Empirical investigation of application of concept of cognitive dissonance to Indian financial markets

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Abstract

Purpose - To empirically test the concept of cognitive dissonance on Indian Stock Market using variables; return on a stock index and volatility of stock return (VIX).

Design/methodology/approach - The entire methodology revolves around five hypothesis (Hypothesis I to V) which have been drawn mainly from Hibbert, *et al.*, (2008), Daigler, *et al.*, (2014) and Bagchi, D. (2014) and Fleming *et al.*, (1995).

Findings - Results could provide evidence that the Cognitive Dissonance seem to be working on the psyche on Indian investors. It was found that not only current return on Nifty but also past Return on Nifty impacted change in volatility of Nifty. Similarly it was also found that Past Volatility Change was impacting Current Volatility. Both these findings showed the applicability of the concept of cognitive dissonance in Indian markets. The results also showed that there was evidence that leverage theory and volatility feedback theory were present in Indian markets.

Research Limitations/implications - Study uses daily closing prices of Indices, intra-day prices at much smaller intervals may be used to get a more insight into the aspect of cognitive dissonance.

Practical implications - The study shows the applicability of cognitive dissonance, leverage theory and volatility feedback theory in Indian stock market.

Originality - The testing of the behavioural concepts like cognitive dissonance amongst Indian investors is still quite under -researched area and more research is required especially to link different behavioural biases to different stock market patterns. Any step in this direction would be a great help in forecasting the market in a better manner.

Keywords - Cognitive dissonance, Volatility feedback, OLS, VIX, ADF Stationarity test.

Paper type - Research paper.

1. Introduction

Cognitive Dissonance is a tendency of a person to adjust his beliefs so that he is able to justify his own past actions. The credit for the development of cognitive dissonance theory goes to a psychologist Leon Festinger, who is of the view that if a person holds two or more conflicting cognitive elements which are inconsistent to each other, the person often encounters a feeling of regret (dissonance) which is due to opposing cognitive elements. He would then try to take care of this dissonance by either removing the opposing cognitive elements or reducing its importance or by adding favourable cognitive elements to justify his action (Festinger, 1954) To give an example a consumer after making a purchase of an item especially an expensive item ; say a car experiences a cognitive dissonance due to alternative usage of funds had the purchase decision of the expensive item not been made. The consumer then tries to console self by adding a favourable element say more comfort or removing opposite element say funds were lying idle to justify the purchase decision.

The important aspect here is that the beliefs of a person is altered so that it conforms to his past actions. Here the person tries to rationalize his thoughts in such a manner so as to reduce his own psychological discomfort (Festinger, 1954,1962).Some researchers have also linked dissonance to the mood of the person; A study by (Jordens and Overwalle,

2005) found that the dissonance attitude increased after having a positive mood and decreased after having a negative mood. These findings of the study actually are in contradiction to earlier theory of dissonance which had actually predicted the opposite i.e. positive mood was associated with lower dissonance while negative mood was aligned with enhancement of dissonance.

The theory of cognitive dissonance has a lot of applications in different fields of management including finance e.g. many a times the investor is tries to pacify himself that his own purchase of the stock was the right decision even though the company falls short of its predicted profits and share price continues to decline. Many studies done on this aspect from point of view of financial markets also support the concept of cognitive dissonance of the investor. Studies have found that money invested in mutual funds which have been winners is much more than money taken out from funds which have been losers. Clearly cognitive dissonance works for losers of funds as they expect the losing stocks to rise in future, however many researchers have provided different answers to this phenomenon like irrationality of investor (Ippolito, 1992), high transaction costs for exiting a fund (Sirri and Tufano, 1992) etc. Clearly one can also add the dimension of cognitive dissonance to such an aspect.

The entire study is structured as follows: Section I gives a brief introduction to the behavioural aspect 'cognitive dissonance'. Section II gives the reviews the existing literature in the area of cognitive dissonance. Section III gives the research gap in existing studies & the research objectives of the study. Section IV describes the theoretical and behavioural models used in the study. Section V describes the data and variables. Section VI gives the methodology employed along with hypothesis to be tested. Section VII provides empirical results of the study and its interpretation and finally Section VIII gives the conclusion which is followed by references and appendices.

