CHAPTER - 4

RESEARCH METHODOLOGY

This chapter highlights the points that are concerned to the way the research has been carried out. It elaborates on sample selection, sources of data and framework for analysis that will be adopted to ensure the existence of herding behavior in Indian stock market at time of stress, bull and bear market conditions, pre-crisis, during crisis and after financial crisis periods and also evaluates the turnover effect, firm size and industry type on herding.

4.1. Introduction

“A research design is a broad plan that states objectives of research project and provides the guidelines what is to be done to realize those objectives. It is, in other words, a master plan for executing a research project” (S. Jaideep, 2016). “Research design helps in answering the research questions or testing the research hypothesis. Basically, it summarizes how the research will be carried out and the tools and techniques will be used. The adoption of a particular methodology depends on the scope, purpose, availability of resources, and the target population. To adopt the right methodology and data collection techniques at the right time is essential to achieve the desired research objectives (Gill and Johnson, 2010)”.

“Research methodology involves various steps that are generally adopted by researcher in studying the research problem along with the logic behind them” (Kothari, 2006). “Research design is the specification of procedures for collecting and analyzing the data necessary to identify or react to a problem or opportunity, such that the difference between the cost of obtaining various levels of accuracy and expected value of information associated with each level of accuracy is maximized” (Tull and Hawkins, 1990). “A suitable research methodology is necessary because it helps in determining the type of data, methods of collecting data, the sampling procedure, time frame and the budget” (Hair et al., 2002). “It is a set of advance decisions that makes up the master plan specifying the methods and procedures for collecting and analyzing the information needed by the decision maker” (Hair et al., 2002; Churchill and Iacobucci, 2004; Malhotra, 2010).
“Research design explains the study period, population, sample selection, data sources, variables employed and tools used for the analysis of collected data. It is very important in determining the quality, validity and reliability of the conclusions arrived at. Therefore, research design helps to keep the computations and thinking on the path to solutions and recommendations” (Luck and Rubin, 2009).

“Stock market efficiency has two meanings. To some, market efficiency means that there is no systematic way to beat the market. To others, it means that security prices are rational – that is, reflect only fundamental or utilitarian characteristics, such as risk, but not psychological or value-expressive characteristics, such as sentiment.” Statman (1999).

“Efficient market hypothesis says that investors are rational. They have full information about the market and while making investments in the stock market investors made full use of the information about the markets, meaning thereby that investors are rational” (Fama, 1970). But, recently, various researchers highlighted the presence of irrationality in the behavior of investors while taking the investment decisions. They found that while making investments in the stock markets investors follow the tips of financial gurus or imitate the market sentiment. “In finance, this is called as investing with herd or herding behavior” (Bikchandani and Sharma, 2001; Lindhe Emma, 2012; Demirer et al., 2010).

Consistent with the previous research on herding in stock market, the study utilized the models developed by “Christie and Huang (1995), Chang, Cheng and Khorana (2000) and Lin and Fu (2010)”. This chapter shows the research methodology that has been adopted to examine the herding in Indian stock market in different time periods i.e. during the bullish and bearish market conditions, pre-crisis, during crisis and after crisis periods and the effect of turnover rate, size and industry on the herding using various parameters such as cross-sectional standard deviation, cross-sectional absolute deviation, high turnover rate, low turnover rate, market capitalization, manufacturing and non-manufacturing.

Time series dataset collected over a period of time for a large sample size gave an opportunity to test the presence of herding that will be hypothesized in the study. Augmented Dickey–Fuller test (ADF) test has been applied on different series like CSSD, CSAD, HTSD, HTAD, LTSD, LTAD, LCSD, MCSD, SCSD, LCAD, MCAD,
SCAD, SDMC, SDNMC, ADMC and ADNMC respectively to test the stationarity of the time series with a null hypothesis of unit root. Further, Jarque-Bera test, Bresuch-Godfrey Serial Correlation LM test and Auto Regressive Conditional Heteroskedasticity Lagrange Multiplier test have been applied, to test the normality, autocorrelation and heteroskedasticity of the error terms respectively. To correct the problem of autocorrelation and heteroskedasticity in some of the series, Newey- West (where the data is not continuous) and GARCH (1, 1) (where the data is continuous) models have been adopted to re-estimate the parameters.

This chapter explains the research plan that has been used to examine the herding in Indian stock market. The chapter has been divided into six parts which shows the methodology to test the hypothesis developed. The sample selection procedure and study period has been discussed in section 4.2. Section 4.3 discusses the sources of data. The next section 4.4 provides the information about the key variables used in the study. Section 4.5 shows the complete framework of analysis used in the study. Section 4.6, 4.7 and 4.8 provides the assumptions about time series analysis, univariate and multivariate analysis respectively. The last section 4.9 summarizes the present chapter.

4.2. SAMPLE SELECTION PROCEDURE AND STUDY PERIOD

4.2.1. Population and Sample Selection

The present study has taken into consideration all the companies that are comprised in the S&P CNX 500\textsuperscript{21}. CNX 500 is an index of National Stock Exchange (NSE)\textsuperscript{22} and it is considered as a representative of the Indian Stock Market. As NSE is the largest stock exchange of the country and most of the trading is done on NSE, so the study has chosen the CNX 500 index to examine herding behavior in Indian stock market.

To achieve the first objective of the study, i.e. determining herding in the Indian stock market under different market conditions and periods, data has been collected for all the companies listed on CNX 500 Index, but only those companies have been selected for the sample that have been regularly traded and survived for the

\textsuperscript{21} The S&P CNX 500 is the India’s first broad-based stock market index of the Indian Stock Market. It consists of 500 stocks listed on NSE. It represents about 96% of the total market capitalization and about 93% of the total turnover on the NSE. The S&P CNX 500 companies are disaggregated into 72 industry indices.

\textsuperscript{22} NSE is the leading stock exchange in India and the fourth largest in the world in terms of trading volume in 2015. It started its operations in 1994 and ranked as the largest stock exchange in terms of daily turnover of the equity shares every year since 1995. It is the first stock exchange which has stated screen-based and online trading in India.
whole study period (Garg and Jindal, 2014). Following the sample selection criteria, the final sample size of 270 companies (see Annexure A) which comprises 54 percent of CNX 500 Index has been taken for the analysis. The sample selection criteria adopted has been shown in table 4.1.

**Table 4.1: Sample Selection Criterion**

<table>
<thead>
<tr>
<th>Sample Selection Criteria</th>
<th>No. of Companies</th>
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<tbody>
<tr>
<td>Initial Sample of CNX500 Index companies as on September, 2014</td>
<td>500</td>
</tr>
<tr>
<td>Less: Companies with missing information for any of the years under study</td>
<td>(230)</td>
</tr>
<tr>
<td>Final Sample</td>
<td>270</td>
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</table>

*Source: Researcher’s own compilation*

For achieving the second objective of the study, i.e., to determine the impact of turnover rate on herding, final sample of the companies i.e. 270 companies have been further divided into high turnover companies and low turnover companies. Table 4.2(a) shows the sample selection criteria for on the basis of their turnover rate and Table 4.2 (b) shows the classification of companies into high and low turnover companies. First, the turnover rate of each and every company for the whole study period has been calculated. Then median turnover rate of all the companies in the sample for individual years i.e. 1999-2014 has been calculated. The companies having turnover rate more than the median turnover rate of a particular year has been considered as high turnover company (HTC) for that year and company having turnover rate less than the median turnover rate has been termed as low turnover company (LTC). In this way, for all the sixteen years HTC and LTC has been chosen (See Annexure D). High turnover standard deviation (HTSD), high turnover absolute deviation (HTAD) has been calculated for high turnover companies and low turnover companies respectively on the basis of “Lin and Fu (2010) model”. Then “CH (1995) & CCK (2000) has been applied to investigate the impact of turnover rate on herding. Turnover rate has been calculated as follows:

**Turnover Rate:** “It is the ratio of the number of shares traded in the market and total number of share outstanding for a particular stock at a particular time. The trading volume in a particular stock during a time period (annually) is defined as a percentage of the total number of shares of that stock outstanding (Lin and Fu, 2010)”. It is calculated as follows:

\[
\text{Turnover Rate} = \frac{\text{Traded Volume}}{\text{Total Shares}}
\]
Table 4.2(a): Sample selection criterion on the basis of turnover rate

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<tbody>
<tr>
<td>Sample Companies</td>
<td>270</td>
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<td>270</td>
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<tr>
<td>Less: Companies with missing information</td>
<td>(11)</td>
<td>(3)</td>
<td>(3)</td>
<td>(1)</td>
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<td>(1)</td>
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<td>(2)</td>
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<tr>
<td>Final sample</td>
<td>259</td>
<td>267</td>
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<td>269</td>
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<td>268</td>
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</tbody>
</table>

Table 4.2(b): Classification of companies in to high and low turnover companies

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<tbody>
<tr>
<td>High Turnover Companies (HTC)</td>
<td>135</td>
<td>135</td>
<td>133</td>
<td>124</td>
<td>124</td>
<td>134</td>
<td>134</td>
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<td>134</td>
<td>134</td>
<td>133</td>
</tr>
<tr>
<td>Low turnover companies(LTC)</td>
<td>124</td>
<td>132</td>
<td>134</td>
<td>145</td>
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<td>135</td>
<td>135</td>
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<td>135</td>
</tr>
</tbody>
</table>

Note: Final companies as per table 4.2(a) have been divided into high turnover companies and low turnover companies on the basis of their turnover rate. Companies having turnover rate more than the median turnover rate of final sample of companies is referred as HTC and having low turnover rate is termed as LTC.
The sample companies have been also classified on the basis of their size: Large cap, Mid cap, and Small cap companies to examine the impact of size of the firm on herding for all the sixteen years. “Market capitalization has been used as a proxy for the size of the firm” (Patro et al., 2012). To examine the size impact, the sample companies have been divided as per their market capitalization as on 31st December, 2014 which is taken as the last date of the study period. Companies having market capitalization of more than 200bn have been considered as Large cap companies (LC), companies having market capitalization between 50bn-200bn called as Mid cap companies (MC) and companies having market capitalization less than 50bn have been termed as Small-Cap companies (SC) in the study. Large-cap companies represented as LC, mid-cap companies as MC and small-cap companies as SC in the study. Out of the total sample of 270 companies, 64 are Large-Cap, 66 are Mid-Cap, and 140 are Small-Cap companies (See Annexure C).

