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Stock Return Volatility in Emerging Equity Market (Kse): The Relative Effects of Country and Global Factors

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This paper focuses on the role of macroeconomic variables and global factors on the volatility of the stock returns in an emerging market like Pakistan. The paper uses two multivariate models, multivariate EGARCH and Vector Auto Regressive (VAR) models to investigate the effect of exchange rate, interest rate, industrial production, money supply, Morgan Stanley Capital International (MSCI) World Index and 6-months LIBOR on stock prices in Pakistan's equity market. The estimate shows that domestic macroeconomic variables have varying degrees of importance in explaining the relationship between stock returns and volatility in Karachi Stock Exchange. The empirical results also show that the two global factors, MSCI World Index and 6-months LIBOR, variables used in this paper explain the stock returns in KSE. An important conclusion drawn from the results is that macroeconomic variables exhibit asymmetric effects on returns volatility. Overall, the results show that Pakistan's stock market is partially integrated as shown by the significant role of both country and global factors.

Field of Research: Finance

1. Introduction

Studies on the link between macroeconomic variables and stock returns are broadly divided into two groups based on the level of market integration. The first strand promotes the view that markets are generally integrated and, as a result, global risk factors are more important in explaining returns volatility than country factors. Most of the studies that emphasize the role of global risk factors have modeled returns as linear function of global risk factors (Ferson and Harvey, 1994; Dumas and Solnim, 1995; Harvey, 1995). A list of most popular factors examined in the integrated market approach includes industrial production, unexpected inflation, changes in expected inflation, real interest rates, term structure risk and price of crude oil.

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Ferson and Harvey (1993a, 1993b) examined all these variables, measured as global aggregates, as potential risk factors for global asset pricing models. The few studies that looked at the role of global risk factors on the stock returns of emerging markets have also implicitly or explicitly emphasized the relevance of market integration in their analyses. Harvey (1995), for example, tested the relationship between returns in the emerging markets and a set of global variables including world inflation, world GDP, world oil prices and trade weighted world exchange rate. Results of his study suggests that standard global asset pricing models, which assume complete integration of capital markets, fails to explain the cross section of average returns in emerging markets. Bekaert and Harvey (1997) use liberalization dates to examine the behavior of volatility in emerging markets. The time series and cross-sectional models analyze the reasons that volatility is different across emerging markets, particularly with respect to the timing of capital market reforms. This study finds that capital market liberalization often increase the correlation between local market returns and the world market but do not drive up local market volatility.

The proponents of complete market segmentation highlight the overriding role of domestic macroeconomic variables in their investigation of return volatility. Again most of these studies are predominantly focused on developed markets (Chen et al., 1986; Fama; 1990; Jorion, 1991; Ely and Robinson, 1997). It has been argued that in less integrated markets, correlation with the world portfolio is weaker and according to Harvey (1998, 2000) only local market variance explains the cross-section in emerging markets.
Chen, Roll and Ross (1986) studying whether innovations in macroeconomic variables affect stock returns, find that the spread between long and short run interest rates, expected and unexpected inflation, industrial production and the spread between high and low grade bonds were found to systematically affect the stock market returns. FAMA (1990) finds that U.S. stock returns and its aggregate real activity are correlated. Ely and Robinson (1997) concludes that stocks do maintain their value relative to movements in overall price indexes and this conclusion generally does not depend on whether the source of the inflation shock is from the real or monetary sector.

Empirical studies that have investigated the level of integration have generally found that emerging stock markets are only partially integrated. Since the markets are neither perfectly segmented nor perfectly integrated, investigating the role of macroeconomic variables at the two extremes may lead to inconclusive results. Hence, the third research strand calls for consideration of both domestic and global variables in the study of emerging markets.
The current study examines the relevance of macroeconomic variables in the framework of partial integration. In other words, the study investigates the effects of both country and global variables on the volatility of emerging market stock returns.

