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Trading volume and serial correlation in stock returns in an emerging market: a case study of Pakistan

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This paper examines the relationship between aggregate stock market trading volume and serial correlation of daily stock returns from December 1991 to April 2006. The empirical results reveal that there is a first-order positive autocorrelation between future and present returns. The serial correlation becomes negative when present returns are weighted by a change in the trading volume. This indicates that the non-informational trade has a significant effect on prices and trading activity in Karachi stock market in addition to present returns, nonlinear volume, and volatility. The results implied that stock market return 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 are found in pre-reforms period (December 14, 1991, to December 31, 2000), post-reforms period (January 01, 2001, to April 2006), before 9/11 events (December 14, 1991, to September 10, 2001), and after 9/11 events (September 10, 2001 to April 21, 2006). The test results for second-order autocorrelation indicate a positive and weak relationship between future and present returns as compared to first-order autocorrelation. However, it is positive when it relates to trading volume in the entire sample period and four subsample periods. This infers that the role of information is effective after two days, but non-informational role is less effective in this duration.

JEL classification: C01, C22
Keywords: stock trading, autocorrelation, information

1. Introduction

The Karachi stock market is one of the leading emerging markets that outperformed all others in the 1990s. There are 659 stocks companies listed with the Karachi Stock Exchange (KSE) with a total market capitalization of US$ 34,701 million, which amounts to 25 percent of gross domestic product (GDP) in Pakistan.[1] This feature of the KSE indicated a shallow market with high turnover, which is common among emerging stock markets. The reasons for the shallowness of the market and the high level of turnover in emerging markets are poor information, insider trading, liquidity, and manipulation. In general, as characteristic of emerging markets, the KSE indicated significant fluctuations since the institution of reforms in the 1990s. However, the market has experienced the booms and busts of comparatively shorter time durations. In addition, KSE is also characterized as a highly speculative market where dissemination of information has been very poor and incidence of insider trading is commonly perceived [Nishat 1999; Nishat and Mustafa 2002]. In this market 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 behavior in stock market. However, these fluctuations create effects similar to those produced by a change in the risk aversion of a significant proportion of market participants [Ali 1997].

The empirical research provides the association between trading volume and stock return volatility.[2] It is also found that high stock volume is linked with volatility. The relation between stock returns and volume is such that volume tends to be higher when stock prices are increasing than when prices are falling. Morse [1980] found that the serial correlations of returns in high-volume periods tend to be positively autocorrelated, but he did not compare high volume with low volume. LeBaron [1992b] and Sentana and Wadhwani [1992] showed that autocorrelation of daily stock returns changes with the variance of returns. Duffee [1992] established the relation between serial correlation and trading volume in aggregate monthly data, while LeBaron [1992a] used nonparametric methods to channel the aggregate daily relation more accurately. Conrad, Hameed, and Niden [1994] tested the relation between individual

[1]In developed market, the market capitalization ratio to GDP is large and turnover is small. It implies that the size of the market is less than the size of the economy in Pakistan.

[2]Karpoff [1986] provides three reasons for this relationship. First, the returns/trading volume relation provides insight into the structure of financial markets. Second, the returns/trading volume relation is important for event studies that use a combination of stock returns and trading volume data to draw inferences. Third, the returns/trading volume relation is critical to the debate over the empirical distribution of speculative prices. Others who contributed included Osborne [1959], Granger and Morgenstern [1963], Crouch [1970], Westerfield [1977], Tauchen and Pitts [1983], Epps and Epps [1976], Harris [1986], Clark [1973], and Gallant, Rossi, and Tauchen [1992].

stock returns autocorrelation and trading volume. 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 a significant relation between timing of innovation outliers in returns and volume.

