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DO INVESTORS MIMIC TRADING STRATEGIES OF FOREIGN INVESTORS OR THE MARKET: IMPLICATIONS FOR CAPITAL ASSET PRICING

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Abstract:

This paper examines the presence of herding on foreign trading at individual stock level and portfolio level in the Colombo Stock Exchange as a response to a long-standing trading belief that investors mimic the trading strategies of foreign investors. The standard CSAD framework of Chang et al (2000) is extended replacing return on market portfolio with return on market foreign portfolio holding in the model specification. The standard CSAD specification is also used to identify the presence of herding towards the market under high market volatility, bullish market condition, high trading and transaction volume, domestic and global market crisis and up and down market conditions. Except for the evidence on herding towards the market under bullish market condition at portfolio level, the regression results under other market conditions do not provide reasonable evidence for the presence of herding on foreign trading or herding towards the market on average. Further, taking CSAD as a proxy for heteroskedastic residuals following the framework of Banz (1981), the capital asset pricing model of Black (1972) is used to test the specification of CSAD. The findings suggest that the form of herding accounted for by CSAD is a manifestation of residual heteroskedasticity.

Key words: *Herding, Capital Asset Pricing, Cross Sectional Absolute Deviation, Foreign Portfolio Return, Market Efficiency*

1. Introduction

The business section of a leading newspaper in Sri Lanka, *Daily Financial Times*, highlights *'Stock market up for ninth straight session on foreign buying'* on 8th April 2017 (See also Reuters 2017, March 25). When this section of newspaper comes to the hands of investment analysts and advisors, it creates a speculation as to whether the investors (traders) of the CSE follow the trading strategies of foreign investors. This perception has been observed as a long-standing belief in the Sri Lanka stock trading industry, without any empirical research finding as to the existence of

such a phenomenon in the Colombo Stock Exchange. There has been a hot debate and significant interest in the recent literature in this section of finance.

Taking foreign ownership as a proxy for investor herding, Lihara *et al* (2016) parsimoniously examine the impact of herding on stock returns. Dornbusch and Park (1995) and many others find that the foreign investor trading leads to destabilize stock markets whereas Choe *et al* (1999) find no evidence for destabilization effect in Korea Stock Exchange. Similarly, Chung *et al* (2017) demonstrate that active trading by foreign investors tends to increase the information asymmetry in the stock market. Foreign investors are more concerned about the fundamental value of the stocks and rely largely on the appraisals and recommendations of investment advisors and their counterparts. They are reluctant to trade on speculation, especially on the insider information from local directors and chief executives, unless resident foreign investors with a good history of trading in the market. This argument is supported by the findings of Tesar and Werner (1995), Bohn and Tesar (1996), Clark and Berko (1996), Brennan and Cao (1997). The literature documents that herding causes price volatility and leads to deviate the prices from the fundamental value of the stocks (See e.g. Dornbusch and Park 1995; Dennis and Strickland 2002; Gabaix, *et al*., 2006 for useful discussions). Foreign investors on the other hand do possess technical know-how of trading under local customs and trading practices. These perceptions and psychological factors of foreign trading may improve the market efficiency as trading is justified by rational and informed investment decisions. Schuppli and Bohl (2010) find that foreign institutions have a stabilization effect in Chinese stock markets and argue on its contribution to market efficiency. A number of empirical papers find evidence for herding by institutional investors in Europe or United States (See e.g. Lakonishok *et al* 1992; Grinblatt *et al* 1995).

From an Asian perspective, the local investors view the investment decisions of foreign investors including timing as wise decisions and tend to imitate the trading strategies of foreign investors. Nofsinger and Sias (1999) find evidence for herding by institutional investors than individual investors and their results suggest positive feedback trading is higher among individual investors than institutional investors. Using high frequency data, Wan and Yang (2017) show that the impact of positive feedback trading on market quality is mixed and find that positive feedback trades contribute to an active-trading market as the liquidity of the market is improved. Wermers (1999) studies the herding effect on stock prices by mutual funds and concludes that the herding accelerates the price change process. Kremer and Nautz (2013) conclude with similar findings that institutional investors in the German stock market herd on a daily basis.

On the other hand, there has been a documented literature on studying the relationship between herding and idiosyncratic volatility intuitively using stochastic volatility models; this literature includes but not limited to Blasco *et al*. (2012), Balcilar *et al.* (2014) and Huang *et al.* (2015). In particular, BenSaïda (2017) studies effect of herding and volume turnover on conditional volatility whereas Babalos *et al* (2015) show change in herding behavior during low and high volatility periods to crisis period.

The objective of this paper is to examine whether the investors of the Colombo Stock Exchange, in common, herd on the trading strategies of foreign investors using monthly returns of individual stocks and portfolios under five market conditions namely high volatility, up and down market, bull market, high trading and transaction volume and market crisis (global and domestic crisis). Further, the standard Cross Sectional Absolute Deviation (CSAD) specification is used to ascertain herding towards the market in addition to modified CSAD under same market conditions. Following Banz (1981), the capital asset pricing framework of Black (1972) is employed to identify the role of market foreign portfolio holding in asset pricing.

This paper is organized as follows. Section two provides model specifications and section three describes the sampling procedure including empirical properties of sample data. Section four is devoted entirely for empirical findings and discussions. Section five concludes the study.

2. The Model Specification

2.1 The Relationship between Return on Market Foreign Holding and Stock Returns

Xie *et al* (2015) use Arbitrage Pricing Theory (APT) to test the presence of herding in Chinese A-share market whereas Hwang and Salmon (2004) suggest a perfect herding specification in conjunction with capital asset pricing and find evidence for herding towards the market portfolio in both bull and bear markets. Asset pricing models (especially Capital Asset Pricing Model (CAPM)) are however criticized for their inability to account for behavioral factors (e.g. herding). An econometric version of single-period capital asset pricing model (henceforth, CAPM) could be written in such a way that the expected return, $E(r_{it})$ of a common stockholder, holding stock i at time t is a function of systematic risk as measured by the market beta (i.e. β_m).

$$r_{it} = \beta_0 + \beta_m r_{mt} + \varepsilon_t, \quad (1)$$

r_{it} is the expected return (portfolio return r_{pt} could also be modeled in the same manner) of stock i at time t and β_0 is the intercept term which serves as a proxy for risk free rate of return. β_m is the market beta coefficient which measures the systematic risk of firm's stock and r_{mt} is the return on market portfolio at time t. $E(\varepsilon_t|r_{mt}) = 0$. $\beta_0 + \beta_m r_{mt}$ is the expectation of return r_{it} at time t, conditional upon information set I (includes information variables relating to systematic and unsystematic risk) available to investors at time t. Herding is not necessarily present in the stock markets. Irrespective of whether foreign or local, traders may tend to herd on trading strategies of a group of traders based on their unique trading style because it enhances their overall return. Practically, investors spend substantial amount of time and money in analyzing the financial performance and status of listed companies and evaluating the respective stocks before the investments are made. If a group of

investors takes the advantage of the skills and talents of another set of investors by simply imitating or following their trading strategies, this could be, in some sense, brought under the category of free rider without harming the standard definition of free rider in economics. This is particularly because the option to follow the chief group is always available and it is beneficial but costless. It is however, assumed that there is no cost involved in respect of borrowing, carrying out transactions and investment appraisals and evaluations (e.g. consultancy fees) as this market is assumed to be efficient (See Fama 1970). Following Banz (1981 p. 4), the common factor F_t is now introduced into the return estimation process as;

$$r_{it} = \beta_0 + \beta_m r_{mt} + \mu_1 F_t + u_t \quad (2)$$

where F_t is the return on market foreign common stock holding at time t distributed with mean zero and unit variance so that $E(u_t|F_t) = 0$. That is, u_t is clearly idiosyncratic (firm's specific) and unrelated to other stocks or any common market variables (e.g. r_m). The heteroskedasticity of unconditionally distributed errors is clearly unknown at this point. On the assumption that the price increments are stationary and an increasing function (See e.g. Clark 1973) of firm's specific (unsystematic) information observation n at time t, the expectation of stochastic noise could be written as $E(u_t|n_t) \geq 0$ and $E(\beta_m r_{mt}|n_t)$ =0. It is also assumed that u_t is well behaved under the standard assumptions of Ordinary Least Squares (OLS) regression.

The return on market foreign holding is used instead of value of foreign holding of individual stocks because the principle objective of this paper is to examine whether the return on market foreign holding could infer the behaviour of stock price changes of individual firms in the presence of herding on foreign investors' trading strategies.

$$F_t = \left[\frac{(f_t - f_{t-1})}{f_{t-1}}\right] \quad (3)$$

where f_t is the value of market foreign holding at time t and f_{t-1} is the value of market foreign holding at time $t-1$. F_t is introduced into equation (4) as a variable predicting stock returns where the expectation of common stockholders of the market is assumed to be a function of the change in the value (i.e. return) of market foreign holding.

$$r_{(it\ or\ pt)} = \beta_0 + \beta_m r_{mt} + \mu_1 \left[\frac{(f_t - f_{t-1})}{f_{t-1}}\right] + u_t, \quad (4)$$

Where β_0 is the intercept and u_t is the error term of the regression. It is also assumed that u_t is $i.i.d.$ with mean zero and variance σ_i^2 so that $u_t|\, n_t \sim N(0, n\sigma^2)$ where n is the number of firm's specific information observations (usually the number of observations) in the sense of Senarathne and Jayasinghe (2017). Coefficient μ_1 measures the magnitude of change in F_t in response to r_{it}. If there is no relationship

between F_t and expected return, the regression simplifies to a standard econometric version of CAPM (i.e. Black (1972)). However, it does not provide any evidence on the relationship between CSAD (deviation between F_t and individual stock returns or portfolio returns) and the market variables used under different market conditions because the distribution of CSAD differs from one observation to another and the form of heteroskedastic error behavior may also differ during the periods of herding under different market conditions (See especially Bansz 1981 and Shleifer 2000, p. 1821 for a discussion on changes in error behavior over time in response to firm's specific information segments). More importantly, CSAD is assumed to be *nonlinearly dependent* on market variables under different market conditions in the presence of herding on foreign trading (See carefully Bansz 1981, p 11). If the CSAD is not associated with heteroskedasticity, given the regression results of equation (4) above, there should be *no nonlinear (negative)* relationship between CSAD and square of the regressor/s. However, the term of herding should involve the co-movement of investment patterns between two investors groups such as mimicking the traded volume and traded target stocks in addition to the co-movement of returns. Therefore, the equation (4) should have some additional explanatory variables such as the role of foreign holding shares and their investment targeted stocks, if time series data are available.

2.2 The Model of Herding

If the return on market foreign common stock holding assumes the same role of return on market portfolio as a common variable in forecasting stock return, it is expected that $\mu_1 = 0$. However, this indifference does indicate about the distribution or the relationship that CSAD forms under different events/variables with which herding behavior in the market may vary over time. This problem will be addressed in the subsequent sections of this paper. Chang *et al* (2000) develop the benchmark model of detecting herding in the equity markets which is subsequently studied by their successors such as Ouarda *et al* (2013), Litimi *et al* (2016) and BenSaïda (2017). On the other hand, Christie and Huang (1995) employ Cross Sectional Standard Deviation (CSSD) to detect the herding behavior. However, scholars such as Economou *et al.* (2011) and BenSaïda (2017)) argue that it is subject to the effect of outliers in the cross-sectional deviation. This study therefore adopts the CSAD model introduced by Chang *et al* (2000) with a slight modification.

When the investors as a whole follow the trading strategies of foreign investors, the deviation of each return observation of individual stocks or portfolios from the return on market foreign portfolio holding must be zero or if not negligible. Note that the heteroscedastic (unconditional) error distribution of specification (4) as proxied by CSAD is examined under different market conditions. The testable hypothesis of this problem is discussed in detail. Substituting return on market foreign

portfolio holding into standard equation of CSAD, the representation could be expressed as;

$$CSAD(P)_{ft} = \frac{1}{N}\sum_{i=1}^{N} | R_{it} - F_t |, \quad (5)$$

at portfolio level and $CSAD_{ft} = \sum_{t=1}^{n} | R_{it} - F_t |$ at individual level where N is the number of firms in the group and n, as usual, is the number of observations in the sample. Note that the notation f is used with time subscript t (f_t) to denote the market *foreign* portfolio at time t and m is used for market portfolio. The CSAD serves as a proxy for heteroscedastic residuals of equation (4). When portfolio returns are computed, equally weighted average returns are considered in line with Tan *et al.* (2008) and BenSaïda (2017). The standard CSAD is read as $CSAD(P)_{mt} = \frac{1}{N}\sum_{i=1}^{N} | R_{it} - R_{mt} |$ where R_{mt} is the return on market portfolio.