This study investigates the following questions regarding the relationship between macroeconomic factors and stock returns in Pakistan's emerging equity market. First, are the mean effects and volatility shocks of macroeconomic variables transmitted to Karachi Stock Market (KSE).And if so, are the shocks persistent. The presence of

persistence in volatility clustering may signify inefficiency of the market, and provide the possibility of arbitrage. Second, whether macroeconomic shocks and global factors have any significant asymmetric effects on the returns volatility of the equity market. Ross (1989) points out that volatility is directly linked to the rate of information flow. Hence, positive and negative macroeconomic shocks may be transmitted differently.

This study is important for domestic and foreign investors in terms of risk management and portfolio diversification strategies for many reasons. First, the accurate measurement of the volatility of financial data is important because economic agents make decisions based on the perceptions that high levels of volatility of financial tend to cause the general erosion of investors' confidence and a flow of capital away from the stock markets (Schwert, 1989, Ballie and DeGennaro, 1990). Second, answers to these questions may be important for decision-making by national policy makers as well as our understanding of how such decisions affect the stock market of the country. Analyzing specific macroeconomic fundamentals can also help us understand the extent to which differences in performance of stock market is justified by economic fundamentals. In addition, the predictability of volatility is important in designing optimal asset allocation decisions as well as dynamic hedging strategies for options and futures (Baillie and Myers, 1991). Therefore understanding the fundamentals underlying volatility is also important for the valuation of stocks and their corresponding derivative products in stock market.

2. Data and Descriptive Statistics

Karachi Stock Exchange, established in 1950, is the largest and the most active of the three stock exchanges of Pakistan. Other regional exchanges are in Islamabad and Lahore which are relatively inactive. KSE currently lists 662 companies with a market capitalization of over Rs. 52 billion. The KSE-100, a capital weighted index, represents major blue chips companies and is fairly representative of the market.

This study uses monthly returns on stock index. The month-end closing values of the KSE-100 index were obtained from online database of Yahoo finance for the period from July 2000 to Jun 2005. The market returns are calculated by taking first difference of logs of two consecutive month-end closing values.

2.1 Country and Global Variables

The domestic macroeconomic variables used for the study are Money supply, Monthly CPI, Industrial production, Exchange rate and Interest rate, while 6-month LIBOR and Morgan Stanley Capital International (MSCI) All Countries World Index are used as global variables. The data on these macroeconomic variables were obtained from monthly publication of International Monetary Fund (IMF). Data on all macro economic variables cover the period July 2000 to Jun 2005.

2.2 Descriptive Statistics

To assess the distributional properties of the monthly stock returns various descriptive statistics are reported in Table 1 that includes mean, variance, standard deviation, kurtosis, skewness. This study covers a period from July 2000 to June 2005. The mean monthly return is 2.55 percent and the standard deviation is 8.7 percent which indicates high volatility of returns that characterize the market as one of the emerging markets. The deviations from the normality in the returns can be seen from the excess positive kurtosis which implies that the underlying distribution has long right tails. Kurtosis of normal distributions is said to be equal to 3. If the kurtosis exceeds 3, the distribution is peaked relative to normal (i.e., leptokurtic). Therefore, stock returns examined in the study exhibit non-normality.

3. Econometric Models

As shown by descriptive statistics in Table 1, the distribution of the return series does not follow a normal distribution; the nature of the distribution suggests volatility clustering, where large returns are followed by large returns and small returns tends to be follow by small returns, leading to contiguous periods of volatility and stability. Such data require appropriate econometric modeling techniques in order to ensure proper interpretation and conclusion.

Engle (1982) developed a model to capture time-varying variance- the Autoregressive Conditional Heteroscedastic (ARCH) approach. The basic ARCH model has led to other related formulations describing the evolution of the variance of time series, such as the Generalized ARCH (GARCH) model. Among the various formulations of the GARCH models, the EGARCH approach has been identified as the most appropriate model for stock indexes. Moreover, parameter restrictions are not necessary because EGARCH models the log of conditional variance, thereby guaranteeing that the variance will be positive. Furthermore, Engle and Ng (1993), report that asymmetric models such as EGARCH provide the best forecast of volatility. Based on the conceptual underpinnings of the study, the hypothesized questions and the past performance of the exponential GARCH model, this study uses a multivariate EGARCH model.