Table 4.3: Sample selection criterion on the basis of firm size

<table>
<thead>
<tr>
<th>Company Classification as per Market-cap</th>
<th>Final Sample (N=270)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large-cap Companies</td>
<td>64</td>
</tr>
<tr>
<td>Mid-cap Companies</td>
<td>66</td>
</tr>
<tr>
<td>Small-cap Companies</td>
<td>140</td>
</tr>
</tbody>
</table>

Source: Researcher’s own compilation

Lastly, the sample companies have been divided into manufacturing and non-manufacturing companies on the basis of two-digit National Industrial Classification code. Table 4.4 shows the industry classification and the total number of companies included in each industry group. Non-manufacturing companies include financial and non-financial companies. “Manufacturing includes the physical or chemical transformation of materials, substances, or components into new products,

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24 The National Industrial Classification (NIC) is an essential Statistical Standard for developing and maintaining comparable data base according to economic activities. Economic units engaged in the same or similar kind of economic activity are classified in the same category of the NIC, regardless of whether they are incorporated enterprises, individual proprietors or government, and whether or not the parent enterprise consists of more than one establishment.
although this cannot be used as the single universal criterion for defining manufacturing. The materials, substances, or components transformed are raw materials that are products of agriculture, forestry, fishing, mining or quarrying as well as products of other manufacturing activities. Substantial alteration, renovation or reconstruction of goods is generally considered to be manufacturing”.

It is apparent from the table 4.4 that 182 companies belong to manufacturing, 75 non-manufacturing and 12 diversified companies but the study has taken only manufacturing and non-manufacturing companies for measuring the impact of industry on herding in Indian stock market (See Annexure B).

Table 4.4: Sample selection criterion on the basis of industry type

<table>
<thead>
<tr>
<th>Industry Group</th>
<th>Final Sample (N=270)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td>182</td>
</tr>
<tr>
<td>Non-manufacturing</td>
<td>75</td>
</tr>
<tr>
<td>Diversified</td>
<td>12</td>
</tr>
</tbody>
</table>

Source: Researcher’s Own Compilation

4.2.2. Period of the Study

The period of the study is sixteen years starting from January 1999 – December 2014. A Number of earlier related studies have adopted calendar year and a time frame of ten- twenty years (eg. Lao and Singh, 2011; Lin Tan, 2010; Hwang and Salmon, 2001; Huong, 2013; Sardjoe, 2012; Xu, 2006; Ibnrubbian, 2012; Garg and Jindal, 2014 etc.), so the present study has selected calendar year and sixteen years to investigate the herding in the long run. In the Indian context also, various studies have been conducted for the periods 2000-2012 (Garg and Jindal, 2014), 2003-2008 (Prosad et al., 2012) etc. but no study has been conducted for the period 1999-2014. The study period also bifurcated to pre financial crisis period 1999-2007, financial crisis period 2008-2009 and post financial crisis period 2010-2014 to study the existence of herding in Indian stock market.
4.3. Sources of Data

This study is principally empirical-based study constituting primarily of secondary data. Various sources have been tapped for retrieving the data relevant to the present study. Since, herding is a short-term observable fact (Garg and Jindal, 2014), therefore, to investigate herding in the short run for Indian scenario, the daily stock prices of 500 stocks that are listed on CNX 500 from January 1999- December 2014 has been collected from “PROWESS DATABASE” maintained by Center for Monitoring the Indian Economy (CMIE). During the period of market stress, daily data confines the scope of detecting herding, so monthly data of the same companies has been collected from the database to examine the herding during long run in the Indian stock market. Further, the database has been explored to examine the turnover rate effect and size effect such as trading volume, total number of shares of high stock companies and low stock companies at the end of every year and market capitalization at the end of the year 2014 of each and every company of the sample. The closing price of the index has been gathered from official website of NSE i.e.www.nseindia.com. The industry effect has also been measured by dividing the companies into manufacturing and non manufacturing codes which are obtained from the “National Industrial Classification Code” list issued by the Central Statistical Organisation maintained by Ministry of Statistics and Programme Implementation, Government of India, New Delhi.

4.4. Variables Selection and Description

The present study primarily aims to scrutinize the presence of herding in Indian Stock Market in different market conditions. Further, it investigates impact of turnover rate and firm size on the herding. The study also wants to investigate herding across different industry sectors over the period of study. Considering these objectives and applicability of known variables in the Indian framework, the variables exercised in the study have been operationalized.

Prowess is a database of the financial performance of over 27000 companies. It includes all the companies listed on NSE and BSE. It is maintained by Centre for Monitoring Indian Economy (CMIE). It provides time series data for the past two decades. It is built from the annual reports, quarterly financial statements, stock exchange feeds and other reliable sources.
4.4.1. Operationalization of Dependent Variables

4.4.1.1. Dependent variables used for examining the presence of herding in Indian stock market in different market conditions

A. Cross Sectional Standard Deviation: CSSD refers to measure an average propinquity of individual returns to market return. “It is the average standard deviation of each stock relative to the return of aggregate stocks in the sample (Christie and Huang, 1995)”. To calculate the CSSD for the period of study, daily as well as monthly stock return of each and every stock of the sample and also the market return of all the companies in the sample for the period of the study has been calculated. CSSD has also been calculated separately for the pre-crisis, during crisis and after crisis periods.

Stock return is the change in the price of share from its previous price. To investigate the presence of herding in different market conditions on daily and monthly basis, daily closing stock prices and monthly closing stock prices have been collected and calculated the stock return by applying the following formula:

\[ R_{i,t} = \log\left( \frac{P_t}{P_{t-1}} - 1 \right) \times 100 \]

Where, \( P_t \) and \( P_{t-1} \) are the prices of stock I at time t and t1 (Garg and Jindal, 2014).

Market Return is the change in the price of index. To calculate the market return, the closing market price of CNX 500 has been collected on the daily as well as on the monthly basis. This is also calculated in the same way as stock return has been calculated.

\[ R_{m,t} = \log\left( \frac{P_t}{P_{t-1}} - 1 \right) \times 100 \]

Where, \( P_t \) and \( P_{t-1} \) are the prices of CNX 500 at time t and t-1 (Garg and Jindal, 2014).

The level of dispersion increases when individuals assets returns differ from market return. “Christie and Huang (1995)” suggested employing cross-sectional standard deviation (CSSD) of returns which is calculated as:
CSSD_t = \sqrt{\frac{\sum_{t=1}^{N_t}(R_{i,t} - R_{m,t})^2}{N_{t-1}}}

Where $R_{i,t}$ is the observed stock return of firm $i$ at time $t$, $R_{m,t}$ is the cross-sectional average of the total number of securities in the sample at time $t$, and $N$ is the number of securities in the sample at time $t-1$.

**B. Cross Sectional Absolute Deviation:** Instead of using CSSD, “Chang et al., (2000)” used the Cross Sectional Absolute deviation as a measure for dispersion. “It is the average absolute value of deviation of each stock relative to the return of equally-weighted market portfolio” (Chang et al., 2000). To calculate CSAD, stock return and market return has to be calculated first as discussed above. This variable shows the non-linear relationship between equity return and market return which is calculated as:

$$CSAD_t = \sqrt{\frac{\sum_{t=1}^{N_t}|R_{i,t} - R_{m,t}|}{N_t}}$$

Where $R_{i,t}$ is the absolute return of security at time $t$ and $R_{m,t}$ is the average absolute return of the total number of securities in the sample and $N$ is the total number of securities in the sample at time $t$.