In the early '90s notable non-informational factors influenced the stock-market activity in Pakistan. These factors included structural changes in stock market, institutional development, financial reforms, and constructing the stock-price index based on market capitalization. These resulted from financial liberalization and deregulation policies [Nishat 1999] and have had an important impact on the form of uncertainty and risk aversion. Earlier, inadequate regulatory and weak enforcement of rules gave rise to the problem of insider trading and unchecked margin requirement trading, resulting in the leverage [Nishat 1999] that could easily force investors into bankruptcy if their expectations about future prices are not realized. A number of mega projects like Pakistan Telecommunication Company Limited (PTCL), Hub Power Company Limited (HUBCO), and others, which attracted especially foreign investors took away all excess liquidity, which in turn sparked off the stock selling for want of liquidity, hence triggering price fluctuations. Preferential treatment for broker as jobber and involvement in speculative trade also cause undue fluctuation in prices. Breakdown in law and order and political instability also adversely affected the stock prices. A large portion of capital inflow in the stock market is due to portfolio investment. The inflow and outflow of capital depends on the country's political and economic condition. It is also the cause of excessive fluctuations in the stock market [Nishat 1999]. Ali [1997] studied the relationship between stock prices and trading volume in the context of the Karachi stock market's daily data, albeit limited to nine months. He found that the significance of non-informational trade explains the fluctuations in stock prices. An important issue should be whether information about trading volume is useful in improving the forecast of price change and return volatility in Pakistan. The basic aim of this study is to investigate the role of non-informational trade in the Karachi stock market. It is difficult to test non-informational trade by merely using the stock-return data. For this purpose we also use the trading volume data to test the role of non-information trade.[3]

[3]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. Suppose price of a certain share decreases, this might be due to the availability of public information or exogenous selling pressure by non-informational trade. If the public information is available then there is expectation of variation in volume, while selling pressure by non-informational trader will show the unusual volume.

The rest of the paper is organized as follows: section 2 discusses econometric methodology and describes the data used in this paper. Section 3 presents the empirical results. The summary and concluding remarks are given in section 4.

2. Econometric methodology and data

The daily stock price and trading volume of the Karachi Stock Exchange are used in this study over the period between December 14, 1991, and April 21, 2006. Stock price (P) data and trading volume (V_t) data are taken from a daily newspaper, *Business Recorder*. The data on stock prices and trading volume are given in absolute form; one of the weaknesses of absolute value, however, is the low frequency variation from the level and variance of the series. To remove the low frequency from volume and return, these variables are expressed in log terms rather than absolute terms. To de-trend the series, growth of the series are calculated. The de-trend series is shown in Graph 2 while Graph 1 shows the price and trading volume without de-trending. To check the stationarity of the data on stock price and trading volume, the Phillips-Perron test is used. The stock return series is generated by the first difference of log prices divided by lag log price, and trading volume is used as the log of daily turnover. Two serial correlations are examined to find the influenced of current price on future price.

$$r_{t+1} = \alpha_0 + \alpha_1 r_t \tag{1}$$

$$r_{t+2} = \beta_0 + \beta_1 r_t \tag{2}$$

To check the day-of-the-week effect (identified earlier by Nishat and Mustafa [2002] in the case of the Pakistan stock market), the dummy variables are introduced in the above equations. The new forms of the equations are as follows:

$$r_{t+1} = \alpha_0 + \alpha_1 r_t + \sum_{i=1}^{5} \alpha_2 D_i r_i \tag{3}$$

$$r_{t+2} = \beta_0 + \beta_1 r_t + \sum_{i=1}^{5} \beta_2 D_i r_i \tag{4}$$

To observe the role of non-informational trade on stock prices, the change in volume as non-information factor is introduced, which are expressed by the product of return and volume. Volume gives the weightage to return on those days when trading volume is higher and the return on those days when it is normal. This provides the impact of returns on the days of higher trade on the next-day return, so equations [3] and [4] become

$$r_{t+1} = \alpha_0 + \alpha_1 r_t + \sum_{i=1}^{5} \alpha_2 Dr_t + \alpha_3 r_t V_t \tag{5}$$

$$r_{t+2} = \beta_0 + \beta_1 r_t + \sum_{i=1}^{5} \beta_2 Dr_t + \beta_3 r_t V_t \tag{6}$$

