International Review of Business Research Papers
Vol. 9. No. 5. September 2013 Issue. Pp. 154 – 168

Feedback Trading Behavior in Dhaka Stock Exchange (DSE), Bangladesh

Abu Taher Mollik[1] and M Khokan Bepari[2]

This paper empirically tests the autocorrelation structure in return series of Dhaka Stock Exchange (DSE) in the framework of feedback trading behavior of noise traders. The daily return series of DSE General Index and DSE 20 Index have been used to capture the effect of non-synchronous trading and the effect of feedback trading. While DSE General return series is expected to have high non-synchronous trading induced autocorrelation, DSE 20 return series is expected to show a high feedback trading led autocorrelation. The results support for the existence of positive feedback trading in DSE. However, feedback trading does not have asymmetric effect on DSE return series in up and down market, suggesting that bad news and good news do not have differential effect on the conditional variance of DSE return series. Thus linking the observed autocorrelation structure in return series to feedback trading behavior of irrational investors, this study concludes that the return autocorrelation and the inefficiency in DSE do not imply abnormal profit opportunities. It has important implications for other inefficient and emerging markets in that inefficiency in the form of return predictability in those markets may not imply abnormal profit opportunities.

Field of Research: Finance

JEL Classification: G11; G12; G14; G15; N25; O53

Keywords: Dhaka Stock Exchange; Return autocorrelation; Feedback trading; Asymmetric GARCH model; Positive feedback trading.

1. Introduction

This paper investigates the autocorrelation structures of DSE return series in the framework of feedback trading hypothesis. Feedback trading means trading based on historical data, while positive feedback trading implies “buy when prices rise; sell when they fall” and negative feedback trading means “sell when prices rise; buy when they fall”. Positive feedback traders reinforce price movements such that prices will continually overshoot the levels suggested by fundamental company information. Market corrects, as is argued by Dean and Faff (2008), for this over-reaction in the following days and prices tend to move in the opposite direction inducing negative autocorrelation. Thus the presence of a large number of feedback traders in the stock market is reflected in the autocorrelation of returns. Feedback trading results in excess volatility which destabilizes stock prices (DeLong, Shleifer, Summers, and Waldmann 1990) and induces return

---

[1]Discipline of Accounting, Banking and Finance, Faculty of Business, Government and Law, University of Canberra, Building 11, Room: C17, Email:abumollik@yahoo.com.au, abu.mollik@canberra.edu.au
[2]Faculty of Business,Government and Law, University of Canberra, Australia, Email: khokan552@yahoo.com; Khokan.Bepari@canberra.edu.au

predictability (Bohl and Reitz 2004) via higher level of autocorrelation. However, this feedback trading induced return predictability does not imply abnormal profit opportunities because higher volatility associated with feedback trading 'makes it harder for rational risk averse investors to exploit the predictable pattern of stock prices' (Koutmos 1997).

Characterized by a smaller number of investors, lower level liquidity, and a high level of volatility, Dhaka Stock Exchange (DSE) is found to be inefficient in weak form (Mobarek & Keasey 2000). Significant level of autocorrelation has been found in the DSE return series. What are the plausible causes of the observed autocorrelation structure in DSE return series? Is it induced by feedback trading behavior of irrational investors? This study addresses these issues. The motivation of the study is to investigate the underlying causes of autocorrelation structure in DSE. Linking the observed autocorrelation structure in return series to feedback trading behavior of irrational investor, the study concludes that return autocorrelation and inefficiency in DSE does not imply abnormal profit opportunities. Thus the present paper contributes to the literature by providing a new explanation of the inefficiency in an emerging stock market.

This paper is organized as follows. Section two provides a review of literature. Section three provides an introduction to the microstructure of DSE while section four explains the empirical models and findings of the study. Section five concludes the paper.