**4.4.1.2. Dependent variables used for investigating the impact of turnover rate effect on herding in Indian stock market**

**A. High turnover standard deviation:** HTSD refers to measure an average proximity of individual returns of high stock companies to the market return. “It is the average standard deviation of each stock relative to the return of total securities in the sample (Christie and Huang, 1995)”. The stock return of high turnover companies ($R_{h,t}$) for all the sixteen years has been calculated by using the stock return formula as discussed previously in this chapter. After calculating stock return, cross-sectional average return of high stock companies ($R_{m,t}$) has been calculated. By using the formula given by “Lin and Fu, 2010”, HTSD has been calculated as follows:

$$HTSD_t = \sqrt{\frac{\sum_{t=1}^{N_t}(R_{h,t} - R_{m,t})^2}{N_{t-1}}}$$
B. Low turnover standard deviation: LTSD refers to measure an average proximity of individual returns of high stock companies to the market return. “It is the average standard deviation of each stock relative to the return of total number of stocks in the sample (Christie and Huang, 1995)”. The stock return of low turnover companies ($R_{l,t}$) for all the sixteen years has been calculated by using the stock return formula as discussed previously in this chapter. After calculating stock return, cross-sectional average return of low stock companies ($R_{m,t}$) has been calculated. By using the formula given by “Lin and Fu, 2010”, LTSD has been calculated as follows:

$$LTSD_t = \sqrt{\frac{\sum_{t=1}^{N_t} (R_{l,t} - R_{m,t})^2}{N_{t-1}}}$$

C. High turnover absolute deviation (HTAD): “It is the average absolute value of deviation of each high stock relative to the return of equally-weighted total number of high stock companies in the market” (Chang et al., 2000). To calculate HTAD, stock return and market return of each high stock company has been calculated first as discussed above and then their absolute value is calculated. This variable shows the non-linear relationship between the equity return and market return of HTC, which is calculated as:

$$HTAD_t = \sqrt{\frac{\sum_{t=1}^{N_t} |R_{h,t} - R_{m,t}|}{N_t}}$$

D. Low turnover absolute deviation (LTAD): “The average absolute value of deviation of each low stock relative to the return of equally-weighted total number of low stock companies in the market” (Chang et al., 2000). To calculate LTAD, stock return and market return of each low stock company has been calculated first as discussed above and then their absolute value is calculated. This variable shows the non-linear relationship between the equity return and market return of LTC, which is calculated as:

$$LTAD_t = \sqrt{\frac{\sum_{t=1}^{N_t} |R_{l,t} - R_{m,t}|}{N_t}}$$
4.4.1.3. Dependent variables used for investigating the impact of size effect on herding in the Indian stock market

A. Large-Cap Standard Deviation: LCSD refers to measure an average proximity of individual returns of large-cap companies to the market return. “It is the average standard deviation of each stock relative to the return of entire stocks in the sample (Christie and Huang, 1995)”. The monthly stock return of large-cap companies \( R_{lc, t} \) for all the sixteen years has been calculated by using the stock return formula as discussed previously in this chapter. After calculating stock return, cross-sectional average return of large-cap companies \( R_{m, t} \) has been calculated. By using the formula given by “Christie and Huang, 1995”, LCSD has been calculated as follows:

\[
LCSD_t = \sqrt{\frac{\sum_{t=1}^{N_t} (R_{lc, t} - R_{m, t})^2}{N_t}}
\]

B. Mid-Cap Standard Deviation: MCSD refers to measure an average proximity of individual returns of large-cap companies to the market return. “It is the average standard deviation of each stock relative to the return of total shares in the sample (Christie and Huang, 1995)”. The monthly stock return of mid-cap companies \( R_{mc, t} \) for all the sixteen years has been calculated by using the stock return formula as discussed previously in this chapter. After calculating stock return, cross-sectional average return of large-cap companies \( R_{m, t} \) has been calculated. By using the formula given by “Christie and Huang, 1995”, MCSD has been calculated as follows:

\[
MCSD_t = \sqrt{\frac{\sum_{t=1}^{N_t} (R_{mc, t} - R_{m, t})^2}{N_t}}
\]

C. Small-cap Standard Deviation: SCSD refers to measure an average proximity of individual returns of large-cap companies to the market return. “It is the average standard deviation of each stock relative to the return of aggregate stocks in the sample (Christie and Huang, 1995)”. The monthly stock return of small-cap companies \( R_{sc, t} \) for all the sixteen years has been calculated by using the stock return formula as discussed previously in this chapter. After calculating stock return, cross-sectional average return of large-cap companies \( R_{m, t} \) has been calculated. By using the formula given by “Christie and Huang, 1995”, SCSD has been calculated as follows:
D. Large-cap absolute deviation: LCAD measures the absolute value of deviation of each large-cap stock to the market return. To calculate LCAD, the absolute value of stock return and market return of each and every large-cap company has been calculated to show the non-linear relationship between the equity return and market return of large-cap companies, which is calculated as:

$$LCAD_t = \sqrt{\frac{\sum_{t=1}^{N_t} |R_{l,t} - R_{m,t}|}{N_t}}$$

C. Mid-cap absolute deviation (MCAD): To determine the non-linear relationship between the mid-cap stock return with the market return, first the absolute value of stock return $|R_{mc,t}|$ and market return $|R_{m,t}|$ of the mid-caps have been calculated. After that, MCAD by using the following formula has been calculated.

$$MCAD_t = \sqrt{\frac{\sum_{t=1}^{N_t} |R_{mc,t} - R_{m,t}|}{N_t}}$$

D. Small-cap absolute deviation: SCAD measures the absolute value of deviation of each small-cap stock to the market return. To calculate SCAD, the absolute value of stock return and market return of each and every small-cap company has been calculated to measure the non-linear relationship between the equity return and market return of small-cap companies, which is calculated as:

$$SCAD_t = \sqrt{\frac{\sum_{t=1}^{N_t} |R_{s,t} - R_{m,t}|}{N_t}}$$

4.4.1.4. Dependent variables used for investigating the impact of industry effect on herding in the Indian stock market

A. Cross-sectional standard deviation for manufacturing companies: SDMNC refers to measure an average proximity of individual returns of manufacturing companies to the market return. “It is the average standard deviation of each stock relative to the return of total stocks in the sample (Christie and Huang,
1995). The monthly stock return of manufacturing companies \((R_{\text{man},t})\) for all the sixteen years has been calculated by using the stock return formula as discussed previously in this chapter. After calculating stock return, cross-sectional average return of manufacturing companies \((R_{m,t})\) has been calculated. By using the formula given by “Christie and Huang, 1995”, CSSD_{\text{man}} has been calculated as follows:

\[
\text{CSSD}_{\text{man}, t} = \sqrt{\frac{\sum_{t=1}^{N_t} (R_{\text{man},ct} - R_{m,t})^2}{N_{t-1}}}
\]

B. Cross-sectional standard deviation for non-manufacturing companies:

“SDNMC refers to measure an average proximity of individual returns of non-manufacturing companies to the market return. It is the average standard deviation of each stock relative to the return of equally-weighted market portfolio (Christie and Huang, 1995)”. The monthly stock return of non-manufacturing companies \((R_{\text{nman},t})\) for all the sixteen years has been calculated by using the stock return formula as discussed previously in this chapter. After calculating stock return, cross-sectional average return of manufacturing companies \((R_{m,t})\) has been calculated. By using the formula given by “Christie and Huang”, CSSD_{\text{nman}} has been calculated as follows:

\[
\text{CSSD}_{\text{nman}, t} = \sqrt{\frac{\sum_{t=1}^{N_t} (R_{\text{nman},ct} - R_{m,t})^2}{N_{t-1}}}
\]

C. Cross-sectional absolute deviation for manufacturing companies (CSAD_{\text{man}}):

“It is the average absolute value of deviation of each stock of the manufacturing industry relative to the return of equally-weighted total number of stock companies in the manufacturing market” (Chang et al., 2000). To calculate CSAD_{\text{man}}, stock return and market return of each stock of the manufacturing company has been calculated first as discussed above and then their absolute value is calculated. This variable shows the non-linear relationship between the equity return and market return of MC, which is calculated as:

\[
\text{CSAD}_{\text{man}, t} = \sqrt{\frac{\sum_{t=1}^{N_t} |R_{\text{man},t} - R_{m,t}|}{N_t}}
\]
D. Cross-sectional absolute deviation for manufacturing companies (CSAD\textsubscript{nman}): “The average absolute value of deviation of each non-manufacturing stock relative to the return of equally-weighted total number of stocks in the non-manufacturing sector (Chang \textit{et al.}, 2000)”. To calculate CSAD\textsubscript{nman,t}, the absolute value of stock return and market return of each stock of non-manufacturing sector has been calculated. This variable shows the non-linear relationship between the equity return and market return of NMC, which is calculated as:

$$CSAD_{nman,t} = \sqrt{\frac{\sum_{t=1}^{N_t} |R_{nman,t} - R_{m,t}|}{N_t}}$$

4.4.2. Operationalization of Independent variables for examining the presence of herding in different time periods and market conditions; impact of turnover rate, size and industry on herding in the Indian stock market.

A. Bearish Market: “When aggregate return lie on the lower tail of the return dispersion (Christie and Huang, 1995)”. It is a situation when stock prices fall and there is a pessimistic situation generated in the market and all the investors starts selling their securities as they anticipated losses due to pessimism. Investigating the herding during the down market in the Indian stock market, bearish market situation has been calculated during the study period as suggested by the model developed by “Christie and Huang, 1995”. Various studies in the Indian context have also used this variable to examining herding during down market situation. If, on day t, $R_{m,t}$ lies in the lower limits then $D_{t}^{L}=1$ and 0 otherwise. Lower limits have been determined at 66% ($R_{m, \pm \sigma}$), 95% ($R_{m, \pm 2\sigma}$) and 99% ($R_{m, \pm 3\sigma}$).