To test any non-linearity in the model we introduced the square of volume, which shows the nonlinear relation between stock returns and trading volume. The reason for taking the volume squared is to capture any nonlinearly that may exist in the relationship between volume and autocorrelation Moreover, volatility is also incorporated in the above equations, thus the equations become

$$r_{t+1} = \alpha_0 + \alpha_1 r_t + \sum_{i=1}^{5} \alpha_2 D_i r_i + \alpha_3 r_t V_t + \alpha_4 r_t V^2 + \alpha_5 r_t \sigma_i^2 \tag{7}$$

$$r_{t+2} = \beta_0 + \beta_1 r_t + \sum_{i=1}^{5} \beta_2 D_i r_i + \beta_3 r_t V_t + \beta_4 r_t V^2 + \beta_5 r_t \sigma_i^2 \tag{8}$$

3. Estimation and interpretation of results

Results from the data from December 14, 1991, to April 21, 2006, are likely to be dominated in post-reform and post-event periods. This is the reason why the study period was split into four subsample periods: pre-reforms period (December 14, 1991, to December 31, 2000), post-reforms periods (January 01, April 21, 2006), before 9/11 events (December 14, 1991, to September 11, 2001), and after 9/11 events (September 12, 2001, to April 21, 2006).

Figure 1

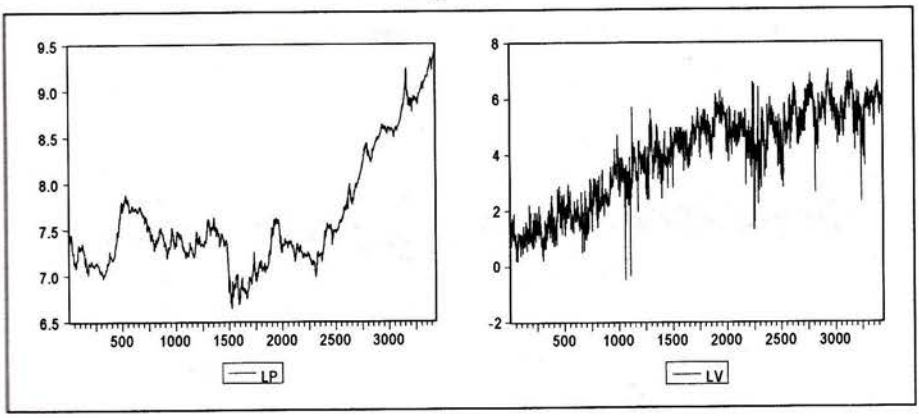

Figure 1 shows high frequency variation in prices and volume. To reduce this variation, the difference of log volume in trading volume and differences of log prices are taken. De-trended volume and prices are exhibited in Figure 2, which shows no trends in mean or variances; however, considerable persistence in prices and volumes is observed. The first daily autocorrelation of de-trended volume and price are about 0.371 and 0.083, and the fifth autocorrelation is 0.001 and 0.040, respectively.

To work with stationary time series of trading volume and stock return, the Phillips-Perron unit root test is used. Results are presented in Table 1, which shows that trading volume and return series are stationary at 1 percent level of significance. Table 2 summarizes the evidence on the first-day autocorrelation of the stock returns. For full sample period and each of the subsample periods, Table 2 shows the autocorrelation with a heteroskedasticity consistent standard errors, and R2 (1) statistics for regression of the one-day lead return on a constant and the return. The higher autocorrelation is observed in pre-reform period, which is 0.021 as compared to post-reform period, which is 0.001. It implies that financial reform has positive effect on Pakistan's stock-market performance. Similarly, the higher autocorrelation is observed before 9/11 events, (i.e., 0.017) as compared to after 9/11 events (i.e., 0.001). It implies that after 9/11, the performance of the stock market improved, which indicates that the capital inflows in Pakistan after 9/11 and that capital is invested through the Karachi stock market. A regression of the one-day lead return linked with the current return with five days of the dummies and has an R2 (2), which represent autocorrelation. The day-of-the-week dummies is significant and R2 (2) is greater than R2 (1) in a full-sample period as well as four subsample periods of the basic regression, which shows that the impact of day-of-the-week effect is larger in the Karachi Stock Exchange.