2. Review of literature

Under literature review our focus is on those research papers which have tested the phenomenon of cognitive dissonance on general or specific business models. In business models one of the most important instances where the concept has been applied include determining post buying behaviour both in case of consumer products as well as financial products. Many researchers in this field are of the view that the study of this phenomenon is important as companies can take necessary steps to improve cognitive dissonance of their customers, however on the other hand if no steps are taken in this direction, it might lead to loss of reputation, order cancellations and also loss of loyal customers.

We begin our review of literature with two research papers on cognitive dissonance ; the credit for both the papers goes to Bolia, Jha and Jha. The first paper (Bolia, Jha and Jha, 2016 A) is general application of cognitive dissonance where these researchers carried out an extensive review of literature by classifying cognitive dissonance concept into different sections like causes and effects of cognitive dissonance, likely measures to reduce the phenomenon and efforts made by researchers. They explored how cognitive dissonance could be used to explain the behaviour of the consumer, how it impacted the individuals, the business entities and what measures have been taken by companies to reduce this phenomenon. Their research showed that sufficient research existed about individual and socio-environmental factors with respect to dissonance but only limited was available on the organizational factors. Their research also found that considerable clarity now exists amongst the organizations as many have made substantial losses in terms of loss of trust and loyal customers, order cancellations and erosion of the brand due to negative word of mouth, all due to cognitive dissonance. Therefore they now feel that the need of the hour was to keep the dissonance in control by adopting successful strategies in this respect. The second paper by (Bolia, Jha and Jha, 2016 B) is based upon survey results of investors in Financial Products. The aim here was to explore the relation between cognitive dissonance and recommendations of specific brand of Financial Products. The results showed that age, education or gender had no impact on level of dissonance, neither was any dissonance on account of different sellers selling their financial product and also type of product sold.

However with respect to brand recommendation, it was found that dissonance was lower amongst those investors who had explored more options before purchasing the product. Yet another dimension of the cognitive dissonance concept was explored by (Pandey and Jamwal, 2016) where the focus was on after purchase dissonance. Three aspects were considered: information search, concerned product and time taken for purchase. It was found that as time taken/time devoted for purchases rise, dissonance falls, thereby giving a strong message to the seller that they must engage the customer for a larger duration and pass on as much information possible to the customer as it leads to customer contentment. It was also found that more the customer involvement, lower the dissonance, hence business firms should emotionally bound the customers to decrease dissonance. Further it was found in the study that dissonance also differed from person to person and this was due to different benchmark levels set by the customer which they experienced post-purchase of the product. Purchase dissonance for further explored by (Nordvall, 2014) where he tried to prove that all the items which fall under not-repeat purchase category give the feeling of cognitive dissonance to the consumer. This was found when a survey was conducted on 100 individuals whose results showed that individuals gave a more favourable score to already chosen items.

An empirical application of dissonance was given by (Bagchi, 2014) where he tried to explain asymmetric behaviour of stock return and stock volatility by adding the angle of cognitive dissonance. The model moves around the fact that volatility in current returns must be fully explained stock returns only for the current period and not any period before current period if the concept cognitive dissonance is applicable. This model was tested on Indian stock markets and it was found that cognitive dissonance relation did exist as two of the three hypotheses could be proved by the study. On the other hand another stock market application of cognitive dissonance was given by (Antoniou, Doukas and Subrahmanyam, 2013) whereby they tested for the relation for two category of investors; whose investing small amounts and those having big investment in stocks. The hypothesis put forth was that for any investor who is optimistic, any kind of bad news results in dissonance and therefore the news diffuses slowly. The analysis however showed that the same was true mainly for small investors as small investors were found to be more reluctant to sell their losing stocks. On the other hand the large investors sold their losing stocks promptly (especially in optimistic periods when stock market was rising) thus confirming that cognitive dissonance impacts small investors with losing (more so during optimistic periods).