B. Bullish Market: “It is defined as a period when aggregate return lie on the upper tail of the return dispersion (Christie and Huang, 1995)”. It is a situation when stock prices are expecting to be rise and investors stars buying the stocks and stop selling to earn profits in the future. Investigating the herding during the up market in the Indian stock market, bullish market situation has been calculated during the study period as suggested by the model developed by “Christie and Huang, 1995”. Various studies in the Indian context have also used this variable to examining herding during down market situation. If, on day t, $R_{m,t}$ lies in the upper limits then $D_{t}^{U}=1$ and 0 otherwise. Upper limits have been determined at 66% ($R_{m, \pm \sigma}$), 95% ($R_{m, \pm 2\sigma}$) and 99% ($R_{m, \pm 3\sigma}$).
C. Absolute value of Market Return \( | R_{m,t} | \): To measure the non-linear pattern of stock return and market return, absolute value of market return has been calculated for the daily as well as monthly data sets for all the objectives of the study. Market return has been taken as the average of the total number of stocks included in the sample for the period of the study.

D. Square-term of the market return \( | R_{m,t}^2 | \): The non-linear relationship has been determined between the stock return and the market return by calculating the square term of market return and taking it as an independent variable as per the “CCK, 2000” model. If the coefficient of \( | R_{m,t}^2 | \) comes negative and statistically significant, it means there is herding in the stock markets.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Variable</th>
<th>Symbol Used</th>
<th>Type of the variable</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Cross-Sectional Standard Deviation</td>
<td>CSSD</td>
<td>Dependent</td>
<td>( \sqrt{\frac{\sum_{t=1}^{N_t} (R_{i,t} - R_{m,t})^2}{N_{t-1}}} )</td>
</tr>
<tr>
<td>2.</td>
<td>Cross-Sectional Absolute Deviation</td>
<td>CSAD</td>
<td>Dependent</td>
<td>( \sqrt{\frac{\sum_{t=1}^{N_t}</td>
</tr>
<tr>
<td>3.</td>
<td>High-turnover Standard Deviation</td>
<td>HTSD</td>
<td>Dependent</td>
<td>( \sqrt{\frac{\sum_{t=1}^{N_t} (R_{h,t} - R_{m,t})^2}{N_{t-1}}} )</td>
</tr>
<tr>
<td>4.</td>
<td>Low-turnover Standard Deviation</td>
<td>LTSD</td>
<td>Dependent</td>
<td>( \sqrt{\frac{\sum_{t=1}^{N_t} (R_{l,t} - R_{m,t})^2}{N_{t-1}}} )</td>
</tr>
<tr>
<td>5.</td>
<td>High-turnover absolute deviation</td>
<td>HTAD</td>
<td>Dependent</td>
<td>( \sqrt{\frac{\sum_{t=1}^{N_t}</td>
</tr>
<tr>
<td></td>
<td>Low-turnover absolute deviation</td>
<td>LTAD Dependent</td>
<td>LTAD&lt;sub&gt;t&lt;/sub&gt;</td>
<td>( \frac{\sum_{t=1}^{N_t}</td>
</tr>
<tr>
<td>---</td>
<td>---------------------------------</td>
<td>----------------</td>
<td>------------------</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Large-Cap Standard deviation</td>
<td>LCSD Dependent</td>
<td>LCSD&lt;sub&gt;t&lt;/sub&gt;</td>
<td>( \sqrt{\frac{\sum_{t=1}^{N_t} (R_{i,t} - R_{m,t})^2}{N_{t-1}}} )</td>
</tr>
<tr>
<td>8.</td>
<td>Mid-Cap Standard deviation</td>
<td>MCSD Dependent</td>
<td>MCSD&lt;sub&gt;t&lt;/sub&gt;</td>
<td>( \sqrt{\frac{\sum_{t=1}^{N_t} (R_{m,i,t} - R_{m,t})^2}{N_{t-1}}} )</td>
</tr>
<tr>
<td>9.</td>
<td>Small-Cap Standard deviation</td>
<td>SCSD Dependent</td>
<td>SCSD&lt;sub&gt;t&lt;/sub&gt;</td>
<td>( \sqrt{\frac{\sum_{t=1}^{N_t} (R_{s,c,t} - R_{m,t})^2}{N_{t-1}}} )</td>
</tr>
<tr>
<td>10.</td>
<td>Large-Cap Absolute deviation</td>
<td>LCAD Dependent</td>
<td>LCAD&lt;sub&gt;t&lt;/sub&gt;</td>
<td>( \sqrt{\frac{\sum_{t=1}^{N_t}</td>
</tr>
<tr>
<td>11.</td>
<td>Mid-Cap Absolute deviation</td>
<td>MCAD Dependent</td>
<td>MCAD&lt;sub&gt;t&lt;/sub&gt;</td>
<td>( \sqrt{\frac{\sum_{t=1}^{N_t}</td>
</tr>
<tr>
<td>12.</td>
<td>Small-Cap Absolute deviation</td>
<td>SCAD Dependent</td>
<td>SCAD&lt;sub&gt;t&lt;/sub&gt;</td>
<td>( \sqrt{\frac{\sum_{t=1}^{N_t}</td>
</tr>
<tr>
<td>13.</td>
<td>Standard deviation for Manufacturing companies</td>
<td>SDMNC Dependent</td>
<td>( \sum_{t=1}^{N_t} \frac{(R_{mnc,t} - R_{m,t})^2}{N_t} )</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>Standard deviation for Non-Manufacturing companies</td>
<td>SDNMNC Dependent</td>
<td>( \sum_{t=1}^{N_t} \frac{(R_{nmnc,t} - R_{m,t})^2}{N_t} )</td>
<td></td>
</tr>
</tbody>
</table>

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### 4.5. Framework of Analysis

The main objective of the study is to examine the herding in the Indian stock market during different market conditions such as bullish and bearish market conditions, pre-crisis, during crisis and after crisis periods and also to investigate the impact of turnover rate, size and industry group on herding. To achieve this objective, variables used in the previous studies along with their importance and relevance have been described in the earlier sections. This section brief about the statistical tools deployed to examine the data collected for the variables in the study.

Analysis measures differ extensively in sophistication and complexity, from simple frequency distribution (percentages) to sample statistics measures (eg. Mean, median, mode, standard deviation and standard error) to multivariate data analysis techniques (viz. least square regression analysis, ARCH (1), GARCH (1, 1) and Newey-West techniques). Different analysis measures will help in statistically testing...
for substantial differences between two sample statistics and association among several variables; testing hypothesized interdependence between two or more variables; evaluating data quality; and building and testing complex models of cause-effect relationships. This section explains the research methodology used to test the hypotheses developed in the study. With the aim of achieving the objectives of the study, the data have been analyzed using built-in tests and models through EVIEWs 8.0 software. Section 4.4.1 describes the empirical tests used to scrutinize the presence of herding in Indian Stock Market in different market conditions and periods. Section 4.4.2 presents the methodology used for investigating the presence of herding on the basis of trading volume, size-wise and industry type over the study period.

4.5.1. Investigating the presence of herding in the Indian Stock market in different market conditions and periods

To investigate the presence of herding in Indian stock market, the methodologies given by “Christie and Huang (1995) (CH) and Chang, Cheng and Khorana (2000) (CCK)” have been used in the present study. “The underlying principle of these models originates from the capital asset pricing model, which expects that with increase in absolute value of the market return, the dispersion in return across securities will be increased. On the other hand, in the presence of herding, the dispersion in securities return will not deviate too far from the market return due to the suppression of investor’s own rational opinion. The dispersion in the securities return will be increasing at a decreasing rate and if the herding is very severe in the market, it may cause a decrease in dispersion. Therefore, herding differentiate itself from the capital asset pricing model leading to a testable hypothesis related to the deviation (CSSD) of returns which is calculated as:

\[
CSSD_t = \sqrt{\frac{\sum_{t=1}^{N_t} (R_{1t} - R_{mt})^2}{N_{t-1}}} \quad \text{------- (1)}
\]
Where $R_{i,t}$ is the observed stock return of firm $i$ at time $t$, $R_{m,t}$ is the cross-sectional average of the total number of stocks in the sample at time $t$, and $N$ is the number of securities in the sample.

“Chirstie and Huang (1995)” used the following regression equation to detect the herding during the market stress:

$$CSSDt = \alpha + \beta_1 D^L_t + \beta_2 D^U_t + e_t. \quad \text{(2)}$$

Where CSSD is the cross-sectional standard deviation, $\alpha$ coefficient shows average dispersion of the sample excluding the regions corresponding to the dummy variables.

Dummy variables in regression equation (2) used as explanatory variables to differentiate the periods of market stress from normal periods, taking into consideration that market stress occurred when aggregate returns lie in upper or lower tail of return dispersion. So that, $D^L_t = 1$, if, on day $t$ $R_{m,t}$ lie in lower tail of return dispersion and 0 otherwise. $D^U_t = 1$, if, on day $t$ $R_{m,t}$ lie in upper tail of return dispersion and 0 otherwise. According to the model, statistically significant negative values of $\beta_1$ and $\beta_2$ in equation (2) will indicate the presence of herding”.

