Trading Volume and Serial Correlation in Stock Returns in Pakistan

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Abstract

This paper examines the relationship between aggregate stock market trading volume and serial correlation of daily stock returns during December 1991 to December 2001. The results show that the non-informational trade has a significant effect on prices and trading activity in addition to present returns, non-linear volume and volatility. It indicates that stock returns moved too much due to change in the fundamentals, aggregate expected returns, and changes in effective risk aversion of market participants. The same results found in pre-nuclear test period (December 14, 1991 to May 28, 1998). However, the weak and insignificant result found in post-nuclear test period (May 28, 1998 to December 31, 2001). The second order autocorrelation indicates a positive and weak relation as compared to first order autocorrelation. Moreover, it is positive when it relates to weighted trading volume in entire sample period and two sub-sample periods. It implies that the role of information is effective after two days and non-informatiol role is less effective.

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1. Introduction

The fluctuation in trading activity is not only explained by publicly available information but also by non-information trade due to events, short selling, and insider traders. These factors are exogenous to the general price behaviour in stock market (Campbell, Grossman and Wang 1993). However, these fluctuation creates the similar effect to those produced by a change in the risk aversion of significant proportion of market participants (Ali, 1997). The academic literature provides the association between trading volume and stock return volatility. It is also found that high stock volume is linked with volatility and positive relation between stock returns and volume. Morse (1980) found that the serial correlation of returns in high volume and high volume periods tend to have positively autocorrelated returns. Le Baron (1992a) and Sentana and Wadhwani (1992) showed that autocorrelation of daily stock returns change with the variance of returns. Duffee (1992) established the relation between serial correlation and trading volume in aggregate monthly data. Campbell, Grossman and Wang (1993) examined the relationship between aggregate stock market trading volume and the serial correlation of daily stock return. They found that a stock price decline on high volume day is more likely than a stock price decline on low volume day to be associated with an increase in the expected stock return. Omran and Mckenzie (2000) investigated the relation between volume of trade and conditional variance of trade and found the significant relation between timing of innovational outliers in returns and volume.

During early nineties the non-informational factors greater influence on stock market activity in Pakistan. These factors are include structured changes in stock market, constructing the stock price index, based on market capitalization. These were the result of financial liberalisation and deregulation policy (Nishat, 1999). This has important impact in the form of uncertainty and risk aversion. Due to inadequate regulatory and weak enforcement of rules, there has risen the problem like as insider trading and unchecked margin requirement trading. As a result these created the leverage (Nishat, 2001), which can easily forced investors in bankruptcy problem if the investors expectation about future prices are not realised. A number of mega project in priority sectors[1] like PTCL, Hubco and others which attracted the investors specially the foreign investors took away all excess liquidity, which in turns sparked off the stock selling for wanted of liquidity and this resulted in price fluctuations. Preferential treatment for broker as jobber and involvement in speculative trade were also the reason of undue fluctuation in prices. The deteriorating situation of law and order and grooming political instability adversely affected the stock prices. A large portion of capital

[1] Government of Pakistan provided subsidies and special tax treatment to these sectors in 1990s (Economic survey of Pakistan, Ministry of Finance).

inflow in stock market was due to portfolio investment. The inflow and out flow of capital depends on the political and economic condition of the country. It is also caused of excessive fluctuation in stock market (Nishat, 2000). Ali (1997) studied the relationship between stock prices and trading volume in context of Karachi stock market's daily data for very small time period i.e. nine months data. He found that significance of non-informational trade in explaining the fluctuations in stock prices.

The purpose of the study is to investigate the non-informational trade in Karachi stock market using trading volume data. It is difficult to test non-informational trade by using merely the stock return data (Ali, 1997). The basic logic to use the volume is that the trading activity has explanatory power in addition to past returns, and price changes accompanied by high volume tend to be reversed (Ali, 1997). We de-trend the data of volume and return and check the stationary of the data by using the Phillips Perron test and then estimate the return on volatility and trading volume. The rest of the paper is organized such that next section discusses the econometric technique, methodology and described the data used in this paper. Section three present the empirical results. Conclusions are given in section four.