4. Unit Root tests

It is important to check whether the data series is stationary before using the Vector Auto Regressive (VAR) and the EGARCH Models. Engel and Granger (1987) suggest different unit root tests. Augmented Dickey Fuller (ADF) test is believed to be the most powerful test among them. The ADF test examines the unit root of the observed data by taking the unit root (non stationarity) as the null hypothesis. The rejection of H_o implies that the series X_t is stationary. Table 2 reports the results of the ADF test. Since the ADF test statistic for monthly stock returns (–7.83) is less than the critical value, the null hypothesis of a unit root is rejected. Therefore, monthly stock returns series are stationary. The result of the ADF tests for the country's macroeconomic and the global factors are also less than the critical values, and are therefore, stationary.

5. Multivariate EGARCH Model

The multivariate Exponential Generalized Auto Regressive Conditional Heteroscedasticity (EGARCH) model used in this study is based on one estimated by Christofi and Pericli (1999). Let R_t be the logarithmic market return at time *t* for j macroeconomic variables, given that j=1, 2, 3, 4, 5, 6, 7 (1= Exchange rate, 2= Domestic interest rate, 3= Industrial production, 4= Money supply, 5= Monthly CPI, 6= MSCI world index, 7= 6-months LIBOR), μ_t and σ^2_t the conditional mean and conditional variance respectively, and *k* is the lag length. ε_t is the innovation at time t (i.e. $\varepsilon_t = R_t - \mu_t$) and Z_t the standardized innovation (i.e. $Z_t = \varepsilon_t / \sigma^2_t$) at time t. The model is specified as follows:

$$\mu_t = \beta_0 + \sum_{j=1}^{7} \sum_{k=1}^{2} \beta_{j(k)} R_{t-k} + \varepsilon_t \quad \text{--------(1)}$$

$$\sigma_T^2 = \exp\left[\alpha_0 + \sum_{j=1}^{7} \sum_{k=1}^{2} \alpha_{j(k)} X_{t-k} + \gamma \ln(\sigma_{t-1}^2) \right] \text{--------(2)}$$

$$X_{j.t-1} = \left[\left| Z_{j.t-1} \right| - E\left(\left| Z_{j.t-1} \right| \right) + \delta_j Z_{j.t-1} \right] \text{--------(3)}$$

Equation (1) models the conditional mean return of country and is specified as a function of the lagged values of its exchange rates, interest rates, industrial production, money supply, the MSCI world index, CPI and the 6-months LIBOR rates. The residuals from first-order autoregressions fitted to these variables are used as proxies for shocks to returns. This specification is meant to investigate the first question of the study – whether the mean shocks of macroeconomic variables are transmitted to the stock market returns. The coefficient β_j measures the degree of effects across macroeconomic variables. A significant β_j coefficient would imply that variable *j* leads market or equivalently, that current returns in variable *j* can be used to predict future returns in market.

The hypothesis tested is that each macroeconomic variable is important in explaining the returns of a country. So the null hypothesis here is that:

H_o: $\beta_i = 0$, *for all i*

Eq. (2) describes the conditional variance process as an extended EGARCH process, which allows the testing and measuring of the asymmetric impact of its own, and, the domestic and global macroeconomic variables' past standardizes innovations on the conditional variance of a market. The specification here examines the research question regarding the transmission of macroeconomic volatility shocks and whether they are persistent over time. The coefficient α_j in Eq. (2) captures the effect of innovations from macroeconomic variable *j* to market. This coefficient specifically measures the significance of past volatilities (standardized residuals) in each macroeconomic variable on the conditional variance of the equity returns.

Significant α_j implies that the past volatilities of a macroeconomic variable impact the conditional volatility of the equity returns. The null hypotheses tested here are that past volatilities in the j's do not impact the conditional variance of the equity returns.