Another interesting example of application of dissonance with respect to fund houses was given by (Goetzmann and Peles, 1997). Using a response method, a survey was conducted amongst fund's investors and the result showed that all types of investors including those well informed ones, had a bias about their past behaviour. The cognitive Dissonance actually helps the mutual fund houses regarding how to make use of strategic information which is usually disseminated though print media. This strategic information convinces the current investors with the feeling that they have made a smart investment. However such advertisements may not be able to influence new investors but at least influence existing investors to stay with the fund. Our next review is (Burhhard and Eckwert, 2005) where they made an attempt to model financial markets with respect to how prices in financial markets tend to over-react and under-react to new information. The model explained how investor decisions were sub optimal as these were taken on the basis of only some part of the information, clearly there must have been some dissonance which would have been overcome by these investors. Also in extreme cases where information was highly positive or highly negative, the distortion in the prices and related dissonance is also extremely high. However, here the informed investors could take advantage of the arbitrage situation by buying under-priced and selling over-priced assets.

3. Research gap and objectives of the study

The review of literature has clearly laid down how by making use of cognitive dissonance a person tries to comfort himself after taking a decision by rationalizing his thoughts. Most researchers have focused on development of this theory and how it could be applied in

practice. Some researchers have given examples from real life situations with business applications e.g. buying any specific product or a financial investor investing in financial products, however these research papers have mostly relied on primary sources of data to test the concept of dissonance. There have been one very few research papers which have tested empirically, the application of the concept of cognitive dissonance and our paper takes a step forward in this direction. The present study therefore provides another dimension to the theory of cognitive dissonance by empirically establishing the relation between variables using statistical and econometric techniques.
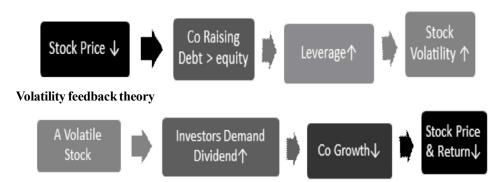
In light of the above the following are the research objectives of our study:

- To understand the relation between the return on a stock index and its volatility with the help of two popular theories; leverage and volatility feedback.
- To incorporate the concept of ccognitive dissonance and to test whether it provides additional explanation to the two theories or is in contradiction to these theories.
- To establish different set of hypothesis to empirically test the relation between the return on a stock index and its volatility.

4. Theoretical and behavioral models used under the study

Before we empirically test the concept of dissonance, there is a need to discuss two popular theories which provide the necessary background and justification for the stated phenomenon 'correlation between return on a stock and the change in the volatility of the same stock is negative'. First theory is the leverage theory (Black, 1976) and according to this theory, whenever there is a fall in the stock price e.g. due to not so good results of the company, it becomes difficult to raise fresh capital as shareholders shall not be willing to part with additional funds for a company giving poor results. On the other hand such a company may manage to raise debt or a bank loan which raises the leverage of the company. Now with the increase in leverage, the risk increases and more the risk more shall produce higher volatility of the stock of the company. Second theory explaining the same phenomenon is the volatility feedback theory and according to this theory when the stock of the company is facing higher volatility (i.e. higher Risk in any period or even in successive recent periods), investors would desire higher return from existing stock of this company which usually comes in the form of higher dividends from the company. Now higher dividend means less ploughing back of profits for growth or expansion resulting in fall in further growth rate and also fall in there turn on stock of the company.

Leverage theory

Volatility feedback theory

Thus both the above theories support the phenomenon of 'negative correlation between return on a stock and the change in the volatility of the same stock'. Cognitive dissonance theory: If we add the behavioural dimension to this phenomenon as an application of cognitive dissonance; question which comes to our mind is: Does this supplement the above two theories? With cognitive dissonance this would imply that as and when the stock price falls say due to bad news about the company, the investors already holding such a

stock get the feeling of dissonance and try to overcome this dissonance by removing the opposing cognitive elements or reducing its importance and thus they do not sell their stock which prevents any impact of stock's volatility, which simply nullifies the argument put forth by the previous two theories that there is a negative relation between return on stock and volatility of the same stock.