2. Econometric Methodology and Data

The main return series used in this paper is daily return (r_t) on value weighted index of stock traded on KSE, over the period December 14, 1991 to December 31, 2001. Trading volume (V_t) data and stock price data are collected from daily newspaper "Business Recorder". The stock return series is generated by first difference of log prices and trading volume is used as the log of daily turn over. We test two serial correlation to find the influence of current price on future price.

$$r_{t+1} = a_0 + a_1 r_i \quad (1)$$

$$r_{t+1} = b_0 + b_1 r_i \quad (2)$$

To check the day of the week effect we introduced the dummy variables.

$$r_{t+1} = a_0 + a_1 r_t + \sum_{i=1}^{5} a_{2i} D_i r_i \quad (3)$$

$$r_{t+1} = b_0 + b_1 r_t + \sum_{i=1}^{5} b_{2i} D_i r_i \quad (4)$$

The role of non-informational trade on stock prices is determined by introducing the change in volume as non-information factor. We multiply the trading volume with returns. Trading volume gives the weight to returns on those days when trading volume is higher than the returns on the days when it is normal. By this

we are able to find the impact of returns on the days of higher trade on the next day returns so our equation wil become:

$$r_{t+1} = a_0 + a_1 r_t + \sum_{i=1}^{5} a_{2i} Dr_t + a_3 r_t V_t \quad (5)$$

$$r_{t+2} = b_0 + b_1 r_t + \sum_{i=1}^{5} b_{2i} D_i r_t + b_3 r_t V_t \quad (6)$$

To test any non-linearity in the model we introduced the square of trading volume and conditional variance, which show the nonlinear relation between stock returns and trading volume.

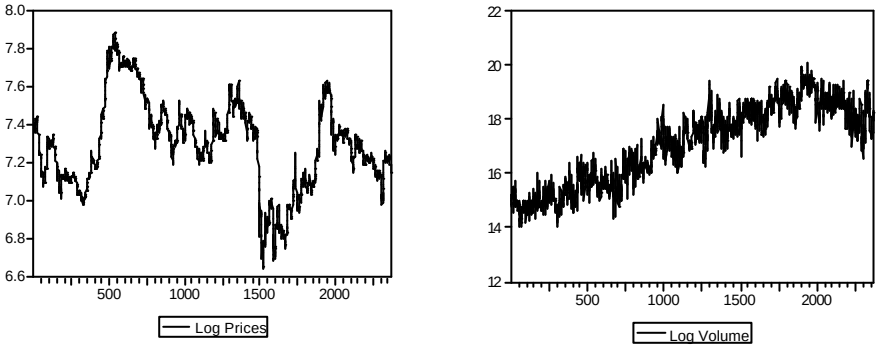
$$r_{t+1} = a_0 + a_1 r_t + \sum_{i=1}^{5} a_{2i} D_i r_i + a_3 r_t V_t + a_4 r_t V^2 + a_5 r_t s_i^2 \quad (7)$$

$$r_{t+2} = b_0 + b_1 r_t + \sum_{i=1}^{5} b_{2i} D_i r_t + b_3 r_t V_t + b_4 r_t V_t^2 + {}_5 r s^2 \quad (8)$$

3. ESTIMATION AND RESULTS

Result with the data from Dec 14, 1991 to Dec 31, 2001 is likely to be dominated in pre-nuclear test period[2]. That is why we split this period into two-sub sample period, i.e. December 14,1991 to May 28, 1998 and May 29, 1998 to December 31, 2001.

Graph 1

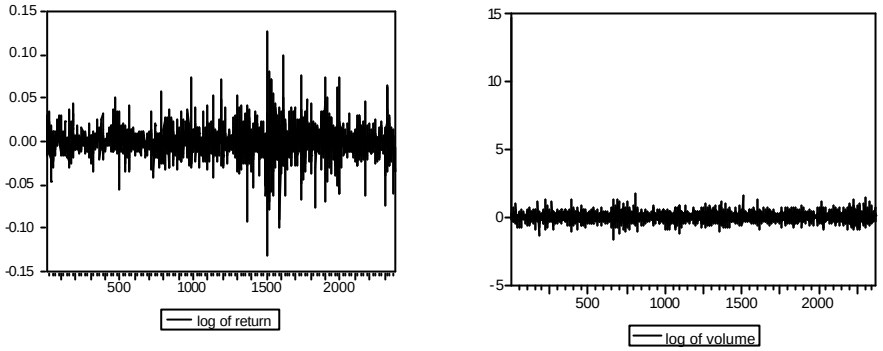


Graph 1 shows high frequency variation in prices and volume. To reduce this variation we have taken difference of log volume and log price. We want to work with stationary time series. When we relate our empirical results to our theoretical mo del, we want to measure trading volume relative to the capacity of the

[2] Pakistan had nuclear test on May 28, 1998 that has significant impact on KSE-100 and it declines from 1040.19 to 789.15 and trading volume from Rs16 million to Rs9 million

market to absorb volume. To remove low frequency variations form the variance we measure turnover in logs rather in absolute value. To de-trend the log turnover series, we subtract a twenty day backward moving average of log turnover[3].