The following regression equation is used under null hypothesis for investor herding on the trading strategies of foreign investors. The relationship between CSAD and F_t should be nonlinear and significantly negative (See e.g. Chang, *et al*., 2000; Henker *et al.,* 2006; and BenSaïda 2017 for arguments using R_{mt} as the regression variable). However, if the assumptions under standard CAPM model can be invoked and F_t plays an influential role as r_{mt} in the herding regression specification, then the relationship between r_{it} or r_{pt} and F_t should be linear and significant in the specification (4). The modified herding specification is given below.

$$CSAD_{ft} = \alpha + \Upsilon_1 F_t + \Upsilon_2 |F_t| + \Upsilon_3 F_t^2 + v_t \quad (6)$$

In the presence of herding on foreign investors' trading, the coefficient Υ_3 is expected to be negative and significant (See e.g. Ouarda *et al* 2013;, BenSaïda 2017). $CSAD_{ft}$ is used as the notation for individual stocks in the regression as in equation (5). Note that the standard CSAD specification for herding on the return on market portfolio is $CSAD(P)_{mt} = \alpha + \Upsilon_1 R_{mt} + \Upsilon_2 |R_{mt}| + \Upsilon_3 R_{mt}^2 + v_t$.

2.3 Herding under Market Conditions

2.3.1 Herding under Excessive Market Return Volatility

Dennis and Strickland (2002), Gleason *et al.* (2004), Gabaix *et al* (2006), Tan *et al.* (2008), Holmes, *et al,* (2013) and Ouarda *et al* (2013) study the relationship between herding and volatility. Huang *et al.* (2015), Litimi, *et al.* (2016) and BenSaïda (2017) use volatility forecasting models such as EGARCH or GARCH and study the relationship between herding and conditional volatility. Scholars such as Tan *et al.,* (2008) and Ouarda *et al* (2013) demonstrate that the investors tend to herd more when

the market volatility is high. Following Ouarda *et al* (2013), a dummy variable D is introduced to capture this asymmetry which takes the value 1 in the periods when volatility exceeds weighted average volatility of the whole sampling period or otherwise 0. Although Ouarda *et al* (2013) consider the weighted average volatility of the preceding six months, weighted average volatility of the entire sampling period is considered as the excessive volatility (due to market microstructure variables as discussed under section 3) is reported during the sampling period (See section 3 for reasoning). The effect of herding during high volatility periods could be studied by the following regression equation.

$$CSAD_{ft} = \alpha + \Upsilon_1 D^{Hvolatility}|F_t| + \Upsilon_2(1 - D^{Hvolatility})|F_t| + \Upsilon_3 D^{Hvolatility} F_t^2 + \Upsilon_4(1 - D^{Hvolatility})F_t^2 + v_t \quad (7)$$

Under null hypothesis for the presence of herding on foreign trading, it is expected that $\Upsilon_3 < 0$ and $\Upsilon_4 < 0$ and $\Upsilon_3 > \Upsilon_4$, if the herding is more pronounced in the high volatility periods. The standard CSAD specification for same is $CSAD_{mt} = \alpha + \Upsilon_1 D^{Hvolatility}|R_{mt}| + \Upsilon_2(1 - D^{Hvolatility})|R_{mt}| + \Upsilon_3 D^{Hvolatility} R_{mt}^2 + \Upsilon_4(1 - D^{Hvolatility})R_{mt}^2 + v_t$

For the purpose of estimating market volatility, the Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGRCH) model of Nelson (1991) which accounts for asymmetric effect of innovations on volatility is used. Such a model is given by;

$$\ln(\sigma_t^2) = \omega + \eta \ln(\sigma_{t-1}^2) + \gamma \frac{u_{t-1}}{\sqrt{\sigma_{t-1}^2}} + \alpha \left[\frac{|u_{t-1}|}{\sqrt{\sigma_{t-1}^2}} - \sqrt{\frac{2}{\pi}} \right] \quad (8)$$

where ω is the constant of the conditional variance equation above and σ_t^2 is the conditional variance at time t. η is the coefficient corresponds to previous period ($t-1$) volatility or lagged conditional variance and γ is the coefficient applicable to leverage effect. γ is expected to be negative if a negative shock has a greater impact on volatility than the positive shocks of the same magnitude. The presence of any significant negative shocks on volatility implies that the investor sentiment is more reactive to negative news than positive news. α explains the effect of long term volatility.

2.3.2 Herding under Up and Down Market

Herding is often observed when stock markets are bullish in many instances. Also, herding is more pronounced when stock markets record a bullish uptrend (See e.g. Ouarda *et al* 2013;, Litimi, *et al.* 2016; BenSaïda 2017). This phenomenon is apparent as investors move in collusion on a common expectation where the

expectation is associated with or driven by the information variables relating to systematic risk that are beyond the control of individual firms (See Senarathne and Jayasinghe 2017). Hence, investors have no recourse but to accept the trading strategies of the majority of investors in the market. Similarly, when the market prices decline and the market is bearish, investors are more prone to follow or mimic the trading strategies of majority of investors (See e.g. Tan *et al* 2008; Houda and Mohamed 2013). A single period dummy variable is introduced to study this asymmetry where it takes the value 1 when the portfolio or individual stock returns are negative or zero and the return on market foreign portfolio holding is positive. Under null hypothesis for the presence of herding, coefficients Υ_3 and Υ_4 should be statistically significant and negative. If the effect of herding is significant in the months when stock market is on uptrend (bullish-uptrend) compared to months on which the market is on down turn (bearish downtrend), it is expected that $\Upsilon_3 < \Upsilon_4$. The estimation equation is given by,

$$CSAD_{ft} = \alpha + \Upsilon_1(1-D)F_t + \Upsilon_2 D F_t + \Upsilon_3(1-D)F_t^2 + \Upsilon_4 D F_t^2 + v_t \quad (9)$$

In addition, the following specification accounts for any evidence of herding during the bullish period, April 2009 to October 2010 where $D^{bullish}$ takes 1 during the period (months) of bullish market and 0 for the balance period (See the discussion in section 2.3.4) Under null hypothesis for the presence of herding, coefficient, Υ_4 should be statistically significant and negative.

$$CSAD_{ft} = \alpha + \Upsilon_1 F_t + \Upsilon_2 |F_t| + \Upsilon_3 F_t^2 + \Upsilon_4 F_t^2 D^{bullish} + v_t \quad (10)$$

Note that the standard CSAD specification is given as $CSAD_{mt} = \alpha + \Upsilon_1(1-D)R_{mt} + \Upsilon_2 D R_{mt} + \Upsilon_3(1-D)R_{mt}^2 + \Upsilon_4 D R_{mt}^2 + v_t$ and $CSAD_{mt} = \alpha + \Upsilon_1 R_{mt} + \Upsilon_2 |R_{mt}| + \Upsilon_3 R_{mt}^2 + R_{mt}^2 D^{bullish} + v_t$ respectively.

2.3.3 Herding under Excessive Transaction Volume and Trading Volume

A number of scholars (for example, Tauchen and Pitts 1983; Karpoff 1987; Lamoureux and Lastrapes 1990; Senarathne and Jayasinghe 2017) examines the information content of stock volume whereas Epps and Epps (1976) and Harris (1987) find that number of transactions is an equal proxy variable for the information arrival at the stock market. Majand and Yung (1991), Venezia *et al.* (2011) and BenSaïda (2017) examine the relationship between volume and herding using transaction volume as a proxy for the information arrival at the market. Therefore, it is expected that the herding behavior may differ substantially from the months in which the transaction volume and trading volume recorded high to low transaction and trading volume periods (See e.g. Tan *et al*. 2008; Ouarda *et al* 2013). The presence of this asymmetry could be examined by the following equations.

(a) Herding under high trading volume,

$$CSAD_{ft} = \alpha + \Upsilon_1 D^{Hvol}|F_t| + \Upsilon_2(1 - D^{Hvol})|F_t| + \Upsilon_3 D^{Hvol} F_t^2 + \Upsilon_4(1 - D^{Hvol})F_t^2 + v_t \quad (11)$$

(b) Herding under high transaction volume,

$$CSAD_{ft} = \alpha + \Upsilon_1 D^{Htrans}|F_t| + \Upsilon_2(1 - D^{Htrans})|F_t| + \Upsilon_3 D^{Htrans} F_t^2 + \Upsilon_4(1 - D^{Htrans})F_t^2 + v_t \quad (12)$$

where D is a dummy variable which takes the value 1 in the months characterized by excessive trading volume and transaction volume. The excessive trading is defined with reference to the average trading and transaction volumes transacted during the sample period. Under null hypothesis for the presence of herding on foreign trading under above two scenarios, it is expected that, $\Upsilon_3 < 0$ and $\Upsilon_4 < 0$ and $\Upsilon_3 > \Upsilon_4$ if the herding is noticeable during high trading and transaction volume.

Note that the standard CSAD equation is given by $CSAD_{mt} = \alpha + \Upsilon_1 D^{Hvol}|R_{mt}| + \Upsilon_2(1 - D^{Hvol})|R_{mt}| + \Upsilon_3 D^{Hvol} R_{mt}^2 + \Upsilon_4(1 - D^{Hvol})R_{mt}^2 + v_t$
and
$CSAD_{mt} = \alpha + \Upsilon_1 D^{Htrans}|R_{mt}| + \Upsilon_2(1 - D^{Htrans})|R_{mt}| + \Upsilon_3 D^{Htrans} R_{mt}^2 + \Upsilon_4(1 - D^{Htrans})R_{mt}^2 + v_t$
respectively

2.3.4 Herding in the Market Crisis Period.

Investors tend to mimic the trading strategies of majority in the market when investors are panic. This is often observed during stock market crisis periods (e.g. financial crisis). The CSE had been subject to market crisis due to overvaluation of securities and European economic crisis through May 2011 to May 2012 (See section 3 for an extensive discussion). A number of scholars documents that herding is present during market crisis periods (See e.g. Bowe and Domuta 2004; Yao *et al* 2014; Litimi *et al* 2016; Bekiros *et al* 2017). In many instances, a stock market crisis is caused by macro-economic factors that are beyond the control of a particular jurisdiction such as global financial and economic crisis. However, stock markets may also be collapsed due to country level economic factors such as regulatory failure to monitor or supervise stock market activities such stockbroker supervision or an imposition of sudden changes (without leaving sufficient time for investors to adjust) to the regulatory framework relating to securities trading. Also, stock markets may be collapsed due to over valuation of counters (i.e. stock bubbles). These factors are within the control of a particular country. CSE provides a good example for these types of crises in securities trading industry (See Kadirgamar 2012 and Reuters 2011, October 19). Section three contains further explanations.

Hwang and Salmon (2004) find evidence for herding towards the market portfolio in both bull and bear markets irrespective of the effect of market

microstructure variables in US and South Korian stock markets. Similarly, Philippas *et al* (2013) find that the deterioration of investor sentiment steers herding and the financial crisis does not affect herding behavior in the market.

To examine the presence of herding in the crisis period, a crisis dummy variable is introduced to equation (6) and the representation would then yield;

$$CSAD_{ft} = \alpha + \Upsilon_1 F_t + \Upsilon_2 |F_t| + \Upsilon_3 F_t^2 + \Upsilon_4 F_t^2 D^{crsis} + v_t \quad (13)$$

The dummy variable D^{crsis} takes the value 1 during the period of crisis or 0 otherwise. Under null hypothesis for the presence of herding, Υ_4 should be statistically significant and negative. The standard CSAD specification is $CSAD_{mt} = \alpha + \Upsilon_1 R_{mt} + \Upsilon_2 |R_{mt}| + \Upsilon_3 R_{mt}^2 + \Upsilon_4 R_{mt}^2 D^{crsis} + v_t$

3. Data

Twenty (20) common stocks are drawn from the population of 295 listed companies as of 30th September 2017 in the Colombo Stock Exchange (CSE) over 15-year sampling period (i.e. 1st January 2002 to 31st December 2016). Stocks are selected on a random sampling basis from two subpopulations (i.e. stocks listed in All Share Price Index (ASPI) and Standard & Poor's 500 Index). CSE lists stocks under S&P 500 based on a number of eligibility criteria, such as market capitalization, liquidity, financial viability and timing of changes. The total 15-year sampling period reflects major economic events (for example conclusion of 30-year civil war on 18th May 2009, global financial crisis and CSE stockbroker credit crisis). The investor composition and the overall performance of the CSE have changed significantly since these economic events (e.g. high bullish period begins in April 2009 and ends in October 2010). In the mid-2011, the regulators had imposed restrictions on stockbroker lending (on credit purchases) by reducing extendable credit on the number of times of net capital (e.g. restriction of maximum credit that could be extended to investors by the stockbrokers). This had caused the market to decline significantly through 1st May 2011 to 31May 2012. European economic crisis of the year 2012 has also had a significant impact on the performance of the CSE. The figure 1 illustrates the change in market variables (conditions) over the sampling periods.

