the variables are cointegrated. This approach uses a

maximum likelihood procedure that tests for the number of cointegration relationships and estimate the parameters of those cointegrating relationships. Likelihood ratio (LR) test statistics and 5% critical vales are reported in Table 3. The results show that there is no long run relationship between exchange rate and stock indices for Pakistan. Consequently, an error correction term need not be included in the Granger causality test equations. Since these results are robust and highly sensitive to the choice of the lag length. The Engle and Granger (1987) confirms this finding[3]. Our this result supports the study of Abdallah and Murinde (1997). In that study no long relationship is found for Pakistan and Korea, while for India and Philippines they find long run relationship between stock prices and exchange rates.

Table 3 Johansen Maximum Likelihood Cointegration Tests

Maximum	**Max**	**Test**		**Trace**	**Test**		
Null	**Alternative**	**Statistic**	**95% critical value**	**Null**	**Alternative**	**Statistic**	**95% critical Value**
KSE	**General**						
r = 0	r = 1	3.363316	15.752	r = 0	r = 1	6.03166	20.168
r ≤ 1	r = 2	2.668344	9.094	r ≤ 1	r = 2	2.668344	9.094
KSE	**Finance**						
r = 0	r = 1	6.086801	15.752	r = 0	r = 1	6.801191	20.168
r ≤ 1	r = 2	0.71439	9.094	r ≤ 1	r = 2	0.71439	9.094
KSE	**Industry**						
r = 0	r = 1	6.121486	15.752	r = 0	r = 1	6.840742	20.168
r ≤ 1	r = 2	0.719255	9.094	r ≤ 1	r = 2	0.719255	9.094
KSE	**Services**						
r = 0	r = 1	4.925422	15.752	r = 0	r = 1	5.302485	20.168
r ≤ 1	r = 2	0.377063	9.094	r ≤ 1	r = 2	0.377063	9.094

As cointegration is found to be sensitive to the choice of lag length therefore we find short run association between stock prices and exchange rate. For this purpose we employ standard Granger causality test to examine whether variables under consideration are causally related at least in one direction, that is, whether change in stock prices causing change in exchange rate or change in exchange rate causing change in stock indices? Taking into account that the results derived from this test may be sensitive to the selection of lag length, the minimal final prediction error suggested by Akaike (1969) has been used. Table-4 reports the F-statistics and probability values constructed under the null hypothesis of non-causality. It can be observed that KSE general index effects exchange rate. This finding is in contrast to the finding of Abdallah and Murinde who found exchange rate Granger cause stock prices. This proves that direction of causality can vary according to the period of study. In the analysis we have an interesting observation that exchange rate Granger cause services sector. Theses analysis explicitly

[3] The results are not reported here but available on request.

show that uni-directional causality exist from stock prices to exchange, while exchange rate effect services sector index.

Table 4. Granger Causality Test between Stock Indices and Exchange Rate.

Null Hypothesis.	**Exchange rate does not Granger stock Indices.**	**Stock indices does not Granger cause exchange rate.**	**Lags.**
KSE General.	3.6735 (0.0577)	5.4572 (0.0212)	1
KSE Finance.	1.8387 (0.1777)	2.5016 (031164)	1
KSE Industry.	2.2342 (0.1377)	2.4910 (0.1172)	1
KSE Services.	5.2928 (0.0232)	0.1227 (0.7267)	1

4. Conclusion

5.

This paper analyses empirically the relationship between four stock indices and exchange rate in Karachi Stock Exchange (KSE). Since the variables in this paper are non-stationary at level and stationary at first difference, therefore, Johanson's cointegration technique has been applied. The results obtained by using this methodology provided no cointegrating relationship among the variables. (Since, methodology of cointegration provides evidence of unique cointegrating vector, therefore, a long run relationship between stock indices and exchange rate does not exist in our analysis. This mean that stock indices and exchange do not move together in the long run.

We next perform Granger non-causality test. The results present some interesting evidence. We find that causality run from general stock prices to exchange rate. We also find that causality runs from exchange rate to services indices. So according to our analysis general stock index affects exchange rate in the short run, therefore the investors can use information obtain from stock market to predict the behavior of exchange rate. Moreover authorities in Pakistan can use the stock prices as a policy tool to attract the foreign portfolio investment by taking stabilizing measures for stock market. Our results provide evidence in favor of portfolio balance models of exchange rate determination that postulates a uni-directional causation that runs from stock prices to exchange rate. However, our results are in contrast to traditional models that hypothesized causation from exchange rate to stock prices. In our analysis, interestingly exchange rate Granger cause services sector, which, suggest that currency fluctuations effect services index. Hence exchange rate movements can affect the prices of services sector. As services sector is a prerequisite for attaining economic growth and improving country's productive capacity by reducing production cost and it has also been widely recognized that economies with efficient services sector are positioned more advantageously in term of over all competitiveness. So exchange rate can be used as policy tool to improve the services sector and stabilization of stock market.

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