Research Paper

Reciprocity in Mutual Funds

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Abstract:- This paper is aimed to study the reciprocity in Indian mutual funds with respect to their benchmark. Funds chosen were- DSP Blackrock Top 100 and HDFC Top 200 with S&P BSE 100 and S&P BSE 200 as their benchmark index. The time-series data was taken up for 10 years ranging from 2006-2016 and econometric time series loop was run over it, followed by AR and ARMA test. Going further, Johansen co-integration test and Granger's causality test was also applied in order to study the presence of linkage between the mutual fund and its respective benchmark. Findings hinted towards co-movement amongst mutual fund and index as the results were in line till ARMA test. All the four time-series were found to be normally distributed, non-auto-correlated, stationary and homoskedastic, thus econometric loop was closed on the last step i.e. heteroskedasticity test. All the time- series were found to be following ARMA with clear evidence of man-made symmetry. But, coming on to co-integration and causality test, there was no sign linkage between mutual fund and index. Hence, neither there was co-integration nor granger causality amongst them.

Keywords: - Mutual Fund, Econometrics, Time-series JEL Codes: - G23, C01, C22

Introduction

Time series is the bunch of quantitative observations that are evenly spaced in terms of time intervals and are measured successively. Time series are analyzed in order to understand the structure and mechanism that produce resulted observations. The understanding of structure of is necessary in order to build a mathematical model on which forecasting or prediction can be based.

S&P BSE 100 was launched on January 3rd, 1989, with base year being 1983- 84, later shifted to 2012 and base being shifted from 100 to 58. Keeping in line with global trends, it was shifted to free- float methodology on April 5th, 2004. BSE 100, as the name suggests consists of 100 scripts.

With tremendous increase in listing of companies on stock exchange, a new index, in line with S&P BSE 100 was launched on May 27th, 1994, namely S&P BSE 200 containing 200 scripts. The base year of same fixed to 1989- 90 and base index value being 100.

DSP Blackrock Top 100 is an open ended equity mutual fund which was incepted on March 10th, 2003, with BSE 100 as its benchmark index. At present, the assets worth Rs 3,418 crores are being managed by Mr. Harish Zaveri. It contains 80- 100% equity, mostly in giant and large cap stocks.

HDFC Top 200 is an open ended equity mutual fund which was launched on October 11th, 1996, with BSE 200 as its benchmark index. In present scenario, asters worth Rs 12,568 crores are being managed by Mr. Rakesh Vyas and Mr. Prashant Jain. It contains 80-100% equity, with major part of it in giant and large cap stocks.

Econometric time-series loop consists of four stages:-
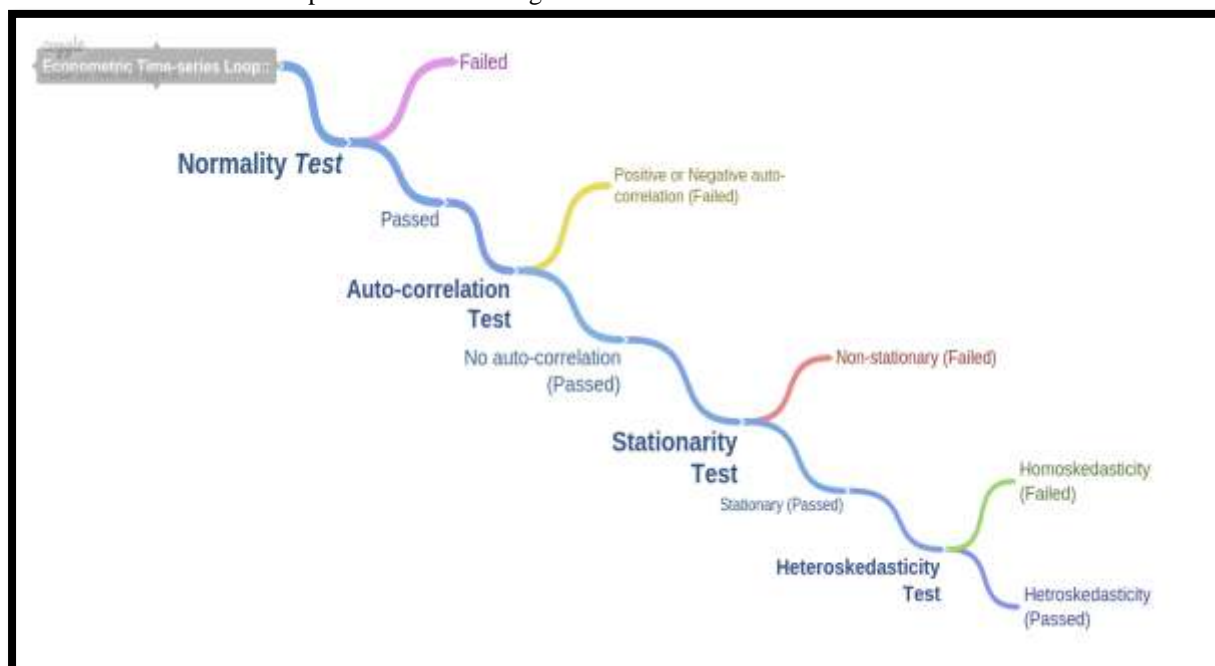

Figure 1: Structure of econometric time-series loop

Auto-regression means the repetition of an event after a definite period of time. The period of repetition can vary from one second to one month to one day to ne month to one year, going on. Thus, it is easily predictable. Moving average refers to. Due this gap between these two, we opt to ARMA which consists of both AR as well as MA. Most of the global stock markets follow ARMA

Co-integration defines the relationship between two independent time-series in terms of direction and impact. Linkage can also be seen in terms of historical data of a time-series driving the future of other time-series. Relationship can be uni- directional or bi- directional.

Every mutual fund involves a benchmark index against which its performance is compared and more often than not the fund follows the stock composition of index itself. But, there always some questions that arise- Does a mutual fund reciprocate its benchmark index? If it does so, then to which extent? Though there has been extensive research undertaken in the field of Indian stock market indices as well as mutual funds, be it in form of efficiency of Indian Markets, Time series analysis, performance, investor perception and co-integration. But, there has been no research yet conducted on the replication of mutual funds. Hence, this gap is the area of study of researcher in order to attempt to above questions in possible manner.

II.   LITERATURE REVIEW

Trivedi & Behrea (2012) on the basis of their research concluded that BSE prices were dependent on IIP, WPI, Interest rate (3- month T- bill rates), Money supply (M3), FIIs and MSCI world index. However, rising WPI and Interest rates were inversely proportional to BSE, and all others being in same direction. They also found the long- term equilibrium, thus shocks gets accommodated slowly. Totala et.al (2013) proposed that efficient markets are an essential infrastructural requirement to ensure continuous capital supply and ensure stability even during downturn. Strong efficiency refers to how quickly a market corrects itself with respect to stock prices, effected due to events like- speculation, global incidents etc. As per their research which runs down for six years spanning from April, 2006 to March, 2012, considering all the indices of NSE, concluded Indian market is not weakly efficient i.e. room for abnormal gains. Lakshmi & Roy (2012) found major Indian indices, namely, Nifty, CNX Nifty Junior, NSE 500, SENSEX, BSE 100 and BSE 500, follow Non- random walk i.e. they are predictable using various technical tool. They applied Jarque-Bera, Box Pierce, Q-statistics and Augmented Dickey-Fuller Tests on the daily, weekly and monthly data of the above indices for the period January 2000 to October 2009. Singh (2010) conducted their research in period of 1991-2002 on BSE 200, including 158 stocks, concluded in same lines of efficiency and decreased volatility in Indian stock market. Despite of LPG policy and numerous capital reforms during his period, homoskedasticity crept in and diluted the benefits of globalisation and reforms. Jayakumar G.S & A (2013) undertook auto-correlation and unit root test on all NSE indices from July, 2009 to December, 2011 and concluded there is no complete dependence on

