Analysis Of Asymmetry In The Price-Volume Relation: Evidence From The Pakistani Stock Market

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PART-I

INTRODUCTION

Market participants keep a close eye on trading volume as it reflects the dynamic interplay between informed traders and uninformed traders who interact with each other and set market clearing prices. Volume represents the total number of shares traded for a given time period and measures the liquidity in a stock or index. The higher the volume, the narrower are the spreads, less slippage, and less volatility. Trading volume is viewed by traders as the critical piece of information that signals the price movements. Stock prices are usually influenced by positive trading volume through the available set of relevant information on the market. A revision in investors' expectations usually leads to an increase in trading volume, which eventually reflects the sum of investors' reaction to news. Trading volume either activates or deactivates the price movements.

The movement in the stock returns and trading volume are influenced by the flow of new information into the market. The relationship between return volatility and trading volume is mixed, which has led many researchers and investors to investigate if any asymmetry exists between these two variables. There are two prominent theoretical models to explain return-volume relationship- One is the mixture of distribution hypothesis (MDH) pioneered by Clark (1973), Epps and Epps (1976) and Tauchen and Pitts (1986) and the second is the sequential information arrival hypothesis (SIAH) of Copeland (1976), Jennings, Stark and Fellingham (1981) and Smirlock and Starks (1985). The mixture of distribution hypothesis explains an influential variable termed as latent news arrival or information flow. If the news is unexpectedly bad, the price of the securities decreases and if the news is unexpectedly good, then it has a positive effect on the price movements of the securities. These movements are supposed to be influenced by the above average trading activity in the market as it adjusts to a new equilibrium. Regarding this phenomenon, the absolute returns trading volume are considered to be positively correlated. It further demonstrates that since the volume volatility variables simultaneously change in response to the arrival of new information, thus there shall be no information content in past volatility data that can be used to forecast volume. On the other hand, the sequential information arrival hypothesis (SIAH) explains the role of the lagged values of volatility in predicting current trading volume and assumes that traders tend to receive information in a sequential, random manner where all traders revise their expectations accordingly. The traders do not receive the information at the same time which creates incomplete equilibrium. To reach the final equilibrium, all traders tend to react to the information signal simultaneously, so that current trading volume can be predicted with accuracy.

The empirical evidence is this regard is mixed. Baklaci and Kasman (2003) for Turkish market, Deo, Srinivasan and Devanadhen (2008) for Asia Pacific market and Darrat, Rehman and Zong (2006) for US market support sequential information arrival hypothesis, whereas, Pyun, Lee and Num (2000) for Korean stock market and Bohl and Henke (2003) for Polish stock market find evidence in favor of mixture of distribution hypothesis. Lucey (2005) finds a mixed evidence for the mixture of distribution hypothesis in the Irish stock market. As regards to causal relationship, Campbell, Grossman and Wang (1993) find that the level of price changes is influenced by high volume that tends to be reversed and reversal is less due to price changes on days with low volume. Mossa and Al-Loughani (1995) show that volume causes absolute price changes for Asian markets. Chordia and Swaminathan (2000) observe trading volume as the source of a wide range of market information. The dynamic relationship between price and volume by autoregressive conditional heteroskedastic (ARCH)

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models is done by Lamoureux and Lastrapes (1990) and Chen, Frith and Rui (2001) and numerous other studies. In case of Pakistani market, Mustafa and Nishat (2008) show that the non-informational trade based on events, short selling and insider trading has significant effect on prices and trading activity. In case of three manufacturing sectors, Mubarik and Javid (2009) observe that stock return and volume follows autoregressive processes and current return is determined by previous returns and volumes. The conditional volatility following GARCH-M process indicates that the lagged volume affects volatility positively and investors get premium for variance risk. The present study is the extension of our earlier work (Mubarik and Javid, 2009), in which, the relationship between trading volume and stock returns of three manufacturing sectors of Pakistan is examined. This study explores the causal relationship between stock returns and trading volume and the level of association of information asymmetry with return-volume relationship of the manufacturing sector of Pakistan. The current study contributes to the existing literature in volume volatility relationship by using the market index and individual stocks. The causal relationship is investigated between volume and volatility by applying Granger Causality test. The dynamic association between volatility and volume is estimated by exponential generalized autoregressive conditional heteroskedastic (EGARCH) model which accounts for time varying volatility process with an asymmetric response to both positive and negative price changes for Pakistani market. This research has been conducted from Feb'2009 to June'2009.

