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Trading Volume and Stock Returns: Evidence from Pakistan's Stock Market

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This paper investigates empirical contemporaneous and causal relationships between stock returns, trading volume and volatility of stock index in Pakistan's stock market. The data relates to Karachi Stock Exchange (KSE-100 Index) and cover the period from Jan 2001 to May 2007. Granger Causality tests were employed to test whether trading volume precedes stock returns, or vice versa. GARCH (1,1) model was employed to test whether the positive contemporaneous relationship between trading volume and stock returns still exists after controlling for non-normality of error distribution. The study finds positive contemporaneous relationship between trading volume and return preserves after taking heteroskedasticity in to account. Moreover, VAR finds a feedback relationship between stock returns and trading volume, i.e., returns cause volume and volume causes returns which is consistent with the theoretical models that imply information content of volume affects future stock returns.

Field of Research: Finance

1. Introduction

The purpose of this paper is to empirically examine the dynamic (causal) relation between stock market returns, trading volume, and volatility in Pakistan's stock market. Researchers have studied the return/volume relationship from different perspectives and in different markets. For example Granger and Morgenstern (1963) have included the relation between price indexes and aggregate trading volume. Crouch (1970) studied relation between contemporaneous absolute price change and trading volume while Westerfield (1977), Tauchman and Pitts (1983) and Rogalski (1978) studied relationship between price change and trading volume. Others have studied the relation between variance of price change and trading volume. This includes Epps and Epps (1976) while Harris (1986) and Clarke (1973) who include squared price change in studying the relationship between stock returns and volume. These studies find positive correlation between trading volume and the absolute value of the stock price change and secondly, a positive correlation between trading volume and the stock price change. Chen, Firth and Rui (2001) summarize four theoretical explanations for the positive relation between the absolute price changes and trading volumes. These include a sequential arrival of information (SAI) model, a mixture of distributions (MD) model, a rational expectations asset-pricing model, and differences of opinion model.

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Developed and tested in their studies by Copeland (1976), Morse (1980). Jennings, Starks, and Fellingham (1981) and Jennings and Barry (1983), according to SAI model, new information is disseminated sequentially to traders, and traders who are not yet informed cannot perfectly infer the presence of informed trading. Consequently, the sequential arrival of new information to the market generated both trading volume and price movements, both of which increase during periods characterized by numerous information shocks. The MD hypothesis states that price volatility and trading volume should be positively correlated because they jointly depend on a common underlying variable. This variable could be interpreted as the rate of information flow to the market.

Rational expectations models show disagreement generated by private information. These models generally involve trading among privately informed traders, uninformed traders, and liquidity or noise traders. Investors trade rationally for both informational and non-informational reasons. Wang (1984) asserts that trading is always accompanied by price changes, since investors are risk-averse. For example, when a group of investors sells shares to rebalance their portfolios, to induce other investors to buy, the price of the stock must drop. As information asymmetry increases, the uniformed investors demand higher discounts in when they buy the stock from the informed investors. Thus these investors are able to cover the risk of trading against private information. Therefore, according to this model, trading volume is always positively correlated with the absolute price changes. The DO model assumes that traders differ in the way in which they interpret the information and each trader believes in the validity of his interpretation. Recently much attention has been paid to emerging markets particularly the Asian markets because of their available extra diversification benefits to foreign equity investors despite their much smaller market capitalization and higher volatility. Among those Asian markets, Pakistan can prove to be an important market for foreign investors as Pakistan’s capital and equity markets have witnessed impressive growth over the last several years, partly on account of market-friendly and investment-friendly policies pursued by the government.