historical prices and prudent investors can exploit the room for gains in not so strongly efficient market on the basis of rejection of null hypothesis in both the tests i.e. no auto- correlation and stationary data.. Bhatt & Nain (2014) and Tripathi & Kumar (2015) spanned their research over the period of 10 years from 2004 to 2014, on Indian pectoral indices like- NSE Bank, PSU Bank, IT, FMCG, Metals etc. found contradictory outcomes in some of them i.e. weak efficiency. They adopted DF, PP, KPSS and Variance ratio test that evidently placed Banks, Metals, PSU Banks and Realty sectors under the umbrella of weak efficiency. Joshi (2010) and Banumathy & Azhagaiah (2015) found out human interference in India's major index- CNX Nifty on the basis of ARCH and various GARCH tests conducted by them that resulted in homoskedasticity for the period of ten years, 2003- 2012. Further, on the basis of unit root test and auto-correlation test, they evidently found that series was non- auto-correlated and stationary Ghosh & Srinivasan (2014) concluded that Indian marker is sentiment driven on the basis of their research on BSE 100 market capitalisation follows investor sentiments of technical analysis- an analytical study. Sen & Bandyopadhyay (2012) concluded that volatility in Indian markets exists in long term, thus leading to high variance in futuristic returns. Alharbi (2009) based a study on Gulf cooperation Council (GCC): Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and UAE and proved the existence of volatility in long- term using GARCH models. Chong et.al (2003) discovered that Australian market was only found to be cointegrated with United States (U.S) and U.S market was found to granger cause Australian market. Thalassinos & Politis (2011) too did the study on similar ground, but taking two categories of indices i.e. European and non- European- U.S.A, Canada, Singapore, Japan and Hong Kong. In conclusion, researchers proposed that there was no co-integration in Japanese, Canadian and Singapore markets, while others were linked. Raj & Dhal (2009) concluded that Indian markets are highly influenced by U.S and U.K, in comparison to regional Asian markets like- Japan, Singapore and Hong Kong. Despite of being volatile, Indian markets constitute of better returns, thus indicating strong fundamentals and opportunity for long horizon investments. Menon et.al (2009) and Taneja (2012) while working on same ground, Indian indices were found to have long-term relation with U.S, France, Japan and Taiwan. According to Kopsch et.al (2015) fund flows into Indian mutual funds industry are dependent on factors like- market fear, exchange rate, expected inflation and investment into debt. Kotishwar (2012) and Alekhya & Saritha (2016), in their study on mutual funds, focused on investor perception/rational behind investing in mutual funds- liquidity, regular income, safety, higher returns etc and challenges faced by the industry- distribution costs, brokers and agents, service, cultural bias, awareness and financial literacy. Bihar et.al (2012) found that due to low awareness, Indian investors don't welcome mutual funds as source of investments and go for orthodox avenues like- Bank deposits etc. Kaur & Kaushik (2016) found that socio-economic characteristics like- age, gender, income and education are the factors influencing awareness about mutual funds in India. Kumar & Arora (2012) on the basis of study on mutual funds in region of Punjab, researcher found that the majority of the respondents have invested in open-ended private funds, mostly in equity oriented and hybrid funds for an average horizon of 3 years. According to Cici (2004) and Hao et.al (2014), active participation of a fund manager and informative calls over stockholding is important in order to outperform the set benchmark. Rajamohan (2015) in a study on similar ground, laid down the importance of active fund managers and the respective fund manager of a fund should be an integral rational behind choosing a fund for investment along with other parameters like- liquidity, returns, expense ratios etc. Costa & Jacob (2011) proved outperformance and portfolio construction indicates towards fund manager's capability and adequacy of benchmark selection. Ruiz & Monjas (2012) proposed adequate benchmark selection not only set the standard for performance measurement, but also affect the investment style, risk and performance of a fund Sensoy (2006) and Sinha (2015) found that investors look at risk adjusted returns and usually it is compared with the set benchmark to form an opinion about a fund's performance. Thus, deviation in positive direction is what expected out of fund's return in comparison to benchmark returns. Kumar & Kumar (2012) found that investors look out for alpha generation by a fund with respect to its benchmark, thus choice of adequate benchmark is very important. Going about study on ELSS schemes, despite of being a single asset class there was diversity in benchmark construction, depending upon philosophy, objective and portfolio of an ELSS scheme. Jones (2011) in a study on volatility in mutual funds concluded that GARCH model was effectively able to capture the nonlinearity and indicating the difficulty in predicting performance of mutual fund, though accurate forecasts can yield handsome returns. Madhavan (2014) found that ETFs had a non-linearity layout, which was well captured by GARCH model, indicating fluctuations and no single trend going forth. Sriram (2015) in his study of co-integration between oil prices and BSE index, researcher found the linkage and greater and negative impact of Oil shocks on BSE. Oil prices granger causing BSE in short- term was also found. Ahmed & Alrashidi (2015) undertook a study in similar space found totally opposite results wherein stock market drove oil prices during recession and not only this, Islamic mutual funds too influenced oil prices and the long- term linkage was spotted amongst them. Hossain et.al (2013) found the co-integration in the returns of mutual funds and Dhaka stock exchange. Also, they found the evidence of mutual funds granger causing DSE in terms of returns and turnover. Kaur (2013) in a study on performance evaluation top ten open-ended mutual funds in terms of Sharpe index, Treynor's index and Jensen's Alpha, the results were found to be

n- line with benchmark of the funds. Tasseven & Teker (2009) found co-integration between Turkish mutual funds and Turkish stock market index- ISE 30, though not that strong. Cha (2001) in a study on relationship between security returns and estimated cash flows took mutual funds as an example and found that stock market granger causes cash flows into equity mutual funds. According to Barbic & Jurkic (2010), mutual funds and index shared co-movements in Croatia. Al-haferi (2013) found out in a study that Anman stock index (Jordan-based), had a significant impact on Jordan mutual funds. But, mutual funds were granger causing the index Low & Ghazali (2007) concluded in their study that there was no co-integration between performance of Unit trust funds and index, but there was Granger Causality in direction of index to funds.

III.   RESEARCH METHODOLOGY

Funds and benchmark-
- DSP BR Top100- and BSE 100
- HDFC Top 200 and BSE 200

Time period-
- Ten years- June 16th, 2006 to June 15th, 2016
- Number of observation- 2455 (each), total- 9820

Source of data-
- Secondary source

Software Used-
- EViews 9.5

Tests-
- **Normality Test- Jarque- Berra (JB) Test:-** Probability distribution of data is studied under this test i.e. at 95% confidence level, only 2.5% data should be at each of the tail-ends of probability distribution or in other words, 95% of the data should around the mean of time-series
- **Auto- correlation Test- Durbin- Watson (DW) Test: -** Internal factors that influence the change and bring out the cyclical trend in time- series, without taking external environment into consideration.
- **Stationarity/Unit Root Test- Augmented Dicky- Fuller (ADF) Test: -** It is carried out in order to check the behaviour of a time- series when external factors are exercising their influence. Thus, when a time series goes back to its original position as an outcome of removal of external stimuli over, is treated as stationary.
- **Heteroskedasticity Test- Auto Regressive Conditional Heteroskedasticity (ARCH) Test: -** Volatility and flow of data is a studied in order to come to conclusion on predictability of data.
- **Auto-regressive (AR) Test: -** It is carried out to check whether the time-series is auto-regressive or it has some portion of moving average in it.
- **Auto-regressive moving average test ARMA (1, 1):-** It is carried to check the presence of both AR and MA portions in a time-series and also, to check whether the data is stochastic or there is some human interference.
- **Co-integration Test- Johansen Co-integration test: -** Study of direction or impact of time- series over the other.
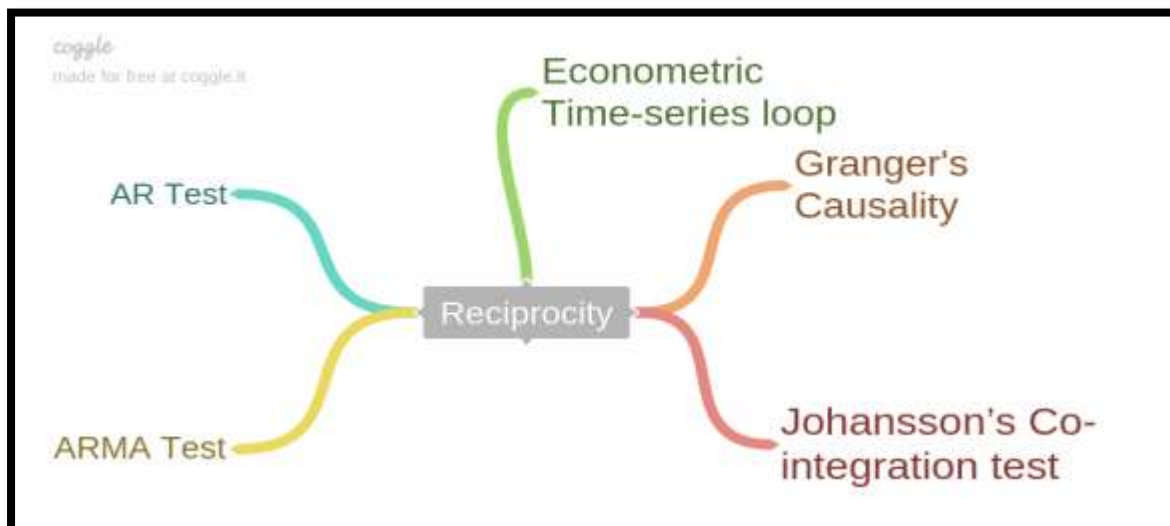- **Granger's Causality Test:-** Direction of influence i.e. unidirectional and Bi-directional is tested

Figure 2: Tests undertaken

Research Findings

This section divided into two parts-   1) DSP BR Top 100 and BSE 100
                                         2) HDFC Top 200 and BSE 200

1:- DSP BR Top 100 and BSE 100
a) Conversion of both the time series into log for reduction in standard error.

It is done in order to bring down the standard error as we dealing with large chunk of data involving 2455 observations in each time-series. Hence, it cuts down steps, facilitates predictability and increases accuracy

Figure 3- Conversion of DSP Top 100 time series to log Figure 4- Conversion of BSE 100 time series to log

b) JB Test

Null Hypothesis, H0- Time series is not normally distributed
Alternate Hypothesis, H1- Time series is normally distributed

Figure 5- Result of normality test for DSP 100

Figure 6- Result of normality test for BSE 100

Parameters	Mutual Fund	Benchmark
Mean	4.537011	8.604762
Median	4.576616	8.612232
Maximum	5.148302	9.116762
Minimum	3.670970	7.788647
Std. Dev.	0.345927	0.285130
Skewness	-0.277222	-0.416668
Kurtosis	2.397579	3.045911
Jarque- Bera	**68.5602**	**72.00644**
Probability	**0.00000**	**0.000000**
Sum	11138.36	21348.41
Sum Sq. Dev.	293.6595	201.6218

Table 1- Resultant outcome of JB test for DSP Top 100 and BSE 100

c) DW Test

Null Hypothesis, H0- Time series is auto- correlated
Alternate Hypothesis, H1- Time series is not auto- correlated

Figure 7- Result of auto-correlation test for DSP Top 100   Figure 8- Result of auto-correlation test for BSE 100

Parameters	Mutual Fund	Benchmark
Probability {CLOSEL(-1)}	0.000000	0.000000
R- squared	**0.998547**	**0.997156**
Adjusted R- squared	0.998546	0.997155
S.E of regression	0.013176	0.015195
Sum Sq. Residual	0.425716	0.572147
Log Likelihood	7143.079	6865.256
F- Statistic	16846.19	868849.1
Probability (F- stats)	0.000000	0.000000
Mean dependent variable	4.537364	8.605030
S>D of dependent variable	0.345555	0.284876
Akaike info criterion	-5.819951	-5.534884
Schwarz criterion	-5.815219	-5.530193
Hannan- Quinn criterion	-5.818231	-5.533180
Durbin- Watson Stat	**1.829759**	**1.822799**