This study is structured as follows: Part 2 discusses the empirical methodology and data. The empirical results are presented in Part 3 and Part 4 offers the concluding remarks.

PART - II

METHODOLOGY AND DATA

The main focus of the study is to examine the stock return, trading volume and volatility relationship. The trading volume serves as a proxy measure in the model for unobservable amount of information that flows into the market. To investigate the relationship between returns, volatility and trading volume, the model developed by Lamoureux and Lastrapes (1990) is adopted. The first step is to estimate stock returns (r_i) for individual firms and market return (r_m) where KSE 100 is taken as market index. The return is defined as log first difference of closing price at each day. The trading volume (V_t) is defined as the log of daily turnover of each stock and the market index. The trading volume is detrended by regressing the volume on time and time square and extracts the residuals which represent detrended trading volume.

$$r_t = \ln(P_t) - \ln(P_{t-1}) \qquad (1)$$

$$V_t = \alpha + \beta_1 t + \beta_2 t^2 \qquad (2)$$

The P_t is closing price of the stock *i* at time t, in case of market index, the KSE 100 at time t and V_t is turnover of stock and KSE 100 at time t. To test the causal relationship between stock return and trading volume both for the market and the firm level, Vector Autoregressive (VAR) model is applied. Before performing VAR, the stationarity of stock returns, market return, stock trading volume and market trading volume is tested by applying Augmented Dicky Fuller (ADF) test. The Granger causality test is applied to investigate causal relationship between stock returns and trading volume. Following Chen, Firth and Rui (2001) ,bivariate autoregressive model is used as given below:

$$r_t = \alpha_0 + \sum_{i=1}^{4} r_{t-i} + \sum_{j=1}^{4} \beta_j V_{t-j} + \varepsilon_t$$

$$V_t = \alpha_0 + \sum_{i=1}^{4} \gamma_i V_{t-i} + \sum_{j=1}^{4} \delta_j r_{t-j} + \varepsilon_t \qquad (3)$$

If β_j coefficients are statically significant, then past values of volume and return yield a better forecast of future return and trading volume causes stock return. The F-test is used to test the hypothesis that $\beta_j = 0$ for all *j*. If δj is different from zero, the return causes volume. If β_j and δj are different from zero, there is a feedback relation between stock returns and trading volume. The Vector Autoregressive (VAR) method is used for estimation and model with four lags is selected on the basis of Schwarz Bayesian Criteria.

The empirical evidence shows that the return distribution is time varying in nature and investors update the mean and variances at the arrival of information. Therefore, the ARCH models, originally introduced by Engle (1982) are useful to study the pattern of volatility clusters in stock returns. Nelson (1991) points out that the changes in stock return volatility have negative correlation with return themselves. As a result, volatility increases in response to bad news and falls in response to good news. To capture asymmetric effect on conditional variance, exponential GARCH model suggested by Nelson (1991) is used. The main advantage of this model is that the parameters are not restricted to be non-negative and explicitly account for asymmetry in stock return volatility. The EGARCH model expresses the conditional variance of stock return as non-linear function of its own past values and past values of standard innovations. In the model below, the past volumes are also included in the conditional variance. To obtain parsimonious estimation, one autoregressive lag is used in the mean equation and conditional variance is specified as EGARCH(1, 1) process with lagged volume in the conditional variance equation. The empirical specification of the model becomes:

$$R_t = \alpha_0 + \alpha_1 R_{t-1} + \varepsilon_t$$

$$\log(h_t) = \omega + \beta \log(h_{t-1}) + \alpha \left| \frac{\varepsilon_{t-1}}{h_{t-1}} \right| + \gamma \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} + \delta V_{t-1} \qquad (4)$$

The conditional variance (h_t) on the left hand side of the equation is in log form implying that the forecasts of conditional variance are always positive. The coefficients α_0, α_1, ω, β, γ, δ are the estimated parameters. The news impact due to stock prices changes is asymmetric if $\gamma \neq 0$ for at least one in model (4). Furthermore, if $\gamma < 0$ implies that leverage effect is present, the mixture of distribution model predicts that $\delta > 0$ and in the presence of volume, if $\delta > 0$, then α and β must be small and statistically insignificant. The persistence of variance as measured by $\alpha + \beta$ should become negligible if accounting for uneven flow of information V_{t-1} explains the presence of EGARCH in the data.