GRAPH 2



Graph 2 shows the transformed series of log stock return and log of trading volume. The graphs show that the trend and low frequency variations have been removed.

Table 1 shows Phillips-Perron Unit Root Test results, which test the stationarity of series of return and trading volume. It indicates that both series are stationary in log form. Table 2 summarise the evidence on the first order autocorrelation of the index return. For each of the sample period, the table reports the autocorrelation with a hetroscedasticity consistent standard errors, and R^2 (Model 1) statistics for regression of the one day ahead return on a constant return. R^2 (Model 1) is just the square of the autocorrelation. The highest autocorrelation is observed in pre-nuclear test period which is 0.059 and the lowest R^2 is observed in post nuclear test period (Model 1) which is 0.001. A regression of one day ahead return on the current return interacted with dummies of five day has an R^2 (Model 2) statistics. R^2 (Model 2) is the greater than R^2 (Model 1) in full sample period and two sub sample periods of the basic regression, which shows day of the week effect, is larger in Karachi stock exchange. The day of the week dummies is significant. We include in all our subsequent regression.

Table 3 shows the relationship between trading volume and the first autocorrelation of value weighted return index. We regress the one day ahead stock return on the current stock return interacted with day of the week dummies, trading volume and trading volume squared and estimated conditional variance. The reason is to take volume squared is to capture any nonlinearly that may exist in the relationship between trading volume and autocorrelation. The results with full sample i.e. 1991-2000 shows that 1.63 percent of the variance of the one day ahead weighted index return can be explained by a regression on current return

[3] Mitchell, Mark L., and J. Harrold Mulhern. (1994) used twenty day moving average to de-trend the data.

interacted with day of the week dummies. However, it is pointed out that R^2 increased by 3.47 percent when the regression one-day ahead regress with dummies and trading volume. The coefficient on the trading volume and stock return product is -0.156 with hetroscedaticity consistent standard error of 0.053. The standard deviation of trading volume is 0.4527. Thus as moves from four standard deviations below the mean to four standard deviations above, the first order autocorrelation of the stock return is reduced by 0.15. This result is not compatible with volatility when volume is excluded from regression. However, non-linear term of trading volume is significantly negative which implies a the strong evidence for any specification than linear volume regression.

The results for pre-nuclear test and post nuclear test respectively are presented in table 3. As shown in pre-nuclear test period, the average first order autocorrelation of the stock return is 0.23 and a regression of the one day ahead return on the current return associated with day of the week dummies are explained by 8.98%. It is increased if we incorporate the trading volume. In post nuclear test period, the first order autocorrelation is smaller i.e. 0.038 and the regression of one day ahead return on current associated with day of the week dummies with volatility are explained by 2.5 percent. In this period R^2 increased by 3.36% if returns regress on trading volume, volatility and trading volume squared. The result points out that the addition of the data after nuclear test has strong effect of trading volume on the first order autocorrelation of returns. In this period the trading volume is significant at 1 percent. Moreover, these dummies are excluded, the volume effect becomes much stronger in 1991-2001. This is because the stock price reversal of the nuclear test is captured by the day of the week dummies when these are included or by trading volume when dummies are omitted.

The second order autocorrelation of returns are highlighted in table 4. The result indicates that the second order autocorrelation of return is smaller but statistically significant. However, when day of the week dummy is incorporated, with current return the R^2 statistics of the regression is relatively higher. Table 5 also shows the trading volume and volatility effects on the second order autocorrelation. The results show the relatively weak trading volume effect as compared to the first order autocorrelation. Over a full sample period 1991-2001, the coefficients of trading volume and trading volume squared are 0.078 and –0.003 with standard error 0.020 and 0.001 respectively. This implies that the second order autocorrelation increase with trading volumes and higher values of volume the positive quadratic term dominates and auto correlation should decrease. In pre-nuclear test period the similar results are observed. However, the results are relatively weak. In post nuclear period the coefficients of trading volume and trading volume squared are –0.042 and 0.003 with standard error 0.06 and 0.003 respectively. This implies that the second order autocorrelation falls with trading volume and at higher value of trading volume the positive quadratic term dominate and autocorrelation should increase.