2. Literature Review

Finance literature explains the autocorrelation structures in the stock return from various perspectives. Boudoukh, Richardson, Whitelaw (1994) summarizes these hypotheses into three basic schools of thought. Loyalists assume an efficient stock market and put forward the concept of non-synchronous trading (Fisher, 1966; Lo and MacKinlay 1990)[i] and transaction cost (Mech, 1993, and Cohen 1980) as reasons for return autocorrelation. Non-synchronous trading assumes that the new information is reflected in highly traded stock prices earlier than in thinly traded stock prices. Once new information affects highly traded stock prices, a time lag occurs when the thinly traded stock prices are affected resulting in the autocorrelation. However, various studies suggest that non-synchronous trading and transaction costs are not sufficient to fully explain the autocorrelation in stock returns (Berlung & Liljeblom 1998; and Pierdzioch & Schertler 2005). Revisionists also assume efficient market and suggest time varying risk premia as the reasons for autocorrelation in index returns. Time varying risk premia is based on the notion that aggregate level of risk is mean reverting but unobservable. An important property of time varying risk premia is that return and return autocorrelations should be consistent and visible in all assets. In periods of high trading volume, investors' estimate of the market risk aversion is more accurate and thus the autocorrelation in the stock return is reduced. However, Safvenblad (1997) observed that this time varying risk premia is more visible in long term expected return than short term one. Heretics**,** is against the validity of efficient market hypothesis. In terms of behavioral finance, they assume the psychological factors to be responsible for autocorrelation in stock returns. Some investors seek trends in past stock prices and base their portfolio decisions on the expectation that such trends will persist. In terms of behavioral finance, this type of investors is usually called a noise trader or a feedback trader. Feedback trading includes trading strategies like profit taking and herding. A distinction is, however, made between positive and negative feedback trading. If large number of traders implements the feedback trading strategy, current stock prices become related to previous prices resulting in autocorrelation in the index returns. Positive feedback trading should result in the negative autocorrelation of returns because it gives rise to a short-run overreaction of stock market prices to new information. Negative feedback trading, in contrast, should result in the positive autocorrelation of returns (Sentana and Wadhwani 1992).

A number of studies have investigated the positive feedback trading and stock return autocorrelation in different stock markets. Sentana and Wadhwani (1992) find existence of positive feedback trading in the US market. They also find that the effect of feedback trading on return autocorrelation is more pronounced in down market than in up market. Koutmos (1997), on the contrary, investigating stock market indices of six developed countries (Australia, Belgium, Germany, Italy, Japan, UK), concludes that the positive feedback trading causes negative autocorrelation in stock returns. Koutmos and Saidi (2001) investigate six emerging Asian stock markets viz. Hong Kong, Malaysia, Philippines, Singapore, Taiwan, and Thailand. They find that the negative innovations influence on volatility more than the positive ones (leverage effect). Bohl and Reitz (2002) show strong evidence of leverage effect in German market. Altay (2006) examines the autocorrelation structure in Istanbul Stock Exchange, and finds evidence of positive feedback trading which is more pronounced in down market than in up market. On the contrary, Koutmos, Pericli and Trigeorgis (2006) document positive feedback trading in the Cyprus Stock Exchange, with little evidence that market declines are followed with higher volatility than market advances, the so-called 'leverage effect', that has been observed in almost all developed stock markets.

Bohl and Siklos (2004) study the feedback trading behavior in emerging markets (Czech Republic, Hungary, Poland & Russia) and in mature markets (Germany, UK and the USA). Their results suggest that positive and negative feedback trading strategies exist in both types of markets but are more pronounced in emerging stock markets than in mature markets. Hence, non-fundamental trading strategies seem to play a more important role in emerging markets than in mature stock markets.

Bohl and Siklos (2005), based on daily data on the Dow Jones Industrial Average index from 1915 to 2004, investigate the trading behavior during stock market downturn and find that there is evidence of positive feedback trading during episodes of stock market crashes. They attribute the stock market crash to feedback trading.

Nofsinger and Sias (1999) study feedback trading behavior of institutional investors versus individual investors and find that either institutional investors positive-feedback trade more than individual investors or institutional herding impacts prices more than herding by individual investors. Kallinterakis and Ferreira (2006), using data from the Portuguese PSI- 20 market index, test for herding and positive feedback trading and find the presence of statistically significant herding and positive feedback trading. They also conclude that herding tends to rise when the market exhibits a definitive direction and tends to decline when the market experiences fluctuations.

Therefore, empirical literature, to date, provides evidence that feedback trading is more pronounced in emerging markets than in developed markets, while the evidence on leverage effect of feedback trading is inconclusive in the emerging markets. The present study investigates the issues of feedback trading and leverage effects in DSE in an attempt to provide further evidence on emerging market.

3. Market Micro-Structure of DSE

The DSE is a small capital market. All the listed companies are divided into 17 sectors. In the total market capitalization, share of the largest 5 sectors (banks, fuel and power, pharmaceuticals, insurance and investment) is 74.72 percent while the banking sector alone constitutes 32.85 percent. The micro-structure of DSE is also characterized by limited provision of information of firm's performance to market participants as most of the firms fail to hold regular annual general meetings and to provide audited financial statements on time to its shareholders. Moreover, there is a lack of professional financial community who can analyze stock market data for the investors. The processing of new information in DSE is rather weak, due to persistence of a large number of non-active instruments, limited role of mutual funds and lack of professionally managed pension fund and limited number of investment and broker houses. Because of these microstructure biases, DSE return series may have non-synchronous trading induced autocorrelation which may limit our investigation of feedback trading induced autocorrelation. To solve this problem, we use DSE 20 return series consisting of the most frequently traded 20 blue chips companies of DSE, which should not have significant non-synchronous trading effect.