Figure 2

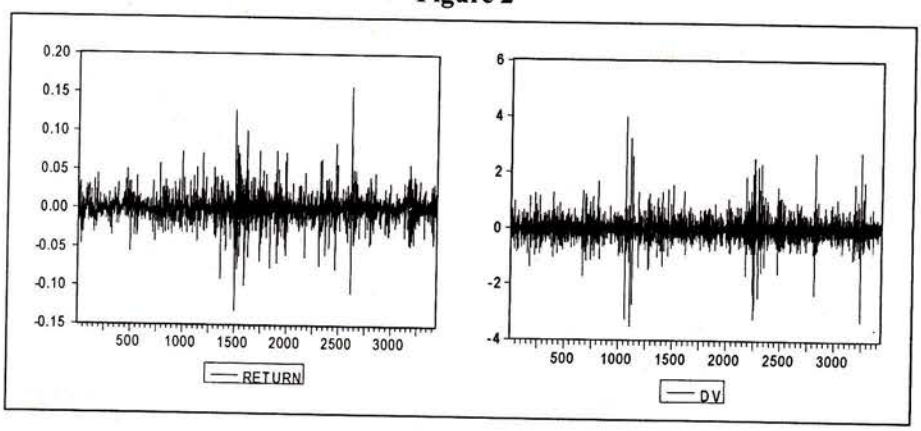

Table 1. Phillips-Perron unit root test

Variable	*PP test*	*Result*
Log of return	-54.55	Stationary
Difference of log volume	-114.73	Stationary

McKinnon critical values for rejection of hypothesis of a unit root at significant level of 1 percent = -3.43; 5 percent = -2.58; and 10 percent = -2.56

Table 2. First auto correlation of stock return

$$r_{t+1} = \alpha + \beta r_t \quad r_{t+1} = \alpha + \sum_{i=1}^{5} \beta D_i r_i$$

Sample period	*B*	*$R^2(1)$*	*$R^2(2)$*
DECEMBER 14, 1991, TO APRIL 21, 2006			
Coefficient	0.0826	0.0068	0.0185
Standard error	0.0170		
t-values	4.8602		
p-values	0.000		
(PRE-REFORMS) DECEMBER 14, 1991, TO DECEMBER 31, 2000			
Coefficient	0.1420	0.0201	0.0303
Standard error	0.0214		
t-values	6.6294		
p-values	0		
(POST-REFORM) JANUARY 01, 2001, TO APRIL 21, 2006			
Coefficient	-0.0331	0.0011	0.0237
Standard error	0.0277		
t-values	-1.19648		
p-values	0.2318		
(BEFORE 9/11) DECEMBER 14, 1991, TO SEPTEMBER 12, 2001			
Coefficient	0.1336	0.0178	0.0296
Standard error	0.0206		
t-values	6.4626		
p-values	0		
(AFTER 9/11) SEPTEMBER 13, 2001, TO APRIL 21, 2006			
Coefficient	-0.03194	0.0010	0.0214
Standard error	0.0297		
t-values	-1.0741		
p-values	0.283		

Table 3 shows the relationship between volume and the first-order autocorrelation of stock returns. One-day-lead stock returns on the current stock return are regressed with day-of-the-week dummies, volume, volume squared, and estimated conditional variance. For full-sample size, i.e., 1991 to 2006, 1.85 percent of the variance of the one-day-lead return has been explained by a regression on current return interacted with day-of-the-week dummies. However, it is noted that R2 increased by 9.7 percent when the regression one-day-lead returns regress with dummies and trading volume. The coefficient on the product volume and stock return is -0.080, with heteroskedasticity-consistent standard error of 0.043. The standard deviation of volume is 0.414. Thus, as we move from four standard deviations below the mean to four standard deviations above, the first-order autocorrelation of the stock return is reduced by 0.08. This result for volume is also compatible with volatility measured. The estimation of volatility is negative and significant with the volume incorporated. However, the nonlinear term of volume is insignificantly negative. Thus, for full sample size, there is no strong evidence for any specification than linear volume regression. The findings for four subsample periods are given in Table 3. As observed in pre-reforms period, the average first-order autocorrelation of the stock return is 0.142 (not given in table) and a regression of the one-day-lead return on the current return associated with day-of-the-week dummies are explained by 3.03 percent. With the incorporation of trading volume, current return explained one-day-lead return by 3.30 percent. These results are consistent with full sample period in four subsample periods. Volatility has no effect on post-reforms period as compared to pre-reforms periods. It is also noted that the performance of the Karachi Stock Exchange improved after 9/11 events because the effect of volatility is insignificant after 9/11 events.