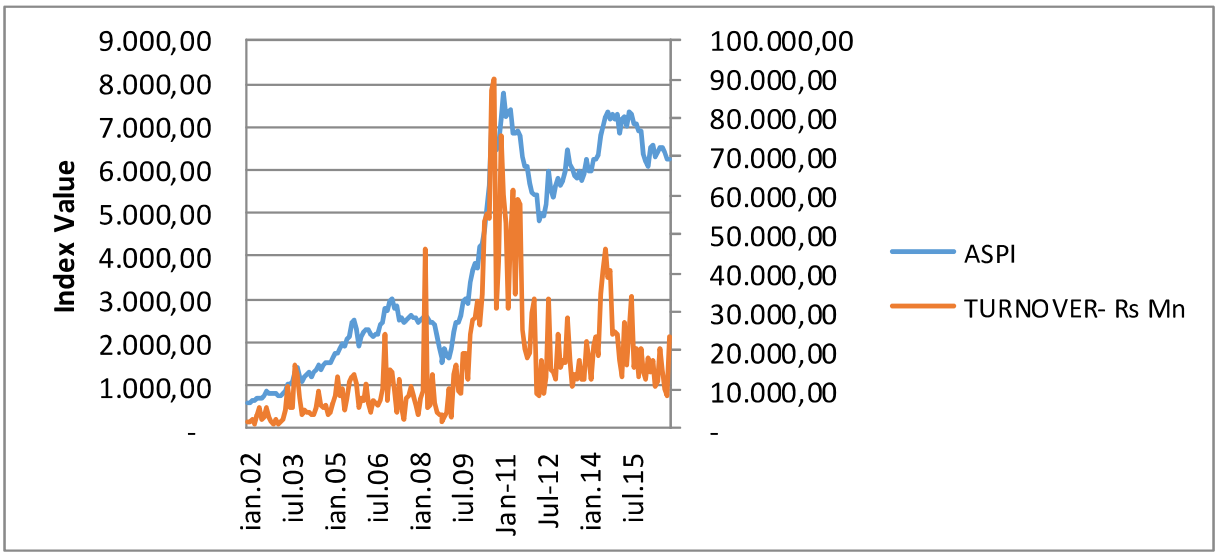

Figure 1. Movement of ASPI and Market Turnover

Descriptive Statistics of Sample Data

Monthly returns of randomly selected individual stocks (firms) are generated from a sample of 20 common stocks. Also, equally weighted average monthly returns are generated from portfolios formed randomly as depicted in table 1.

Table 1 - The Compositions of Portfolios

Serial No.	Co	Sector	Portfolio				
			20stocks	15stocks	10stocks	5stocks	S&P500
1	Aitken Spence	Diversified	✓	✓			✓
2	Asiri Hospital Holdings	Healthcare	✓	✓			
3	Commercial Bank of Ceylon	Banks, Finance & Insurance	✓	✓		✓	
4	DFCC Bank	Banks, Finance & Insurance	✓		✓	✓	✓
5	East West Properties	Land & Property	✓	✓			
6	Galadari Hotels (Lanka)	Hotels & Travels	✓	✓	✓		
7	Hatton National Bank	Banks, Finance & Insurance	✓				
8	John Keells Holdings	Diversified	✓	✓	✓		✓
9	Kelani Tyres	Manufacturing	✓	✓	✓		
10	Lanka Orix Leasing Company	Banks, Finance & Insurance	✓			✓	
11	Laxapana Batteries	Manufacturing	✓	✓	✓		
12	Madulsima Plantations	Plantations	✓				
13	Marawila Resorts	Hotels & Travels	✓	✓	✓		
14	National Development Bank	Banks, Finance & Insurance	✓	✓	✓		✓
15	Renuka Foods (Voting)	Beverage, Food & Tobacco	✓	✓			
16	Royal Ceramics Lanka	Manufacturing	✓		✓		
17	Swisstek (Ceylon)	Manufacturing	✓	✓		✓	
18	Tal Lanka Hotels	Hotels & Travels	✓	✓	✓		
19	Sampath Bank	Banks, Finance & Insurance	✓	✓		✓	✓
20	York Arcade Holdings	Land & Property	✓	✓	✓		

Descriptive statistics are computed for each individual stock and five portfolios (See Table 2). Basic statistical properties include mean, median, maximum, minimum, standard deviation, skewness and kurtosis. Jarque–Bera test statistic is computed to ascertain the unconditional normality of return distribution which gives an indication of normality of regression errors in their unconditional distributions. Augmented Dickey–Fuller test (ADF) statistic is computed to estimate the stationarity of portfolio and

individual stock returns. Stock price change (including price change variance) predictability is associated with the form of heteroskedasticity in OLS regression residuals (See e.g. Senarathne and Jayasinghe (2017). Breusch and Pagan test (Obs*R-squared) is used to understand this asymmetry in equation (4).

Table 2. Descriptive Statistics of Sample Data

Co. serial No.	JB	ADF	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Obs.	BP*	Prob.
1	118529.40	-13.52	-0.002	0.000	0.421	-2.883	0.235	-10.238	127.39	179	2.78	0.249
2	91529.75	-13.39	0.002	0.000	0.280	-2.278	0.192	-9.311	112.20	179	4.75**	0.093
3	1327.83	-12.31	0.000	0.005	0.408	-0.683	0.113	-1.742	15.88	179	3.93	0.140
4	1228.49	-12.55	0.001	-0.010	0.478	-0.845	0.128	-0.918	15.70	179	0.11	0.944
5	951.84	-14.42	0.007	-0.009	1.195	-0.693	0.193	1.761	13.73	179	0.71	0.698
6	2579.91	-14.07	0.007	-0.019	1.237	-0.516	0.163	2.723	20.78	179	15.18*	0.001
7	1475.37	-12.54	0.009	0.006	0.315	-0.730	0.108	-1.922	16.53	179	6.97*	0.031
8	76.12	-12.13	0.006	0.005	0.470	-0.400	0.103	0.125	6.18	179	0.04	0.979
9	383.16	-12.80	0.013	0.000	0.693	-0.845	0.155	-0.031	10.17	179	0.89	0.638
10	35066.11	-12.18	0.002	0.001	0.828	-2.377	0.226	-6.217	70.43	179	0.25	0.881
11	169.98	-14.76	0.005	0.000	0.788	-0.386	0.153	1.257	7.12	175	6.92*	0.031
12	119.65	-13.64	-0.002	-0.012	0.640	-0.397	0.141	1.028	6.44	179	7.50*	0.024
13	19.98	-13.65	-0.001	-0.029	0.486	-0.340	0.138	0.686	3.89	179	10.94*	0.004
14	21893.11	-13.37	0.005	0.000	2.090	-1.851	0.236	0.996	57.14	179	0.85	0.651
15	312.10	-12.58	-0.001	-0.006	0.719	-0.599	0.132	0.335	9.43	179	5.62**	0.060
16	21580.31	-14.28	0.012	0.000	2.296	-2.189	0.267	0.408	56.78	179	0.93	0.627
17	126.88	-15.09	0.018	0.000	0.862	-0.355	0.174	1.184	6.43	175	6.40*	0.041
18	818.84	-13.26	0.010	-0.015	0.889	-0.318	0.136	2.082	12.62	179	19.01*	0.000
19	489.31	-13.55	0.009	-0.003	0.350	-0.590	0.099	-0.460	11.05	179	1.78	0.411
20	46.20	-13.97	0.006	0.000	0.606	-0.392	0.152	0.768	4.96	179	7.46*	0.024
Portfolio Level												
20stcoks	214.00	-13.15	0.020	0.012	0.474	-0.193	0.101	1.473	7.51	177	3.12	0.209
15stocks	314.17	-12.94	0.019	0.007	0.556	-0.213	0.101	1.572	8.72	177	13.49*	0.001
10stcoks	2126.18	-13.89	0.024	0.002	0.914	-0.212	0.136	3.107	18.80	177	1.63	0.441
5stocks	108.28	-11.48	0.016	0.009	0.430	-0.312	0.098	0.927	6.35	177	17.72*	0.000
S&P500	25526.33	-13.17	0.019	0.005	1.463	-0.309	0.143	6.087	60.56	177	3.53	0.171

Notes:

1. JB is the Jarque–Bera test statistic for normality. Under null hypothesis for normality, critical value of χ^2(2) distribution at 5% significance level is 5.99.
2. ADF is the Augmented Dickey–Fuller test statistic for stationarity of returns for maximum 13 lags. Under null hypothesis for returns having a unit root, the critical value at 5% significance level is -2.87.
3. BP is the Breusch and Pagan test (Obs*R-squared) for detecting heteroskedasticity of OLS regression residuals as specified in equation (4). * Statistically significant at 5% assuming conditional normality. **Statistically significant at 10%.

ADF test results accept hull hypothesis of non-stationarity of returns as test statistics exceed the critical value of -2.87 for all firms and the portfolios. Nonnomaility of empirical return distribution is also confirmed by the results of JB test. The critical value of 5.99 exceeds in all stocks and portfolios. This phenomenon has already been addressed in empirical researches (See e.g. Fama (1970)). Nonnomaility of return distribution causes the heteroskedasticity of regression residuals (See e.g. White (1980)). Homoscedasticity of error term is observed for eight individual firms at 5% significance level and two firms at 10% significance level. Also, homoscedasticity is reported at 5% significance level for two portfolios (i.e. 15stock and 5stock portfolios). Kurtosis exceeds 3 in all firms and portfolios and Skewness exists in their unconditional distributions.

4. Findings and Discussions

The Table 3 outlines the regression results of estimation equation (4). Except for Asiri Hospital Holdings, β_m is statistically significant for all firms and portfolios at 5% significance level. The coefficient μ_1 is statistically insignificant for all individual firms and portfolios except for John Keells Holdings and 15stocks portfolio whose coefficients become statistically significant at 5% and 10% respectively (all regression coefficients from equation 4 to 13 are estimated using robust least square regression, adjusting standard errors for consistent heteroskedasticity and autocorrelation (Newey and West 1987) which resolves possible multicollinearity issues). These results warrant further investigations into herding on foreign trading under different market conditions as discussed under section two.

Table 3. Results of OLS Regression

3.1 Individual Stock Level

$$r_{it} = \beta_0 + \beta_m r_{mt} + \mu_1 \left[\frac{(f_t - f_{t-1}}{f_{t-1}}\right] + u_t$$

Firm	β_m	*P* value	μ_1	*P* value
1	0.773*	0.001	0.492	0.213
2	0.307	0.306	-0.167	0.331
3	0.728*	0.000	0.151	0.297
4	1.151*	0.000	0.125	0.220
5	1.305*	0.000	-0.021	0.900
6	1.360*	0.000	0.119	0.644
7	0.858*	0.000	0.151	0.413
8	0.875*	0.000	0.299*	0.000
9	1.322*	0.000	0.026	0.850
10	1.086*	0.002	0.187	0.233
11	1.105*	0.000	0.115	0.271
12	1.410*	0.000	-0.165	0.122
13	1.205*	0.000	0.142	0.152
14	1.406*	0.000	-0.033	0.827
15	1.123*	0.000	-0.027	0.848
16	0.862*	0.001	0.074	0.590
17	1.090*	0.000	0.077	0.466
18	1.370*	0.000	0.080	0.632
19	0.982*	0.000	0.040	0.637
20	1.238*	0.000	0.011	0.951

3.2 Stock Portfolio Level

$$r_{pt} = \beta_0 + \beta_m r_{mt} + \mu_1 \left[\frac{(f_t - f_{t-1}}{f_{t-1}}\right] + u_t,$$

Portfolio	β_m	*P* value	μ_1	*P* value
20stcoks	1.158*	0.000	0.071	0.181
15stocks	1.133*	0.000	0.104**	0.077
10stcoks	1.333*	0.000	0.080	0.301
5stocks	1.023*	0.000	0.100	0.213
S&P500	1.282*	0.000	0.095	0.228

Notes

*Statistically significance at 5% assuming conditional normality.