DATA

The sample for this study comprises of seventy firms listed on the Karachi Stock Exchange, which is the main equity market of Pakistan. The firms which are selected are most active and representative of different sectors namely automobile, banking, cement, chemical, engineering, fuel and energy, fertilizer, insurance, pharmaceutical, sugar, textile composites, textile spinning, textile weaving and woolen. The KSE 100 index is used as the market index. The data is collected from the website of Business Recorder for the period of July 1998 to December 2008 comprising of 2,574 observations.

PART – III

EMPIRICAL RESULTS

The first step is to check the stationarity of data by applying ADF test and results show that return series and log of volume series are stationary. The analysis begins with the investigation of causal relationship between market return and market volume. In the next stage, the EGARCH model is estimated to examine the asymmetry in the conditional variance where volume is also included as information set. Then, for more in depth analysis, same procedure is applied at firm level data.

MARKET LEVEL ANALYSIS

The contemporaneous relation between return and trading volume based on VAR model is examined by F-test and results reported in Table 1 show that there is feedback relationship between market return and trading volume. This finding indicates that market returns are influencing volume and volume is influenced by market return in case of Pakistani market. The results of testing the conditional autoregressive model with EGARCH specification are presented in Table 2. The result of AR (1) model suggests that market return has autocorrelation of first order. This pattern indicates that disturbances experienced as included in information set during any period have permanent effect on future path of market returns The results of variance equation indicates that negative shocks have more impact on the volatility than positive shocks because the parameter is negative and highly significant, which implies that variance tends to fall when return surprises are negative. In other words, negative shocks cause same volatility than positive shocks. The volume is also affecting the conditional variance positively and significantly as shown by parameter δ. Trading volume as proxy of information innovation does not reduce the importance of α and β in explaining the persistence in volatility in market return in Pakistani market.

FIRM LEVEL ANALYSIS

The results of Granger Causality test, F-test at firm level are reported in Table 3. Out of 70 stocks, 36 stocks indicate that return causes volume, 9 stocks indicate that volume causes return, 17 stocks indicate bidirectional causation and the remaining 6 shows no causation at all. The findings of firm level relationship between return, volatility and volume based on EGARCH model with lagged trading volume as unobserved measure of information that flows into the market are reported in Table 4. The results show presence of significant autoregressive process of first order for almost all stocks. This pattern indicates that past stock returns determine the future path of returns. In other words, shocks in rate of return experienced during a period have a rigid relationship with future returns. The EGARCH equation parameterizes conditional variance and an intercept of these equations shows that the portion of price volatility remains constant over time. This equation shows asymmetry in variance behavior, that is negative shocks have more effect on variance compared to positive shock which is measured by γ. The results reveal that this coefficient is significant in 61 out of 70 stocks. Out of 61 significant parameters, 25 are negative, implying that variance tends to fall when return surprises are negative and indicating that in these firms, negative shock causes more change in variance than positive shocks. The remaining 36 stocks have positive significant γ parameter showing that positive shocks causes same affect as negative shocks on variance. These results mostly do not provide support to theoretical proposition that negative shocks cause greater volatility than positive shocks. Ahmad and Qasim (2004) come to the same conclusion for Pakistani market. With regards to the affect of volume on conditional variance as information innovation, the result shows that out of 66 significant results, in case of 60 stocks, volatility increases as volume increases and for 6 stocks, volatility decreases as volume increases. The results suggest that there is positive association between stock return variance and lagged trading volume for most of the stocks. The inclusion of trading volume as innovation in conditional variance does not reduce the importance of α and β. The results indicate that the persistence of volatility remains after incorporating trading volume in conditional variance for most of the stocks just like overall market. This suggests that return volatility and trading volume are found to follow lead-lag pattern in large number of stocks which supports the sequential information arrival hypothesis. The results of Baklaci and Kasman (2003) for Turkish market, Deo *et al.* (2008) for Asia Pasfic market, and Darrat *et al.* (2006) for US market also reject the mixture of distribution hypothesis.