Table 2- Resultant outcome of DW test for DSP Top 100 and BSE 100

d) ADF Test

Null Hypothesis, H0- Time series is non- stationary
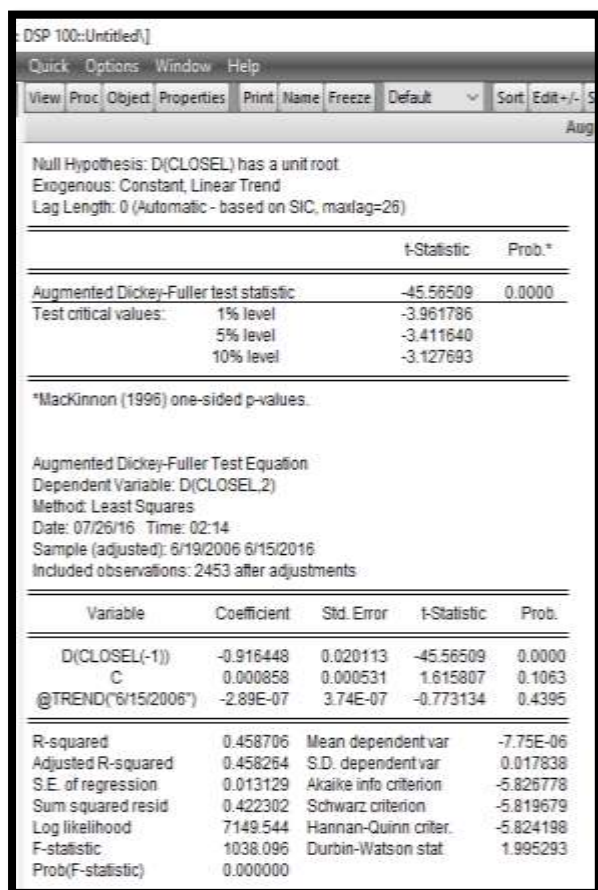Alternate Hypothesis, H1- Time series is stationary

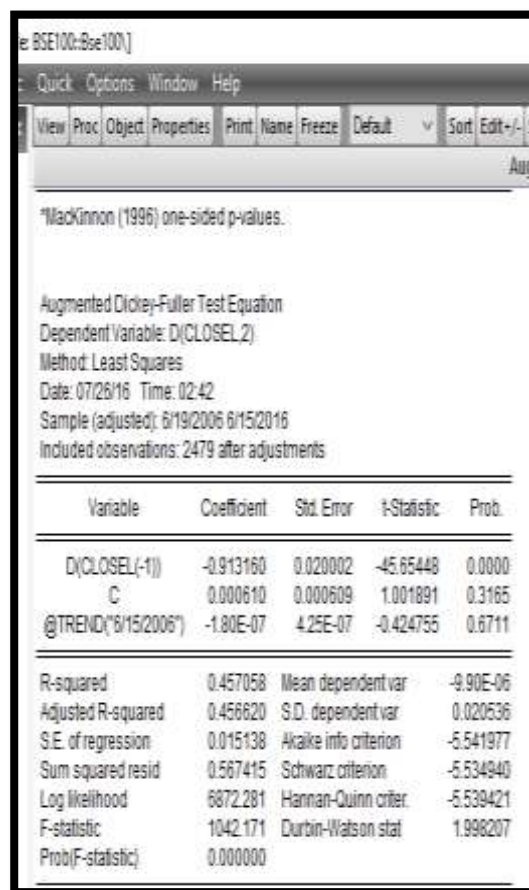Figure 9- Result of stationarity test for DSP Top 100

Figure 10- Result of stationarity test for DSP Top 100

Parameters	Mutual Fund	Benchmark
Probability {CLOSEL(-1)}	**0.000000**	**0.000000**
R- squared	0.458706	0.457058
Adjusted R- squared	0.458264	0.456620
S.E of regression	0.013129	0.015138
Sum Sq. Residual	0.422302	0.567415
Log Likelihood	7149.544	6872.281
F- Statistic	1038.096	1042.171
Probability (F- stats)	0.000000	0.000000
Mean dependent variable	-7.75E-06	-9.90E-06
S>D of dependent variable	0.017838	0.020536
Akaike info criterion	-5.826778	-5.541977
Schwarz criterion	-5.819679	-5.534940
Hannan- Quinn criterion	-5.824198	-5.539421
Durbin- Watson Stat	1.995293	1.998207

Table 3- Resultant outcome of ADF test for DSP Top 100 and BSE 100

e) ARCH Test

Null Hypothesis, H0- Time series is homoskedastic

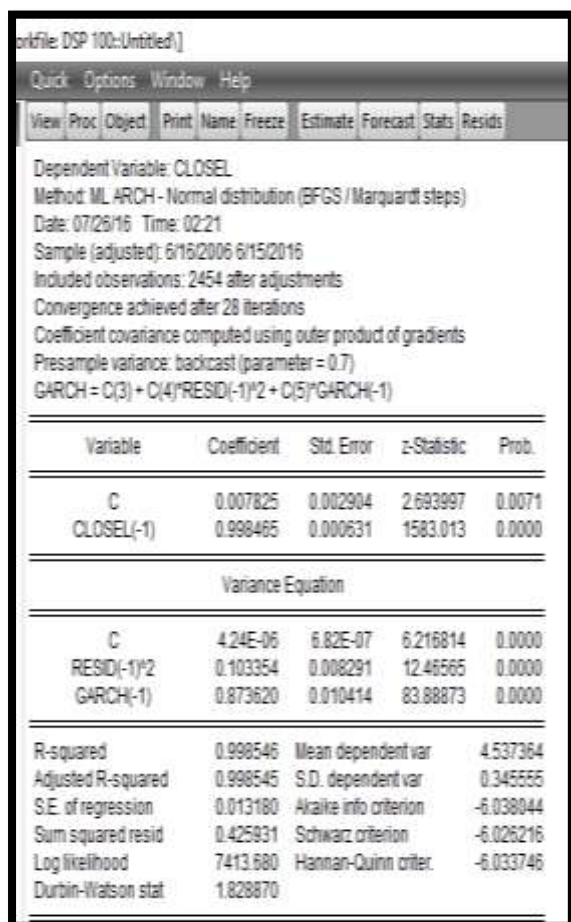Alternate Hypothesis, H1- Time series is heteroskedastic

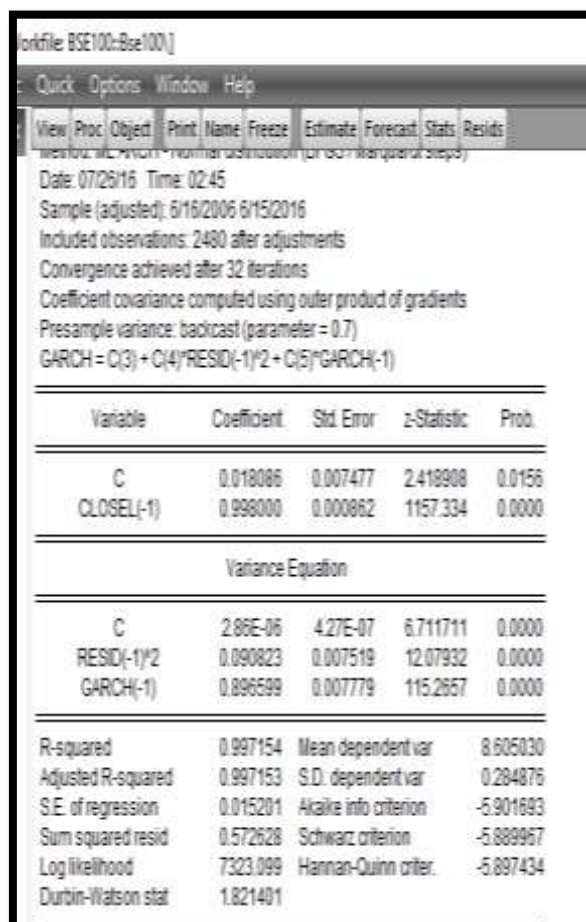Figure 11- Result of heteroskedasticity test for DSP Top 100

Figure 12- Result of heteroskedasticity test for BSE 100

Parameters	Mutual Fund	Benchmark
Probability {CLOSEL(-1)}	**0.000000**	**0.000000**
Probability [GARCH (-1)]	0.000000	0.000000
R- squared	0.998546	0.997154
Adjusted R- squared	0.998545	0.997153
S.E of regression	0.013180	0.015201
Sum Sq. Residual	0.425931	0.572628
Log Likelihood	7413.680	7323.099
Mean dependent variable	4.537364	8.605030
S>D of dependent variable	0.345555	0.284876
Akaike info criterion	-6.038044	-5.901693
Schwarz criterion	-6.026216	-5.889967
Hannan- Quinn criterion	-6.033746	-5.897434
Durbin- Watson Stat	1.828870	1.821401