“To investigate the nonlinear pattern of herding, Chang, Cheng and Khorrana (2000) model has been used. CCK (2000) in their study found that a rational asset pricing model expects a linear relationship between the market volatility and return dispersion under normal market conditions. This shows that with the increase in market return, the dispersion in individual stock return will also increase and vice versa. Instead of using CSSD, CCK used cross-sectional absolute deviation (CSAD) of market return. CCK has given the following equation to detect the herding under all the conditions i.e. over the whole distribution of market return:

$$CSAD_t = \alpha + \beta_1 |R_{m,t}| + \beta_2 |R_{m,t}^2| + e_t \quad \text{---- (3)}$$

Where CSAD is a measure of return dispersion, which is measured by cross-sectional absolute deviation:

$$CSAD_t = \sqrt{\frac{\sum_{t=1}^{N_t} |R_{i,t} - R_{m,t}|}{N_t}} \quad \text{------------- (4)}$$
Where $R_{i,t}$ is the return of security at time $t$ and $R_{m,t}$ is the average return of the total number of securities in the sample. It should be noted that both $|R_{m,t}|$ absolute value of the market return at time $t$ and its squared term $R_{m,t}^2$ are included as independent variables in equation (3).

A positive and statistically significant coefficient of $\beta_1$ in equation (3) will indicate that there is a linear relationship between market volatility and return dispersion. To find the nonlinear relationship, a nonlinear market return variable $R_{m,t}^2$ will be included in the equation (3), where the presence of negative and significant $\beta_2$ will indicate herd behavior”.

“To investigate the presence of herding during bull and bear phases of market individually, the following two equations have been used:

$$CSAD_{t, UP} = \alpha + \beta_{1,UP} | R_{m,t, UP} | + \beta_{2,UP} R_{m,t, UP}^2 + e_t \quad \quad \cdots (5)$$

$$CSAD_{t, DOWN} = \alpha + \beta_{1,DOWN} | R_{m,t, DOWN} | + \beta_{2,DOWN} R_{m,t, DOWN}^2 + e \quad \quad \cdots (6)$$

Where $R_{m,t, UP}$ is the market return at time $t$ when the market rises; $R_{m,t, UP}^2$ is the quadratic term of previous one; and is the CSAD at time $t$ corresponding to $R_{m,t, UP}$.

Similar symbols with superscript DOWN are used respectively in the case of down market. Furthermore, the absolute value of $R_{m,t, UP}$ and $R_{m,t, DOWN}$ used to simplify the comparison of the linear term coefficient in equation (5) and (6). The market has been considered to be rising when its return will be larger than zero; otherwise it has been regarded as falling. Here also negative and significant $\beta_{2,UP}$ and $\beta_{2,DOWN}$ will capture herding behavior.

To check the herding in extreme high and low market conditions using CCK model, the following two equations used on daily datasets with the following specifications:

$$CSAD_{t, UP} = \alpha + \beta_{1,UP} | R_{m,t, UP} | \cdot D_{t, U} + \beta_{2,UP} R_{m,t, UP}^2 \cdot D_{t, U} + e_t, R_{m,t} > 0 \quad \quad \cdots (7)$$

$$CSAD_{t, DOWN} = \alpha + \beta_{1,DOWN} | R_{m,t, DOWN} | \cdot D_{t, L} + \beta_{2,DOWN} R_{m,t, DOWN}^2 \cdot D_{t, L} + e_t, R_{m,t} < 0 \quad \quad \cdots (8)$$
Where $D_{t}^{U} = 1$, if the market return on day $t$ lies in the extreme upper tail of the distribution and equal to zero otherwise, and $D_{t}^{L} = 1$, if the market return on day $t$ lies on the extreme lower tail of the distribution and is equal to zero otherwise. To decide about the upper tail and lower tail, again 1%, 5% and 10% criteria will be used”.

“CH model” has also been employed for three sub-sample periods: before financial crisis (1999-2007), during financial crisis (2008-09) and after financial crisis (2010-2014).

4.5.2. Investigate the impact of turnover rate on herding

To test the turnover rate (traded volume/ total shares) effect on herding, the model suggested by “Lin and Fu (2010)” will be used. HTSD, LTSD have been calculated for the HTC and LTC companies respectively as discussed above in the earlier sections. To determine the non-linear relationship and herding in high and low companies during bull and bear phase individually and in extreme up and down market conditions, “CCK (2000) model” has been used. LTAD and HTAD have been calculated as per “CCK (2000)” are shown in the previous sections.

To detect the herding in high stock companies and low stock companies during market stress, following equations have been used:

$$HTSD_t = \alpha + \beta_1 D_{t}^{U} + \beta_2 D_{t}^{L} + e_t$$  \hspace{1cm} \text{(9)}

$$LTSD_t = \alpha + \beta_1 D_{t}^{U} + \beta_2 D_{t}^{L} + e_t$$  \hspace{1cm} \text{(10)}

To determine the non-linear pattern of HTC and LTC, “CCK (2000)” has given the following equation to detect the herding under all the conditions i.e. over the whole distribution of market return:

$$HTAD_t = \alpha + \beta_1 |R_{m,t}| + \beta_2 |R^2_{m,t}| + e_t$$  \hspace{1cm} \text{(11)}

$$LTAD_t = \alpha + \beta_1 |R_{m,t}| + \beta_2 |R^2_{m,t}| + e_t$$  \hspace{1cm} \text{(12)}

4.5.3. Examining the impact of firm size on herding in the Indian stock market

To examine the impact of firm size on herding in the stock market, the whole sample will be divided according to their capitalization i.e. large-cap, mid-cap, and small-cap firms in the market. The market capitalization will be used as a proxy for firm size “(Patro et al., 2012)”. LCSD, MCSD and SCSD have been calculated as shown in the earlier section.
To detect the herding in all these types of firms during market stress, following equations have been used:

\[
\text{LCSD}_t = \alpha + \beta_1 D^U_t + \beta_2 D^L_t + e_t
\]  \hspace{1cm} \text{(13)}

\[
\text{MCSD}_t = \alpha + \beta_1 D^U_t + \beta_2 D^L_t + e_t
\]  \hspace{1cm} \text{(14)}

\[
\text{SCSD}_t = \alpha + \beta_1 D^U_t + \beta_2 D^L_t + e_t
\]  \hspace{1cm} \text{(15)}

To determine the non-linear pattern in all types of companies, “CCK (2000)” has given the following equation to detect the herding under all the conditions i.e. over the whole distribution of market return:

\[
\text{LCAD}_t = \alpha + \beta_1 |R_{m,t}| + \beta_2 |R^2_{m,t}| + e_t
\]  \hspace{1cm} \text{(16)}

\[
\text{MCAD}_t = \alpha + \beta_1 |R_{m,t}| + \beta_2 |R^2_{m,t}| + e_t
\]  \hspace{1cm} \text{(17)}

\[
\text{SCAD}_t = \alpha + \beta_1 |R_{m,t}| + \beta_2 |R^2_{m,t}| + e_t
\]  \hspace{1cm} \text{(18)}

To detect the herding in large-cap, mid-cap and small-cap during market bull and bear phase individually, following equations have been used:

\[
\text{LCAD}_t^{\text{UP}} = \alpha + \beta_1^{\text{UP}} |R_{m,t}^{\text{UP}}| + \beta_2^{\text{UP}} R^2_{m,t}^{\text{UP}} + e_t
\]  \hspace{1cm} \text{(19)}

\[
\text{LCAD}_t^{\text{DOWN}} = \alpha + \beta_1^{\text{DOWN}} |R_{m,t}^{\text{DOWN}}| + \beta_2^{\text{DOWN}} R^2_{m,t}^{\text{DOWN}} + e_t
\]  \hspace{1cm} \text{(20)}

\[
\text{MCAD}_t^{\text{UP}} = \alpha + \beta_1^{\text{UP}} |R_{m,t}^{\text{UP}}| + \beta_2^{\text{UP}} R^2_{m,t}^{\text{UP}} + e_t
\]  \hspace{1cm} \text{(21)}

\[
\text{MCAD}_t^{\text{DOWN}} = \alpha + \beta_1^{\text{DOWN}} |R_{m,t}^{\text{DOWN}}| + \beta_2^{\text{DOWN}} R^2_{m,t}^{\text{DOWN}} + e_t
\]  \hspace{1cm} \text{(22)}

\[
\text{SCAD}_t^{\text{UP}} = \alpha + \beta_1^{\text{UP}} |R_{m,t}^{\text{UP}}| + \beta_2^{\text{UP}} R^2_{m,t}^{\text{UP}} + e_t
\]  \hspace{1cm} \text{(23)}

\[
\text{SCAD}_t^{\text{DOWN}} = \alpha + \beta_1^{\text{DOWN}} |R_{m,t}^{\text{DOWN}}| + \beta_2^{\text{DOWN}} R^2_{m,t}^{\text{DOWN}} + e_t
\]  \hspace{1cm} \text{(24)}