4. Data and Research Findings

The DSE General daily price index (consisting of all shares in DSE) and DSE 20 price index (blue chips companies) for the period of 1 January, 2001 to 31 December, 2007 are analyzed. This period is selected because during this period there was no abnormal market crash or market rise in DSE which allows us to examine more accurately the feedback traders induced autocorrelation in DSE. The natural log of the relative price is computed for the daily intervals to produce a time series of continuously compounded returns,

R_t, which is the one period return in period t, is therefore measured as

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

Descriptive statistics for the DSE Gen and DSE 20 daily returns are shown in Table 1. Both series have negative skewness, and kurtosis greater than 3, suggesting a long left tailed and leptokurtic distribution. The distributions of the return series do not follow normal distribution. The Jarque-Bera tests also reject the null hypothesis of normality of the return series.

Table 1: Descriptive statistics

Statistics	DSE Gen	DSE 20
Mean	0.00082	0.00034
Maximum	0.05760	0.06410
Minimum	-0.07360	-0.07470
Std. Dev.	0.010492	0.011070
Skewness	-.164	-.092
Kurtosis	5.118	5.634
Jarque-Bera	1699.676***	2406.929***
Probability	0.0000	0.0000
Ljung-box Q statistics (1)	27.410***	33.665***
Ljung-box Q statistics (15)	50.064***	65.628***
Ljung-box Q statistics^2(15)	78.039***	89.537***

***Significant at 1 % level

Rejection of normality can be partially attributed to temporal dependencies in the moments of the series especially second-moment temporal dependencies. It is common to test for such dependencies using the Ljung–Box (LB) test statistics (Bollerslev, Engle, and Nelson 1994). The Ljung–Box (LB) test statistics applied to returns (testing for first moment dependencies) and squared returns (testing for second moment dependencies) are provided. The hypothesis that all autocorrelations up to 15th lags are jointly zero is rejected for both the returns and the squared returns in both the return series.

This provides evidence of temporal dependencies in the first moment of the distribution of returns, due to, perhaps non-synchronous trading or market inefficiencies. Autocorrelation of the squared returns provides evidence of time-varying second moments. However, the LB-statistic is not capable of detecting any sign reversals in the autocorrelations due to positive feedback trading. It also fails to explain whether volatility and autocorrelation are linked because of the presence of positive feedback trading. It simply provides an indication that first-moment and second moment dependencies are present and justifies the use of ARCH-type specification for the variance.

Table 2: Autocorrelation estimation of GARCH (1, 1) model

Parameters	DSE Gen	DSE 20
	$R_t = \alpha + \rho R_{t-1} + \epsilon_t$	
α	0.0003*	-0.0002
p-value	0.0840	0.3569
ρ	0.1864***	0.2053***
p-value	0.0000	0.0000
	$\sigma^2_t = \omega + \delta_0\varepsilon^2_{t-1} + \delta_1\sigma^2_{t-1} + \mu_t$	
ω	1.02E-06***	9.19E – 06***
p-value	0.0001	0.0000
δ_0	0.1734***	0.2221***
p-value	0.0000	0.0000
δ_1	0.8362***	0.7146***
p-value	0.0000	0.0000
Durbin-Watson stat.	2.0862	2.1207
F statistics	5.1729	5.4404
Log likelihood	5209.091	5905.492
Akaike info criterion	-6.5574	-6.4601
Schwarz criterion	-6.5326	-6.4214

Significant at 1 % level; ** Significant at 10% level.

GARCH (1, 1) model parameter estimations (Table 2) of daily returns present statistically significant one-day lagged autocorrelations for both the DSE Gen and DSE 20 index return series. One day lagged autocorrelation parameter (ρ) for both the indices are positive and statistically significant at 1 percent level. These findings can be considered as evidence in favour of non-synchronous trading and/or feedback trading hypothesis. As is explained in Cambell, Lo and MacKinlay (1997), non-synchronous trading would imply positive autocorrelation in index returns, and we observe positive autocorrelation in Dhaka stock exchange. However, at this point, the evidence is not clear as to whether non-synchronous trading or feedback trading is the cause of autocorrelation in return series. One indication at this point might be that the autocorrelation of DSE 20 return series is greater than that of DSE General return series. Given that DSE 20 index is supposed to be less influenced by non-synchronous trading it should have lower magnitude of autocorrelation than that of DSE General Index. Thus there might have other causes behind the observed autocorrelation. Dividing the total autocorrelation into two parts; constant autocorrelation and autocorrelation depending on the volatility of returns may provide information about the reasons for the autocorrelation.