**Statistically significance at 10% assuming conditional normality.

The following line graphs of randomly selected four individual securities and portfolios show the variations (over time) in the residuals drawn from equation (1) and (4), although $\mu_{\perp}$ becomes statistically insignificant at a reasonable significance level as in equation (4). Taking CSAD as a proxy for unconditional heteroskedastic residual u_t,an examination on the relationship between CSAD and square of the regressors as in equations (6) to (13) would resolve this puzzle.

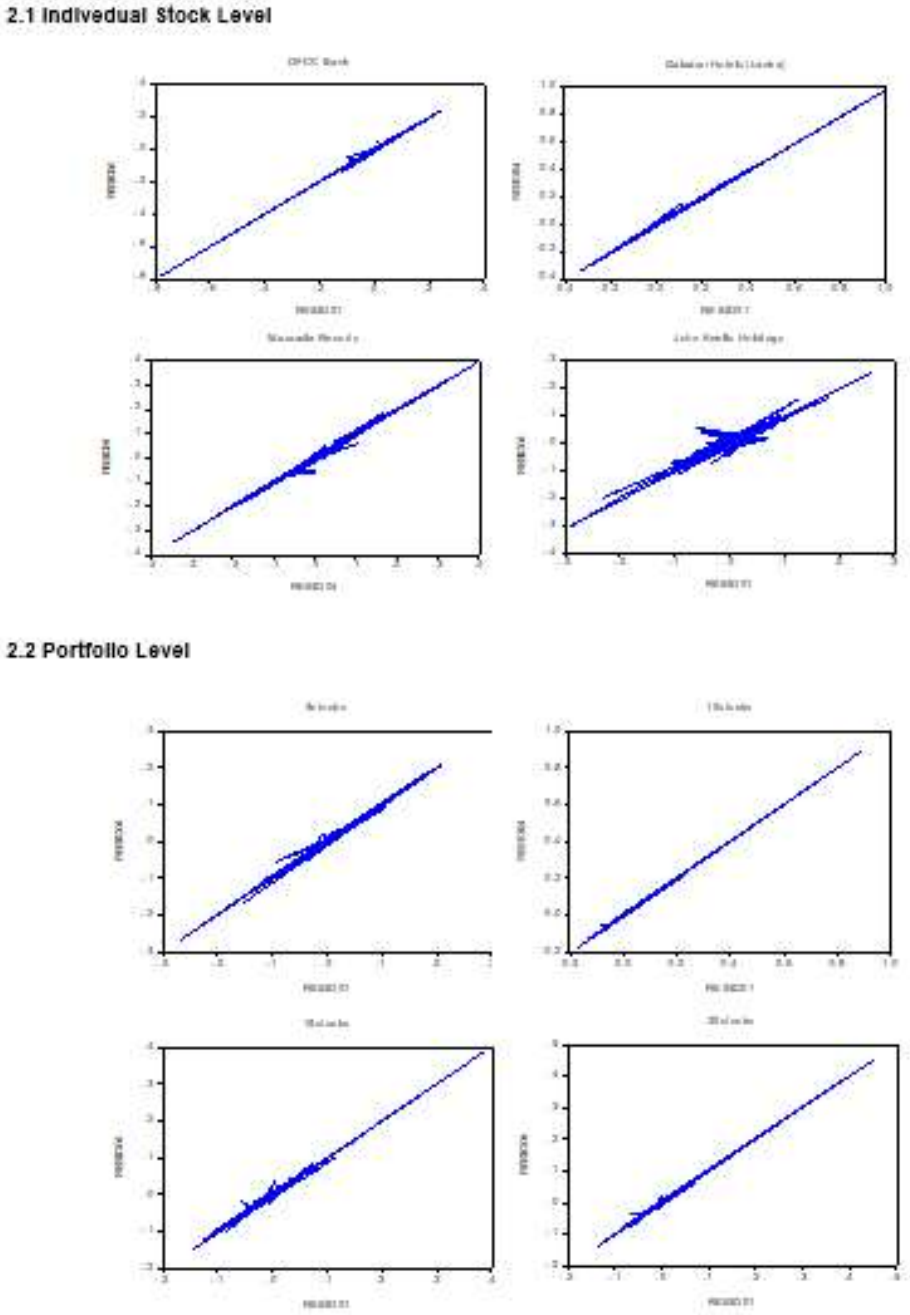

Figure 2. Behaviour of Regression Residuals

4.1 Herding

Two CSAD herding specifications as in equation (6) have been used to test the herding towards market foreign portfolio and the market in general. The test results as outlined in Table (4) reveal that the coefficient Υ_3 of equation (6) is *positive* for all individual firms under modified herding specification except for Aitken Spence whose coefficient is *negative* but not significant enough to provide evidence for the presence of herding at individual stock level. At the portfolio level, the coefficient Υ_3 is *positive* for all portfolios constructed under modified CSAD framework. The test results under general herding specification show that coefficient Υ_3 is *negative* for nine firms but only two firms (York Arcade Holdings and Laxapana Batteries) are statistically significant at 5% and 10% significance levels respectively. Coefficient Υ_3 is *positive* for all portfolios. These results are inline with the observations of Sewwandi (2016) who finds no evidence for herding in the CSE under general CSAD framework at market level. The above observation provides *some evidence* for the existence of randomness of price changes in the CSE.

Table 4. Herding

4.1 Herding on Foreign Trading

4.1.1 Individual Stock Level

$$CSAD_{ft} = \sum_{t=1}^{n} | R_{it} - F_t |$$

Regression equation - $CSAD_{ft} = \alpha + \Upsilon_1 F_t + \Upsilon_2 |F_t| + \Upsilon_3 F_t^2 + u_t$

Firm	Υ_1	P value	Υ_2	P value	Υ_3	P value
1	-0.337	0.289	1.366	0.187	-2.310	0.455
2	0.256	0.350	0.268	0.590	2.983*	0.021
3	0.011	0.841	0.019	0.903	2.351*	0.000
4	0.017	0.781	0.284	0.103	1.421*	0.022
5	0.041	0.604	-0.102	0.746	2.641*	0.005
6	0.205	0.168	-0.667	0.101	6.006*	0.005
7	-0.120	0.156	0.176	0.487	1.565	0.151
8	-0.123*	0.026	0.134	0.399	1.109**	0.055
9	0.086	0.196	-0.140	0.563	2.616*	0.000
10	-0.105	0.450	0.299	0.417	0.799	0.589
11	0.118*	0.049	0.352	0.312	0.082	0.936
12	0.083	0.151	-0.489**	0.073	3.909*	0.000
13	-0.046	0.516	-0.172	0.438	1.843**	0.085
14	0.068	0.618	-0.009	0.991	2.088	0.373
15	0.087	0.300	0.318	0.170	0.922	0.334
16	0.010	0.905	-0.900	0.285	4.245**	0.094
17	0.149	0.103	-0.033	0.927	1.637	0.206
18	0.181*	0.020	-0.275	0.194	3.836*	0.000
19	-0.064	0.385	0.335	0.170	0.887	0.391
20	0.051	0.417	-0.190	0.521	2.245*	0.014

4.1.2 Stock Portfolio Level

$$CSAD(P)_{ft} = \frac{1}{N}\sum_{i=1}^{N} | R_{it} - F_t |,$$

Regression equation - $CSAD(P)_{ft} = \alpha + \Upsilon_1 F_t + \Upsilon_2 |F_t| + \Upsilon_3 F_t^2 + u_t$

Portfolio	Υ_1	P value	Υ_2	P value	Υ_3	P value
20stcoks	-0.017	0.811	-0.093	0.691	2.288*	0.037
15stocks	-0.003	0.964	0.040	0.847	1.951**	0.070
10stcoks	0.046	0.495	-0.199	0.547	2.852*	0.008
5stocks	0.020	0.656	-0.178	0.185	2.800*	0.000
S&P500	0.043	0.671	0.439	0.218	0.828	0.515

4.2 Herding on Market

4.2.1 Individual Stock Level

$$CSAD_{mt} = \sum_{t=1}^{n} | R_{it} - R_{mt} |$$

Regression equation - $CSAD_{mt} = \alpha + \Upsilon_1 R_{mt} + \Upsilon_2 |R_{mt}| + \Upsilon_3 R_{mt}^2 + u_t$

Firm	Υ_1	P value	Υ_2	P value	Υ_3	P value
1	-0.084	0.696	0.948	0.105	-3.708	0.224
2	0.470	0.101	0.590	0.156	0.816	0.793
3	0.197*	0.008	-0.264	0.490	3.122	0.149
4	0.106	0.143	-0.057	0.781	3.030*	0.024
5	-0.043	0.746	-0.293	0.667	3.185	0.356
6	0.264	0.115	-0.221	0.587	4.888	0.171
7	0.009	0.911	0.223	0.432	-0.339	0.798
8	-0.067	0.322	0.292	0.256	-0.498	0.785
9	0.135	0.167	0.644*	0.042	-0.752	0.696
10	-0.005	0.976	-0.119	0.841	3.495	0.379
11	0.254*	0.001	0.684**	0.061	-2.432**	0.081
12	0.077	0.427	-0.317	0.294	3.860**	0.058
13	0.141*	0.016	0.105	0.792	0.687	0.786
14	0.216	0.356	-0.100	0.887	2.134	0.463
15	0.114	0.239	0.656	0.133	-1.835	0.584
16	0.429*	0.037	0.905	0.388	-5.745	0.362
17	0.358*	0.001	0.076	0.884	0.009	0.998
18	0.240*	0.016	0.185	0.688	1.951	0.579
19	0.118*	0.038	0.455*	0.025	-1.395	0.209
20	0.176**	0.084	1.133*	0.005	-5.737*	0.009

4.2.2 Stock Portfolio Level

$$CSAD(P)_{mt} = \frac{1}{N}\sum_{i=1}^{N} | R_{it} - R_{mt} |,$$

Regression specification - $CSAD(P)_{mt} = \alpha + \Upsilon_1 R_{mt} + \Upsilon_2 |R_{mt}| + \Upsilon_3 R_{mt}^2 + u_t$

Portfolio	Υ_1	P value	Υ_2	P value	Υ_3	P value

20stcoks	0.136*	0.004	0.022	0.912	0.894	0.486
15stocks	0.168*	0.013	0.136	0.570	0.452	0.766
10stcoks	0.199*	0.026	0.185	0.556	0.451	0.794
5stocks	0.165*	0.001	-0.236	0.102	2.319*	0.004
S&P500	0.193	0.241	0.196	0.647	1.095	0.536

Note

*Statistically significant at 5% assuming conditional normality
**Statistically significant at 10% assuming conditional normality

4.2 Herding under Excessive Market Return Volatility

Under modified CSAD framework at individual stock level, coefficient Υ_3 (equation 7) becomes *negative* for seven firms with statistically insignificant student t statistics at 5% or 10% significance level (See Table 5). This coefficient is assigned to measure the magnitude of change in the high volatility dummy ($D^{Hvolatility}$) in response to CSAD. It is also observed that coefficient Υ_4 is *positive* for nineteen firms (although *negative*, Laxapana Batteries is insignificant) rejecting the null hypothesis for the presence of herding during high volatility period (or other than low volatility period). Similar estimation results are observed under stock portfolio level where the coefficient Υ_3 becomes *negative* for two portfolios and statistically insignificant at 5% or 10% significance level. Again, coefficient Υ_4 is *positive* for all portfolios. These results do not provide evidence for the presence of herding on foreign trading during high or low volatility periods.

Although coefficient Υ_3 of twelve firms under standard CSAD model becomes *negative*, they remain statistically insignificant in the estimation results as observed. Out of seven firms whose coefficient Υ_4 becomes *negative*, only two firms namely, Laxapana Batteries and Sampath Bank report statistically significant coefficients at 5% significance level. York Arcade Holdings reports significant *negative* coefficient Υ_4 at 10% significance level under standard model. The test results show that coefficients, Υ_3 and Υ_4 are *positive* for all portfolios formed. Overall, the results reveal that either herding on foreign trading or herding towards market as a whole, does not present during the high volatility periods.