Table 4- Resultant outcome of ARCH test for DSP Top 100 and BSE 100
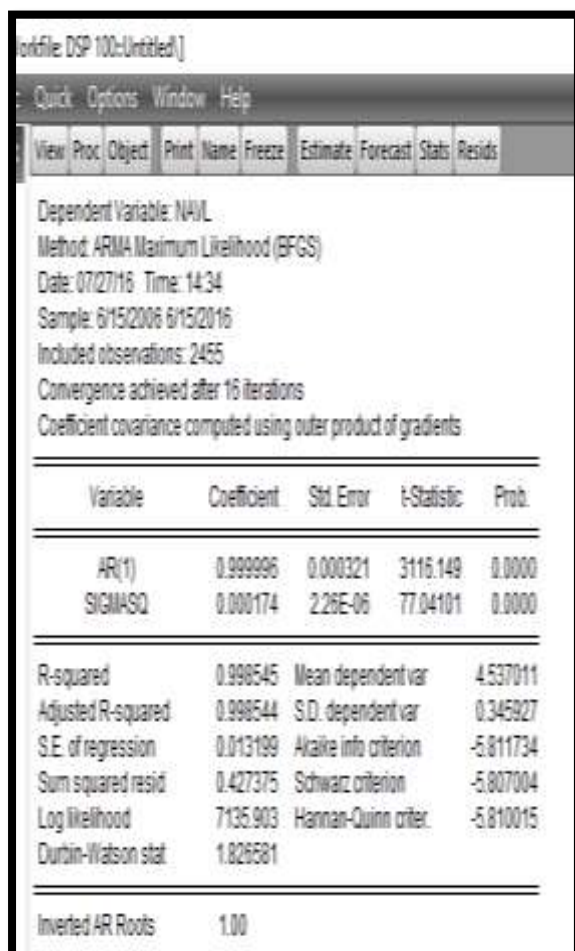
f) AR Test

Workfile: DSP 100:Untitled\]	Workfile: BSE100:Bse100\]
Quick Options Window Help	Quick Options Window Help
View Proc Object Print Name Freeze Estimate Forecast Stats Resids	View Proc Object Print Name Freeze Estimate Forecast Stats Resids
Dependent Variable: NAVL	Dependent Variable: CLOSEL
Method: ARMA Maximum Likelihood (BFGS)	Method: ARMA Maximum Likelihood (BFGS)
Date: 07/27/16 Time: 14:34	Date: 07/27/16 Time: 14:37
Sample: 6/15/2006 6/15/2016	Sample: 6/15/2006 6/15/2016
Included observations: 2455	Included observations: 2481
Convergence achieved after 16 iterations	Convergence achieved after 16 iterations
Coefficient covariance computed using outer product of gradients	Coefficient covariance computed using outer product of gradients

DSP Top 100:

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AR(1)	0.999996	0.000321	3116.149	0.0000
SIGMASQ	0.000174	2.26E-06	77.04101	0.0000
R-squared	0.998545	Mean dependent var		4.537011
Adjusted R-squared	0.998544	S.D. dependent var		0.345927
S.E. of regression	0.013199	Akaike info criterion		-5.811734
Sum squared resid	0.427375	Schwarz criterion		-5.807004
Log likelihood	7135.903	Hannan-Quinn criter.		-5.810015
Durbin-Watson stat	1.826581			
Inverted AR Roots	1.00			

BSE 100:

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AR(1)	0.999998	0.000127	7890.535	0.0000
SIGMASQ	0.000231	2.84E-06	81.54395	0.0000
R-squared	0.997154	Mean dependent var		8.604762
Adjusted R-squared	0.997153	S.D. dependent var		0.285138
S.E. of regression	0.015213	Akaike info criterion		-5.527444
Sum squared resid	0.573719	Schwarz criterion		-5.522755
Log likelihood	6858.794	Hannan-Quinn criter.		-5.525741
Durbin-Watson stat	1.822366			
Inverted AR Roots	1.00			

Figure 13- Result of AR test for DSP Top 100   Figure 14- Result of AR test for BSE 100

Parameters	Mutual Fund	Benchmark
Probability	0.000000	0.000000
R- squared	0.998544	0.997154
Durbin- Watson stat	1.826581	1.822366
Akaike Info Criterion	-5.811734	-5.527444
Schwarz Criterion	-5.807004	-5.522755
Hannan- Quinn Criterion	-5.810015	-5.525741

Table 5- Resultant outcome of AR test for DSP Top 100 and BSE 100

g) **ARMA Test**

Figure 15- Result of ARMA test for DSP Top 100

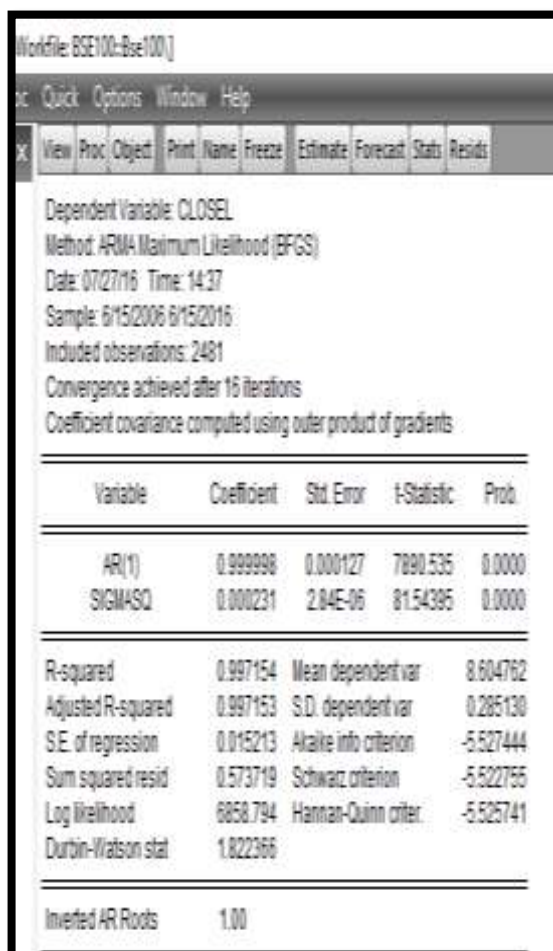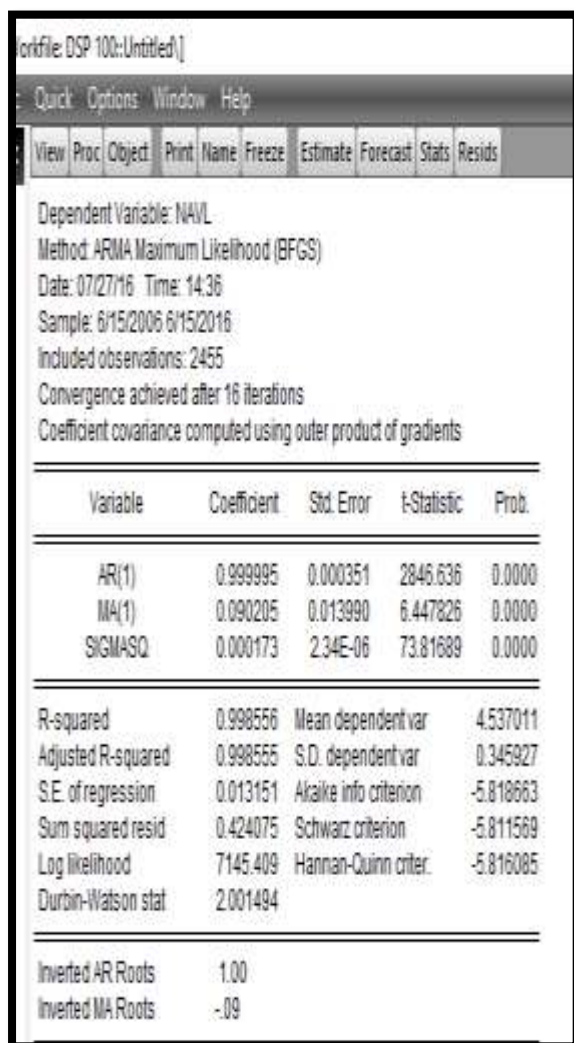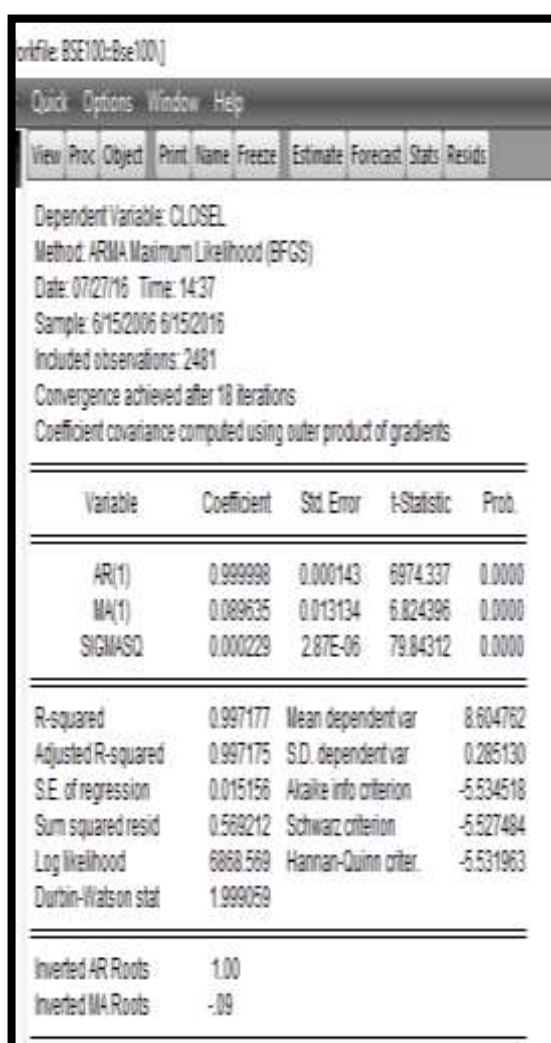Figure 16- Result of ARMA test for BSE 100

Parameters	Mutual Fund	Benchmark
Probability	0.000000	0.000000
Probability	0.000000	0.000000
R- squared	0.998556	0.997177
Durbin- Watson stat	2.001494	1.999059
Akaike Info Criterion	-5.818663	-5.534518
Schwarz Criterion	-5.811569	-5.527484
Hannan- Quinn Criterion	-5.816085	-5.531963