Shiller-Sentana-Wadhwani (SSW) model is widely applied in finance literature[ii] to divide the total autocorrelation into two parts; constant autocorrelation and autocorrelation depending on the volatility of returns. The model has a testable implication that during periods of low volatility returns are positively autocorrelated and during periods of high volatility return autocorrelation turns negative. The reversal in the sign of return autocorrelation is consistent with the presence of positive feedback traders in the stock market. The model has two inbuilt autocorrelation parameters that help to capture effect of feedback trading.[iii] We use this specific characteristic to provide empirical evidence on the presence of positive feedback traders in DSE. Asymmetric GARCH models are combined with SSW (Shiller 1984; Sentana and Wadhwani 1992) theoretical model that provides a testable implication for feedback trading. The model and the empirical results are provided in table 3.[iv]

In the model, impact of feedback trader in the autocorrelation structure of return series are given by the signs of γ_1 and γ_2. Following Sentana and Wadhwani (1992), negative feedback trading dominates at low volatility levels and positive feedback trading dominates at high levels of volatility. When the volatility is zero, the autocorrelation is captured by the coefficient of y_1. As the volatility rises, the autocorrelation is captured by the coefficient of $y_1 + y_2$. Negative feedback trading results in positively autocorrelated stock returns and positive feedback trading results in negatively autocorrelated stock returns. The sign of the autocorrelation will be determined by the type of the feedback trading prevalent among the feedback traders.

While the statistically significant autocorrelation coefficient γ_1 (constant part of the autocorrelation coefficient) may provide evidence of feedback trading and /or non-synchronous trading, the statistically significant negative γ_2 parameters for both the return series singles out feedback trading as the cause of return autocorrelation and at the same time rejects the effect of non-synchronous trading and time varying risk premia on the auto-correlation coefficient. Period of high volatility is also period of high trading volume. Thus, in the period of high volatility, the effect of non-synchronous trading should be small. Any increase in autocorrelation (in absolute terms) or its sign reversal from positive to negative one should be attributed to feedback trading. 'Models of non-synchronous trading do not usually predict negative autocorrelation in index returns' (Sentana and Wadhwani 1992). Negative autocorrelation in returns series suggests positive feedback trading, which increases with the increase in volatility. Negative and statistically significant γ_2 parameter in the daily return series for both the indices is an important evidence of positive feedback trading in DSE. This is further confirmed by the fact that DSE 20 return series shows similar autocorrelation structure which is unexpected in case of a highly liquid. As non-synchronous trading should not affect the autocorrelation structure of the highly liquid DSE 20 return series, a similar autocorrelation structure in both the indices reinforces the existence of positive feedback trading in DSE. The sign of γ_3 parameter indicates the asymmetry of feedback trading in up and down markets. A statistically significant positive γ_3 coefficient implies a stronger feedback effect in down market while a negative γ_3 coefficient implies a stronger feedback effect in the up market. While the γ_3 parameter estimates for the return series are positive, it is significant only in case of DSE 20. These findings suggest that feedback trading has symmetric effect on DSE General return series in both up and down market and asymmetric effect on DSE 20 return series with a greater effect in the down market relative to the up market. The differential effect of feedback trading in two return series can be rationalized based on the fact that DSE 20 index is highly liquid and more frequently traded. Given that DSE 20 index constitutes of securities with high level of market capitalization and high level of liquidity, risk averse investors are highly exposed to risk in down market and they off load these securities quickly in herding.

Table 3: Parameter estimations of Koutmos version of SSW- GARCH (1,1) model for testing feedback trading hypothesis

Parameters	DSE Gen	DSE 20
$R_t = \alpha + \gamma_0 (\sigma^2_t) - (\gamma_1 + \gamma_2 \sigma^2_t) R_{t-1} + \gamma_3 \lvert R_{t-1} \rvert + \epsilon_t$		
α	-0.0001	-0.0011***
p-value	0.5590	0.0001
γ_0	3.3981	1.3803
p-value	0.3764	0.7669
γ_1	0.2425***	0.2846***
p-value	0.0000	0.0000
γ_2	-365.1448**	-389.6968***
p-value	0.0212	0.0002
γ_3	0.0538	0.1538***
p-value	0.1825	0.0007
$\sigma^2_t = \omega + \delta_0 \varepsilon^2_{t-1} + \delta_1 \sigma^2_{t-1} + \mu_t$		
ω	1.03E-06***	8.66E-06***
p-value	0.0000	0.0000
δ_0	0.1726***	0.2221***
p-value	0.0000	0.0000
δ_1	0.8368****	0.7195***
p-value	0.0000	0.0000
Durbin-Watson stat.	1.9672	1.9789
F statistics	7.2836	12.1344
Log likelihood	5217.439	5923.475
Akaike info criterion	-6.5594	-6.4702
Schwarz criterion	-6.5332	-6.4536