5. Description of data and about the variables

The study considers time series daily log transformed data collected from the National Stock Exchange of India and the period of Study is from April 1, 2013 - March 31, 2018 (5 years). The data has been collected for two indices namely the NSE Nifty and India VIX .NSE Nifty is the flagship index of fifty diversified stocks listed on the National Stock Exchange of India and represents the return on stock in our study. These fifty shares account for 12 important industry sectors and represent 62.9 percent of the total free float market capitalization on NSE as on 31st March 2017 .The second variable under study is India which is a volatility index and is based upon the option prices. India VIX is an indicator of expected market volatility over the next thirty calendar days (www.nseindia.com). For the purpose of analysis under the studywe consider the two variables at first difference levels i.e. Return on NSE Nifty and Change in VIX . The applicable formula used for transformation of the two variables is given as ln. $\left(\frac{P_t}{P_{t-1}} \right)$; where P_t denotes Closing Price of the NSE Nifty (or VIX) on day 't' and P_{t-1} denotes Closing Price of the NSE Nifty (or VIX) on preceding day or 't-1'. The data for the two has been taken from website of nseindia.com.

6. Data diagnostics

Under Data Diagnostics we perform three types of tests; test for stationarity, serial correlation and stability.

6.1 Stationarity test

The first diagnostics is the test of stationarity for which we perform Augmented Dickey Fuller Unit root test (applicable model: with trend and intercept). Under this we have developed two equations for our two variables namely return on NSE nifty and change in volatility given as under :-

$$\Delta \text{ Return on NSE Nifty}_t = \alpha_1 + (\alpha_2 - 1) \text{ Return on NSE Nifty}_{t-1} + \sum_{i=1}^{m} \alpha_{3i} \ \Delta \text{ Return on NSE Nifty}_{t-i} + \alpha_4 \, t + e_t \ \dots \text{eq.(i)}$$

$$\Delta \text{ Change in VIX}_t = \beta_1 + (\beta_2 - 1) \text{ Change in VIX}_{t-1} + \sum_{i=1}^{m} \beta_{3i} \ \Delta \text{ Change in VIX}_{t-i} + \beta_4 \, t + v_t \ \dots \text{eq.(ii)}$$

Consider eq (i) , the variable under consideration is Return on NSE Nifty :-

- Δ Return on NSE Nifty$_t$ = change in Return on NSE Nifty in period t,

- $(\alpha_2 - 1)$ is the coefficient of the Stationarity for variable Return on NSE Nifty.

- $\sum_{i=1}^{m} \alpha_{3i} \ \Delta$ Return on NSE Nifty$_{t-i}$ denotes change in Return on NSE Nifty in period t-i and is included in the augmented form to take care of autocorrelation. Here the term sums up 'm lag' times till the autocorrelation is removed ,

- $\alpha_4 \, t$ = the deterministic trend variable and its inclusion would imply that only stochastic trend is detected,

- e_t = random error term.

Similarly we carry out stationarity test for our second variable namely; Change in VIX given as equation (ii)

The Null Hypothesis for Stationarity test would be:-

$(H_0) : \alpha_2 - 1 = 0$ or $\alpha_2 = 1$ (Return on NSE Nifty is not stationary)

Alternate Hypothesis shall be :-

(H_a): $\alpha_2 - 1 < 0$, (Return on NSE Nifty is stationary, one sided hypothesis avoids explosive process)

Similarly we develop our hypothesis for second variable; Change in VIX

6.2 Stability test

Under the stability test, wecarry out the test of parameter stability using CUSUM Plots. CUSUM are plots of the recursive residuals after normalizing. Now if the parameters after initial no. of observations don't settle down and the sum goes outside the critical bounds, it is an indication of parameter instability.

7. Methodology adopted and hypothesis to be tested

The entire methodology has been built around five hypothesis which have been drawn from different research papers namely; (Bagchi, D., 2014), (Fleming *et al.*, 1995), (Hibbert *et. al.*, 2008) and (Daigler, *et al.*, 2014).