H_o: $\alpha_i = 0$ for all i

The coefficient γ in Eq. (2) measures the persistence in volatility. A high value suggests that an information shock tends to persist for some time into the future. The presence of persistence in volatility clustering may imply the inefficiency of the market. The variable

$X_{j,t-1}$ is specified in Eq. (3) and is intended to capture the asymmetric effect of past standardized innovations, $Z_{j,t-1}$ ($Z_{j,t-1} = \varepsilon_{j,1-t} / \sigma_{j,t-1}$), on current volatility. This specification is intended to investigate, whether there are asymmetric effects in the transmission of the volatilities of macroeconomic variables. The term $|Z_{j.t-1}| - E(|Z_{j.t-1}|)$ measures the size effect, while the term $\delta_j Z_{j.t-1}$ measures the sign effect. If the lagged values of the market and/or macroeconomic variable advance and decline impacts volatility symmetrically, the coefficient δ_j would not be expected to be significant. If declines in macroeconomic variable j ($Z_{j,t-1} >0$) are followed by higher (lower) volatility than the variable's advances ($Z_{j,t-1} >0$), then δ_j would be expected to be negative (positive) and significant. Assuming that α_j is positive, the larger the deviation of past standardized innovation from its expected value, the larger the impact (positive or negative) on the current variance. The null hypothesis tested is that:

H_o: $\alpha_j = 0$ and $\delta_j = 0$ for $\alpha_j > 0$ and $\delta_j > 0$

6. Empirical Results of the EGARCH Model

The exponential GARCH results for the relative effects of country and global factors on stock returns are reported in Table 3. It reports the empirical results for Karachi Stock Exchange past returns, modeled as lagged returns in the GARCH model are positive and significant in explaining current returns. This result is consistent with the volatility clustering phenomena of most emerging markets. That is, higher periods of returns are followed by higher returns and vice versa. Table 3 also reports that the industrial production coefficient is positive but insignificant. In fact most previous studies have found low or no effect of industrial activity on security prices. Hardouvetis (1987), for instance, concludes that financial markets respond primarily to monetary and not real activity news. So the failure to detect any significant effect may be due to the fact that the impact horizon is short under this model. The money supply variable is negative and significant (-1.56308). The reason may be that Pakistan has experienced higher levels of inflationary trends that tend to depress stock prices. The coefficient for CPI is negative and significant (-4.63263). The reason may be that higher inflation uncertainty increases risk, the discount factor and so leads to decline in stock prices. The table also reports that the stock market is positively impacted by the global factor; MSCI World Index. The coefficient for MSCI world Index is (0.638144) positive and significant. This finding suggests that Pakistan's stock market have increased interaction with the global economy ever since it opened up for foreign investors. While coefficients for exchange rate and interest rate are negative but insignificant. This is because currency exchange rate and interest rate in emerging markets like Pakistan is controlled by government policies. This situation means that the exchange rate and interest rate are less predicting factors compared to the situation in developed markets. The fundamental economic factors such as exchange rate, deposit interest rate, have been found to be more predicting factor in case of developed stock markets, this is due to the fact that fundamental factors are tied and controlled in the emerging economies and may be less relevant to predict stock volatility.

7. Analysis of the Conditional Variance Equation

Table 4 reports the estimated coefficients of the conditional equations and shows MSCI World Index, Money Supply, CPI and LIBOR have significant impact on the stock price volatility. The implication of this result is that increases in the volatilities of these country and global variables leads to increases in the volatility of the Pakistan's stock market. While the coefficients of the exchange rate, interest rate and industrial production are not significant in explaining the volatility in the stock market. The reason may be that in emerging markets, investors in financial markets respond mainly to monetary news instead of real activity news. Similar studies of interest rate volatility on Brazil and Argentina's market also found insignificant results for interest rates volatility. The money supply (-1.733) and the CPI (-0.0057) variables are negative and significant. A possible explanation may be that high levels of inflation tend to depress stock prices. The table also reports that the coefficients of MSCI World Index, Exchange rate and interest rate not significant in explaining stock market volatility.

8. Analysis of Asymmetric Component

The EGARCH proposed by Nelson (1991) estimates the conditional variance as a function of standardized innovations and allows the conditional variance to respond asymmetrically to positive and negative innovations. The estimates from the multivariate EGARCH model shows that the country and global variables do not impact stock prices symmetrically as has been assumed by some previous studies. Table 4 (5.3 reports that the symmetry effect hypothesis is rejected in case of Pakistan's stock market suggesting that macroeconomic variables do exhibit asymmetric effect. This asymmetric coefficient is (-.7223747) negative and is significant at 5% level and the negative sign indicates that negative news about macroeconomic variables affect stock prices more than positive news. The results also suggest that stock market sensitivity to macroeconomic news depends on the size and sign of the surprise in the news. The negative sign of the asymmetry coefficient suggests that bad economic news is followed by higher stock market volatility than good economic news.