***Significant at 1 % level; **Significant at 5% level.

For both DSE Gen and DSE20 return series, ω, δ_0 and δ_1 parameters in the conditional variance equation are statistically significant at 1 percent level which means the conditional variance is affected by the last information arrival into the market as well as one day lagged conditional variance. In the mean equation, coefficient γ_0, a measure of impact of the rational investors on returns, is not statistically significant for both the return series. It implies that the conditional variances (σ^2_t) do not have statistically significant effect on index returns and thus investors are not compensated, in the CAPM framework, with higher return for taking higher risk in DSE. When the expected volatility rises, rational investors influence prices negatively, and in such a case γ_0 would be negative. Our results reveal just the opposite. Statistically significant positive γ_0 for both the return series in our analysis would, therefore, suggest the lack of rational traders' influence on prices during volatility changes.

Table 4: Parameter estimation of MG-GARCH (1, 1) model

Parameters	DSE Gen	DSE 20
$R_t = \gamma_0 \frac{R_{t-\tau}}{1+R^c_{t-\tau}} - \gamma_1 R_{t-1} + \epsilon_t$ (c=2 and τ=1)		
γ_0	169.9216***	146.1155***
p-value	0.0037	0.0000
γ_1	-169.6712***	-145.8385***
p-value	0.0037	0.0000
$\sigma^2_t = \omega + \delta_0\varepsilon^2_{t-1} + \delta_1\sigma^2_{t-1} + \mu_t$		
ω	9.61E-07***	8.09E-06***
p-value	0.0000	0.0000
δ_0	0.1660***	0.2164***
p-value	0.0000	0.0000
δ_1	0.8427***	0.727821***
p-value	0.0000	0.0000
Akaike info criterion	-6.677054	-6.4642
Schwarz criterion	-6.659917	-6.4491
Durbin-Watson stat.	1.9282	1.9954
Log likelihood	5219.779	5916.514

***Significant at 1 % level

Taking the complex behavior in stock markets into account, it is more robust than the traditional stochastic approach to model the observed data by a nonlinear chaotic model disturbed by dynamic noise (Kyrtsou and Terraza 2003). Following Kyrtsou (2005) and Kyrtsou and Serletis (2006) we employ a Mackey-Glass-GARCH (MG-GARCH) process model to confirm the existence of feedback trading. The model has either negligible or zero autocorrelations in the conditional mean, and a rich structure in the conditional variance. This model also permits to capture volatility-clustering phenomena, which is treated as an endogenous process. The optimal c and τ are chosen on the basis of Log Likelihood and Schwarz criteria. In this case c=2 and τ=1 are selected. The main characteristic of the non-linear trading strategy in the mean equation of the above model is that it can take into account dynamics produced by both positive and negative feedback traders. The coefficients γ_0 and γ_1 vary over time. If $\gamma_0 + \gamma_1 > 0$, we observe positive feedback behavior, while $\gamma_0+\gamma_1<0$ reveals negative feedback (Kyrtsou and Labys 2007). Its advantage over simple GARCH and AR-GARCH alternatives has been shown in Kyrtsou and Terraza (2003).

The results are reported in Table 4. For both the indices, $\gamma_0 > 0$ and $\gamma_1 <0$. Both the parameters are statistically significant. Besides, $\gamma_0 + \gamma_1 >0$ for both the indices. These findings support the existence of positive feedback trading in DSE. All the parameters in the variance equations are statistically significant and the sum of the ARCH coefficient and the GARCH coefficient is close to one for both of the return series, implying volatility clustering and persistence.

Asymmetric response to shocks is made explicit in Nelson's (1991) Exponential GARCH (EGARCH) model. It allows volatility to respond more rapidly to falls in the market than to corresponding rises which is an important stylized fact for financial assets and is known as leverage effect. We employ EGARCH model to test the robustness of leveraged effect captured in Koutmos version of SSW-GARCH model. The estimated results are reported in Table 5.

Bohl and Siklos (2004), constructed a TGARCH (1,1) model, along with the SSW model, which differentiates the effect of good news and bad news on conditional variance and provides the opportunity to test the feedback trading behavior after the good news and bad news enter the market. We employ TGARCH model to test the robustness of leveraged effect captured in Koutmos version of SSW-GARCH model. In the model I_{t-1} is the news entering in the market in time t-1 and the effect of good news ($\epsilon_{t-1} \geq 0$) on the conditional variance is δ_0, and the effect of bad news ($\epsilon_{t-1}<0$) is ($\delta_0 + \delta_1$). This means that a statistically significant δ_1 coefficient is evidence in favor of asymmetric effect of good news and bad news on conditional variances. The estimated results are reported in Table 6.