Table 6- Resultant outcome of ARMA test for DSP Top 100 and BSE 100

h) Johansen's Co-integration Test
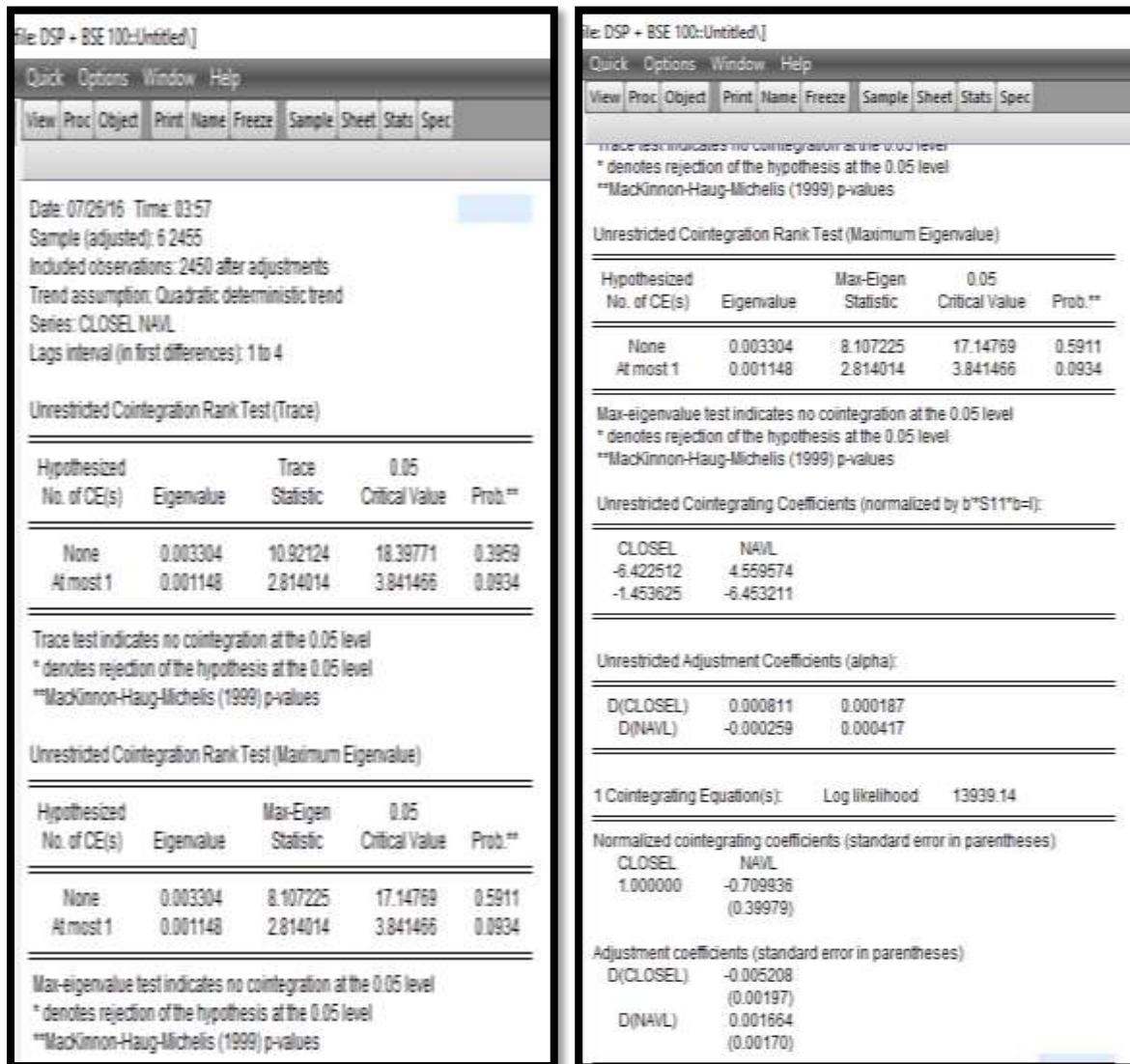
Figure 17 & 18-Result of Co-integration test for DSP Top100 and BSE 100

- Trace test failed at 0.05 significance level
- Eigenvlue test failed at 0.05 significance level
- Critical value being 13768

i) Granger's Causality
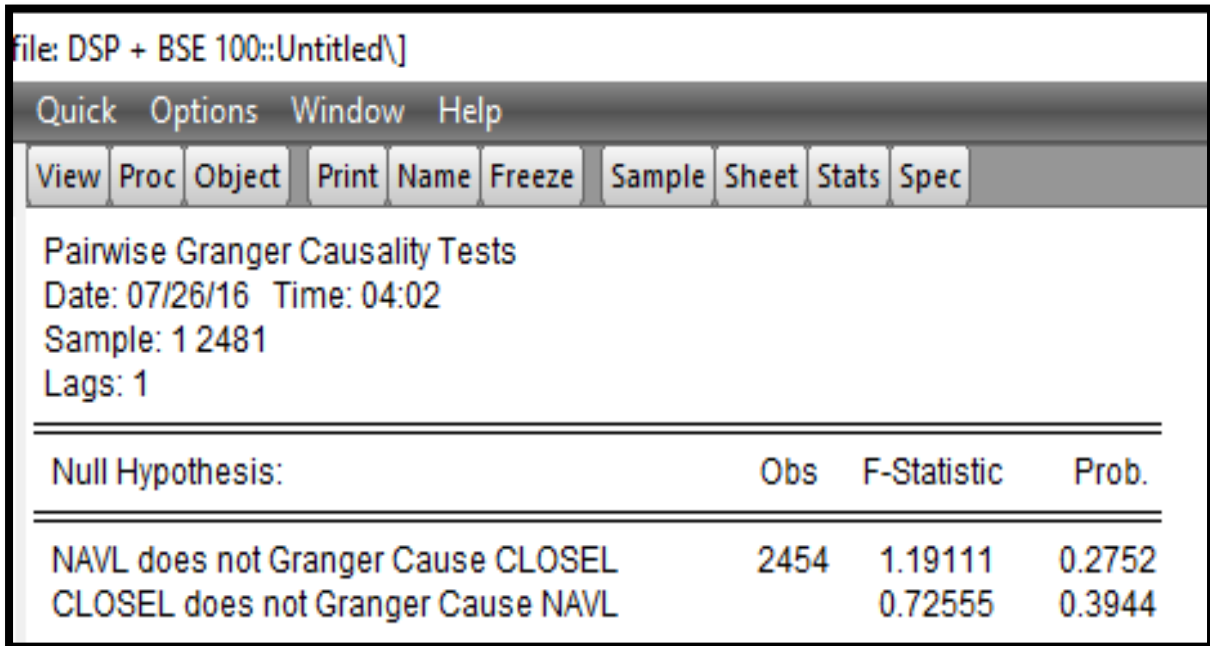
Figure 19- Result of Causality test for DSP Top 10 and BSE 100

2:- HDFC Top 200 and BSE 200

a) Conversion of both the time series into log for reduction in standard error.

It is done in order to bring down the standard error as we dealing with large chunk of data involving 2455 observations in each time-series. Hence, it cuts down steps, facilitates predictability and increases accuracy.
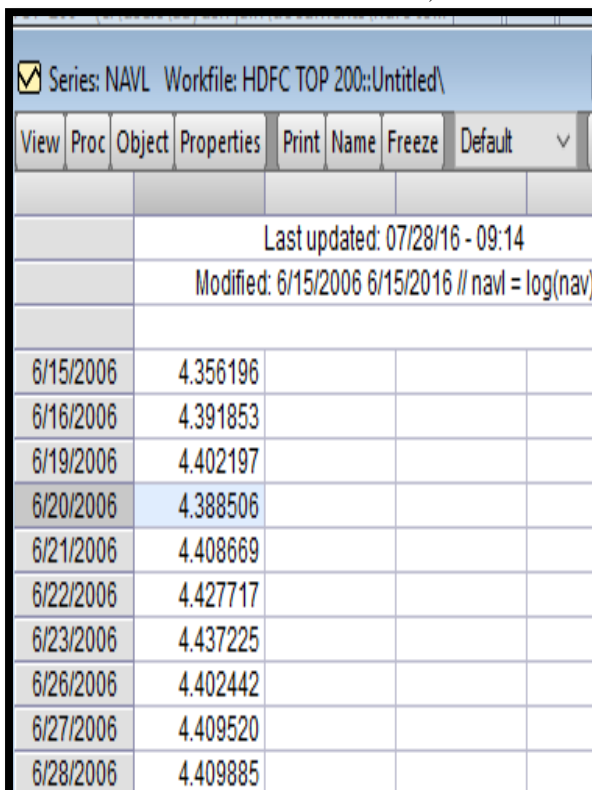
Figure 20- Conversion of HDFC Top 200 time series to log
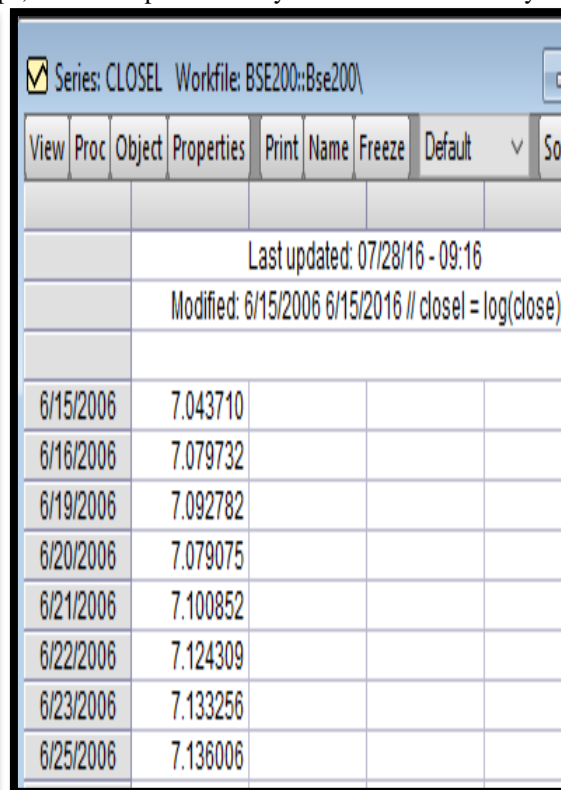
Figure 21- Conversion of BSE 200 time series to log

b) JB Test

Null Hypothesis, H0- Time series is not normally distributed
Alternate Hypothesis, H1- Time series is normally distributed