Table 5. Herding under Excessive Market Return Volatility

5.1 Herding on Foreign Trading

5.1.1 Individual Stock Level

$$CSAD_{ft} = \sum_{t=1}^{n} |R_{it} - F_t|$$

Regression equation -

$$CSAD_{ft} = \alpha + \Upsilon_1 D^{Hvolatility}|F_t| + \Upsilon_2(1 - D^{Hvolatility})|F_t| + \Upsilon_3 D^{Hvolatility} F_t^2 + \Upsilon_4(1 - D^{Hvolatility})F_t^2 + u_t$$

Firm	Υ_1	P value	Υ_2	P value	Υ_3	P value	Υ_4	P value
1	2.064	0.155	0.457	0.130	-5.430	0.230	0.911	0.386
2	0.339	0.486	0.754	0.465	1.324	0.392	2.247	0.306
3	-0.125	0.525	0.099	0.556	3.258*	0.000	1.882*	0.006
4	0.513**	0.082	0.120	0.533	0.494	0.696	1.962*	0.000

5	0.111	0.821	-0.240	0.476	1.959	0.261	3.004*	0.007
6	-1.026*	0.018	-0.372	0.293	9.084*	0.003	4.006*	0.010
7	0.210	0.316	0.028	0.926	1.264*	0.043	2.157	0.136
8	0.331**	0.074	-0.117	0.479	-0.053	0.934	2.171*	0.004
9	0.027	0.938	-0.185	0.589	2.051	0.149	2.692*	0.004
10	0.688	0.381	-0.261	0.522	-0.988	0.801	2.647*	0.023
11	0.344	0.310	0.540	0.177	0.220	0.845	-0.677	0.546
12	-0.755*	0.016	-0.161	0.577	4.853*	0.000	2.902*	0.002
13	0.241	0.280	-0.371*	0.037	-1.160	0.188	3.336*	0.000
14	0.789	0.501	-0.529	0.385	-1.251	0.747	3.895*	0.030
15	0.642*	0.044	0.150	0.605	-0.385	0.826	1.456**	0.077
16	-0.288	0.737	-1.251	0.115	0.925	0.730	5.937*	0.005
17	0.286	0.543	-0.307	0.498	0.281	0.898	2.567**	0.081
18	-0.292	0.277	-0.211	0.309	5.049*	0.000	2.902*	0.000
19	0.634*	0.036	0.121	0.493	-1.018	0.477	2.032*	0.000
20	-0.579*	0.043	0.211	0.542	3.835*	0.000	0.930	0.387

5.1.2 Stock Portfolio Level

$$CSAD(P)_{ft} = \frac{1}{N}\sum_{i=1}^{N} |R_{it} - F_t|,$$

Regression equation -

$$CSAD(P)_{ft} = \alpha + \Upsilon_1 D^{Hvolatility} |F_t| + \Upsilon_2 (1 - D^{Hvolatility}) |F_t| + \Upsilon_3 D^{Hvolatility} F_t^2 + \Upsilon_4 (1 - D^{Hvolatility}) F_t^2 + u_t$$

Portfolio	Υ_1	P value	Υ_2	P value	Υ_3	P value	Υ_4	P value
20stcoks	0.234	0.364	-0.285	0.166	0.212	0.880	3.410*	0.000
15stocks	0.348	0.196	-0.111	0.487	-0.054	0.971	2.944*	0.000
10stcoks	0.126	0.749	-0.455	0.164	1.258	0.356	3.832*	0.000
5stocks	0.034	0.870	-0.335*	0.037	1.758*	0.023	3.423*	0.000
S&P500	0.995**	0.093	-0.015	0.933	-1.810	0.384	2.529*	0.000

5.2 Herding on Market

5.2.1 Individual Stock Level

$$CSAD_{mt} = \sum_{t=1}^{n} |R_{it} - R_{mt}|$$

Regression Equation -

$$CSAD_{mt} = \alpha + \Upsilon_1 D^{Hvolatility} |R_{mt}| + \Upsilon_2 (1 - D^{Hvolatility}) |R_{mt}| + \Upsilon_3 D^{Hvolatility} R_{mt}^2 + \Upsilon_4 (1 - D^{Hvolatility}) R_{mt}^2 + u_t$$

Firm	Υ_1	P value	Υ_2	P value	Υ_3	P value	Υ_4	P value
1	1.960	0.137	-0.200	0.590	-9.935	0.198	3.114	0.248
2	0.361	0.393	-0.527	0.742	0.239	0.901	14.752	0.460
3	-0.497	0.123	-0.105	0.863	4.981*	0.003	2.890	0.463
4	0.153	0.655	-0.282	0.432	2.124	0.344	4.652	0.101
5	0.045	0.958	-0.489	0.459	1.892	0.708	3.002	0.308

6	-0.162	0.719	-0.094	0.743	6.078	0.229	3.623*	0.045
7	0.246	0.208	0.182	0.715	-0.488	0.612	-0.013	0.997
8	0.257	0.343	0.401	0.141	-0.331	0.883	-1.599	0.343
9	0.856*	0.038	0.189	0.621	-2.189	0.390	3.317	0.220
10	0.600	0.564	-0.856	0.244	-0.447	0.945	7.180	0.201
11	1.179**	0.065	1.290*	0.006	-3.822	0.175	-7.835*	0.010
12	-0.317	0.332	-0.505	0.160	3.602**	0.097	6.002**	0.055
13	0.365	0.406	-0.403	0.306	-0.940	0.733	4.874**	0.065
14	0.477	0.670	-0.389	0.532	0.514	0.895	2.568	0.520
15	1.021*	0.044	0.530	0.180	-3.168	0.430	-1.759	0.539
16	0.763	0.449	1.250	0.375	-2.728	0.609	-8.098	0.379
17	0.688	0.222	-1.135*	0.035	-3.967	0.200	10.011*	0.001
18	0.584	0.319	-0.044	0.877	1.016	0.831	2.853	0.129
19	0.533	0.103	0.545*	0.009	-0.911	0.625	-2.573*	0.028
20	0.838**	0.058	1.564*	0.018	-3.403	0.119	-8.391**	0.066

5.2.2 Stock Portfolio Level

$$CSAD(P)_{mt} = \frac{1}{N}\sum_{i=1}^{N} |R_{it} - R_{mt}|,$$

Regression Specification -

$$CSAD(P)_{mt} = \alpha + \Upsilon_1 D^{Hvolatility} |R_{mt}| + \Upsilon_2 (1 - D^{Hvolatility}) |R_{mt}| + \Upsilon_3 D^{Hvolatility} R_{mt}^2 + \Upsilon_4 (1 - D^{Hvolatility}) R_{mt}^2 + u_t$$

Portfolio	Υ_1	P value	Υ_2	P value	Υ_3	P value	Υ_4	P value
20stcoks	0.147	0.563	-0.167	0.339	0.916	0.611	1.899*	0.035
15stocks	0.208	0.518	0.017	0.911	0.939	0.665	1.081	0.127
10stcoks	0.422	0.267	0.041	0.908	0.712	0.764	0.048	0.980
5stocks	-0.063	0.761	-0.532*	0.003	2.113**	0.061	4.175*	0.000
S&P500	0.533	0.346	-0.122	0.615	0.720	0.700	1.694	0.253

Notes

*Statistically significant at 5% assuming conditional normality

** Statistically significant at 10% assuming conditional normality

4.3 Herding under Up and Down Market Conditions

The coefficient Υ_3 (estimation equation 9) corresponds to down market is *positive* for all firms (statistically significant at 5% significance level for eighteen firms). This fails to establish evidence for the presence of herding on foreign trading at individual stock level during down market period. Although, the coefficient Υ_4 of up market dummy is *negative* for seven firms, only one firm (Taj Lanka Hotels) becomes statistically significant at 5% (See Table 6). Similar results are observed in the regression at portfolio level under modified CSAD framework where the coefficient Υ_3 is *positive* and statistically significant at 5% significance level. The coefficient Υ_4 is *negative* (statically insignificant) for only 5stocks portfolio.

Further, the test results under standard CSAD model (as Table 6 outlines) show that the coefficient Υ_3 is *negative* (statistically insignificant at 5% or 10%) only for three

firms. The coefficient Υ_4 corresponds to up market dummy under standard CSAD model is *negative* for only four firms (not significant). Although the coefficient Υ_3 is statistically significant at 5% or 10% at portfolio level under standard CSAD framework, the recorded coefficients are *positive*. These results reject the null hypothesis for the presence of herding on foreign trading or herding towards the market, under up and down market conditions.

Table 6. Herding under Up and Down Market Condition

6.1 Herding on Foreign Trading

6.1.1 Individual Stock Level

$$CSAD_{ft} = \sum_{t=1}^{n} |R_{it} - F_t|$$

Regression equation - $CSAD_{ft} = \alpha + \Upsilon_1(1-D)F_t + \Upsilon_2 DF_t + \Upsilon_3(1-D)F_t^2 + \Upsilon_4 DF_t^2 + u_t$

Firm	Υ_1	P value	Υ_2	P value	Υ_3	P value	Υ_4	P value
1	-0.294	0.280	-0.338	0.569	2.312*	0.002	11.153*	0.004
2	-0.070	0.175	1.780	0.242	2.821*	0.000	5.568	0.675
3	-0.082	0.153	1.449*	0.000	2.173*	0.000	-1.890	0.193
4	-0.009	0.885	0.521**	0.076	2.348*	0.000	2.522	0.166
5	-0.012	0.898	0.588	0.121	2.208*	0.000	0.734	0.562
6	0.132	0.424	0.740*	0.045	3.697*	0.001	1.666	0.509
7	-0.158**	0.071	0.631*	0.015	2.125*	0.000	0.825	0.604
8	-0.145*	0.009	0.858*	0.000	1.572*	0.000	0.204	0.892
9	0.024	0.784	0.367	0.120	1.924*	0.000	1.721*	0.020
10	-0.214*	0.044	0.865	0.297	1.207*	0.007	0.859	0.739
11	0.073	0.332	-0.002	0.994	1.022*	0.000	3.208**	0.098
12	0.021	0.778	0.580*	0.021	2.195*	0.000	0.671	0.399
13	-0.142*	0.047	0.843*	0.041	1.155*	0.012	-0.927	0.687
14	0.037	0.845	0.333	0.423	1.950*	0.001	1.946	0.198
15	-0.073	0.471	1.497*	0.000	1.668*	0.000	-2.072	0.309
16	-0.141*	0.037	2.793	0.188	1.228**	0.080	-12.817	0.393
17	-0.041	0.766	0.136	0.638	0.552	0.357	2.729*	0.019
18	0.118	0.145	1.305*	0.000	2.933*	0.000	-1.626**	0.052
19	-0.125**	0.079	1.094*	0.002	1.963*	0.000	-1.659	0.456
20	-0.064	0.318	1.052*	0.016	1.141*	0.001	-0.871	0.510

6.1.2 Stock Portfolio Level

$$CSAD(P)_{ft} = \frac{1}{N}\sum_{i=1}^{N} |R_{it} - F_t|,$$

Regression equation - $CSAD(P)_{ft} = \alpha + \Upsilon_1(1-D)F_t + \Upsilon_2 DF_t + \Upsilon_3(1-D)F_t^2 + \Upsilon_4 DF_t^2 + u_t$

Portfolio	Υ_1	P value	Υ_2	P value	Υ_3	P value	Υ_4	P value
20stcoks	-0.036	0.583	0.654*	0.017	1.962*	0.000	2.797	0.112
15stocks	-0.015	0.835	0.626*	0.014	2.078*	0.000	2.950**	0.070
10stcoks	0.024	0.751	0.163	0.649	2.162*	0.000	5.458*	0.015

5stocks	-0.008	0.860	1.068*	0.000	2.209*	0.000	-0.049	0.979
S&P500	0.047	0.692	0.743*	0.038	2.288*	0.000	1.413	0.495

6.2 Herding on Market

6.2.1 Individual Stock Level

$$CSAD_{mt} = \sum_{t=1}^{n} | R_{it} - R_{mt} |$$

Regression Equation -

$$CSAD_{mt} = \alpha + \Upsilon_1(1-D)R_{mt} + \Upsilon_2 D R_{mt} + \Upsilon_3(1-D)R_{mt}^2 + \Upsilon_4 D R_{mt}^2 + u_t$$