4. Conclusion

This study investigates the relationship between aggregate stock market trading volume and serial correlation of daily stock returns during December 14, 1991 to December 31, 2001. The study also identifies any difference in this relationship during pre-nuclear test (December 14, 1991 to May 28, 1998) and post-nuclear test (May 29, 1998 to December 31, 2001). The results indicate a first order positive autocorrelation between future returns and present returns. The correlation becomes negative when present returns are weighted by a change in the trading volume. This implies that non-informational trade has a significant effect on prices and trading activity has explanatory power in addition to present returns, non-linear trading volume and volatility. The results also indicate that stock market moved too much due to change in the fundamentals, aggregate expected returns, and changes in effective risk aversion of market participants. Moreover, the same results found in pre-nuclear test period. However, the weak and insignificant results were found in post-nuclear test period. It concludes that the addition of post-nuclear test period leads to stronger evidence for trading volume effect on first order auto-correlation. The second order auto-correlation results indicates a positive and weak relationships as compared to first order auto-correlation. However, it positive when it relates to weighted trading volume in entire sample period and two sub-sample periods. It implies that the role of information is effective after two days and non-informational role is less effective.

References

Ali, S. S. (1997). "Prices and Trading Volume in Pakistan Stock Markets", Journal of Economic Cooperation Among Islamic Countries, 18, 3, 115-137.

Cambell,J. Y. Sanford J. Grossman and Jiang Wang. (1993). Trading Volume and Serial Correlation in Stock Return", Quarterly Journal of Economics, 905-939.

Duffee, Gregory, (1992) "Trading Volume and Return Reversal". Finance and Economics Discussion Series no. 192, Board of Governors of the Federal Reserves System.

LeBaron, B. (1992a) "Some Relation between Volatility and Serial Correlation in Stock Market Returns". Journal of Business, LXV, 199-219.

Mitchell, Mark L., and J. Harrold Mulhern. (1994). "The impact of public information on the stock market." Journal of Finance, 49, No.3. pp. 923—950.

Morse, D. (1980) "Asymmetric Information in Securities Markets and Trading Volume", Journal of Financial and Quantitative Analysis, XV, 1129-1146.

Nishat, M. (1999), "The Impact of Institutional Development on Stock Prices in Pakistan," Doctoral Dissertation, Auckland Business School, University of Auckland.

Nishat, M. (2000), **"**Institutional Development and Risk Premia in Pakistan**",** Paper presented at Asia-Pacific Finance Association Conference 2000, held in Shanghai, China.

Nishat, M. (2001), **"**The Systematic Risk and Leverage Effect in Corporate Sector of Pakistan", Pakistan Development Review.

Nishat, M. and Mustafa, K. (2002). "Anomalies in Karachi Stock Market", (Draft).

Omran, M.F. and McKenzie F. (2000). Hetroscedasticity in Stock Return Data: Revisited Volume verses GARCH Effects", Applied Financial Economics, 10, 553-560.

Sentana, E. and Sushil Wadhwani (1992), "Feedback Traders and Stock Return Autocorrelation: Evidence from a Century of Daily Data", Economic Journal, CII 415-425.

Uppal, J. (1993), The Internalisation of the Pakistan Stock Market: An Empirical Investigation", Pakistan Development Review, 32:4 605-618.

Table 1
Phillips Perron Unit Root Test

Variable	PP test	Result
Log of return	-43.4825	Stationary
Difference of Log Volume	-112.72	Stationary
McKinnon critical values for rejection of hypothesis of a unit root at significant level of 1%= -3.43: at 5%= -2.58 at 10%= -2.56		

Table 2
I[st] auto correlation of stock return.

$$r_{t+1} = a_0 + a_1 r_t$$

$$r_{t+2} = b_0 + b_1 r_t$$

Sample period	α	R^2(Model 1)	R^2(Model 2)
Dec. 14, 1991 to Dec. 31, 2001			
Coefficient	0.126	0.015	0.031
Standard error	0.020		
t-values	6.190		
p-values	0.000		
(Pre-nuclear test) Dec. 14, 1991 to May 28 1998			
Coefficient	0.224	0.056	0.059
Standard error	0.025		
t-values	8.820		
p-values	0.000		
(Post-nuclear test) May 29 1998 to Dec. 31, 2001			
Coefficient	0.038	0.001	0.038
Standard error	0.033		
t-values	1.159		
p-values	0.057		