To check the herding in extreme high and low market conditions, the following equations have been used:

\[
\text{LCAD}_t^{\text{UP}} = \alpha + \beta_1^{\text{UP}} |R_{m,t}^{\text{UP}}| \ast D_t^{\text{UP}} + \beta_2^{\text{UP}} R^2_{m,t}^{\text{UP}} \ast D_t^{\text{UP}} + e_t, R_{m,t} > 0
\]  \hspace{1cm} \text{(25)}

\[
\text{LCAD}_t^{\text{DOWN}} = \alpha + \beta_1^{\text{DOWN}} |R_{m,t}^{\text{DOWN}}| \ast D_t^{\text{DOWN}} + \beta_2^{\text{DOWN}} R^2_{m,t}^{\text{DOWN}} \ast D_t^{\text{DOWN}} + e_t, R_{m,0}
\]  \hspace{1cm} \text{(26)}
MCAD_{t}^{UP} = \alpha + \beta_{1}^{UP} | R_{m,t}^{UP} | * D_{t}^{UP} + \beta_{2}^{UP} R^{2}_{m,t}^{UP} * D_{t}^{UP} + e_{t}, R_{m,t} > 0 \quad \ldots (27)

MCAD_{t}^{DOWN} = \alpha + \beta_{1}^{DOWN} | R_{m,t}^{DOWN} | * D_{t}^{DOWN} + \beta_{2}^{DOWN} R^{2}_{m,t}^{DOWN} * D_{t}^{DOWN} + e_{t}, R_{m,t} < 0 \quad \ldots (28)

SCAD_{t}^{UP} = \alpha + \beta_{1}^{UP} | R_{m,t}^{UP} | * D_{t}^{UP} + \beta_{2}^{UP} R^{2}_{m,t}^{UP} * D_{t}^{UP} + e_{t}, R_{m,t} > 0 \quad \ldots (29)

SCAD_{t}^{DOWN} = \alpha + \beta_{1}^{DOWN} | R_{m,t}^{DOWN} | * D_{t}^{DOWN} + \beta_{2}^{DOWN} R^{2}_{m,t}^{DOWN} * D_{t}^{DOWN} + e_{t}, R_{m,t} < 0 . \quad (30)

“CH (1995) model” has also been applied on three sub-sample periods: before the financial crisis (1999-2007), during the global financial crisis (2008-09) and after the global financial crisis (2010-2014) for all types of companies individually.

4.5.4. Examining the impact of industry type on herding in the Indian stock market

To examine the impact of industry type on herding in the Indian Stock Market, sample firms will be classified into two digit groups of industries based on the NIC code: manufacturing, non-manufacturing and diversified companies. Cross-sectional standard deviation for manufacturing, non-manufacturing has been calculated and applied the regression equation using software EVIEWS 8.0 to detect the impact of herding in different sectors.

To detect the herding in different sectors during market stress, following equations have been used:

CSSD_{man,t} = \alpha + \beta_{1}^{U} + \beta_{2}^{L} + e_{t} \quad \ldots (31)

CSSD_{nman,t} = \alpha + \beta_{1}^{U} + \beta_{2}^{L} + e_{t} \quad \ldots (32)

To determine the non-linear pattern of manufacturing and non-manufacturing companies, CCK has given the following equation to detect the herding under all the conditions i.e. over the whole distribution of market return:

CSAD_{man,t} = \alpha + \beta_{1} | R_{m,t} | + \beta_{2} | R^{2}_{m,t} | + e_{t} \quad \ldots (33)

CSAD_{nman,t} = \alpha + \beta_{1} | R_{m,t} | + \beta_{2} | R^{2}_{m,t} | + e_{t} \quad \ldots (34)
To detect the herding in manufacturing companies and non-manufacturing companies during market bull and bear phase individually, following equations have been used:

\[ CSAD_{\text{man.},t}^{\text{UP}} = \alpha + \beta_1^{UP} | R_{m,t}^{UP} | + \beta_2^{UP} R^2_{m,t}^{UP} + e_t \] \hspace{1cm} \ldots (35)

\[ CSAD_{\text{man.},t}^{\text{DOWN}} = \alpha + \beta_1^{DOWN} | R_{m,t}^{DOWN} | + \beta_2^{DOWN} R^2_{m,t}^{DOWN} + e_t \] \hspace{1cm} \ldots (36)

\[ CSAD_{\text{nman.},t}^{\text{UP}} = \alpha + \beta_1^{UP} | R_{m,t}^{UP} | + \beta_2^{UP} R^2_{m,t}^{UP} + e_t \] \hspace{1cm} \ldots (37)

\[ CSAD_{\text{nman.},t}^{\text{DOWN}} = \alpha + \beta_1^{DOWN} | R_{m,t}^{DOWN} | + \beta_2^{DOWN} R^2_{m,t}^{DOWN} + e_t \] \hspace{1cm} \ldots (38)

To check the herding in extreme high and low market conditions, the following equations have been used:

\[ CSAD_{\text{man.},t}^{\text{UP}} = \alpha + \beta_1^{UP} | R_{m,t}^{UP} |* D_t^U + \beta_2^{UP} R^2_{m,t}^{UP} * D_t^U + e_t, R_{m,t} > 0 \] \hspace{1cm} \ldots (39)

\[ CSAD_{\text{man.},t}^{\text{DOWN}} = \alpha + \beta_1^{DOWN} | R_{m,t}^{DOWN} |* D_t^L + \beta_2^{DOWN} R^2_{m,t}^{DOWN} * D_t^L + e_t, R_{m,t} < 0 \] \hspace{1cm} \ldots (40)

\[ CSAD_{\text{nman.},t}^{\text{UP}} = \alpha + \beta_1^{UP} | R_{m,t}^{UP} |* D_t^U + \beta_2^{UP} R^2_{m,t}^{UP} * D_t^U + e_t, R_{m,t} > 0 \] \hspace{1cm} \ldots (41)

\[ CSAD_{\text{nman.},t}^{\text{DOWN}} = \alpha + \beta_1^{DOWN} | R_{m,t}^{DOWN} |* D_t^L + \beta_2^{DOWN} R^2_{m,t}^{DOWN} * D_t^L + e_t, R_{m,t} < 0 \] \hspace{1cm} \ldots (42)

“CH (1995) model” has been applied on three sub-sample periods: before financial crisis (1999-2007), during financial crisis (2008-09) and after financial crisis (2010-2014) for both types of industries i.e. manufacturing and non-manufacturing.

4.6. Time series Analysis and its assumptions

Time series Analysis is a collection of quantitative observations made consecutively in time. “A time series is a set of observations on the values that a variable takes at different times (Gujrati, 2003)”. Various assumptions are related to time series data. First, the time series included in the regression models should be stationary to find the true values of computed t-statistics under OLS regression (Bhaumik, 2015). Further, the autocorrelation and heteroskedasticity of the error terms should be checked.

Augmented Dickey Fuller: An augmented Dickey–Fuller test (ADF) is a test for a unit root in a time series sample. It is an augmented version of the Dickey–Fuller test for a larger and more complicated set of time series models. It has been used to check the stationarity of time series with a null hypothesis of unit root and found all the series are stationary. The results of unit root test have been shown in the table 4.6.
Table 4.6: Results of ADF- Test

<table>
<thead>
<tr>
<th></th>
<th>CSSD</th>
<th>CSAD</th>
<th>HTSD</th>
<th>LTSD</th>
<th>LCSD</th>
<th>MCSD</th>
<th>SCSD</th>
<th>SDMNC</th>
<th>SDNMC</th>
</tr>
</thead>
<tbody>
<tr>
<td>t-statistic</td>
<td>-5.81</td>
<td>-4.76</td>
<td>-5.48</td>
<td>-4.54</td>
<td>-4.19</td>
<td>-3.32</td>
<td>-2.20</td>
<td>-4.26</td>
<td>-4.23</td>
</tr>
</tbody>
</table>

Source: The results are obtained using EVIEWS 8.

**Breusch-Godfrey Serial Correlation LM Test:** It is used to check the presence of autocorrelation in the error terms of the series. “Autocorrelation is the correlation of a time series with its own past and future values. It is assumed that if there is an autocorrelation of error terms in the time series data, there is some missing information that could be commenced in the model. If the p-value of chi-square stat. (=obs. $R^2$) is less than 0.05 at 95% level, the null hypothesis of no autocorrelation has been accepted (Bhaumik, 2015)”. This test has been applied in the data and found no autocorrelation of residuals of different series except for LTSD whose value is 0.15 which is more than 0.05. To correct the autocorrelation problem, Newey and West method has been used and applied the OLS regression with HAC standard errors and improved the results. Table 4.7 shows the results of Breusch-Godfrey Serial Correlation LM test.

Table 4.7: Results of Breusch-Godfrey Serial Correlation LM Test

<table>
<thead>
<tr>
<th>Probability of obs. $R^2$</th>
<th>CSSD</th>
<th>CSAD</th>
<th>HTSD</th>
<th>LTSD</th>
<th>LCSD</th>
<th>MCSD</th>
<th>SCSD</th>
<th>SDMNC</th>
<th>SDNMC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.15</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Source: The results are obtained using EVIEWS 8.0.