The findings also support the result of the Koutmos version of SSW- GARCH (1, 1) model. The γ_0 parameter which implies the effect of conditional volatility on index returns is statistically insignificant for DSE Gen under both the methods. Although, the γ_0 parameter is statistically significant for DSE 20 return series under both the model, its sign is positive. When the expected volatility rises, rational investors influence prices negatively, γ_0 is expected to be negative .Our results reveal just the opposite. Statistically significant positive γ_0 for both the return series in our analysis would, therefore, suggest the lack of rational traders' influence on prices during volatility changes. Hence, the findings of our analysis may be interpreted to mean that the rational traders do not influence prices when the volatility changes in DSE. Statistically significant (at 1 percent significant level) γ_1 parameters and their positive sign for both the return series indicate positive autocorrelation arising from non-synchronous trading. Whereas the statistically significant γ_2 parameters (at 10 percent level for DSE Gen, and at 1 percent level for DSE 20) and their negative signs for both the return series imply the existence of positive feedback trading in DSE. Hence, positive feedback trading is an important reason of short-term movements in DSE. Positive feedback traders cause negative autocorrelation in returns and, as a result, higher predictability of returns which may imply weak form of efficiency in DSE. However, it does not imply abnormal profit opportunity because 'higher predictability arising from higher serial correlation is still compatible with equilibrium' (Sentana and Wadhwani, 1992) because 'higher volatility (risk) makes it harder for rational risk averse investors to exploit the predictable pattern of stock prices' (Koutmos, 1997). This argument may be supported further by our findings that rational traders do not influence prices when the volatility rises in DSE (implied by insignificant γ_0 parameter).

Table 5: Parameter estimation of SSW –EGARCH (1, 1) model

$R_t = α+ μ (σ^2_t) - (\gamma_0 + \gamma_1 σ^2_t) R_{t-1} + ϵ_t$

$$\ln(\sigma^2_t) = \omega + \delta_0 \left|\frac{\varepsilon_{t-1}}{\sigma_{t-1}}\right| + \delta_1 (\frac{\varepsilon_{t-1}}{\sigma_{t-1}}) + \delta_2 \ln \sigma^2_{t-1}$$

	SSW-EGARCH(1,1)	
Parameters	DSE Gen	DSE 20
α	-3.12E-05	-0.0010***
p-value	0.8770	0.0016
γ_0	5.9675	10.2386***
p-value	0.1266	0.0005
γ_1	0.2506***	-0.2780***
p-value	0.0000	0.0000
γ_2	-388.4171***	379.6216***
p-value	0.0017	0.0057
ω	-0.5376***	-1.0798***
p-value	0.0000	0.0000
δ_0	0.3169***	0.3698***
p-value	0.0000	0.0000
δ_1	0.0017	0.0274
p-value	0.8786	0.4977
δ_2	0.9688***	0.9131***
p-value	0.0000	0.0000
$\delta_0 + \delta_2$	1.28	1.28
Akaike info criterion	-6.6702	-6.4721
Schwarz criterion	-6.6428	-6.4480
Durbin-Watson stat.	1.9588	1.9624
F statistics	6.8260	10.8672
Log likelihood	5217.417	5926.769

***Significant at 1 % level.

In the conditional variance equation, parameters $\delta_0 + \delta_2$ is close to one in case of TGARCH while in case of EGARCH the sum is greater than one. Thus volatility is persistent. The parameter which is of greater importance at this point is δ_1 which shows the asymmetric effect of information on conditional variance. A statistically significant and positive δ_1 parameter in case of TGARCH model implies leverage effect in the market. In other words, bad news has greater influence on the conditional variance than good news. In case of EGARCH model, the leverage effect to be positive δ_1 should be negative and statistically significant. In our analysis, δ_1 parameter is not statistically significant and does not have the expected sign for both DSE Gen and DSE 20 return series under both the models. All the parameters in variance equation are positive (for TGARCH model), thus non-negativity restriction of conditional variance is fulfilled ($\delta_0 + \delta_1$) / δ_0 is positive but not significantly high). For both indices $\delta_0 > \delta_1$. These findings may be interpreted to mean that there is no leverage effect in DSE return series, thereby, bad news and good news has the same magnitude of impact. Statistically significant and positive δ_2 parameters for both the indices under EGARCH model indicate a high level of volatility clustering, implying that the positive stock price changes are associated with further positive changes and vice versa.

The validity of these empirical findings depends on the correct specification of the model. A minimum requirement is that the standardized residuals are zero-mean and unit-variance i.i.d. processes. Correct specification of the models are ensured by diagnostic checking of conditional variance equations in order to test the hypothesis that the normalized estimated residuals are i.i.d. GARCH models are estimated using robust standard errors under the assumption of normality. The LB-Q statistics are not significant for up to 15 lags of squared standard error for all the specifications, thus the residuals of the estimated models are white noise with no serial dependence. Lagrange multiplier (LM) test for the presence of ARCH effect in the residuals reveals no such effect for the models used. Thus the residuals do not exhibit conditional autoregressive heteroskedasticity. All the models are correctly specified.