Figure 22- Result of normality test for HDFC Top 200

Figure 23- Result of normality test for BSE 200

Parameters	Mutual Fund	Benchmark
Mean	5.236246	7.704327
Median	5.290255	7.714106
Maximum	5.906078	8.222414
Minimum	4.356196	6.870479
Std. Dev.	0.395043	0.290775
Skewness	-0.247997	-0.397721
Kurtosis	2.269377	3.080959
Jarque- Bera	**80.02899**	**66.08592**
Probability	**0.000000**	**0.000000**
Sum	12896.87	17114.44
Sum Sq. Dev.	384.2175	209.6845

Table 7- Resultant outcome of JB test for HDFC Top 200 and BSE 200

c) DW Test

Null Hypothesis, H0- Time series is auto- correlated
Alternate Hypothesis, H1- Time series is not auto- correlated

Figure 24- Result of auto-correlation test for HDFC Top 200

Figure 25- Result of auto-correlation test for BSE 200

Parameters	Mutual Fund	Benchmark
Probability {CLOSEL(-1)}	0.000000	0.000000
R- squared	**.0998725**	**0.997355**
Adjusted R- squared	0.998724	0.997354
S.E of regression	0.014099	0.014945
Sum Sq. Residual	0.488996	0.553452
Log Likelihood	6999.778	6906.450
F- Statistic	1926532	934399.5
Probability (F- stats)	0.000000	0.000000
Mean dependent variable	5.236603	7.704594
S>D of dependent variable	3094725	0.290531
Akaike info criterion	-5.684629	-5.568105
Schwarz criterion	-5.679910	-5.563414
Hannan- Quinn criterion	-5.682914	-5.566401
Durbin- Watson Stat	**1.825672**	**1.804260**

Table 8- Resultant outcome of DW test for HDFC Top 200 and BSE 200

d) ADF Test

Null Hypothesis, H0- Time series is non- stationary
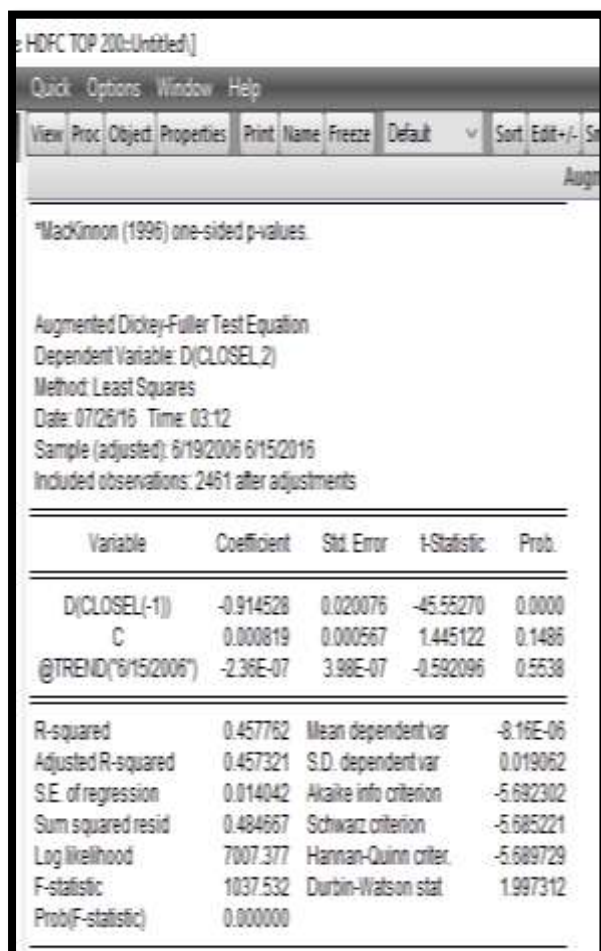
Alternate Hypothesis, H1- Time series is stationary

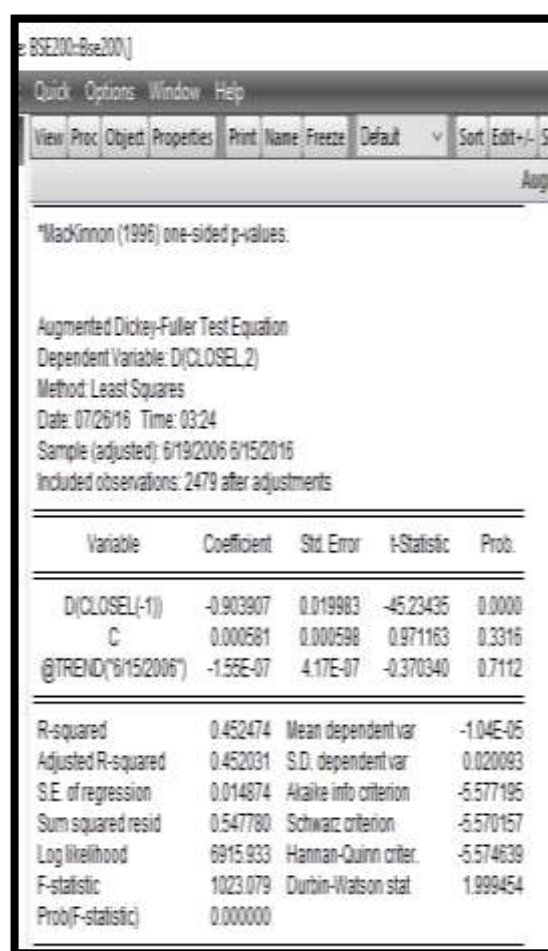Figure 26- result of stationarity test for HDFC Top 200   Figure 27- Result of stationarity test for BSE 200

Parameters	Mutual Fund	Benchmark
Probability {CLOSEL(-1)}	**0.000000**	**0.000000**
R- squared	0.457762	0.452474
Adjusted R- squared	0.457321	0.452031
S.E of regression	0.014042	0.014874
Sum Sq. Residual	0.484667	0.547780
Log Likelihood	7007.377	6915.933
F- Statistic	1037.532	1023.079
Probability (F- stats)	0.000000	0.000000
Mean dependent variable	-8.16E-06	-1.04E-05
S.D of dependent variable	0.019062	0.020093
Akaike info criterion	-5.692302	-5.577195
Schwarz criterion	-5.685221	-5.570157
Hannan- Quinn criterion	-5.689729	-5.574639
Durbin- Watson Stat	1.997312	1.999454

Table 9- Resultant outcome of ADF test for HDFC Top 200 and BSE 200

e) ARCH Test
Null Hypothesis, H0- Time series is homoskedastic
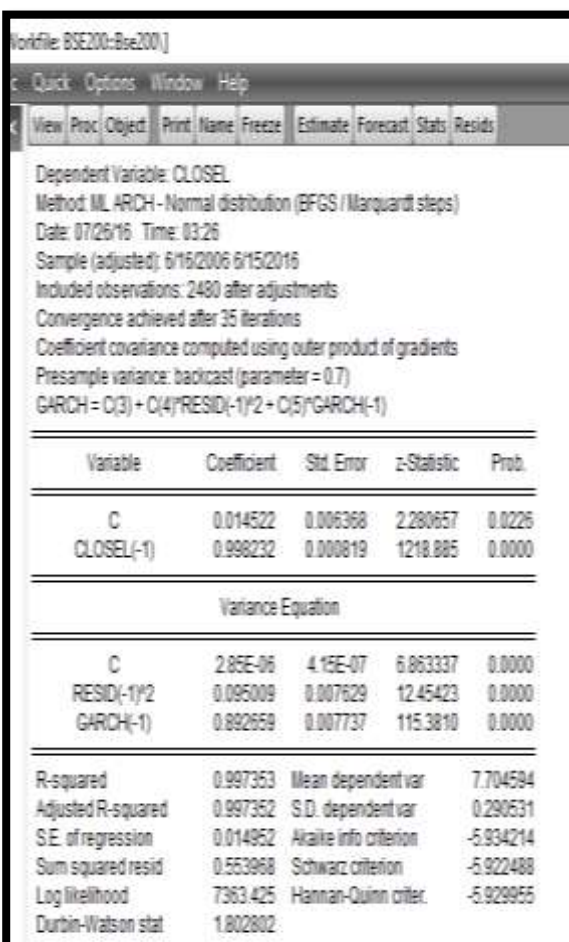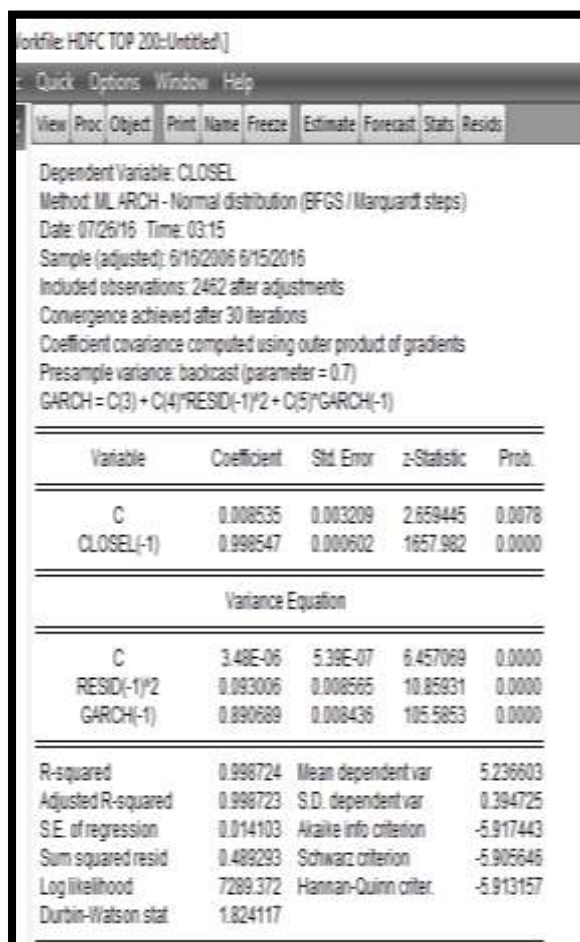Alternate Hypothesis, H1- Time series is heteroskedastic