PART – IV

CONCLUSION

This study examines the causal relationship between stock returns and trading volume and the level of association of information asymmetry with return, volatility and volume relationship at market and firm level in case of Pakistan for the period of 1998 to 2008. For this purpose, 70 KSE listed firms are selected which are active and representative of different sectors of economy and KSE 100 index is chosen as market index. To test for return-volume causality and the association of asymmetric information with return-volume relation, Granger Causality test and EGARCH model is applied respectively. The results show that in the overall market, there is a bi-directional causal relationship between market return and market volume. In case of firm level, the evidence indicates that for more stocks, return is causing volume than volume causing return. The relationship between trading volume and return volatility is analyzed by applying EGARCH model where volume is taken as proxy for rate of information arrival. The empirical results verify that that there is significant relation between trading volume and return volatility contemporaneously when volume is integrated into the conditional variance equation both for overall market and at firm level. These results are supported by several empirical findings of emerging markets (Baklaci and Kasman, 2003 and Deo *et al.*, 2008). The results reveal that the persistence of volatility does not diminish after introducing trading volume in conditional variance for overall market and majority of the stocks. The results suggest that return volatility and trading volume are found to follow lead-lag pattern in overall market and for large number of stocks which supports the sequential information arrival hypothesis.

Baklaci and Kasman (2003) for Turkish market, Deo et al. (2008) for Asia Pacific market, and Darrat *et al.* (2006) for US market have come up with the same conclusion. The existence of substantial speculative trading and price limits observed in Pakistani market might be responsible for this outcome.

Table 1: Causal Relation Between Market Return and Volume

	Vm causes Rm	Rm causes Vm
KSE 100	26.72*	19.09*

Note: The * indicates significance at 1%

Table 2: Relation Between Market Return, Volatility and Volume by EGARCH Model

	α_0	α_1	ω	α	γ	β	δ	R^2
KSE 100	0.01*	0.02*	-13.95*	0.81*	-0.54*	0.32*	0.20*	0.29
	(6.95)	(3.05)	(-34.6)	(27.91)	(-24.02)	(15.32)	(8.43)	

Note: The * indicates significance at 1%

Table 3: Empirical Results of Granger Causality Test At Firm Level Data

Return causes Volume		Volume causes Return		Bi-directional Causation		No Causation	
Company	**F-stat**	**Company**	**F-stat**	**Company**	**F-stat**	**Company**	**F-stat**
INDU PSMC	48.53* 22.85	GNDL	4.07*	HOND	1.22* 12.55*	EFUG	0.07* 0.54*
MTL MCBL	2.85* 56.33	ZELP	3.56*	ACBL	0.11* 33.41*	RLCL	0.05* 0.04*
BOPL BAHL	58.66* 6.55*	HUBC	27.11*	FABL	1.28* 29.78*	GENP	1.26* 2.68*
DGKC LUCK	87.93* 59.31*	PROG	6.86*	BAPL	0.94* 0.10*	OLSMR	2.70* 1.83*
FUJI MLCF	102.846* 322.781*	MZSM	3.82*	DADX	2.02* 9.27*	MINT	0.49* 2.19*
SITC NIRE	7.01* 3.07*	DKTM	6.36*	TAXE	0.20* 1.69*	HKKT	0.09* 1.02*
ICI BOC	176.041* 8.45*	GFIL	2.88*	PECO	1.34* 0.69*		
CSAP AMAT	5.15* 6.21*	YOUTM	4.95*	ENGRO	5.46* 25.36*		
CENI ABOT	3.05* 7.08*	HABM	3.85*	FFCL	6.89* 10.05*		
FEROZ HINOON	6.11* 8.14			AICL	6.89* 10.05*		
PNGRS SGML	5.09* 3.23*			SEARL	3.86* 18.29*		
COWM DAWH	9.45* 8.53*			MOON	8.26* 16.92		
FZCM PRL	68.39* 5.56*			VAWL	3.85* 16.69*		
POL MARI	7.31* 20.69*			KESC	2.91* 35.74*		
JPGL JDWS	55.48* 9.47*			ZHTM	3.35* 15.73*		
NAKIR BNWM	5.41* 12.9*			SAPF	4.51* 12.07*		
OTSU SMTM	14.74* 3.65*			ADOS	5.43* 13.38*		
KOIL RCML	5.57* 10.11*						