Table 4 shows the second-order autocorrelation of return. As observed, the second-order autocorrelation of return is small but statistically significant. However, when day-of-the-week dummies are incorporated with current return, the R2 statistics of the regression is relatively higher. The same pattern is found in pre-reforms period and before 9/11 events. However, in post-reforms periods and after 9/11 events the autocorrelation of returns is statistically insignificant. Table 5 shows the volume and volatility effects on the second-order autocorrelation. The result shows a relatively weak value effect of volume and volatility on two-days lead returns as compared to the first autocorrelation. Over a full sample period, 1991-2006, it is found that the coefficient of volume and volume squared is 0.045 and 0.043, respectively, with the standard error of 0.044 and 0.037, respectively. This implies that the second-order autocorrelation increases with volumes. However, the result is statistically insignificant. In pre-reforms period and before 9/11 events the same trends are observed. However, the relationship is relatively weaker. In post-reforms period and after 9/11 events, no trends are observed in two-day stock returns and current stock returns, five-day dummy, volume, squared volume, and volatility.

Table 3. Volume volatility and first autocorrelation

$$r_{t+1} = \alpha_0 + \alpha_1 r_t + \sum_{i=1}^{5} \alpha_2 D_i r_i + \alpha_3 r_t V_t + \alpha_4 r_t V^2 + \alpha_5 r_t \sigma_i^2$$

	α_1	α_2	α_3	R^2
December 14, 1991, to April 21, 2006				
VOLUME				
Coefficient	-0.0800	-0.0228		0.020300
Standard error	0.0438	0.0368		
z- statistics	-1.8244	-0.6203		
P-values	0.0682	0.535		
VOLATILITY				
Coefficient			-48.79167	0.019617
Standard error			25.45227	
z- statistics			-1.916987	
P-values			0.0553	
VOLUME AND VOLATILITY				
Coefficient	-0.0819	-0.0225	-50.09052	0.021407
Standard error	0.0438	0.0368	25.4429	
z- statistics	-1.8673	-0.6121	-1.968742	
P-values	0.0619	0.5405	0.0491	
(Pre-reforms) December 14, 1991, to December31, 2000				
VOLUME				
Coefficient	-0.1439	0.0209		0.032940
Standard error	0.0672	0.0700		
z- statistics	-2.1414	0.2996		
P-values	0.0323	0.7645		
VOLATILITY				
Coefficient			-80.56372	0.033566
Standard error			30.15538	
z- statistics			-2.67162	
P-values			0.0076	
VOLUME AND VOLATILITY				
Coefficient	-0.1523	0.0249	-83.79761	0.036441
Standard error	0.0672	0.0699	30.15518	
z- statistics	-2.2667	0.3566	-2.778879	
P-values	0.0235	0.7214	0.0055	

Table 3. Volume volatility and first autocorrelation (continued)