Figure 28- Result of ARCH test for HDFC Top 200   Figure 29- Result of ARCH test for BSE 200

Parameters	Mutual Fund	Benchmark
Probability {CLOSEL(-1)}	**0.000000**	**0.000000**
Probability [GARCH (-1)]	0.000000	0.000000
R- squared	0.998724	0.997353
Adjusted R- squared	0.998723	0.997352
S.E of regression	0.014103	0.014952
Sum Sq. Residual	0.489293	0.553968
Log Likelihood	7289.372	7363.425
Mean dependent variable	5.236603	7.704594
S>D of dependent variable	0.394725	0.290531
Akaike info criterion	-5.917443	-5.934214
Schwarz criterion	-5.905646	-5.922488
Hannan- Quinn criterion	-5.913157	-5.829955
Durbin- Watson Stat	1.824117	1.802802

Table 10- Resultant outcome of ARCH test for HDFC Top 200 and BSE 200

f) AR Test
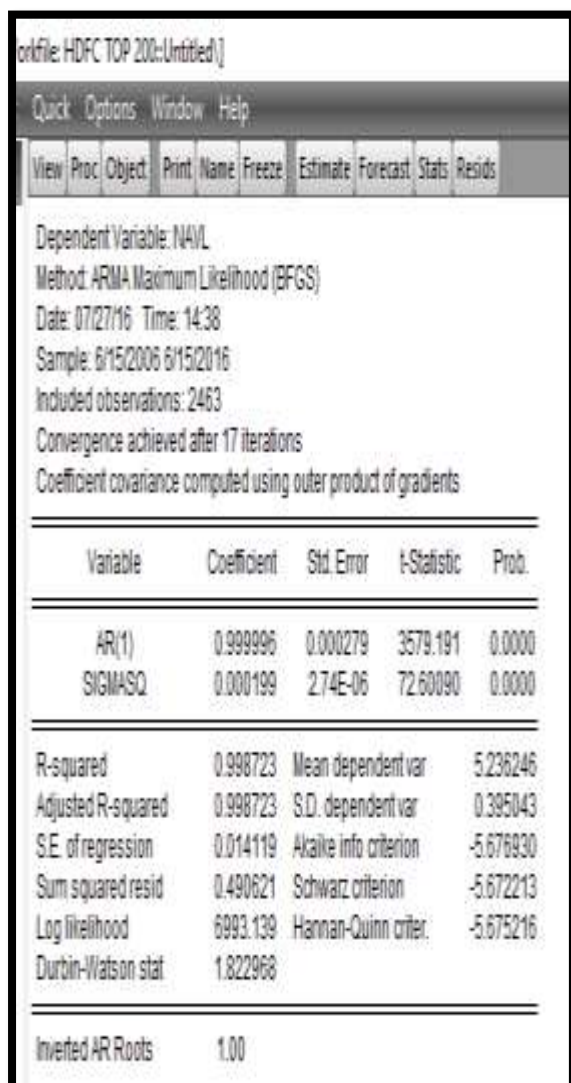
Figure 30- Result of AR test for HDFC Top 200   Figure 31- Result of AR test for BSE 200

Parameters	Mutual Fund	Benchmark
Probability	0.000000	0.000000
R- squared	0.998723	0.997354
Durbin- Watson stat	1.822968	1.803790
Akaike Info Criterion	-5.676930	-5.560839
Schwarz Criterion	-5.672213	-5.556150
Hannan- Quinn Criterion	-5.675216	-5.559136

Table 11- Resultant outcome of AR test for HDFC Top 20 and BSE 200

g) ARMA Test
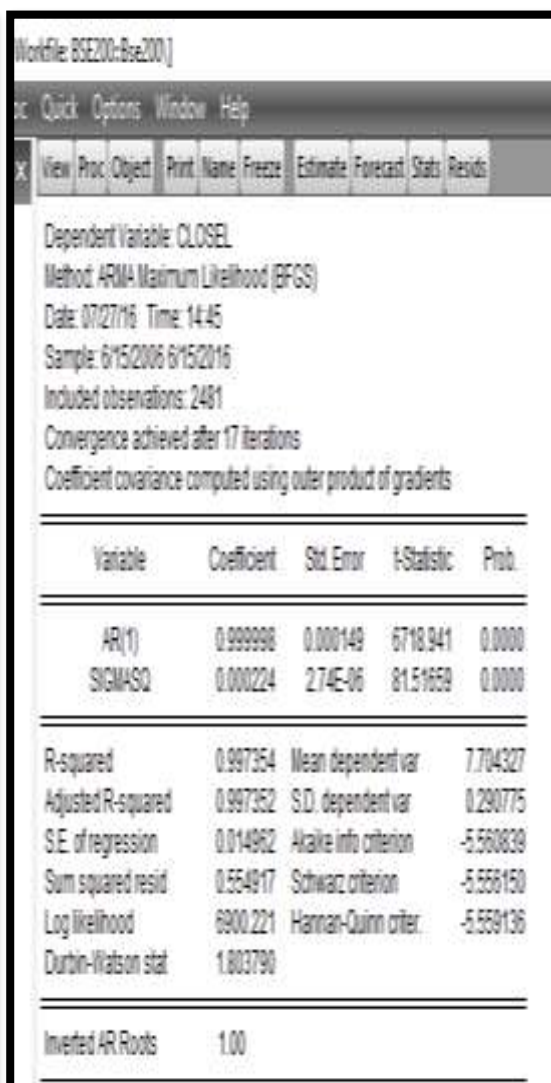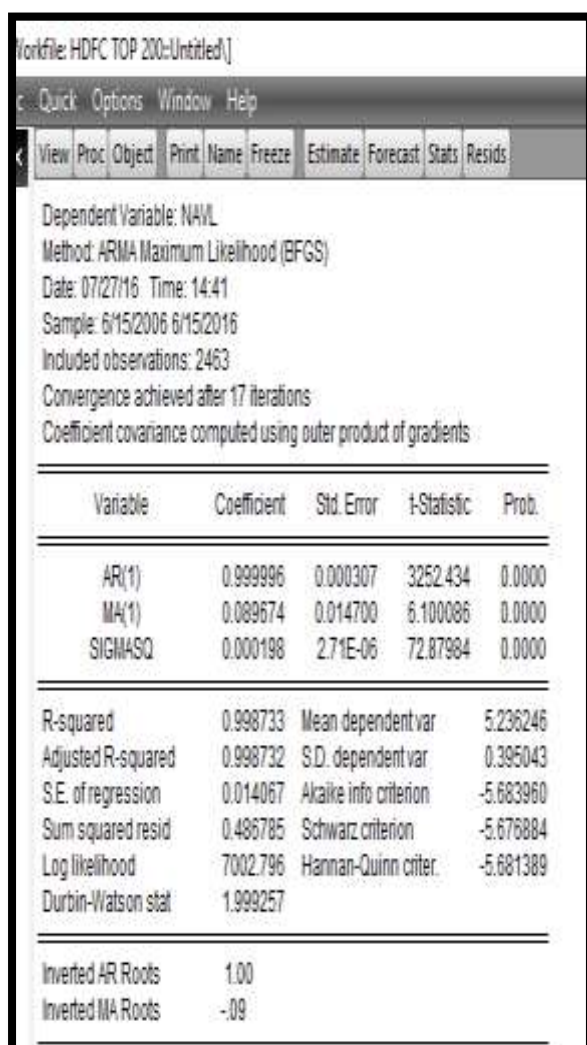
Figure 32- Result of ARMA test for HDFC Top 200   Figure 33- Result of ARMA test for BSE 200
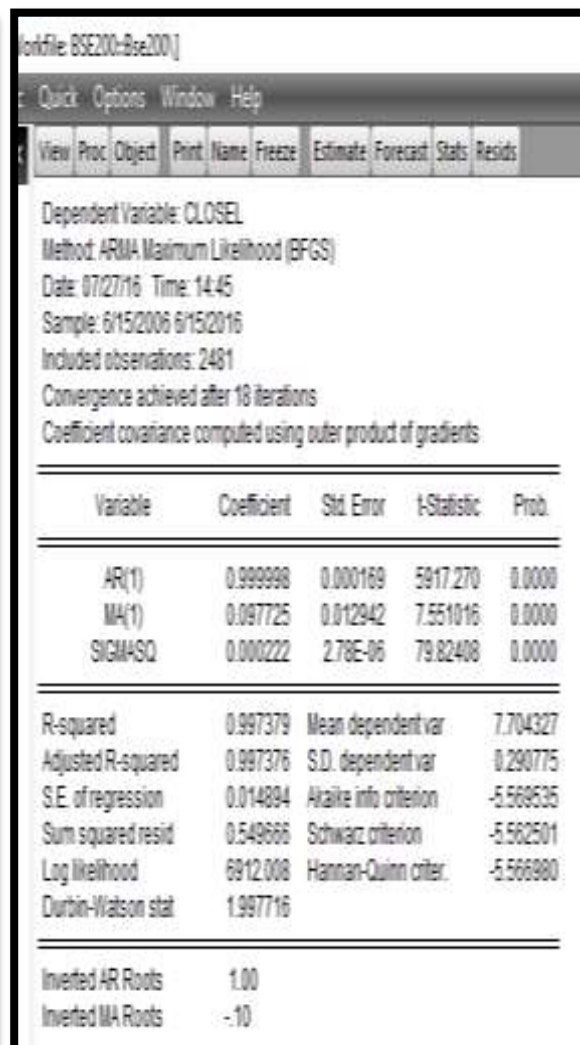
Parameters	Mutual Fund	Benchmark
Probability	0.000000	0.000000
Probability	0.000000	0.000000
R- squared	0.998733	0.997379
Durbin- Watson stat	1.999257	1.997716
Akaike Info Criterion	-5.683960	-5.569535
Schwarz Criterion	-5.676884	-5.562501
Hannan- Quinn Criterion	-5.681389	-5.566980