9. Multivariate Vector Auto Regressive Model

Developed by Sims in 1990, the VAR model is based on multivariate time series analysis, in which a variable, R_t, is stated as a function of the past history of R_t and the past history of other variables (R_2….R_n) that influence R_t. The following multivariate VAR model is used following Granger (1969).

$$R_t = \alpha_1 + \sum_{i=1}^{m} \beta_i R_{t-i} + \sum_{i=1}^{n} \gamma_j K_{t-i} + \varepsilon_i$$

Where R_t is monthly return at time t for stock index., and β_i, γ_j, are parameters, *m* and *n* are the lag lengths for monthly stock index returns and the macroeconomic and global factors respectively to be used in the equation. The above-mentioned Granger (1969) Causality test is designed to examine whether time series move one after the other or

contemporaneously. When they move contemporaneously, one provides no information for characterizing the other. If some of the γ_j values are statistically not zero, then K is said to Granger-cause stock returns. If γ_j parameters are statistically equal to zero, then economic variables are not impacting the stock returns. A standard F-test can be applied to test the null hypothesis that economic variables and the global variables fail to Granger cause the stock returns.

$H_{o:}\ \gamma_j = 0$ *, for all j macroeconomic variables*

Using the Akaike's (1969) Final Prediction Error criterion for determining the auto-regressive lag length, the equation is estimated for m = 1 and n = 1.

Table 5 reports the VAR coefficients for the response of the stock market to the shocks from the country and global factors. The results show that MSCI World Index, Money Supply, CPI, LIBOR are important variables in explaining stock price performance, as the coefficients of these variables are significant. These variables significantly impact the performance of the stock prices.

10. Conclusion and Implications

A number of previous studies have reported that a relationship between macroeconomic variables and equity market returns. However, most of these studies have typically focused on developed market. This paper extends the literature by investigating whether there are relationships between macroeconomic variables and the stock returns in an emerging market like Pakistan's stock market. This paper uses two multivariate models, multivariate EGARCH and Vector Auto Regressive (VAR) models to investigate the effect of exchange rate, interest rate, industrial production, money supply, Morgan Stanely Capital International (MSCI) World Index and 6-month LIBOR on stock prices in Karachi Stock Exchange. The estimate shows that domestic macroeconomic variables have varying degrees of importance in explaining the relationship between stock returns and volatility in KSE. The empirical results show that the two global, MSCI World Index and 6-months LIBOR, variables used in this paper explains the stock returns in KSE. An important conclusion drawn from the results is that macroeconomic variables exhibit asymmetric effects on returns volatility. In particular the results show that for KSE the past returns, modeled as lagged returns in the GARCH model are positive and significant in explaining current returns. This result is consistent with the volatility clustering phenomenon of most emerging markets.

The estimated coefficients of EGARCH models show that stock returns respond significantly to money supply, CPI and LIBOR and MSCI World Index. Similar results are found for the VAR model.

The estimated coefficient of EGARCH conditional equation shows that only money supply, CPI and LIBOR volatility in Pakistan has significant impact on stock price volatility. The implication of this result is that an increase in money supply and CPI volatility in Pakistan leads to an increase in volatility of the stock market. The industrial production coefficient as reported by VAR is positive but not significant. Previous studies have found low or no effect of industrial activity on security prices. Hardouvelis

(1987), for instance concludes that financial markets respond primarily to monetary and not real activity news.
The measure of persistence of volatility shocks in the EGARCH model suggests that news information in this market does not die quickly but is persistent over time. The symmetry effect hypothesis is rejected suggesting that macroeconomic variables do exhibit asymmetric effect in Pakistan's stock market. The negative signs indicate that negative news about macroeconomic variables in Pakistan's stock market affect stock prices more than positive news do. The result suggests that bad economic news is followed by higher stock market volatility than good economic news. The finding is consistent with the findings in some other studies. Overall, the results show that Pakistan's stock market is partially integrated as shown by the significant role of both country and global factors. The above conclusions have important implications for both investors and policy makers.