	α_1	α_2	α_3	R^2
(Post-reform) January 01, 2001, To April 21, 2006				
VOLUME				
Coefficient	-0.064183	-0.0074		0.024975
Standard error	0.058691	0.0428		
z- statistics	-1.093579	-0.1749		
P-values	0.2743	0.8611		
VOLATILITY				
Coefficient			29.54661	0.023932
Standard error			54.05127	
z- statistics			0.546641	
P-values			0.5847	
VOLUME AND VOLATILITY				
Coefficient	-0.064905	-0.0084	32.82472	0.025324
Standard error	0.058693	0.0428	54.12383	
z- statistics	-1.10583	-0.1975	0.6064	
P-values	0.269	0.8434	0.5443	
(Before 9/11) December 14, 1991, to September 11, 2001				
VOLUME				
Coefficient	-0.12788	0.0231		0.0319
Standard error	0.0606	0.0587		
z- statistics	-2.1071	0.3951		
P-values	0.0352	0.6928		
VOLATILITY				
Coefficient			-72.624	0.0322
Standard error			29.3477	
z- statistics			-2.4746	
P-values			0.0134	
VOLUME AND VOLATILITY				
Coefficient	-0.1376	0.0169	-75.9480	0.0347
Standard error	0.0607	0.0593	29.3535	
z- statistics	-2.2656	0.2847	-2.5873	
P-values	0.0236	0.7759	0.0097	

Table 3. Volume volatility and first autocorrelation (continued)

	α_1	α_2	α_3	R^2
(After 9/11) September 12, 2001, to April 21, 2006				
VOLUME				
Coefficient	-0.0898	-0.0213		0.0253
Standard error	0.0647	0.0482		
z- statistics	-1.3873	-0.4429		
P-values	0.1656	0.6579		
VOLATILITY				
Coefficient			37.8759	0.0218
Standard error			57.2856	
z- statistics			0.6611	
P-values			0.5086	
VOLUME AND VOLATILITY				
Coefficient	-0.0792	-0.0136	43.4194	0.0239
Standard error	0.0645	0.0480	57.4258	
z- statistics	-1.2283	-0.2840	0.7560	
P-values	0.2196	0.7764	0.4498	

Table 4. Second autocorrelation of stock return

$$r_{t+2} = \alpha + \beta r_t \qquad r_{t+2} = \alpha + \sum_{i=1}^{5} \beta D_i r_i$$

Sample period	*B*	*$R^2(1)$*	*$R^2(2)$*
DECEMBER 14, 1991, TO APRIL 21, 2006			
Coefficient	0.061393	0.003769	0.012276
Standard error	0.01704		
t-values	3.602881		
p-values	0.0003		
(PRE-REFORMS) DECEMBER 14, 1991, TO DECEMBER 31, 2000			
Coefficient	0.085775	0.007358	0.030323
Standard error	0.021577		
t-values	3.97525		
p-values	0.0001		
(POST-REFORM) JANUARY 01, 2001, TO APRIL 21, 2006			
Coefficient	0.010401	0.000108	0.010301
Standard error	0.027767		
t-values	0.374582		
p-values	0.708		

Table 4. Second autocorrelation of stock return (continued)

Sample period	*B*	$R^2(1)$	$R^2(2)$
(BEFORE 9/11) DECEMBER 14, 1991, TO SEPTEMBER 12, 2001			
Coefficient	0.080976	0.006541	0.022191
Standard error	0.020804		
t-values	3.892272		
p-values	0.0001		
(AFTER 9/11) SEPTEMBER 13, 2001, TO APRIL 21, 2006			
Coefficient	0.010938	0.000120	0.011872
Standard error	0.029685		
t-values	0.368458		
p-values	0.7126		

4. Summary and concluding remarks

This study investigates the relationship between aggregate stock-market trading volume and serial correlation of daily stock returns during the period between December 1991 and April 2006, with pre-reforms period (December 14, 1991, to December 31, 2000), post-reforms period (January 01, 2001, to April 2006), before 9/11 events (December 14, 1991, to September 10, 2001), and after 9/11 events (September 10, 2001, to April 21, 2006). The results indicate the first-order positive autocorrelation between future returns and present returns. The correlation becomes negative when returns are weighted by a change in the trading volume. This implies that the non-informational trade has a significant effect on prices and trading activity has explanatory power in addition to present returns, nonlinear volume, and volatility. It infers that the 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 pattern is found in pre-reforms period and before 9/11 events. The weak and insignificant result is found in post-reforms period and after 9/11 events. It concludes that the addition of post-reforms period after 9/11 events has led to a stronger evidence for volume effect on first-order auto correlation. The second-order autocorrelation is positive and weak compared to first autocorrelation. However, it is positive when it relates to trading volume in the entire sample period and four subsample periods. It implies that the role of information is effective after two days, and non-informational role is less effective.