Pakistan’s stock market took major steps in its development when significant measures were taken in the early Nineties for privatization, economic liberalization, relaxation of foreign exchange controls, and the easing of the regulations on the repatriation of profits, investment and operations of financial institutions. The most significant step was, however, the opening of the equity market to international investors in February 1991. The market became bullish after its opening and market capitalization (in $) and trading value (in $) increased by 157 percent and 168 percent in the first year of liberalization. This was, however, followed by a correction phase in the first year of its opening to foreign investors. However, the market remained relatively inactive until early 200. Since then, KSE-100 index (Pakistan’s benchmarked stock market) has increased from 1521 points in June 2000 to 12370 points in April 2007 – a rise of over 10,800 points or an increase of 713 percent. Similarly aggregate market capitalization has increased from PK Rs 392 billion ($ 7.6 billion) in June 2000 to PK Rs 3604 billion ($ 59.4 billion) in April 2007, showing an increase of 819 percent. The listed capital at KSE has increased from PK Rs 236.4 billion in 2000 to PK Rs 535.5 billion in March 2007. Similarly, daily turnover of shares at KSE has increased from 48 billion in fiscal year 1999-2000 to 105 billion shares during fiscal year 2005-06.

A number of factors are attributed to the bullish sentiment in Pakistan’s stock market during the last seven years (2000-07). These factors include: speedy privatization process of state-owned enterprises, attracting foreign investors in prestigious organizations, like Pakistan Telecommunication Company Limited and National Refinery etc., allowing foreign investors to repatriate their funds without any restriction; reduction in the interest rates by the banks; continuous improvement in economic fundamentals and higher industrial growth[1]. These factors, coupled with various laws and rules, were introduced mainly for the protection of small investors, and to bring efficiency in trade through automation and curbing insider trading. These measures were taken besides strengthening the structure of the Security Exchange Commission of Pakistan (SECP). These important developments and measures have contributed to the phenomenal growth in Pakistan's equity market during the last several years.

Following economic liberalization in Pakistan in 1990, researchers and academicians have shown some interest in analyzing the stock market behavior, including the volume, return and volatility relationships. Ali (1997) examined the relationship between stock prices and trading volume. Using daily data for a period of 9 months for Karachi Stock Exchange, the author found a significant impact of non-informational trade in explaining fluctuations in the stock prices. This study covered only Nine months time period, which is very short and, therefore, a longer horizon is needed to confirm the results. Mustafa and Nishat (2004) investigated the relationship between aggregate trading volume and serial correlation of daily stock returns data for a period of 10 years from Dec 1991 to Dec 2000. The authors used a dummy variable to account for day-of-the-week effect and two serial correlations in the equation to account for the influence of current prices on future prices. The role of the non-informational trade on stock prices was determined by introducing the change in volume as non-informational factor. Additionally, square of trading volume and conditional variance were included to control for non-linearity in the model. The empirical results of their paper indicate a significant effect of non-informational trade on stock prices and trading activity for the period in addition to current returns, non-linear trading volume and volatility.

Mamoon (2007) explored a host of issues pertaining to activities at the Karachi Stock Exchange including; short to medium-term relationship between stock market return and trading volume, the nature of volatility in stock prices, trading volume and the three economic variables namely whole sale price index, manufacturing sector's production index and money supply. Third objective of his study was to determine inertia, stability, seasonality, and independence across the measures of stock market volatility. The author used State Bank General Price Index (SBGPI) for a period from Jan 1992 to June 199 using daily and monthly data series for volatility and index returns, respectively. SBGPI covers all the stocks listed on the Karachi Stock Exchange and provides a complete representation of the market. In the first part of his empirical study, the author regressed growth rate of stock prices (GP) for monthly data series and GP Square (GP^2) for daily data series, as measures of stock returns and returns volatility respectively, on growth rate of volume (GV), as an explanatory variable, by employing Ordinary Least Square method while addressing the problem of autocorrelation by including AR and MA terms in the regression equation. The author also used lagged values of GV up to 4 lags as dependent variables to capture the nature of dependency of stock returns on trading volume. The findings of his study suggested that the relationship between trading volume and rate of return is found in the short run only, that is, based on holding period of one day. As the holding period is increased to one month (medium term analysis), the relationship becomes quite weak and insignificant. This confirmed his earlier conclusions in the paper that market activity is mostly driven by short-term speculative activities and sentiments. His empirical results are consistent to the study in the measurement of stock markets' integration by Ahmad (1998).