Note: The * indicates significance at 1%

Table 4: Relation Between Stock Return, Volatility and Volume by EGARCH Model

Company	α_0	α_1	ω	α	γ	β	δ	R^2
GNDL	0.02	0.01	-0.21	0.19	0.01	0.96*	0.02	0.23
HOND	0.11	0.06*	-0.55*	0.22*	-0.03	0.94*	0.01*	0.29
INDU	0.01*	0.05*	0.72*	0.26*	0.03*	0.92*	-0.03*	0.30
PSMC	-0.08**	0.03	-1.74*	0.41*	0.07*	0.77*	-0.02*	0.31
MTL	0.12*	0.30**	1.76*	0.25*	0.16*	0.77*	0.01	0.24
ACBL	0.24	0.04*	-3.78*	-0.59*	-0.09*	0.59*	0.03*	0.27
MCBL	0.10**	0.08*	-1.43*	0.36*	-0.01	0.82*	-0.01*	0.36
BOPL	0.02	0.11	-0.89*	0.34*	0.04*	0.87*	-0.01*	0.31
FABL	-0.03	0.12	-1.55*	0.30*	-0.01**	0.82*	0.09**	0.28
BAHL	0.03	0.13*	-2.51*	0.43*	0.10*	0.74*	0.03*	0.27
DGKC	0.02	0.31*	0.36*	0.34*	-0.02	0.88*	0.01*	0.36
LUCK	0.14	-0.37*	0.25*	0.23*	-0.04*	0.96*	0.07*	0.26
FUJI	0.03	0.05	-3.83*	-2.94	0.04*	0.01*	0.07*	0.28
MLCP	0.02	0.06	-0.44*	0.22*	-0.07**	0.93*	0.01*	0.27
ZELP	0.01**	0.06*	-0.51*	0.14*	0.09*	0.92*	0.04*	0.31
BAPL	0.03	0.15*	-1.49*	0.35*	-0.08*	0.78*	-0.04*	0.27
SITC	0.01*	-0.05*	-1.04*	0.27*	0.06*	0.86*	-0.02*	0.49
NIRE	0.01	-0.09*	-0.66	0.20*	0.03*	0.86*	-0.02*	0.26
ICI	0.02*	0.16*	-0.50*	0.36*	0.01	0.89*	-0.03*	0.25
BOC	-0.06*	0.23*	12.56*	0.25*	-0.10*	-0.37*	0.25*	0.29
CSAP	0.11	0.13**	-0.47*	0.15*	0.02*	0.94*	0.06*	0.30
ADOS	0.08	0.25*	0.37*	0.05*	0.15*	-0.24*	0.18*	0.46
DADX	-0.04	0.12	-9.66*	-0.25*	0.05*	-0.02*	0.55*	0.27
TAXE	0.27	0.04*	-7.49*	0.32*	0.03*	0.23*	0.52*	27
PECO	0.12	0.21	-0.56*	0.18*	0.01**	0.93*	0.02*	0.30
DAWH	-0.03	0.22**	-1.08*	0.44*	-0.05*	-0.17*	0.33*	0.25
ENGRO	-0.02	0.89	-5.34*	0.70*	-0.14*	0.59*	0.12*	0.24
FFCL	-0.07*	0.08*	-19.81*	0.24*	0.01	-0.65	0.48*	0.28
AICL	-0.07***	0.36**	-3.55*	0.50*	-0.80*	0.64*	0.05*	0.41
EFUG	0.01	0.13*	-11.3*	0.22*	-0.23*	-0.20*	0.39*	0.39
PROG	-0.09*	0.12*	10.34*	0.41*	0.05*	-0.13*	0.57*	0.28
CENI	-0.06	0.13	-12.29*	0.17*	0.09*	-0.42*	0.31*	0.33
RLCL	-0.03	0.14**	-10.9*	0.16*	-0.14*	-0.20*	0.41*	0.31
ABOT	-0.01*	0.09*	-13.7*	0.86*	-0.19*	-0.37*	0.45*	0.32
FEROZ	-0.37	0.10*	-13.6*	0.12*	0.07*	-0.45*	0.55*	0.21
HINOON	-0.03	0.13	-0.46*	0.22*	-0.04*	0.94*	-0.01*	0.29
SEARL	0.15	0.16*	-2.21*	0.41*	-0.01**	0.75*	0.02*	0.33
OTSU	0.02	0.12	-1.00*	0.14*	0.07*	0.87*	0.05***	0.30
HABM	0.06	0.15*	-0.51*	0.18*	0.04*	0.94*	0.03*	0.27
MZSM	0.06	0.15*	1.84*	0.28*	-0.03*	0.67*	0.02*	0.32
PNGRS	0.03	0.13	-1.60*	0.28*	-0.06*	0.70*	0.02*	0.29
SGML	0.02	0.06*	-1.85*	0.29*	0.05*	0.72*	0.03*	0.31
JDWS	0.02*	0.07*	-0.47*	0.18*	0.06*	0.93*	0.01*	0.35
BNWM	0.02	0.14**	-1.71*	0.10*	0.09*	0.78*	0.01*	0.32
COWM	0.08***	0.01***	-12.9*	0.42*	0.24*	-0.79*	0.57*	0.37
HAWM	-0.02	0.22*	-1.64*	0.27*	0.05*	0.82*	0.02*	0.32
MOON	-0.01	0.45*	-1.59*	0.49*	-0.11*	0.84*	0.11*	0.25
HUBC	0.01	0.21	-0.20	0.35*	0.06*	0.92	0.04*	0.30
GENP	0.02*	0.21*	-2.66*	0.33*	0.02*	0.94	-0.03*	0.21