Firm	Υ_1	P value	Υ_2	P value	Υ_3	P value	Υ_4	P value
1	-0.115	0.612	0.380	0.127	1.470*	0.044	2.915	0.627
2	0.122**	0.074	-5.672	0.127	1.077	0.117	87.349**	0.085
3	0.099	0.144	1.473*	0.012	1.147**	0.086	-2.709	0.375
4	0.063	0.408	0.508*	0.000	2.703*	0.000	3.482*	0.002
5	-0.016	0.913	-1.247**	0.052	1.110	0.415	12.828*	0.008
6	0.235	0.237	0.916*	0.008	3.858**	0.079	-0.281	0.884
7	-0.028	0.741	0.488*	0.007	0.977*	0.032	1.193	0.526
8	-0.100	0.188	0.495*	0.000	1.224	0.117	2.657*	0.003
9	0.099	0.335	0.407**	0.092	2.576*	0.012	2.244*	0.043
10	-0.069	0.687	-0.864	0.117	1.394	0.129	14.543*	0.000
11	0.240**	0.053	0.536*	0.000	0.739	0.180	-0.161	0.922
12	0.074	0.494	-0.234	0.577	1.959**	0.099	5.511**	0.073
13	0.089	0.194	0.010	0.977	0.647	0.336	4.486*	0.024
14	0.211	0.388	0.362**	0.057	1.609	0.341	1.085	0.599
15	-0.028	0.771	0.520	0.262	1.478	0.265	6.094	0.204
16	0.204*	0.033	3.437	0.102	-0.457	0.747	-8.139	0.609
17	0.265**	0.061	0.583*	0.000	-0.471	0.617	1.636*	0.001
18	0.192**	0.085	0.512**	0.085	2.945*	0.023	4.993**	0.071
19	0.068	0.272	0.375**	0.080	1.025*	0.003	3.317**	0.079
20	0.122	0.234	0.152	0.775	-0.056	0.930	4.471	0.246

6.2.2 Stock Portfolio Level

$$CSAD(P)_{mt} = \frac{1}{N}\sum_{i=1}^{N} | R_{it} - R_{mt} |,$$

Regression Specification -

$$CSAD(P)_{mt} = \alpha + \Upsilon_1(1-D)R_{mt} + \Upsilon_2 D R_{mt} + \Upsilon_3(1-D)R_{mt}^2 + \Upsilon_4 D R_{mt}^2 + u_t$$

Portfolio	Υ_1	P value	Υ_2	P value	Υ_3	P value	Υ_4	P value
20stcoks	0.134*	0.004	0.024	0.928	1.035*	0.042	19.408*	0.005
15stocks	0.163*	0.011	-0.055	0.842	1.167*	0.037	18.630*	0.005
10stcoks	0.189*	0.031	0.285	0.206	1.420**	0.099	5.762**	0.056
5stocks	0.158*	0.001	0.808*	0.024	1.182*	0.001	1.816	0.702
S&P500	0.177	0.261	0.879*	0.000	2.136*	0.007	1.244	0.469

Notes
*Statistically significant at 5% assuming conditional normality
** Statistically significant at 10% assuming conditional normality

4.3.1 Herding in the Bullish Market Conditions

The results of specification designed to test the presence of herding in the bullish market period under modified CSAD framework show that coefficient Υ_4 (introduced to capture the presence of herding during the period of bullish market) is *negative* for eleven firms. However, only one firm namely Madulsima Plantations is statistically significant at 5% significance level (See Table 7). Although statistically insignificant at 5%, the coefficient Υ_4 of 10stcoks portfolio records a *negative* value.
Out of twelve firms whose coefficient Υ_4 becomes *negative* under standard CSAD model, seven firms record significant coefficients representing 35% of the total number of firms in the sample. The residuals of *five* firms (out of seven significant firms) are heteroskedastic as estimated by equation (4). Surprisingly, three portfolios namely 20stcoks, 15stcoks and 10stcoks record *negative* and statistically significant (at 5% significance level) coefficients supporting null hypothesis for the presence herding towards the market under standard CSAD framework.

Table 7. Herding under Bullish Market Condition

7.1 Herding on Foreign Trading

7.1.1 Individual Stock Level

$$CSAD_{ft} = \sum_{t=1}^{n} | R_{it} - F_t |$$

Regression equation - $CSAD_{ft} = \alpha + \Upsilon_1 F_t + \Upsilon_2 |F_t| + \Upsilon_3 F_t^2 + \Upsilon_4 F_t^2 D^{bullish} + u_t$

Firm	Υ_1	P value	Υ_2	P value	Υ_3	P value	Υ_4	P value
1	-0.360	0.250	1.340	0.202	-2.356	0.450	0.936	0.304
2	0.046	0.645	0.032	0.925	2.572**	0.055	8.285	0.326
3	-0.001	0.981	0.005	0.973	2.327*	0.001	0.479	0.372
4	0.013	0.847	0.279	0.101	1.413*	0.026	0.176	0.834
5	0.072	0.444	-0.066	0.832	2.704*	0.004	-1.258	0.263
6	0.275**	0.085	-0.588	0.112	6.144*	0.002	-2.786	0.128
7	-0.142	0.107	0.151	0.543	1.521	0.164	0.879	0.150
8	-0.146*	0.007	0.107	0.471	1.062**	0.072	0.933	0.396
9	0.120	0.112	-0.103	0.682	2.681*	0.000	-1.313	0.164
10	-0.076	0.622	0.331	0.360	0.856	0.550	-1.147	0.301
11	0.122**	0.059	0.357	0.317	0.092	0.928	-0.193	0.761
12	0.132**	0.059	-0.435	0.114	4.005*	0.000	-1.918*	0.015
13	-0.025	0.771	-0.148	0.499	1.885**	0.095	-0.838	0.394
14	0.088	0.617	0.014	0.986	2.128	0.360	-0.798	0.678
15	0.083	0.413	0.314	0.183	0.914	0.339	0.168	0.887
16	0.002	0.987	-0.909	0.283	4.229**	0.095	0.330	0.746
17	0.181**	0.072	0.003	0.993	1.697	0.184	-1.243	0.211
18	0.195*	0.037	-0.260	0.187	3.863*	0.000	-0.544	0.585

19	-0.081	0.328	0.317	0.175	0.856	0.411	0.630	0.423
20	0.080	0.242	-0.158	0.596	2.301*	0.009	-1.137	0.293

7.1.2 Stock Portfolio Level

$$CSAD(P)_{ft} = \frac{1}{N}\sum_{i=1}^{N} | R_{it} - F_t |,$$

Regression equation - $CSAD(P)_{ft} = \alpha + \Upsilon_1 F_t + \Upsilon_2 |F_t| + \Upsilon_3 F_t^2 + \Upsilon_4 F_t^2 D^{bullish} + u_t$

Portfolio	Υ_1	P value	Υ_2	P value	Υ_3	P value	Υ_4	P value
20stcoks	-0.023	0.766	-0.102	0.648	2.273*	0.039	0.373	0.594
15stocks	-0.008	0.926	0.034	0.866	1.941**	0.074	0.246	0.747
10stcoks	0.055	0.474	-0.185	0.584	2.872*	0.009	-0.514	0.470
5stocks	0.014	0.772	-0.187	0.162	2.785*	0.000	0.368	0.539
S&P500	0.042	0.724	0.437	0.243	0.825	0.512	0.075	0.946

7.2 Herding on Market

7.2.1 Individual Stock Level

$$CSAD_{mt} = \sum_{i=1}^{n} | R_{it} - R_{mt} |$$

Regression Equation - $CSAD_{mt} = \alpha + \Upsilon_1 R_{mt} + \Upsilon_2 |R_{mt}| + \Upsilon_3 R_{mt}^2 + R_{mt}^2 D^{bullish} + u_t$

Firm	Υ_1	P value	Υ_2	P value	Υ_3	P value	Υ_4	P value
1	-0.162	0.497	1.165	0.107	-6.063	0.158	4.062*	0.003
2	0.222*	0.011	1.295**	0.098	-6.597	0.164	12.379	0.265
3	0.188*	0.012	-0.239	0.558	2.851	0.250	0.466	0.685
4	0.123	0.125	-0.100	0.654	3.503*	0.036	-0.861	0.489
5	0.011	0.936	-0.378	0.587	4.354	0.239	-2.940*	0.039
6	0.374**	0.074	-0.515	0.290	8.113**	0.078	-5.856**	0.090
7	0.007	0.941	0.229	0.447	-0.413	0.791	0.137	0.838
8	-0.096	0.125	0.369**	0.097	-1.345	0.315	1.537	0.412
9	0.188**	0.072	0.502*	0.050	0.800	0.616	-2.815**	0.100
10	0.001	0.996	-0.134	0.852	3.671	0.507	-0.331	0.923
11	0.250*	0.005	0.684**	0.063	-2.462**	0.070	0.258	0.827
12	0.143	0.164	-0.493**	0.087	5.795*	0.014	-3.527*	0.026
13	0.183*	0.006	-0.006	0.987	1.910	0.347	-2.318*	0.037
14	0.285	0.354	-0.257	0.682	3.952	0.247	-3.645	0.391
15	0.146	0.250	0.579	0.259	-0.959	0.826	-1.669	0.512
16	0.421**	0.053	0.924	0.361	-5.959	0.306	0.388	0.842
17	0.431*	0.000	-0.033	0.942	1.505	0.528	-4.860*	0.000
18	0.308*	0.021	0.008	0.985	3.901	0.239	-3.584	0.150
19	0.097	0.130	0.512*	0.026	-2.020	0.132	1.146	0.229
20	0.226*	0.034	0.982*	0.010	-4.210*	0.042	-2.483*	0.013

7.2.2 Stock Portfolio Level

$$CSAD(P)_{mt} = \frac{1}{N}\sum_{i=1}^{N} | R_{it} - R_{mt} |,$$

Regression Specification -

$$CSAD(P)_{mt} = \alpha + \Upsilon_1 R_{mt} + \Upsilon_2 |R_{mt}| + \Upsilon_3 R_{mt}^2 + R_{mt}^2 D^{bullish} + u_t$$

Portfolio	Υ_1	P value	Υ_2	P value	Υ_3	P value	Υ_4	P value
20stcoks	0.156*	0.003	-0.043	0.797	1.606	0.166	-1.681*	0.016
15stocks	0.198*	0.007	0.035	0.846	1.557	0.161	-2.610*	0.002
10stcoks	0.235*	0.021	0.066	0.816	1.750	0.290	-3.056*	0.025
5stocks	0.165*	0.001	-0.234	0.136	2.305*	0.016	0.034	0.975
S&P500	0.210	0.261	0.140	0.706	1.711	0.283	-1.454	0.483

Notes

*Statistically significant at 5% assuming conditional normality

** Statistically significant at 10% assuming conditional normality

4.4 Herding under Excessive Transaction Volume and Trading Volume

4.4.1 High Trading Volume

Coefficient Υ_3 (equation 11) assigned to capture the herding on foreign trading under high volume trading becomes *negative* for four firms at individual stock level (not significant at 5% or 10% significance level). The coefficient Υ_4 records a *positive* value for nineteen firms, rejecting null hypothesis for the presence of herding in the months characterized by low or average trading volume at individual stock level. Coefficients Υ_3 and Υ_4 are positive for all portfolios under modified CSAD framework. These results do not provide evidence for the presence of herding on foreign trading during high volume trading period at both individual stock and portfolio levels.

The results under standard CSAD model show that, out of twelve firms with recoded *negative* coefficient Υ_3, John Keells Holdings and Renuka Foods are subject to herding towards the market at 5% and 10% significance levels respectively. Except for York Arcade Holdings and Laxapana Batteries which produce statistically significant coefficient Υ_4 at 5% and 10% significance levels respectively, none of the other individual firms records a statistically significant *negative* coefficient Υ_4 assigned to capture the presence of herding under standard CSAD model, during normal (other than high volume trading) volume trading periods. Similar results are shown under portfolio level where only two portfolios record a *negative* coefficient (Υ_3) assigned to detect herding towards the market during high volume trading period. However, the recorded coefficients are statistically insignificant. These evidence, under both CSAD frameworks, is insufficient to conclude the presence of herding in high volume trading periods.