[1] For details, see Economic Survey, Govt. of Pakistan, 2007

Empirical results of our study can be summarized in that this paper finds feedback relationship between trading volume and stock returns for Pakistan's stock market, which is consistent with the theoretical models that imply information content of volume affects future returns. These findings are consistent with the argument of Gallant, Rossi and Tauchen (1992) that more can be learned about the stock market through studying the joint dynamics of stock prices and trading volume than by focusing only on the univariate dynamics of stock prices. The rest of the paper is paper is organized as follows. Next section describes data characteristics followed by discussion of methodology and empirical results while the last section concludes the paper.

2. Data

This study uses daily closing value and the trading volume series for Karachi Stock Exchange (KSE-100) Index from Jan 1, 2001 to May 23, 2007. Karachi Stock Exchange (KSE) is the largest and the oldest of the three stock exchanges in Pakistan. The other two exchanges are in Lahore and Islamabad. KSE, established in 1947 soon after creation of Pakistan, began trading with a 50 shares index. But the market remained relatively inactive until 1991 when liberalization measures, particularly the opening of the market to international investors, were announced. Today more than 660 listed companies are quoted on the exchange. KSE-100 Index, established in 1991, is a capital weighted index and a basket of 100 companies representing about 90 percent of market capitalization of the Exchange. Pakistan's stock market is benchmarked through KSE-100 index. Data on the closing value of the KSE-100 index and trading volume series was collected from online database of Westminster and Eastern Financial Services Limited.

2.1 Descriptive Statistics

To assess the distributional properties of the daily stock prices, the daily trading volume and returns volatility, various descriptive statistics are reported in Table 1 that includes mean, variance, standard deviation, kurtosis, skewness. Daily stock returns were calculated using the continuously compounded returns; they were calculated as the log of the daily difference of the market index closing value for stock returns. The returns were thus defined as follows:

$$R_t = L_n \left(P_t \middle/ P_{t-1} \right) \qquad (1)$$

Where R_t is return for stock index for day t, P_t is the total closing value for stock index on day t and t-1 respectively and L_n stands for Natural logarithm. Table 1 presents the basic statistics relating to the returns and trading volume for KSE-100 Index. The statistics show that returns are negatively skewed, although the skewness statistics is not large. The negative skewness implies that the return distributions of the shares traded on the index have a heavier tail of large value and hence a higher probability of earning negative returns. The results also show that the distribution of returns have fait tails compared with normal distribution. It implies that much of the non-normality is due to leptokurtosis, which has very high values as reported in the Table 1. Also the result of the Jarque-Bera test rejects the normality assumptions of the returns series and trading volume. Similar results were found by Khilji (1993) for Pakistan's stock market that examined the time series behavior of monthly stock returns over the period July 1981 to June 1992 and found that the distribution of the returns of various series were not normal and were generally, positively skewed and leptokurtic.

**Table 1—Summary Descriptive statistics:
Daily observation of KSE returns and Trading Volume**

	Returns	Volume
Mean	0.00198	8.445529
Median	0.002656	8.49812
Maximum	0.758296	9.173824
Minimum	-0.77669	2.653213
Std. Dev.	0.049709	0.359237
Skewness	-0.32278	-4.34721
Kurtosis	143.3468	65.51851
Jarque-Bera	875724.6*	177129*
Observations	1167	1167

Note: * shows significance at 1%

Some previous studies report evidence of both linear and nonlinear time trends in trading volume series (e. g., Chen, Firth and Rui, 2001 and Gallent, Rossi, Tauchman, 1992). This study, therefore, tests trend stationarity in trading volume by regressing the series on a deterministic function of time. To allow for a non-linear time trend, we include a quadratic time trend term:

$$V_t = \alpha + \beta T^2 + \varepsilon_t \ldots\ldots\ldots\ldots..(2)$$

where V_t is raw trading volume in the stock market. Table 2 shows results from regressing trading volume on nonlinear time trend variable. The coefficient for the quadratic term is statistically significant. We also regressed trading volume on a linear time trend variable but the coefficient was statistically insignificant and there was no significant improvement in the model fit. Therefore, we use trading volume adjusted for nonlinear time trends for Pakistan’s stock market. The detrended trading volume is the residuals from equation (2).