**Auto Regressive Conditional Heteroskedasticity** model has been applied to check the heteroskedasticity of the error terms in the data. “If the residuals or error terms in the regression model has changed from observation to observation, it is the problem of heteroskedasticity” (Apte, 1990). “If the computed $\chi^2$ (i.e. observed $R^2$) is statistically significant at 1% level (p-value<0.01), it means presence of heteroskedasticity (Bhaumik, 2015)”. To remove the problem of heteroskedasticity found in the error terms of data, GARCH (1, 1) model has to be used. For the present
study, ARCH (1) has been applied on the error terms and the found heteroskedasticity in some of the variables. Therefore, to restrain this problem, regression results have obtained by applying Auto Regressive conditional heteroskedasticity regression method with variance and distribution specification of GARCH (1, 1) model. But, where the series are not continuous, instead of using GARCH (1, 1) model; Newey-West method has been used to solve the problem of heteroskedasticity.

Table 4.8: Results of heteroskedasticity (ARCH Test)

<table>
<thead>
<tr>
<th>CSSD</th>
<th>CSAD</th>
<th>HTSD</th>
<th>LTSD</th>
<th>LCSD</th>
<th>MCSD</th>
<th>SCSD</th>
<th>SDMNC</th>
<th>SDNMC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prob. of Obs. * R²</td>
<td>0.00</td>
<td>0.00</td>
<td>0.83</td>
<td>0.05</td>
<td>0.17</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Source: The results are obtained using EVIEW 8.0.

4.7. Univariate Analysis and Normality Test

“Univariate analysis is suitable for single measurement of each element in the sample. It is the simplest form of statistical analysis. “Uni” means “one”, so it deals with only one variable. It can be inferential and descriptive. But its major purpose is to describe. Descriptive statistics helps in providing the important information about the variable used in the study. So, in order to examine the variables under study, descriptive statistics i.e. mean, median, range and standard deviation of the variables have been used”.

“The most fundamental assumption underlying many statistical techniques is that data should be normally distributed (Hair et al., 1998)”. The normality assumption permits us to derive the probability, or sampling distribution of β₁ and β₂. It simplifies the task of establishing confidence intervals and test statistical inferences. Normally distributed data develops the reliability and validity of the results obtained with many statistical techniques. Therefore, Jarque-Bera test has been used to test the normality of the data. This test measures the difference of skewness and kurtosis of the series with those from the normal distribution. Table 4.9 shows the results of normality test of all the variables. It has been found that the p-value of all the variables are less than 0.05, hence the distributions are non-normal. Though the series are not normal but one can still rely on the results obtained by OLS and considered
robust and valid, because of the large sample size (N=270) having 3994 daily observations for the study (Wooldridge, 2003). Central limit Theorem has been used in the case of non-normality. This theorem states that normality assumption is no longer required when the sample is large (Johnson and Wichern, 2003).

Table 4.9: Results of Jarque-Bera Test

<table>
<thead>
<tr>
<th></th>
<th>CSSD</th>
<th>CSAD</th>
<th>HTSD</th>
<th>HTAD</th>
<th>LTSD</th>
<th>LTAD</th>
<th>LCSD</th>
<th>LCAD</th>
<th>MCSD</th>
<th>MCAD</th>
<th>SCSD</th>
<th>SCAD</th>
<th>SDMNC</th>
<th>SDNMC</th>
</tr>
</thead>
<tbody>
<tr>
<td>t-statistic</td>
<td>2485.40</td>
<td>1222.394</td>
<td>1.38</td>
<td>2.72</td>
<td>27.56</td>
<td>15.24</td>
<td>288.43</td>
<td>217.62</td>
<td>202.23</td>
<td>96.70</td>
<td>16.66</td>
<td>16.45</td>
<td>156.5062</td>
<td>178.6398</td>
</tr>
<tr>
<td>Prob.</td>
<td>0.00</td>
<td>0.00</td>
<td>0.50</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Source: The results are obtained using EVIEWS 8.0.

4.8. Multivariate Analysis

Multivariate analysis helps in analyzing more than two variables at one time. This technique is suitable to find out the relationship when there are more than two independent variables and one dependent variable present in the study.

The data in the present study concerned to the sixteen years from January 1999-December 2014 and included 270 S&P CNX 500 Index listed companies with 3994 daily observations. To examine presence of herding in different market conditions, non-linear pattern and impact of turnover rate, size and industry group on herding in Indian stock market has been analysed by the regression equations given by “Christie and Huang 1995 and Chang, Cheng and Khorrranna, 2000”. “Regression analysis is a very influential and supple tool for analyzing the associative relationship between a metric dependent variable and one or more independent variables. This analysis shows the causal relation between the independent and dependent variables. A simple regression used only one independent variable whereas when there are two or more independent variables are analysed it is called as multiple regression”.

The herding in Indian stock market in different periods examined using the least square regression analysis in EVIEWS 8.0 software. After analyzing the regression equations, ARCH (1) test has been applied on the error terms generated.
from the regression results to detect the heteroskedasticity. The problem of heteroskedasticity has been found in some of the series and corrected by GARCH (1,1) model in case of continuous data and with Newey-West procedure in case of non-continuous data.

### 4.9. Summary

This chapter explains the research methods used to examine the herding in the Indian stock market in different market situations and time periods and also find out the impact of turnover rate, size and industry group on the herding. The population and sample selection criteria for all the objectives of the study have been discussed. Further, the sources of the data from where the data has been gathered, time period for which the study has been conducted and the framework of analysis has been discussed. Inclusive information about the dependent and independent variables of the study has been explained. The summary of the variables definition, symbols used, their source has been given in the table 4.5. To check the assumptions of time series data, results of unit root test, autocorrelation, heteroskedasticity and normality of the error terms has also been reported in the table 4.6, 4.7, 4.8 and 4.9 respectively. Table 4.10 elaborates on summary of regression models used in the study. It provides a quick look on the research methodology used to attain the objectives of the study. It also shows the tools and techniques adopted to fulfill the stated objectives.
Table 4.10: Summary of Regression Models and Research Methodology

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Regression Models</th>
<th>Methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td>To examine the presence of herding in different market conditions</td>
<td>CSSD$_t = \alpha + \beta_1 D_t + \beta_2 D_t^U + e_t$</td>
<td>ADF test, Least square using EVIEWS 8, Serial-Correlation LM Test, Jarque-Bera Test, Arch Test using lag(1) and GARCH (1,1).</td>
</tr>
<tr>
<td>To examine the non-linear pattern of herding in the Indian stock market</td>
<td>CSAD$_t = \alpha + \beta_1</td>
<td>R_{m,t}</td>
</tr>
<tr>
<td>To determine herding in bull and bear phases of the Indian stock market</td>
<td>CSAD$_t^{UP} = \alpha + \beta_1^{UP}</td>
<td>R_{m,t}^{UP}</td>
</tr>
<tr>
<td></td>
<td>CSAD$_t^{DOWN} = \alpha + \beta_1^{DOWN}</td>
<td>R_{m,t}^{DOWN}</td>
</tr>
<tr>
<td>To examine the non-linear pattern of herding in the Indian stock market during up and down market situations</td>
<td>CSAD$_t^{UP} = \alpha + \beta_1^{UP}</td>
<td>R_{m,t}^{UP}</td>
</tr>
<tr>
<td></td>
<td>CSAD$_t^{DOWN} = \alpha + \beta_1^{DOWN}</td>
<td>R_{m,t}^{DOWN}</td>
</tr>
</tbody>
</table>
| To investigate the impact of turnover rate on herding | $HTSD_t = \alpha + \beta_1 D_{t} + \beta_2 D_{t} + e_t$  
$LTSD_t = \alpha + \beta_1 D_{t} + \beta_2 D_{t} + e_t$ | ADF test, Serial-Correlation LM Test, Jarque-Bera Test, Least square using EVIEWS 8, Arch Test using lag(1) and GARCH (1,1). |
| To examine the non-linear pattern of herding in the high and low turnover companies | $HTAD_t = \alpha + \beta_1 | R_{m,t} | + \beta_2 | R^2_{m,t} | + e_t$  
$LTAD_t = \alpha + \beta_1 | R_{m,t} | + \beta_2 | R^2_{m,t} | + e_t$ | ADF test, Serial-Correlation LM Test, Jarque-Bera Test, Least square using EVIEWS 8, Arch Test using lag(1) and GARCH (1,1). |
| To detect herding during bull and bear phases in the high and low volume companies | $HTAD_{t,UP} = \alpha + \beta_1 | R_{m,t,UP} | + \beta_2 | R^2_{m,t,UP} | + e_t$  
$HTAD_{t,DOWN} = \alpha + \beta_1 | R_{m,t,DOWN} | + \beta_2 | R^2_{m,t,DOWN} | + e_t$  
$LTAD_{t,UP} = \alpha + \beta_1 | R_{m,t,UP} | + \beta_2 | R^2_{m,t,UP} | + e_t$  
$LTAD_{t,DOWN} = \alpha + \beta_1 | R_{m,t,DOWN} | + \beta_2 | R^2_{m,t,DOWN} | + e_t$ | ADF test, Serial-Correlation LM Test, Jarque-Bera Test, Least square using EVIEWS 8, Arch Test using lag(1) and Newey-West. |
| To examine the herding in high and low volume companies during extreme up and down market situations | $HTAD_{t,UP} = \alpha + \beta_1 | R_{m,t,UP} | * D_{t,UP} + \beta_2 | R^2_{m,t,UP} | * D_{t,UP} + e_t, R_{m,t,UP} > 0$  
$HTAD_{t,DOWN} = \alpha + \beta_1 | R_{m,t,DOWN} | * D_{t,DOWN} + \beta_2 | R^2_{m,t,DOWN} | * D_{t,DOWN} + e_t, R_{m,t,DOWN} < 0$ | ADF test, Serial-Correlation LM Test, Jarque-Bera Test, Least square using EVIEWS 8, Arch Test using lag(1) and Newey-West. |
To investigate the impact of size on herding
\[
\text{LTAD}_t^{\text{UP}} = \alpha + \beta_1^{\text{UP}} R_{m,t}^{\text{UP}} D_t^{\text{UP}} + \beta_2^{\text{UP}} R_{m,t}^{\text{UP}} + \epsilon_t, R_{m,t} > 0
\]
\[
\text{LTAD}_t^{\text{DOWN}} = \alpha + \beta_1^{\text{DOWN}} R_{m,t}^{\text{DOWN}} D_t^{\text{DOWN}} + \beta_2^{\text{DOWN}} R_{m,t}^{\text{DOWN}} + \epsilon_t, R_{m,t} < 0
\]