JPGL	-0.01**	0.06*	-0.88*	0.35*	0.09	0.87*	0.02*	29
KESC	-0.55	0.04	0.48*	0.39*	0.01***	0.91*	0.03*	0.22
MARI	0.08**	0.13*	-0.86*	0.23*	0.01	0.89*	0.01*	0.28
POL	0.06	0.09*	-6.23*	0.74*	0.06*	0.15*	0.01*	0.31
PRL	-0.40	0.18*	-0.21*	0.14*	0.05*	0.97*	0.04*	0.25
DKTM	-0.06**	0.07*	-3.50*	0.23*	0.11*	0.54*	0.04	0.31
FZCM	0.05	0.23*	-0.62*	-0.12*	0.13*	0.91*	0.08*	0.35
ITFT	-0.05*	0.14*	-8.87*	0.22*	-0.20*	0.11*	0.56*	0.36
RCML	0.01	0.22	-9.57	0.23*	0.18*	-0.01*	0.59*	0.36
OLSMR	0.05**	0.13*	-10.69*	0.22*	-0.20*	-0.17*	0.52*	0.31
GFIL	-0.01*	0.24*	-11.8*	0.29*	-0.18*	-0.31*	0.52*	0.38
KOIL	0.13*	0.11*	13.97*	-0.23*	-0.27*	0.22*	0.69*	0.29
ZHTM	-0.07*	0.14*	-8.55*	0.64*	0.50*	0.12*	0.46*	0.35
SAPF	-0.01*	-0.04	-9.10*	0.32*	-0.05*	0.15*	0.49*	0.27
AMAT	0.09	0.04*	-8.60*	0.64*	-0.02*	-0.03*	0.72*	0.26
HKKT	0.03	0.05*	-7.82*	0.38*	0.13*	0.04*	0.35*	0.31
SMTM	-0.01	0.14*	-12.82*	0.25*	-0.01**	0.33*	0.40*	0.27
YOUTM	-0.05**	0.47*	-9.52*	0.40*	0.08*	-0.02*	0.52*	0.28
NAKIR	-0.02***	0.05**	14.25*	0.21*	-0.42*	-0.35*	0.02*	0.29

The * indicates significance at 1%, ** indicates at 5% and *** indicates significance at 10% level

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