Table 8 – Herding under High Trading Volume

8.1 Herding on Foreign Trading

8.1.1 Individual Stock Level

$$CSAD_{ft} = \sum_{t=1}^{n} |R_{it} - F_t|$$

Regression equation -

$$CSAD_{ft} = \alpha + \Upsilon_1 D^{Hvol} |F_t| + \Upsilon_2 (1 - D^{Hvol}) |F_t| + \Upsilon_3 D^{Hvol} F_t^2 + \Upsilon_4 (1 - D^{Hvol}) F_t^2 + u_t$$

Firm	Υ_1	P value	Υ_2	P value	Υ_3	P value	Υ_4	P value
1	2.579	0.162	0.547	0.152	-5.758	0.282	0.344	0.818
2	0.344	0.326	0.340	0.627	1.628	0.110	3.475*	0.025
3	0.526*	0.030	-0.239	0.117	0.417	0.626	3.481*	0.000
4	0.607**	0.076	0.168	0.332	0.483	0.674	1.756*	0.007
5	0.096	0.814	-0.163	0.676	1.917	0.124	2.914*	0.038
6	-0.177	0.694	-0.943*	0.009	2.470**	0.060	8.356*	0.000
7	0.534*	0.011	-0.184	0.369	-0.203	0.780	3.308*	0.000
8	0.345	0.170	-0.087	0.676	0.389	0.655	1.947**	0.086
9	-0.040	0.902	-0.140	0.646	1.998**	0.079	2.807*	0.002
10	1.055	0.250	-0.205	0.568	-2.085	0.579	2.933*	0.015
11	0.375	0.320	0.442	0.231	-0.100	0.930	-0.186	0.877
12	-0.322	0.498	-0.531*	0.027	3.005*	0.026	4.306*	0.000
13	-0.537*	0.040	-0.036	0.897	3.134*	0.002	1.289	0.440
14	-0.122	0.839	0.139	0.884	2.683	0.117	1.382	0.654
15	0.150	0.574	0.501**	0.070	1.626	0.101	0.139	0.903
16	-0.584	0.527	-0.947	0.238	3.889	0.140	3.934	0.148
17	-0.190	0.625	0.166	0.730	2.007	0.106	0.994	0.671
18	-0.032	0.919	-0.304	0.205	2.315*	0.012	4.433*	0.001
19	0.480	0.135	0.314	0.250	1.247	0.182	0.379	0.815
20	-0.325	0.396	-0.047	0.892	2.928*	0.012	1.544	0.218

8.1.2 Stock Portfolio Level

$$CSAD(P)_{ft} = \frac{1}{N}\sum_{i=1}^{N} |R_{it} - F_t|,$$

Regression equation -

$$CSAD(P)_{ft} = \alpha + \Upsilon_1 D^{Hvol}|F_t| + \Upsilon_2(1 - D^{Hvol})|F_t| + \Upsilon_3 D^{Hvol} F_t^2 + \Upsilon_4(1 - D^{Hvol})F_t^2 + u_t$$

Portfolio	Υ_1	P value	Υ_2	P value	Υ_3	P value	Υ_4	P value
20stcoks	-0.136	0.474	-0.058	0.842	2.659*	0.000	1.999	0.243
15stocks	-0.104	0.446	0.118	0.682	2.642*	0.000	1.493	0.388
10stcoks	-0.291	0.362	-0.150	0.683	3.002*	0.001	2.760*	0.039
5stocks	0.074	0.755	-0.258*	0.046	1.875*	0.009	3.193*	0.000
S&P500	0.440**	0.096	0.482	0.329	0.847	0.256	0.652	0.731

8.2 Herding on Market

8.2.1 Individual Stock Level

$$CSAD_{mt} = \sum_{t=1}^{n} |R_{it} - R_{mt}|$$

Regression Equation -

$$CSAD_{mt} = \alpha + \Upsilon_1 D^{Hvol}|R_{mt}| + \Upsilon_2(1 - D^{Hvol})|R_{mt}| + \Upsilon_3 D^{Hvol} R_{mt}^2 + \Upsilon_4(1 - D^{Hvol})R_{mt}^2 + u_t$$

Firm	Υ_1	P value	Υ_2	P value	Υ_3	P value	Υ_4	P value
1	2.550	0.146	0.310	0.105	-13.598	0.147	0.162	0.891
2	0.650	0.108	0.527	0.272	-0.875	0.720	3.292	0.497
3	-0.091	0.833	-0.364	0.430	3.164	0.107	4.199	0.133
4	0.141	0.752	-0.159	0.523	2.316	0.350	3.947*	0.031
5	-0.135	0.829	-0.333	0.667	0.802	0.784	3.665	0.378
6	-0.022	0.954	-0.404	0.394	2.005	0.273	7.513	0.115
7	0.183	0.296	0.229	0.546	-0.476	0.583	-0.235	0.913

8	0.618**	0.057	0.146	0.601	-3.638*	0.016	0.552	0.801
9	0.689	0.194	0.590	0.108	-1.012	0.728	0.085	0.971
10	1.407	0.285	-0.717	0.201	-4.983	0.473	7.120**	0.100
11	0.409	0.418	1.017*	0.048	0.506	0.820	-3.811**	0.076
12	0.115	0.789	-0.515**	0.087	1.998	0.476	5.233*	0.020
13	0.146	0.681	0.020	0.961	-1.049	0.593	2.149	0.380
14	-0.626	0.336	0.054	0.941	4.759	0.140	2.040	0.466
15	0.927*	0.037	0.512	0.332	-4.848**	0.068	-0.092	0.983
16	-0.017	0.987	1.277	0.295	4.202	0.401	-7.851	0.274
17	0.208	0.699	-0.136	0.813	-1.841	0.473	2.718	0.405
18	0.776**	0.095	-0.158	0.612	-3.292	0.252	5.531**	0.056
19	0.527	0.213	0.412*	0.044	-0.770	0.725	-0.972	0.458
20	0.587	0.154	1.332*	0.009	-3.137	0.147	-6.211*	0.020

8.2.2 Stock Portfolio Level

$$CSAD(P)_{mt} = \frac{1}{N}\sum_{i=1}^{N} |R_{it} - R_{mt}|,$$

Regression Specification -

$$CSAD(P)_{mt} = \alpha + \Upsilon_1 D^{Hvol}|R_{mt}| + \Upsilon_2(1 - D^{Hvol})|R_{mt}| + \Upsilon_3 D^{Hvol} R_{mt}^2 + \Upsilon_4(1 - D^{Hvol})R_{mt}^2 + u_t$$

Portfolio	Υ_1	P value	Υ_2	P value	Υ_3	P value	Υ_4	P value
20stcoks	0.067	0.740	-0.099	0.637	0.313	0.774	2.418**	0.097
15stocks	0.156	0.335	-0.020	0.931	-0.585	0.537	2.568**	0.073
10stcoks	0.110	0.728	0.045	0.886	-0.243	0.860	2.693	0.165
5stocks	-0.154	0.458	-0.333**	0.075	2.744*	0.003	3.392*	0.002
S&P500	0.246	0.374	0.039	0.925	0.491	0.690	3.116**	0.054

Notes
*Statistically significant at 5% assuming conditional normality
** Statistically significant at 10% assuming conditional normality

4.4.2 High Transaction Volume

Coefficient Υ_3 assigned to capture the presence of herding during high transaction volume has become *negative* for three firms but insignificant at 5% or 10% significance level. The coefficient Υ_4 of eighteen firms are *positive* (not significant) under modified CSAD model (estimation equation 12). Coefficient Υ_3 and Υ_4 of all portfolios are *positive* in the regression results at stock portfolio level. Under standard CSAD framework, the coefficient Υ_3 is *negative* for thirteen firms. However, only John Keells Holdings and York Arcade Holdings produce statistically significant coefficients at 5% along with Renuka Foods at 10% significance level. Coefficient Υ_3 of 15stocks and 10stocks portfolios under standard CSAD model are *negative* but not significant at 5% or 10% significance level and coefficient Υ_4 is positive for all portfolios. There is no sufficient evidence for herding towards the market at portfolio level as Υ_3 (*negative* for only two firms, although not significant at 5% or 10%), which accounts for herding during the months characterized by high transaction volume, becomes statistically insignificant.

Table 9 – Herding under High Transaction Volume

9.1 Herding on Foreign Trading

9.1.1 Individual Stock Level

$$CSAD_{ft} = \sum_{t=1}^{n} |R_{it} - F_t|$$

Regression equation -

$$CSAD_{ft} = \alpha + \Upsilon_1 D^{Htrans}|F_t| + \Upsilon_2(1 - D^{Htrans})|F_t| + \Upsilon_3 D^{Htrans} F_t^2 + \Upsilon_4(1 - D^{Htrans})F_t^2 + u_t$$

Firm	Υ_1	P value	Υ_2	P value	Υ_3	P value	Υ_4	P value
1	2.589	0.166	0.533	0.158	-5.631	0.286	0.407	0.786
2	0.364	0.286	0.304	0.663	1.545	0.114	3.564*	0.025
3	0.415	0.115	-0.219	0.183	0.706	0.425	3.471*	0.000
4	0.534	0.133	0.196	0.258	0.716	0.537	1.680*	0.011
5	0.010	0.981	-0.147	0.713	2.074**	0.095	2.941*	0.037
6	-0.305	0.507	-0.958*	0.010	2.762*	0.035	8.421*	0.000
7	0.404**	0.060	-0.169	0.430	0.095	0.890	3.330*	0.000
8	0.302	0.246	-0.079	0.713	0.513	0.558	1.945**	0.092
9	-0.187	0.570	-0.073	0.812	2.496*	0.027	2.534*	0.007
10	0.917	0.327	-0.172	0.647	-1.623	0.663	2.834*	0.026
11	0.420	0.243	0.435	0.250	-0.150	0.887	-0.229	0.855
12	-0.465	0.315	-0.502*	0.041	3.287*	0.014	4.303*	0.000
13	-0.630*	0.012	0.010	0.973	3.360*	0.001	1.146	0.500
14	-0.123	0.832	0.129	0.895	2.550	0.115	1.510	0.637
15	0.044	0.852	0.580*	0.025	2.070*	0.020	-0.226	0.836
16	-0.553	0.540	-0.968	0.241	3.703	0.138	4.123	0.142
17	-0.206	0.575	0.164	0.740	1.964**	0.076	1.042	0.664
18	-0.177	0.588	-0.273	0.269	2.671*	0.003	4.361*	0.002
19	0.440	0.179	0.340	0.239	1.328	0.142	0.366	0.824
20	-0.376	0.231	-0.044	0.902	2.875*	0.002	1.679	0.190

9.1.2 Stock Portfolio Level

$$CSAD(P)_{ft} = \frac{1}{N}\sum_{i=1}^{N} |R_{it} - F_t|,$$

Regression equation -

$$CSAD(P)_{ft} = \alpha + \Upsilon_1 D^{Htrans}|F_t| + \Upsilon_2(1 - D^{Htrans})|F_t| + \Upsilon_3 D^{Htrans} F_t^2 + \Upsilon_4(1 - D^{Htrans})F_t^2 + u_t$$

Portfolio	Υ_1	P value	Υ_2	P value	Υ_3	P value	Υ_4	P value
20stcoks	-0.202	0.261	-0.046	0.881	2.778*	0.000	2.014	0.247
15stocks	-0.169	0.155	0.138	0.643	2.772*	0.000	1.476	0.400
10stcoks	-0.296	0.326	-0.157	0.678	2.941*	0.001	2.833*	0.040
5stocks	0.044	0.859	-0.275*	0.039	1.873*	0.011	3.316*	0.000
S&P500	0.402	0.135	0.492	0.332	0.936	0.207	0.634	0.745

9.2 Herding on Market

9.2.1 Individual Stock Level

$$CSAD_{mt} = \sum_{t=1}^{n} |R_{it} - R_{mt}|$$

Regression Equation -

$$CSAD_{mt} = \alpha + \Upsilon_1 D^{Htrans}|R_{mt}| + \Upsilon_2(1 - D^{Htrans})|R_{mt}| + \Upsilon_3 D^{Htrans} R_{mt}^2 + \Upsilon_4(1 - D^{Htrans})R_{mt}^2 + u_t$$