To examine the non-linear pattern of herding in the different types of companies
\[
\text{LCSD}_t = \alpha + \beta_1 D_t + \beta_2 D_t + \epsilon_t
\]
\[
\text{MCSD}_t = \alpha + \beta_1 D_t + \beta_2 D_t + \epsilon_t
\]
\[
\text{SCSD}_t = \alpha + \beta_1 D_t + \beta_2 D_t + \epsilon_t
\]

To detect herding during bull and bear phases in large, mid and small-cap companies
\[
\text{LCAD}_t^{\text{UP}} = \alpha + \beta_1^{\text{UP}} R_{m,t}^{\text{UP}} D_t^{\text{UP}} + \beta_2^{\text{UP}} R_{m,t}^{\text{UP}} + \epsilon_t
\]
\[
\text{LCAD}_t^{\text{DOWN}} = \alpha + \beta_1^{\text{DOWN}} R_{m,t}^{\text{DOWN}} D_t^{\text{DOWN}} + \beta_2^{\text{DOWN}} R_{m,t}^{\text{DOWN}} + \epsilon_t
\]
\[
\text{MCAD}_t^{\text{UP}} = \alpha + \beta_1^{\text{UP}} R_{m,t}^{\text{UP}} D_t^{\text{UP}} + \beta_2^{\text{UP}} R_{m,t}^{\text{UP}} + \epsilon_t
\]
\[
\text{MCAD}_t^{\text{DOWN}} = \alpha + \beta_1^{\text{DOWN}} R_{m,t}^{\text{DOWN}} D_t^{\text{DOWN}} + \beta_2^{\text{DOWN}} R_{m,t}^{\text{DOWN}} + \epsilon_t
\]
\[
\text{SCAD}_t^{\text{UP}} = \alpha + \beta_1^{\text{UP}} R_{m,t}^{\text{UP}} D_t^{\text{UP}} + \beta_2^{\text{UP}} R_{m,t}^{\text{UP}} + \epsilon_t
\]
\[
\text{SCAD}_t^{\text{DOWN}} = \alpha + \beta_1^{\text{DOWN}} R_{m,t}^{\text{DOWN}} D_t^{\text{DOWN}} + \beta_2^{\text{DOWN}} R_{m,t}^{\text{DOWN}} + \epsilon_t
\]

ADF test, Least square using EVIEWS 8, Serial-Correlation LM Test, Jarque-Bera Test, Arch Test using lag(1) and GARCH (1,1).
To examine the herding in all types of companies during extreme up and down market situations

$$\begin{align*}
\text{LCAD}_{t, \text{UP}} &= \alpha + \beta_{1, \text{UP}} | R_{m,t} | + \beta_{2, \text{UP}} R^2_{m,t} + \beta_1 D_t \text{UP} + \beta_2 D_t \text{UP} + \epsilon_t, R_{m,t} > 0 \\
\text{LCAD}_{t, \text{DOWN}} &= \alpha + \beta_{1, \text{DOWN}} | R_{m,t} | + \beta_{2, \text{DOWN}} R^2_{m,t} + \beta_1 D_t \text{DOWN} + \beta_2 D_t \text{DOWN} + \epsilon_t, R_{m,t} < 0 \\
\text{MCAD}_{t, \text{UP}} &= \alpha + \beta_{1, \text{UP}} | R_{m,t} | + \beta_{2, \text{UP}} R^2_{m,t} + \beta_1 D_t \text{UP} + \beta_2 D_t \text{UP} + \epsilon_t, R_{m,t} > 0 \\
\text{MCAD}_{t, \text{DOWN}} &= \alpha + \beta_{1, \text{DOWN}} | R_{m,t} | + \beta_{2, \text{DOWN}} R^2_{m,t} + \beta_1 D_t \text{DOWN} + \beta_2 D_t \text{DOWN} + \epsilon_t, R_{m,t} < 0 \\
\text{SCAD}_{t, \text{UP}} &= \alpha + \beta_{1, \text{UP}} | R_{m,t} | + \beta_{2, \text{UP}} R^2_{m,t} + \beta_1 D_t \text{UP} + \beta_2 D_t \text{UP} + \epsilon_t, R_{m,t} > 0 \\
\text{SCAD}_{t, \text{DOWN}} &= \alpha + \beta_{1, \text{DOWN}} | R_{m,t} | + \beta_{2, \text{DOWN}} R^2_{m,t} + \beta_1 D_t \text{DOWN} + \beta_2 D_t \text{DOWN} + \epsilon_t, R_{m,t} < 0
\end{align*}$$

To investigate the impact of industry group on herding

$$\begin{align*}
\text{CSSD}_{\text{man.}} &= \alpha + \beta_1 D_t + \beta_2 D_t^U + \epsilon_t \\
\text{CSSD}_{\text{non-man.}} &= \alpha + \beta_1 D_t + \beta_2 D_t^U + \epsilon
\end{align*}$$

To examine the non-linear pattern of herding in the different industries

$$\begin{align*}
\text{CSAD}_{\text{man.}, t} &= \alpha + \beta_1 | R_{m,t} | + \beta_2 | R^2_{m,t} | + \epsilon_t \\
\text{CSAD}_{\text{non-man.}, t} &= \alpha + \beta_1 | R_{m,t} | + \beta_2 | R^2_{m,t} | + \epsilon_t
\end{align*}$$

ADF test, Serial-Correlation LM Test, Jarque-Bera Test, Least square using EVIEWS 8, Arch Test using lag(1) and Newey-West.
To detect herding during bull and bear phases in manufacturing and non-manufacturing companies

<table>
<thead>
<tr>
<th>Equation</th>
<th>Herding Test</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{CSAD}<em>{\text{man.t, UP}} = \alpha + \beta_1 \text{UP} \mid \text{R}</em>{m,t} \text{UP} + \beta_2 \text{UP} \text{R}_{m,t}^2 \text{UP} + e_t$</td>
<td>ADF test, Serial-Correlation LM Test, Jarque-Bera Test, Least square using E VIEWS 8, Arch Test using lag(1) and Newey-West.</td>
<td>Researcher’s Own Compilation</td>
</tr>
<tr>
<td>$\text{CSAD}<em>{\text{man.t, DOWN}} = \alpha + \beta_1 \text{DOWN} \mid \text{R}</em>{m,t} \text{DOWN} + \beta_2 \text{DOWN}$</td>
<td>ADF test, Serial-Correlation LM Test, Jarque-Bera Test, Least square using E VIEWS 8, Arch Test using lag(1) and Newey-West.</td>
<td></td>
</tr>
<tr>
<td>$\text{R}_{m,t}^2 \text{DOWN} + e_t$</td>
<td>ADF test, Serial-Correlation LM Test, Jarque-Bera Test, Least square using E VIEWS 8, Arch Test using lag(1) and Newey-West.</td>
<td></td>
</tr>
<tr>
<td>$\text{CSAD}<em>{\text{man.t, UP}} = \alpha + \beta_1 \text{UP} \mid \text{R}</em>{m,t} \text{UP} + \beta_2 \text{UP} \text{R}_{m,t}^2 \text{UP} + e_t$</td>
<td>ADF test, Serial-Correlation LM Test, Jarque-Bera Test, Least square using E VIEWS 8, Arch Test using lag(1) and Newey-West.</td>
<td></td>
</tr>
<tr>
<td>$\text{CSAD}<em>{\text{man.t, DOWN}} = \alpha + \beta_1 \text{DOWN} \mid \text{R}</em>{m,t} \text{DOWN} + \beta_2 \text{DOWN}$</td>
<td>ADF test, Serial-Correlation LM Test, Jarque-Bera Test, Least square using E VIEWS 8, Arch Test using lag(1) and Newey-West.</td>
<td></td>
</tr>
<tr>
<td>$\text{R}_{m,t}^2 \text{DOWN} + e_t$</td>
<td>ADF test, Serial-Correlation LM Test, Jarque-Bera Test, Least square using E VIEWS 8, Arch Test using lag(1) and Newey-West.</td>
<td></td>
</tr>
</tbody>
</table>

Source: Researcher’s Own Compilation
REFERENCES