Thus considering SSW-GARCH models and MG- GARCH models together, this study concludes that positive feedback trading exists in DSE. All the models are in broad agreement with the findings that bad news and good news does not have asymmetric impact on the conditional variance and thereby the feedback trading has the same effect on DSE return series in both up and down markets. These findings are consistent with the findings of Koutmos, Pericli and Trigeorgis (2006) wherein positive feedback trading is documented in an emerging market, the Cyprus Stock Exchange, with little evidence of asymmetric feedback trading in up and down markets.

Table 6: Parameter estimation of SSW-TARCH (1,1) and SSW –EGARCH(1,1) model

$$R_t = \alpha + \mu(\sigma^2_t) - (\gamma_0 + \gamma_1 \sigma^2_t) R_{t-1} + \epsilon_t$$

$$\sigma^2_t = \omega + \delta_0 \varepsilon^2_{t-1} + \delta_1 I_{t-1} \varepsilon^2_{t-1} + \delta_2 \sigma^2_{t-1} + \mu_t, \quad I_{t-1} = \begin{cases} 1, \text{ if } \epsilon_{t-1} < 0 \\ 0, \text{ if } \epsilon_{t-1} \geq 0 \end{cases}$$

	SSW-TGARCH(1,1)	
Parameters	DSE Gen	DSE 20
α	0.0005***	-0.0008**
p-value	0.0031	0.0129
γ_0	3.2400	9.0099***
p-value	0.2572	0.0086
γ_1	-0.1980***	0.2807***
p-value	0.0000	0.0000
γ_2	266.5684*	-393.9232***
p-value	0.0677	0.0001
ω	7.80E-07	8.20E-06***
p-value	0.5753	0.0000
δ_0	0.1984***	0.2326***
p-value	0.0000	0.0000
δ_1	0.0253	-0.0426
p-value	0.2593	0.1392
δ_2	0.7930***	0.7325***
p-value	0.0000	0.0000
$(\delta_0+\delta_1) / \delta_0$	1.13	0.82
$\delta_0 + \delta_2$	0.99	0.97
Akaike info criterion	-6.5894	-6.4805
Schwarz criterion	-6.5632	-6.4437
Durbin-Watson stat.	1.9392	1.9622
F statistics	7.0692	11.0559
Log likelihood	5197.003	5918.598

***Significant at 1 % level; ** Significant at 5% level; * Significant at 10% level

5. Conclusions

This paper examines the auto correlation structure of DSE return series in the framework of behavioral finance to test the feedback trading hypothesis. The findings imply significant autocorrelation in the DSE return series which is supportive of positive feedback trading. Additional analysis reveals that bad news and good news has the same magnitude of effect on the conditional variance of DSE return series, and thereby, the feedback trading is not asymmetric in DSE in up and down markets. Linking the observed autocorrelation structure in return series to feedback trading behavior of irrational investor, this study concludes that the return autocorrelation and the inefficiency in DSE do not imply return predictability and abnormal profit opportunities. It has important implications for other inefficient and emerging markets in that the inefficiency in the form of return predictability in those markets may not imply abnormal profit opportunities. Future studies should investigate other market microstructure related explanation of autocorrelation pattern in DSE. Why the feedback trading is not asymmetric in DSE in up and down markets also merits attention for investigation.

Endnotes

[i]Initially developed by Fisher (1966) and subsequently augmented by Lo and MacKinlay (1990). It assumes that the new information is reflected in highly traded stock prices earlier than in thinly traded stock prices. Once new information affects highly traded stock prices, a time lag occurs when the thinly traded stock prices are affected resulting in autocorrelation . When index returns are analyzed in this context, inclusion of thinly traded stocks in the index cause positive autocorrelation in the index returns.

[ii]One important exception in recent years is the work by Dean and Faff (2008) who uses Markov switching regime model to document feedback trading induced sign reversal in autocorrelation structure in Australian equity and bond index. Their findings are similar to those of previous findings using other models.

[iii]See Sentana and Wadhwani (1992) for the derivation of the model.

[iv]Sentana and Wadhwani (1992) model does not have the term $\gamma_3|R_{t-1}|$. Koutmos (1997) introduced the term with SW (1992) model to capture the asymmetric impact of feedback trading in up and down market. We use this term for the same purpose.

References

Altay, E 2006, 'Autocorrelation in Capital Markets: Feedback Trading in Istanbul Stock Exchange', *Journal of Financial Management an Analysis*, vol.19, no. 2, pp.10-21.