11. Implications

The results reported in this study suggest that macroeconomic variables are important with regard to stock market volatility in Pakistan. International investors can therefore, improve their portfolio performance by considering the stability in economic fundamentals as determinants of stock market volatility. Policy makers, on the other hand, can concentrate their efforts to attain stability in economic fundamentals in order to reduce volatility and minimize investor uncertainty. Policy makers should be sensitive to asymmetric effects of volatility in the market. Effective macroeconomic management, market transparency and availability of information can provide a market environment with low asymmetric information and its related problem.

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Appendices

Tables

Table 1
Summary Statistics of Monthly KSE Returns

Mean	0.025528
Median	0.021724
Maximum	0.241114
Minimum	-0.15455
Std. Dev.	0.087079
Skewness	0.29688
Kurtosis	2.771848

Table 2: Augmented Dickey Fuller Test Results for stock returns and macroeconomic variables

KSE Returns	-7.838*	1% Critical Value	-3.569
MSCI World Index	-6.717*	5% Critical Value	-2.924
Money Supply	-8.429*	10% Critical Value	-2.597
Exchange Rate	-3.904*		
CPI	-6.219*		
LIBOR	-3.941*		
Interest Rate	-7.792*		

* shows significance at 1%

Table 3: Mean Effects of Macroeconomic Variables on Stock Returns

$$\mu_t = \beta_0 + \sum_{j=1}^{7} \sum_{k=1}^{2} \beta_{j(k)} R_{t-k} + \varepsilon_t \text{ -------- (1)}$$

	Coefficient	Std. Error	t-Statistic
Past Returns	0.022553**	0.012718	1.77323
Industrial Production	0.00076	0.000826	0.920069
CPI	-4.63263*	1.362635	-3.39976
Exchange Rate	-1.36637	0.969568	-1.40925
Interest Rate	0.003296	0.158029	0.020855
LIBOR	0.51002*	0.115744	4.406457
Money Supply	-1.56308*	0.516928	-3.02378
MSCI World Index	0.638144*	0.213747	2.985511
C	0.129876*	0.032461	4.000937
R^2	0.213745		

Note: ** shows significance at 10% and * at 5% level.

Table 4: EGARCH RESULTS

$$\sigma_T^2 = \exp\left[\alpha_0 + \sum_{j=1}^{7}\sum_{k=1}^{2}\alpha_k X_{t-k} + \gamma \ln(\sigma_{t-1}^2)\right] \text{-------(2)}$$

	Co-eff.	Std. Err.	t-statistic
MSCI World Index	0.31387	0.26243	1.2
Money Supply	-2.32176*	0.79826	-2.91
Exchange Rate	0.19775	0.98254	0.2
CPI	-3.64433*	1.67786	-2.17
LIBOR	0.40508*	0.14652	2.76
Interest Rate	-0.06653	0.14909	-0.45
Asymmetric effect	-0.72237*	0.34156	-2.11
γ	-0.84674*	0.22810	-3.71
α_0	-9.94651*	1.27097	-7.83
ARCH + GARCH terms	0.70		

Note: * shows significance at 5% level.

Table 5: Results of Vector Auto Regressive Model

$$R_t = \alpha_1 + \sum_{i=1}^{m}\beta_i R_{t-i} + \sum_{i=1}^{n}\gamma_j K_{t-i} + \varepsilon_i$$

F-Statistic	2.81*	R^2	0.31
	Coef.	Std. Err	t
α_1	0.116614	0.3588285	0.32
KSE Returns	-0.11335	.1136981	-1.00
MSCI World Index	0.678133*	.2638073	2.57
Money Supply	-1.73345*	.7685238	-2.26
Exchange Rate	0.006148	.0067167	0.92
CPI	-0.0057*	.002718	-2.10
LIBOR	0.320005**	.1677306	1.91
Interest rate	0.00212	.0070671	0.30
Industrial Production	9.92E-05	.0002094	0.47

Note: * shows significance at 5% and ** at 10% level.