Firm	Υ_1	P value	Υ_2	P value	Υ_3	P value	Υ_4	P value
1	2.543	0.127	0.120	0.648	-13.793	0.137	1.003	0.512
2	0.520	0.200	0.552	0.213	-0.132	0.953	3.098	0.529
3	-0.069	0.864	-0.411	0.395	2.858	0.134	4.477	0.119
4	0.180	0.666	-0.211	0.429	1.905	0.429	4.259*	0.023
5	-0.014	0.981	-0.392	0.633	-0.125	0.961	4.046	0.353
6	0.024	0.948	-0.428	0.378	1.618	0.336	7.674	0.109
7	0.297**	0.061	0.175	0.662	-1.255	0.185	0.137	0.951
8	0.629*	0.039	0.112	0.702	-3.779*	0.009	0.719	0.749
9	0.571	0.282	0.654	0.107	-0.381	0.903	-0.286	0.909
10	1.264	0.311	-0.843	0.170	-4.707	0.492	7.672**	0.087
11	0.439	0.422	0.988*	0.050	0.310	0.898	-3.645**	0.083
12	0.031	0.940	-0.530**	0.068	2.470	0.405	5.225*	0.018
13	0.211	0.515	-0.001	0.997	-1.500	0.392	2.307	0.354
14	-0.399	0.513	0.006	0.993	3.536	0.241	2.410	0.415
15	0.734*	0.042	0.604	0.260	-3.530**	0.056	-0.721	0.868
16	0.179	0.853	1.237	0.332	2.987	0.519	-7.440	0.314
17	0.283	0.627	-0.171	0.756	-2.400	0.378	2.944	0.351
18	0.699	0.115	-0.162	0.606	-3.085	0.262	5.520**	0.055
19	0.613	0.106	0.342	0.110	-1.395	0.479	-0.551	0.684
20	0.882*	0.022	1.245*	0.021	-4.764*	0.015	-5.623*	0.044

9.2.2 Stock Portfolio Level

$$CSAD(P)_{mt} = \frac{1}{N}\sum_{i=1}^{N} |R_{it} - R_{mt}|,$$

Regression Specification -

$$CSAD(P)_{mt} = \alpha + \Upsilon_1 D^{Htrans}|R_{mt}| + \Upsilon_2(1 - D^{Htrans})|R_{mt}| + \Upsilon_3 D^{Htrans} R_{mt}^2 + \Upsilon_4(1 - D^{Htrans})R_{mt}^2 + u_t$$

Portfolio	Υ_1	P value	Υ_2	P value	Υ_3	P value	Υ_4	P value
20stcoks	0.077	0.682	-0.101	0.631	0.158	0.871	2.481**	0.086
15stocks	0.183	0.221	-0.020	0.932	-0.792	0.345	2.629**	0.066
10stcoks	0.176	0.554	0.036	0.910	-0.547	0.672	2.781	0.152
5stocks	-0.092	0.630	-0.380*	0.044	2.200*	0.024	3.713*	0.001
S&P500	0.269	0.326	0.033	0.937	0.295	0.814	3.192**	0.053

Notes

*Statistically significant at 5% assuming conditional normality

** Statistically significant at 10% assuming conditional normality

4.5. Herding in the Market Crisis Period

The coefficient Υ_4 (equation 13) introduced to capture the presence of herding on foreign trading under modified CSAD framework becomes *negative* and statistically significant at 5% significance level for four firms (See Table 10). Out of these four firms, three firms produce heteroskedastic residuals under estimation (4). Except for two portfolios namely, 10stocks and 5stocks (whose *negative* coefficients are not statistically significant), all portfolios record a *positive* coefficient Υ_4. These results do not provide sufficient evidence for the presence of herding on foreign trading during the period of crisis.

Similar regression results are observed under standard CSAD model. Only one firm namely Asiri Hospital Holdings (out of eight firms with negative coefficients) produces a statistically significant negative coefficient Υ_4 at 10% significance level. None of the other firms provides statistically significant *negative* coefficients at the portfolio level or individual stock level. As such, the results suggest that there is no satisfactory

evidence to identify herding towards the market at portfolio or individual stock level during the crisis period.

Table 10 – Herding under Market Crisis

10.1 Herding on Foreign Trading

10.1.1 Individual Stock Level

$$CSAD_{ft} = \sum_{t=1}^{n} | R_{it} - F_t |$$

Regression equation - $CSAD_{ft} = \alpha + \Upsilon_1 F_t + \Upsilon_2 |F_t| + \Upsilon_3 F_t^2 + \Upsilon_4 F_t^2 D^{crsis} + u_t$

Firm	Υ_1	P value	Υ_2	P value	Υ_3	P value	Υ_4	P value
1	-0.377	0.279	1.217	0.193	-1.375	0.577	-1.543	0.179
2	0.240	0.377	0.207	0.694	3.365**	0.061	-0.630	0.523
3	-0.010	0.838	-0.060	0.696	2.842*	0.000	-0.812*	0.000
4	0.013	0.839	0.268	0.140	1.519*	0.034	-0.162	0.607
5	0.049	0.588	-0.070	0.832	2.441*	0.044	0.331	0.648
6	0.132	0.257	-0.938*	0.020	7.700*	0.000	-2.799*	0.005
7	-0.186*	0.016	-0.072	0.701	3.115*	0.000	-2.560*	0.000
8	-0.127*	0.046	0.116	0.512	1.220	0.130	-0.183	0.745
9	0.082	0.248	-0.156	0.547	2.715*	0.001	-0.164	0.603
10	-0.103	0.456	0.305	0.429	0.757	0.648	0.068	0.905
11	0.106**	0.099	0.309	0.398	0.346	0.764	-0.432	0.221
12	0.070	0.274	-0.539**	0.055	4.219*	0.000	-0.512	0.293
13	-0.020	0.794	-0.076	0.776	1.243	0.401	0.991	0.281
14	0.063	0.685	-0.027	0.975	2.202	0.460	-0.188	0.869
15	0.099	0.253	0.363	0.187	0.646	0.615	0.455	0.505
16	0.030	0.723	-0.827	0.359	3.787	0.210	0.756	0.484
17	0.152	0.132	-0.022	0.959	1.566	0.382	0.117	0.909
18	0.148*	0.032	-0.397**	0.069	4.598*	0.000	-1.260*	0.008
19	-0.049	0.552	0.388	0.152	0.547	0.685	0.577	0.485
20	0.056	0.407	-0.172	0.584	2.129*	0.039	0.192	0.584

10.1.2 Stock Portfolio Level

$$CSAD(P)_{ft} = \frac{1}{N}\sum_{i=1}^{N} | R_{it} - F_t |,$$

Regression equation - $CSAD(P)_{ft} = \alpha + \Upsilon_1 F_t + \Upsilon_2 |F_t| + \Upsilon_3 F_t^2 + \Upsilon_4 F_t^2 D^{crsis} + u_t$

Portfolio	Υ_1	P value	Υ_2	P value	Υ_3	P value	Υ_4	P value
20stcoks	-0.014	0.835	-0.084	0.764	2.229	0.136	0.101	0.897
15stocks	0.000	0.999	0.052	0.842	1.869	0.217	0.141	0.868
10stcoks	0.042	0.559	-0.212	0.556	2.942*	0.027	-0.155	0.780
5stocks	0.011	0.814	-0.210	0.113	3.016*	0.000	-0.370	0.195
S&P500	0.053	0.647	0.473	0.251	0.603	0.723	0.387	0.647

10.2 Herding on Market

10.2.1 Individual Stock Level

$$CSAD_{mt} = \sum_{t=1}^{n} | R_{it} - R_{mt} |$$

Regression Equation - $CSAD_{mt} = \alpha + \Upsilon_1 R_{mt} + \Upsilon_2 |R_{mt}| + \Upsilon_3 R_{mt}^2 + \Upsilon_4 R_{mt}^2 D^{crsis} + u_t$

Firm	Υ_1	P value	Υ_2	P value	Υ_3	P value	Υ_4	P value
1	-0.089	0.706	0.986	0.109	-3.903	0.206	-10.055	0.284

2	0.458	0.115	0.630	0.133	0.643	0.838	-5.649**	0.053
3	0.183**	0.053	-0.297	0.489	3.353	0.166	1.665	0.668
4	0.134	0.172	-0.050	0.862	3.179**	0.060	-0.829	0.805
5	0.034	0.802	-0.166	0.826	2.446	0.533	31.459*	0.000
6	0.239	0.157	0.479	0.308	0.843	0.809	-1.787	0.777
7	0.035	0.690	0.203	0.551	-0.329	0.860	-4.406	0.104
8	-0.062	0.284	0.079	0.764	0.914	0.614	18.974	0.163
9	0.125	0.262	0.922*	0.022	-2.301	0.335	-2.874	0.679
10	-0.060	0.757	-0.472	0.434	5.589	0.168	3.295	0.714
11	0.054	0.719	0.859**	0.057	-1.655	0.426	0.636	0.865
12	0.168	0.164	0.102	0.784	1.383	0.564	1.326	0.703
13	0.107	0.175	0.145	0.729	0.097	0.969	3.945	0.169
14	0.224	0.353	0.113	0.875	1.317	0.654	0.982	0.799
15	0.091	0.442	0.985*	0.030	-3.102	0.343	-3.757	0.345
16	0.407*	0.040	0.856	0.419	-5.839	0.366	3.166	0.581
17	0.208	0.202	0.319	0.536	1.716	0.543	9.388*	0.046
18	0.226*	0.027	0.618	0.181	-0.320	0.918	3.297	0.551
19	0.138**	0.055	0.568**	0.053	-2.406	0.163	-1.100	0.494
20	0.195**	0.082	1.337*	0.003	-6.297*	0.012	0.449	0.930

10.2.2 Stock Portfolio Level

$$CSAD(P)_{mt} = \frac{1}{N}\sum_{i=1}^{N} | R_{it} - R_{mt} |,$$

Regression Specification -

$$CSAD(P)_{mt} = \alpha + \Upsilon_1 R_{mt} + \Upsilon_2 |R_{mt}| + \Upsilon_3 R_{mt}^2 + \Upsilon_4 R_{mt}^2 D^{crsis} + u_t$$

Portfolio	Υ_1	P value	Υ_2	P value	Υ_3	P value	Υ_4	P value
20stcoks	0.177*	0.007	0.210	0.428	-0.229	0.884	2.924**	0.093
15stocks	0.187*	0.022	0.391	0.189	-1.089	0.521	2.458	0.221
10stcoks	0.232*	0.017	0.407	0.239	-0.735	0.655	2.625	0.146
5stocks	0.188*	0.006	-0.268	0.222	2.708*	0.029	2.563**	0.053
S&P500	0.223	0.194	0.291	0.532	0.931	0.631	1.075	0.570

Notes

*Statistically significant at 5% assuming conditional normality

** Statistically significant at 10% assuming conditional normality

5. Concluding Remarks

The first and the foremost literature of Jules Regnault (1863) as documented by Jovanovic and Le Gall (2001) and its successive extensions by Bachelier (1900) as documented in 2011 and Fama (1965) suggest that stock price changes are completely random and determined by new information. Thus, stock price changes cannot be predicted with reasonable accuracy. Contrarily, the literature shows that certain patterns of stock price changes can be observed (e.g. Mandelbrot (1963). The notion of clustering of price changes and volatility is associated with heteroskedasticity that varies over time based on firm specific information segments (See e.g. Shleifer 2000, p. 1821, Senarathne and Jayasighe 2017) and as such, the magnitude of price changes or price change volatility can be predicted (e.g. Sharpe (1964), Engle (1982)). Among many other determinants that stand contrary to the efficient stock market concept, investor herding takes priority. If the investors herd towards the market or any common market variable in general, arbitrage opportunities may be available in the market until they are eliminated by informed trading. The principle research problem as

outlined under introduction has been examined from a practical standpoint. Except for the test results of estimation equation 10 which show that returns of three portfolios (out of five) are subject to herding towards the market in the high market bullish period, the outcomes of regression estimation equations 6, 7, 9, 11, 12 and 13 do not provide sufficient evidence for the presence of herding on foreign trading or herding towards market under different market conditions. Although exclusive, these findings provide *some evidence* for the random walk behavior of stock price changes in the CSE.

Moreover, a careful observation reveals that a vast majority of firms and portfolios detected under herding is subject to heteroskedasticity (see Table 2) in equation (4). Although these observations are limited to a sample of randomly selected twenty firms from the Colombo Stock Exchange, the results suggest that the form of herding detected by CSAD is a reflection of residual heteroskedasticity (contemporaneous) of Black (1972) versions of least square regressions.

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