Berlung, T and Liljeblom, E 1998, 'Market Serial Correlation on a Small Security Market: A Note', *Journal of Finance,* vol.43, no. 5, pp.1265-1274.

Bohl, M, Reitz S 2002, '*The Influence of Positive Feedback Trading on Return Autocorrelation: Evidence for the German Stock Market'*, Working Paper Series of Postgraduate Research Programme "Capital Markets and Finance in the Enlarged Europe", 1/2002

Bohl, M T and Siklos, P L 2004, '*Empirical Evidence on Feedback Trading in Mature and Emerging Stock Markets'*, Research paper series, Quantitative Finance Research Centre, University of Technology, Sydney.

Bohl, MT and Siklos, PL 2005, 'Trading Behavior during Stock Market Downturns: The Dow, 1915 – 2004', paper presented at the workshop of Applied Economic Research of the Deutsche Bundesbank and the Institute for International Integration Studies, Trinity College Dublin.

Bollerslev, T, Engle, RF and Nelson, D 1994, 'ARCH Models', in R.F. Engle and D. L. McFadden, eds, *Handbook of Econometrics*, Vol IV (Elsevier Science B.V.).

Boudoukh, J Richardson, MP, Whitelaw, MP 1994, 'A Tale of Three Schools: Insights on Autocorrelations of Short-Horizon Stock Returns', *Review of Financial Studies*, vol.7, no.3, pp.539-73.

Dean, WG and Faff, RW, 2008, 'Evidence of feedback trading with Markov switching regimes', *Review of Quantitative Finance and Accounting,* vol. 30, no. 2, pp.133-151.

DeLong, BJ, Shleifer, A, Summers, LH and Waldmann, RJ 1990, 'Positive Feedback Investment Strategies and Destabilizing Rational Speculation', *Journal of Finance,* vol.45, no. 2, pp.379 -395.

Fisher, L 1966, 'Some New Stock Market Indexes', *Journal of Business*, vol.39, no.1, pp.191-225.

Koutmos, G 1997, ‘Feedback Trading and the Autocorrelation Pattern of Stock Returns: Further Empirical Evidence’, *Journal of International Money and Finance*, vol.16, no. 4, pp. 625-636.

Koutmos,G, Pericli, A and Trigeorgis, L 2006, ‘Short-term Dynamics in the Cyprus Stock Exchange’, *European Journal of Finance*, vol.12, no. 3, pp.205-216.

Kyrtsou, C 2005, ‘Evidence for neglected linearity in noisy chaotic models’, *International Journal of Bifurcation and Chaos*, vol.15, no.10, pp.3391-3394.

Kyrtsou, C and Terraza, M 2003, ‘Is it possible to study chaotic and ARCH behaviour jointly? Application of a noisy Mackey-Glass equation with heteroskedastic errors to the Paris Stock Exchange returns series’, *Computational Economics*, vol. 21, no. 3, pp. 257-276.

Kyrtsou, C and Labys, W 2007, ‘Detecting positive feedback in multivariate time series: the case of metal prices and US inflation’, *Physica A*, vol.377, no.1, pp. 227-229.

Lo, AW and MacKinlay, AC 1990, ‘An Econometric Analysis of Nonsynchronous Trading’, *Journal of Econometrics*, vol.45, no.1-2, pp.181-211.

Mech, T S 1993, ‘Portfolio return autocorrelation’, *Journal of Financial Economics,* vol. 34, no.3, pp.307–44.

Mobarek, A and Keasey, K 2000, ‘Weak- form Market Efficiency of an Emerging Market: Evidence from Dhaka Stock Market of Bangladesh’,Presented at ENBS Conference, Oslo, Available online at: http://www.bath.ac.uk/cds/enbs-papers-pdfs/mobarek-new.pdf.

Nelson, D 1991, ‘Conditional Heteroskedasticity in Stock Returns: A New Approach’, *Econmetrica,* vol.59, no. 2, pp.347-370.

Nofsinger, JR, and Sias, RW 1999, ‘Herding and Feedback Trading by Institutional and Individual Investors’, *Journal of Finance,* vol.54, no.6, pp. 2263-2295.

Pierdzioch, C and Schertler, A 2005, ‘Sources of Predictability of European Stock Markets for High-Technology Firms, Kiel Institute for World Economics’, Kiel Working Paper no. 1235.

Sentana, E and Whadwani, S 1992, ‘Feedback traders and stock return autocorrelations: evidence from a century of daily data’, *Economic Journal*, vol.102, no. 411, pp.415–425.

Shiller, RJ 1984, ‘Stock prices and social dynamics’, *Brookings Papers on Economic Activity*, vol. 2, pp.457–498.