Table 2—Non-Linear trend in trading volume

Variable	Coeff.	Std. Error	t-Stat
C	4.82E+08	9003615	53.52
β	-339.853	17.663	-19.24
R^2	0.25795		

Note: * shows significance at 1% level

2.2 Unit Root Tests

Before launching analysis and applying various models to the data, this paper adopts Augmented Dickey Fuller (1979) test and Phillips-Perron test (1988) to ensure that every variable is under stationarity to avoid spurious regressions.

ADF regression: $\Delta X_t = \alpha + \beta X_{t-1} + \sum_{i=1}^{n} \delta_i \Delta X_{t-1}$.......... (2)

Phillips-Peron regression: $\alpha_0 + \alpha X_{t-1} + \varepsilon_t$....................(3)

Where x_t is the stock return or the de-trended volume. In these tests, the null hypothesis is that a series is nonstationary (i.e., difference stationary): $\beta = 0$, and $\alpha = 1$. Table 3 shows that the null hypothesis that the stock return series and trading volume series are nonstationary (i.e., have a unit root) is rejected for both stock returns and trading volume series whether we allow for three lags or five lags. This confirms that both trading volume and stock returns series are stationary and are, therefore, useful for further statistical analysis.

Table 3–Unit root tests for stock returns, trading volume and return volatility

Variable	ADF Test Stat	PP test	H_0 :Nonstationarity
(R_t)	-19.1398	-63.9145	Rejected
(V_t)	-5.14596	-16.5519	Rejected
(R_t^2)	-13.396	-13.396	Rejected

Note: PP and ADF stands for Philip Perron and Augmented Dickey Fuller respectively

3. Empirical Results

3.1 Contemporaneous Relationships

This study first examines returns-volume relations by testing for contemporaneous correlation. The following regression equation is estimated for this purpose.

$$R_t = a + \sum_{t=1}^{n} \beta R_{t-i} + bV_t + \varepsilon_t, \text{ ....(4)}$$

Where R_t is return at time t measured according to equation (1) and V_t is natural logarithm of the trading volume at time t and R_{t-I} is included in the equation to account for serial correlation in the returns series. Table 4 reports the results of the regression for equation (4). As the Table shows that the coefficients of regressing stock returns on trading volume are significant at 5% level. Therefore, there exists a positive contemporaneous relationship between trading volume and returns. The findings of this study about Pakistan’s stock market are consistent with previous results from Lee and Rui (2000) for Chinese stock markets and with the results from US data. Moreover, LJ Box statistics up to lag 36 is statistically insignificant indicating that the model does not suffer from the problem of serial correlation. ARCH LM test indicates the presence of ARCH effect. We therefore, us GARCH model in the next section to further investigate the relationship between trading volume and stock returns.

Table 4—Regression of daily trading volume on stock returns

$R_t = a + bV_t + \varepsilon_t$, where R_t is return at time t and V_t is trading volume at time t

F-test (N=1065)	4.56**	R^2	0.0043
Variable	**Coefficient**	**Std. Error**	**t-Statistic**
b	0.0068754	0.004235	2.252399**
a	-0.0560864	0.035799	-1.57*
β_3	-.144211	0.030258	-4.76*
LB (Q) 36	42.62	ARCH LM Test	24.48
Prob, (Q)	0.20		

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

3.2 Trading Volume and Conditional Volatility

To test whether the positive contemporaneous relationship between trading volume and stock returns still exists after controlling for non-normality of error distribution, a class of stochastic processes known as Generalized Autoregressive Conditional Heteroskedasticity (GARCH) has been used in this paper. This approach is widely used and is most effective measure in estimating and measuring volatility in asset returns. A number of empirical studies have shown that the financial time series have shown volatility-clustering phenomenon, i.e., large changes tend to be followed by large changes and small changes tend to be followed by small changes. Following Lee and Rui (2000), and on the basis of AIC and SBIC values, the following GARCH (1,1) model is estimated as given below.

$$R_t = \alpha_0 + \alpha_1 R_{t-1} + \alpha_2 V_t + \varepsilon_t \quad \text{.......................... (5)}$$

$$\varepsilon_t^2 \left| (\varepsilon_{t-1}^2, \varepsilon_{t-2}^2, ...) \approx N(0, h_t) \right. \quad \text{........................... (6)}$$

$$h_t = \beta + \beta_1 \varepsilon_{t-1}^2 + \beta_2 h_{t-1} \quad \text{.............................. (7)}$$

Where h_t is the variance of the error term, ε, at time t in the equation (6). β is a constant and β_1 is a coefficient that relates the past values of squared residuals, ε_{t-1}^2, to current volatility, and β_2 is a coefficient that relates current volatility to the volatility of the previous period.