Let Ret on Nifty be the return on the NSE Nifty for any day/present day (Say Day 1).In our study we shall be selecting this day when the closing index shows a fall from the previous day's closing. Thus on day 1 when there is a fall in the return on Nifty, this should lead to a rise in volatility according to the leverage theory (For Details please refer to Section IV: Theoretical and Behavioral Models used under the study). This has been hypothesized as Hypothesis 1 and in case leverage theory is to apply to our data set, then Hypothesis I must be rejected .Thus we have :-

Hypothesis$_{01}$: One day return (Ret on Nifty$_t$) is not an important factor to determine change in volatility of Nifty (Δ VIX$_t$) :

However on the other hand, if the Null Hypothesis is proved to be correct, it would imply that one day or current day's return on NSE Nifty is not important factor to determine change in volatility of Nifty or the leverage theory is not applicable to Indian stock markets (NSE) and the theory would only be applicable when alternate hypothesis is proved to be correct. The results of empirical testing of this hypothesis are discussed in Section VIII in the paper. Nextlet us assume there is some unfavourable information about the stock markets leads to fall in market's return. Now such type of scenario should ideally lead to heightened volatility which may continue for few days. On the other hand if this unfavourable information does not induce any change in volatility say next day or even in subsequent days or putting the same in different words ; lag(s) of Ret on Nifty, does not cause current change in Volatility of Nifty which gives us Hypothesis No. 2 :-.

Hypothesis$_{02}$: Lagged returns (Ret on Nifty$_{t-1}$, Ret on Nifty$_{t-2}$ etc.) are not an important factor to determine change in volatility of Nifty (Δ VIX$_t$) .

Both the Hypothesis 1 and 2 can be tested with the help of the equation (iii) given below :-

Change in VIX$_t$ (Δ VIX$_t$)= β_1 + β_2 Ret on Nifty$_t$ + β_3 Ret on Nifty$_{t-1}$ + β_4 Ret on Nifty$_{t-2}$+ β_5 Ret on Nifty$_{t-3}$+ β_6 Ret on Nifty$_{t-4}$ + u$_t$ …(iii)

H$_{o1}$: β_2 =0, H$_{A1}$: β_2 $\neq$ 0

H$_{o2}$: β_3 = β_4 = β_5 = β_6 ….=0 , H$_{A2}$: β_3 = β_4 = β_5 = β_6 ….$\neq$ 0

Now in the above equation (iii),

Change in VIX$_t$= change in the Volatility Index of the NSE during period 't' which according to the leverage theory should be a function of only Return on NSE Nifty Index during period 't' i.e. Ret on Nifty$_t$.

Coefficient β_2 = Slope coefficient of the return on Nifty Index

Coefficient β_2, β_3, β_4, β_5 and β_6 are the slope coefficients of Lag 1 to Lag 4 of the Return on Nifty

u_t = random error term.

Now if in our equation (iii), coefficient β_2 is significant and also negative we would be rejecting the Null Hypothesis No. 1 (H_{o1}) implying that this is due to the application of leverage theory or the contemporaneous relation holds. However if on the other hand the coefficient of further lags (β_3 and beyond) on return on Nifty are found to be insignificant, we would be accepting the Null Hypothesis No. 2 (H_{o2}). This would again mean leverage theory applies to Indian Markets as it shows that change in VIX is a function of current return on NSE Nifty only, however this would also mean that the concept of cognitive dissonance is also applicable (as when prices fall due to bad news, it induces cognitive dissonance amongst investors which enable them not to sell their stocks which again does not result in rise in volatility.)

$Hypothesis_{03}$: Changes in Volatility (ΔVIX_t, ΔVIX_{t-1}, ΔVIX_{t-2}) are not an important factor in determining Ret on Nifty$_t$. This hypothesis is just the opposite of above hypothesis no. 2 i.e. Does change in volatility of the variable and its lag impact the return on the stock? This hypothesis is tested with the help of equation (iv) given below :-

Ret on Nifty$_t$ = α_1 + $\alpha_2 \Delta VIX_t$ + $\alpha_3 \Delta VIX_{t-1}$ + $\alpha_4 \Delta VIX_{t-2}$ + $\alpha_5 \Delta VIX_{t-3}$ + $\alpha_6 \Delta VIX_{t-4}$ + v_t...(iv)

H_{o3} : $\alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 ..... = 0$,

H_{A3} : $\alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 ... \neq 0$

In the above equation (iv) , ΔVIX is the change in the volatility index of the NSE and we have included current period 't' and four lag periods 't-1', t-2, 't-3' and 't-4'

Coefficient α_2 = Slope coefficient for the change in the volatility index of the NSE

Coefficients α_3 to α_6 = Slope coefficients for Lag 1 to Lag 4 ofchange in the Volatility Index of the NSE

Thus if the above case Null Hypothesis No. 3 (H_{o3}) is rejected or proved to be in-correct , then Changes in Volatility (ΔVIX_t, ΔVIX_{t-1}, ΔVIX_{t-2}) are an important factor in determining Ret on Nifty$_t$. This would also imply that second theory or the volatility feedback theory (for details refer to Section IV) is applicable and there should be a fall in the return on NSE Nifty Stock Index with heightened volatility.