Table 12- Resultant outcome of ARMA test for HDFC Top 200 and BSE 200

h) Johansen Co-integration Test
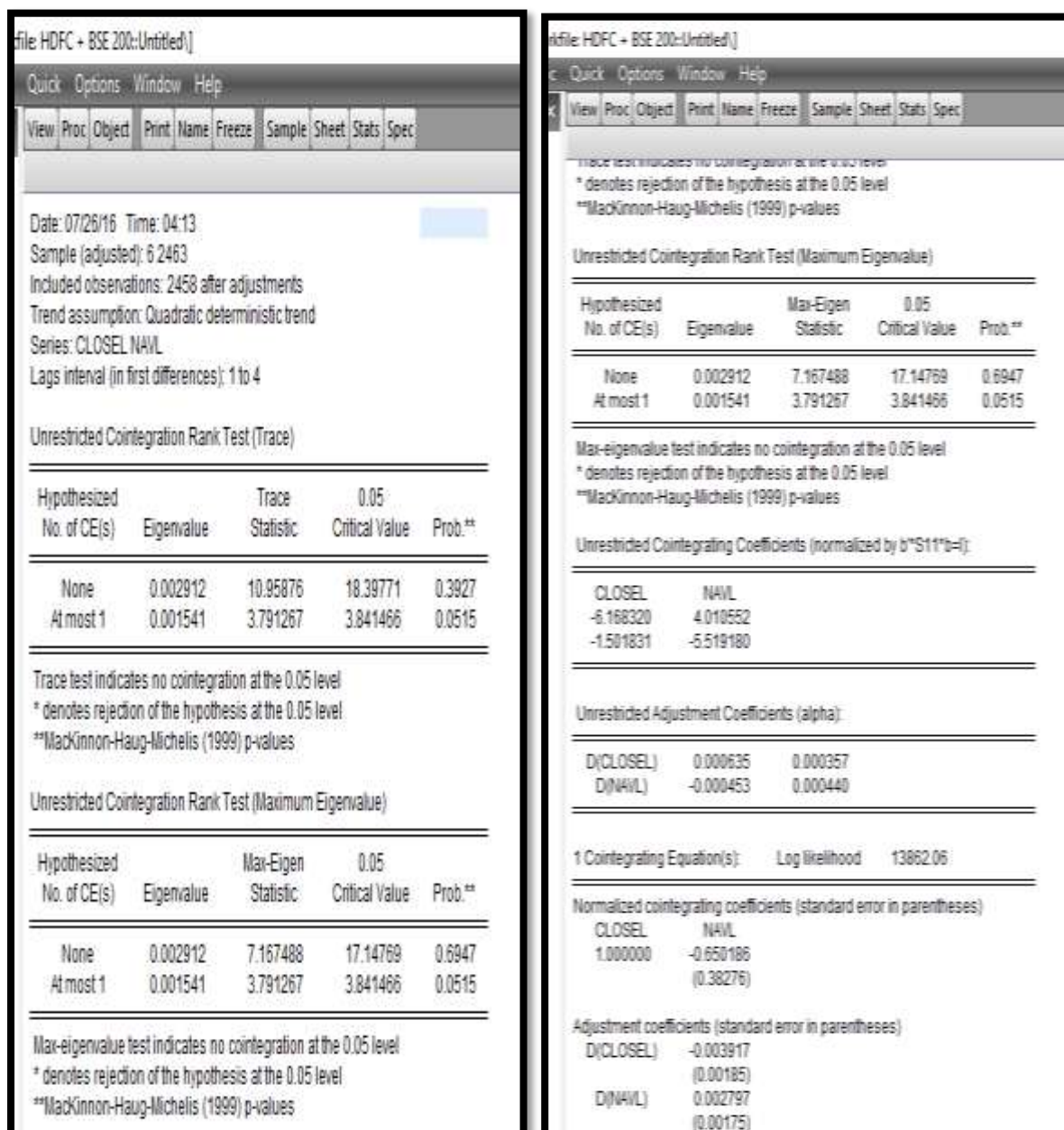
Figure 34 & 35- Result of Co-integration test for HDFC Top 200 and BSE 200

- Trace test failed at 0.05 significance level
- Eigenvlue test failed at 0.05 significance level
- Critical value being 13836

i) Granger's Causality Test

Figure 36- Result of Causality test for HDFC Top 200 and BSE 200

Interpretation

1. Normality Test

Since p- value is 0.0 which is less than 0.05, hence we will reject the null hypothesis, therefore time series is normally distributed i.e. 95% of the data is concentrated around the mean of time series.

Jarque- Bera being: - BSE 100- 72
DSP Top 100- 68.56
BSE 200- 66.08
HDFC Top 200- 80.02

Less than 1000 signify that test is weak, but since normality is satisfied we can continue with the loop.

2. Auto- correlation Test

R-square is: - BSE 100- 99.72%
DSP Top 100- 98.56%
BSE 200- 99.74%
HDFC Top 200- 99.82%

Therefore, out of e100 times the test is run, 99 times it will show accurate result.

Durbin Watson Stats being: - BSE 100- 1.82
DSP Top 100- 1.83
BSE 200- 1.8
HDFC Top 200- 1.83

Which is closer to 2, hence there is no auto- correlation; therefore there is no cyclicity or cyclical trend in the time series. Thus, loop will continue.

3. Stationarity Test

Probability value being 0.0 which is less than 0.05, hence we will reject the null hypothesis, there time series is stationary which means it takes into consideration the impact of external factors, but comes back to its original position as and when external stimuli is removed.. Thus, loop will continue.

4. Heteroskedasticity Test

Probability value being 0.0 which is less than 0.05, hence we will reject the null hypothesis, therefore time series is homoskedastic which means there is a trace of human interference due to which the volatility or free movement of markets is narrowed down to a specific band. Thus loop will close down.

5. AR Test

DSP Top 100 and BSE 100- After AR test, we found p-value to be 0.00, R-squared to be 99% and DW stat being 1.8 for both fund as well as index, but symmetry in Akaike, Schwarz and Hannan-Quinn criterion, evident the presence of a MA factor in time-series.

HDFC Top 200 and BSE 200:- After AR test, we found p-value to be 0.00, R-squared to be 99% and DW stat being 1.8 for both fund as well as index, but symmetry in Akaike, Schwarz and Hannan-Quinn criterion, evident the presence of a MA factor in time-series.

6. ARMA Test

• DSP Top 100 and BSE 100- After carrying out ARMA test p-value remained 0.00, whereas R-squared increased to 99.7% and DW stat to 2, thus better results. But, symmetry in Akaike, Schwarz and Hannan-Quinn criterion persisted, thus hinting towards man-made symmetry.

7. Co-integration Test

DSP Top 100 and BSE 100

- Trace test failed means that both the time- series are not moving in similar direction.
- Eigen value test failed means that both the time- series do not have any impact on one another.
- Thus, there no linkage or influential factor between two time- series.
- Critical Value being 13768 which is more than acceptable limit of 10000, indicating there is high degree of volatility and prediction of time- series on the basis of other is not possible.

HDFC Top 200 and BSE 200

- Trace test failed means that both the time- series are not moving in similar direction.
- Eigen value test failed means that both the time- series do not have any impact on one another.
- Thus, there no linkage or influential factor between two time- series.
- Critical Value being 13836 which is more than acceptable limit of 10000, indicating there is high degree of volatility and prediction of time- series on the basis of other is not possible

8. Granger Causality Test

DSP Top 100 and BSE 100

With probability values being- 0.28 and 0.39, which are more than 0.05
Therefore, we have to accept null hypothesis i.e.

- ➢ DSP Top 100 does not Granger cause BSE 100
- ➢ BSE 100 does not Granger cause DSP Top 100

HDFC Top 200 and BSE 200

With probability values being- 0.19 and 0.7, which are more than 0.05
Therefore, we have to accept null hypothesis i.e.

- ➢ HDFC Top 200 does not Granger cause BSE 200
- ➢ BSE 200 does not Granger cause HDFC Top 200

Further scope of research

This research has been done for two Indian mutual funds with two different indices as their benchmark. Therefore, this study could be forwarded to various other categories of mutual funds having different benchmark in India or abroad.

IV.   CONCLUSION

The study shows the partial co-movement between mutual funds- DSP Top 100 and HDFC Top 200, and benchmark index- S&P BSE 100 and S&P BSE 200 in form of Econometric loop, where both the mutual funds and indices showed normal distribution along with stationarity and no evidence of auto-correlation. The loop was closed on the context of time-series being failing heteroskedasticity test and thus were seen to be homoskedastic. Both funds and indices were proved to be following auto-regression moving average- ARMA (1,1) approach with clear evidence of man-made symmetry or human interference due to symmetric layout of Akaike, Schwarz and Hanan-Quinn criterion. But, when it came to co-integration, results were outdoing the general conceptions that either mutual funds drive stock prices due to bulk sale/purchase or stock market index granger cause mutual funds' returns due similarity in portfolio concentration, but as per this study, there is no linkage between mutual funds' returns and stock market index i.e. there neither directional nor impactful co-integration between the two. Hence, neither mutual fund granger cause index, nor index granger cause mutual funds or in other words mutual fund do not reciprocate its benchmark index.

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