Table 5—GARCH Results

$$R_t = \alpha_0 + \alpha_1 R_{t-1} + \alpha_2 V_t + \varepsilon_t ....(5)$$

$$h_t = \beta + \beta_1 \varepsilon_{t-1}^2 + \beta_2 h_{t-1} .....(7)$$

Log likelihood	3010.111	Wald chi2 (1)	80.55*
KSE Return	Coef.	Std. Err	z
Constant (α_0)	-0.03528	0.004402	-8.01*
KSE returns (α_1)	-15.4134	0.960205	-16.05*
Log volume (α_2)	0.004667	0.00052	8.98*
Variance Equation			
β	-9.24554	0.064984	-142.27*
ARCH (β_1)	0.490537	0.051794	9.47*
GARCH (β_2)	0.126869	0.026696	4.75*

Note: * shows significance at 1%

GARCH results are given in Table 5. First, the likelihood ratio (LR) statistic is very large which implies that the GARCH model is an attractive representation of daily stock behavior, successfully capturing the temporal dependence of return volatility. Second, the GARCH parameterization is statistically significant. Third, the β_2 coefficient in the conditional variance equation is considerably smaller than the β_1, implying that small market surprises induce relatively large revisions in future volatility. Fourth, the coefficients of regressing returns on trading volume are positive and significant using the GARCH (1,1) model. The positive contemporaneous relationship between trading volume and return preserves after taking heteroskedasticity into account. These results are consistent with the findings of the Lee and Rui (2000) for Chinese stock markets. Additionally, the coefficients for ARCH and GARCH are also significant showing the presence of GARCH effect in the daily stock returns.

3.3 Causal Relationship Between Trading Volume And Return (Dynamic Relationship)

To test whether trading volume precedes stock returns, or vice versa, following bivariate Vector Auto Regressive (VAR) model is used in this study.

$$R_t = \alpha_1 + \sum_{i=1}^{m} \beta_{i1} V_{t-i} + \sum_{i=1}^{n} \gamma_{i1} R_{t-i} + \varepsilon_{i1} ....(8)$$

$$V_t = \alpha_2 + \sum_{i=1}^{m} \beta_{i2} R_{t-i} + \sum_{i=1}^{n} \gamma_{i2} V_{t-i} + \varepsilon_{i2} ....(9)$$

Where R_t is stock returns at time t and V_t is the trading volume respectively. α_1 and α_2 are intercepts, and β_{i1}, γ_{i1}, β_{i2}, γ_{i2} are parameters, *m* and *n* are the lag lengths for returns and trading volume to be used in the equation. The above-mentioned Granger (1969) Causality test is designed to examine whether two 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 β_{i1} values are statistically not zero, then volume is said to Granger cause returns. Similarly, if some β_{i2}'s are not statistically zero, then stock returns are said to Granger cause the trading volume. If both $\beta^{i's}$ are significant then a feedback relationship is said to exist. However, if both the parameters are statistically

equal to zero, then both stock prices and trading volume move contemporaneously. A standard F-test can be applied to test the null hypothesis that stock returns fails to Granger-cause the trading volume or the trading volume fails to Granger cause the stock returns.

Mathematically:

$$H_{o:}\ \ \beta_{i1} = 0, \text{ for all } i, \text{ and, } \ \ H_{0:}\ \ \ \beta_{i2} = 0, \text{ for all } i,$$

Given the importance of the predictability of stock returns, this study focuses on the causal relation from volume to returns. For the estimation of the Granger Causality, $m = 4$ for stock returns and $n = 5$ for trading volume is used in this study considering the values of both the Akaike Information Criterion (AIC) and Schwarz Information Criterion (Results are not given here).
Table 6 and 7 presents the results of causal relation tests based on a bivariate model. F-statistics and corresponding significance level are also shown. Panel A of Table 6 shows the results of the test of the null hypothesis that returns do not Granger-cause volume. The F-statistic is significant at 1% level.