TABLE 3
Volume Volatility and First Autocorrelation

$$r_{t+1} = a_0 + a_1 r_t + \sum_{i=1}^{5} a_{2i} D_i r_i + a_3 r_t V_t + a_4 r_t V^2 + a_5 r_t s_i^2$$

	α_3	α_4	α_5	R^2
Dec. 14, 1991 to Dec. 31, 2001				
Volume	-0.156			0.035
Standard error	0.054			
z- statistics	-5.740			
P-values	0.000			
Volume			8.405	0.016
Standard error			9.960	
z- statistics			0.843	
P-values			0.399	
Vol. And volatility	-0.155	-2.890	47.84	0.037
Standard error	0.389	0.396	9.990	
z- statistics	0.390	-0.626	4.780	
P-values	0.691	0.530	0.000	
Dec. 14, 1991 to May 28 1998				
Volume	-0.093			0.069
Standard error	0.019			
z- statistics	-4.751			
P-values	0.000			
Volatility			37.750	0.089
Standard error			21.440	
z- statistics			6.420	
P-values			0.000	
Vol. And volatility	0.156	-0.009	160.20	0.069
Standard error	0.029	0.001	25.410	
z- statistics	7.106	-7.580	6.300	
P-values	0.000	0.000	0.000	
May 29 1998 to Dec. 31, 2001				
Volume	-0.082			0.033
Standard error	0.058			
z- statistics	-1.410			
P-values	0.158			
Volatility			-47.380	0.026
Standard error			20.510	
z- statistics			-2.309	
P-values			0.021	
Vol. And volatility	0.069	-0.003	-13.831	0.036
Standard error	0.078	0.003	17.820	
z- statistics	0.880	-0.805	-0.770	
P-values	0.370	0.420	0.430	

Table 4
2nd order auto correlation of stock return.

$$r_{t+2} = a_0 + a_1 r_t$$
$$r_{t+2} = b_0 + b_1 r_t$$

Sample period	β	R^2(Model 1)	R^2(Model 2)
Dec. 14, 1991 to Dec. 31, 2001			
Coefficient	0.117	0.029	0.039
Standard error	0.020		
t-values	5.721		
p-values	0.000		
Dec. 14, 1991 to May 28 1998			
Coefficient	0.076	0.018	0.024
Standard error	0.026		
t-values	2.914		
p-values	0.003		
May 29 1998 to Dec. 31, 2001			
Coefficient	0.057	0.006	0.015
Standard error	0.033		
t-values	1.700		
p-values	0.088		

Table 5
Volume Volatility and First Autocorrelation

$$r_{t+2} = b_0 + b_1 r_t + \sum_{i=1}^{5} b_{2i} D_i r_t + g_1 V_t r_t + g_2 V_t^2 r_t + g_3 s_i^2 r_t$$

	γ_1	γ_2	γ_3	R^2
Dec. 14, 1991 to Dec. 31, 2001				
Volume	0.015			0.024
Standard error	0.006			
z- statistics	2.200			
P-values	0.027			
Volatility		64.658		0.015
Standard error		9.98		
z- statistics		6.47		
P-values		0.000		
Vol. Volatility	0.078	-0.002	56.96	0.046
Standard error	0.020	0.001	14.070	
z- statistics	3.780	-2.540	4.040	
P-values	0.000	0.011	0.000	
Dec. 14, 1991 to May 28 1998				
Volume	0.009			0.019
Standard error	0.008			
z- statistics	1.106			
P-values	0.268			
Volatility		-3.62		0.053
Standard error		16.57		
z- statistics		-0.218		
P-values		0.826		
Vol. And volatility	0.057	-0.002	175.45	0.097
Standard error	0.024	0.001	16.29	
z- statistics	2.330	-1.68	10.77	
P-values	0.0198	0.091	0.00	
May 29 1998 to Dec. 31, 2001				
Volume	0.015			0.062
Standard error	0.009			
z- statistics	1.587			
P-values	0.112			
Volatility		-3.624		0.053
Standard error		16.57		
z- statistics		-0.218		
P-values		0.826		
Vol. And volatility	-0.042	0.003	-52.69	0.078
Standard error	0.068	0.003	25.18	
z- statistics	-0.610	0.95	-2.09	
P-values	0.540	0.34	0.036	