Table 5. Volume volatility and first autocorrelation

$$r_{t+2} = \alpha + \sum_{i=1}^{5} \beta_i D_i r_t + \gamma_1 V_t r_t + \gamma_2 V_t^2 r_t + \gamma_3 \sigma_i^2 r_t$$

	γ_1	γ_2	γ_3	R^2
December 14, 1991, to April 21, 2006				
VOLUME				
Coefficient	0.045654	0.043803		0.013600
Standard error	0.044041	0.037027		
z- statistics	1.036623	1.18298		
P-values	0.3	0.2369		
VOLATILITY				
Coefficient			-61.26217	0.013933
Standard error			25.5297	
z- statistics			-2.399643	
P-values			0.0165	
VOLUME AND VOLATILITY				
Coefficient	0.043402	0.044181	-60.41278	0.015211
Standard error	0.044021	0.037003	25.52709	
z- statistics	0.985937	1.19399	-2.366614	
P-values	0.3242	0.2326	0.018	
(Pre-Reforms) December 14, 1991, to December 31, 2000				
VOLUME				
Coefficient	0.102324	-0.036434		0.025386
Standard error	0.067503	0.070346		
z- statistics	1.515849	-0.517934		
P-values	0.1297	0.6046		
VOLATILITY				
Coefficient			-61.98174	0.026180
Standard error			30.27056	
z- statistics			-2.047591	
P-values			0.0407	
VOLUME AND VOLATILITY				
Coefficient	0.096356	-0.0336	-59.98719	0.027180
Standard error	0.067524	0.070312	30.29992	
z- statistics	1.426995	-0.477867	-1.979781	
P-values	0.1537	0.6328	0.0479	

Table 5. Volume volatility and first autocorrelation (continued)

	γ_1	γ_2	γ_3	R^2
(Post-Reform) January 01, 2001, to April 21, 2006				
VOLUME				
Coefficient	-0.005156	0.082118		0.013535
Standard error	0.059058	0.043111		
z- statistics	-0.087307	1.904779		
P-values	0.9304	0.057		
VOLATILITY				
Coefficient			-3.44602	0.010300
Standard error			54.44915	
z- statistics			-0.063289	
P-values			0.9495	
VOLUME AND VOLATILITY				
Coefficient	-0.004958	0.082419	-9.380813	0.013558
Standard error	0.059092	0.043163	54.49025	
z- statistics	-0.083909	1.909484	-0.172156	
P-values	0.9331	0.0564	0.8633	
(Before 9/11) December 14, 1991, to September 11, 2001				
VOLUME				
Coefficient	0.102563	0.003699		0.025570
Standard error	0.061136	0.059138		
z- statistics	1.677627	0.06255		
P-values	0.0936	0.9501		
VOLATILITY				
Coefficient			-63.62155	0.025866
Standard error			29.51781	
z- statistics			-2.155362	
P-values			0.0312	
VOLUME AND VOLATILITY				
Coefficient	0.085924	-0.028641	-55.86143	0.024693
Standard error	0.061093	0.059711	29.51171	
z- statistics	1.406453	-0.479651	-1.892857	
P-values	0.1597	0.6315	0.0585	

Table 5. Volume volatility and first autocorrelation (continued)

	γ_1	γ_2	γ_3	R^2
(After 9/11) September 12, 2001, to April 21, 2006				
VOLUME				
Coefficient	-0.027179	0.101006		0.016027
Standard error	0.064713	0.048214		
z- statistics	-0.419993	2.094969		
P-values	0.6746	0.0364		
VOLATILITY				
Coefficient			16.79719	0.009589
Standard error			57.21961	
z- statistics			0.293556	
P-values			0.7692	
VOLUME AND VOLATILITY				
Coefficient	-0.027115	0.101093	-2.167482	0.016029
Standard error	0.064764	0.04829	57.65905	
z- statistics	-0.418673	2.093433	-0.037591	
P-values	0.6755	0.0365	0.97	

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