Table 6 —VAR Results for relationship between Returns and trading volume

$$R_t = \alpha_1 + \sum_{i=1}^{m} \delta_i V_{t-i} + \sum_{i=1}^{n} \lambda_i R_{t-i} + \varepsilon_{i1} \text{..........} \quad ...(8)$$

$$V_t = \alpha_2 + \sum_{i=1}^{m} \beta_i R_{t-i} + \sum_{i=1}^{n} \gamma_i V_{t-i} + \varepsilon_{i2} \text{.............}(9)$$

Panel: A		Panel: B	
VOLUME		RETURNS	
Coefficient		Coefficient	
α_2	-0.13914**	α_1	1.033957**
γ_1	-0.50967**	δ_2	-0.90862**
γ_2	-0.31931**	δ_2	-1.23646**
γ_{3_1}	-0.17664**	δ_3	-1.08779**
γ_4	-0.06153**	δ_4	-0.87644**
γ_5	-0.03354	δ_5	-0.28332
β_1	-0.0029	λ_1	0.27051**
β_2	-0.01029**	λ_2	0.172293**
β_3	0.081767**	λ_3	0.11827**
β_4	-0.04618**	λ_4	0.156115**
β_5	-0.00543	λ_5	0.161295**
F-statistic	86.79*	F-statistic	103.80*
Adjusted R^2	0.45	Adj. R^2	0.49

*Note: ** shows significance at 5% and * at 1%*

Panel B, Table 6, shows that in the test of null hypothesis, volume does not Granger-cause return. The F-statistic is significant at the 1% level. This finding implies that in the presence of current and past returns, trading volume adds some significant predictive

power for future returns. The results from panel A and B imply a feedback system in case of Pakistan's stock market. In other words, returns are influenced by volume and volume is influenced by returns. Overall, the model fits are slightly better for equation (8) than equation (9) as shown by the higher adjusted R-square for equation (8). The evidence indicates slightly stronger evidence of volume causing returns than returns causing volume.

Table 7 reports VAR results for the relationship between trading volume and return volatility. Panel C and D report results for equation (10) and equation (11) respectively. F-statistics are significant at the 1% level. Again, model fits are better for equation (10) than equation (11). Results find stronger evidence of volume causing returns volatility. In other words, volume helps predict volatility. In Clark's (1973) mixture model, trading volume is a proxy for the speed of information flow, a latent common factor that affects volatility and returns. These results also support some theoretical models that imply information content of volume affects future returns

Table 7
VAR Results for relationship between Return Volatility and Trading Volume

Panel: C		**Panel: D**	
Volume		**Return Volatility**	
Coefficients		Coefficients	
π_1	0.283282**	η_1	0.00918**
π_2	0.162803**	η_2	0.01335**
π_3	0.099486**	η_3	-0.0565**
π_4	0.142395**	η_4	0.01008**
π_5	0.167272**	η_5	0.02096**
ν_1	1.358747**	θ_1	0.91921**
ν_2	-0.31728	θ_2	-0.6116**
ν_3	0.579015	θ_3	0.4610**
ν_4	-0.49204	θ_4	-0.3056**
ν_5	0.167269	θ_5	0.1477**
Adj. R^2	0.48	Adj. R^2	0.63
F-statistic	99.81*	F-statistic	182.53*

Note: ** *shows significance at 5% and* * at 1%.

4. Conclusion

This paper examined empirical causal relationships between trading volume, stock return and return volatility in Pakistan's stock market. The main focus of the paper has been whether information about trading volume is useful in improving forecasts of returns and

return volatility in a dynamic environment. The study finds that there is a feedback relationship between trading volume and stock returns, which is consistent with the theoretical models that imply information content of volume affects future returns. These findings are consistent with the argument of Gallant, Rossi and Tauchen (1992) that more can be learned about the stock market through studying the joint dynamics of stock prices and trading volume than by focusing only on the univarite dynamics of stock prices.

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