$Hypothesis_{04}$: Current Changes in Volatility (ΔVIX_t) cannot be induced by past changes in volatility (ΔVIX_{t-1}, ΔVIX_{t-2}) or (ΔVIX_t) does not follow an autoregressive process

ΔVIX_t = λ_1 + $\lambda_2 \Delta VIX_{t-1}$ + $\lambda_3 \Delta VIX_{t-2}$ + $\lambda_4 \Delta VIX_{t-3}$ + $\lambda_5 \Delta VIX_{t-4}$ + e_t...(v)

($\lambda_2 ... \lambda_5$ are the slope coefficients of coefficients for Lag 1 to Lag 4 of change in the Volatility Index of the NSE)

The Null and Alternate hypothesis shall be :-

H_{o4} : $\lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = ... 0$, H_{A4} : $\lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 .... \neq 0$

Now in the above equation (v), if Null Hypothesis No. 4 (H_{o4}) is rejected or proved to be in-correct , then past volatility changes (ΔVIX_{t-1}, ΔVIX_{t-2}, ΔVIX_{t-3} and ΔVIX_{t-4}) are an important factor in determining current change in volatility . This hypothesis can easily be explained by cognitive dissonance principle. Rejection of H_{o4} would imply that the current volatility cannot be determined by past volatility as dissonance would put a barrier to it. Thus rejection of the hypothesis implies non- applicability of cognitive dissonance.

$Hypothesis_{05}$: Relation between ΔVIX_t (i.e. Current volatility) and Ret on Nifty$_t$ (i.e. Current return) is asymmetrical.

The asymmetrical relation between volatility and return was first modelled by (Fleming *et. al.,* 1995) and (Schwert, 1989, 1990), however Schwert used stock return data and then went ahead to compute volatility of the return, Fleming used data on implied volatility or VIX which is options based. The asymmetry as pointed out in their research was that the increase in volatility, corresponding to negative stock return is larger than decrease in volatility

corresponding to a similar size positive return.

The asymmetry relation (Hypothesis$_{05}$) can be modelled by regressing ΔVIX_t on the following variables : two lead stock returns, two lag stock returns and contemporaneous stock market returns. We also include absolute value of the contemporaneous stock market return as another independent variable. (Flemming *et.al.,* 1995) (See eq. vi below)

$$\Delta VIX_t = \pi_1 + \sum_{l=-2}^{+2} \pi_i \text{Ret on Nifty}_{t+l} + \pi_7 |\text{Ret on Nifty}_t| + u_t \dots\dots\dots\dots(vi) \text{ (where}$$

'*l*' is the lag/lead, *i*= 2 to 6)

(in the above equation (vi); if '*l*' takes the value -2 (Lag 2 of Return on Nifty) , '*i*' shall be 2, which has a slope coefficient of π_2 . Similarly if '*l*' = -1 (Lag 1of Return on Nifty), '*i*' shall be 3 and corresponding slope coefficient is π_3. If '*l*' is 0(contemporaneous or Return on Nifty in Period 't') , '*i*' shall be 4, whose slope coefficient shall be π_4 , if '*l*' is +1(Lead Period 1 for Return on Nifty), '*i*' shall be 5 and has slope coefficient as π_5 and finally if '*l*' is +2 (Lead Period 2 for Return on Nifty), '*i*' shall be 6 with a slope coefficient of π_6 .We also have coefficient π_7 which is the slope coefficient for absolute Return on Nifty, ut is the random error term)

Null Hypothesis: The coefficient of two lags, two leads, coefficient of contemporary relation and also absolute return on Nifty are simultaneously equal to zero.

$H_{05} : \pi_2 = \pi_3 = \pi_4 = \pi_5 = \pi_6 = \pi_7 = 0$,

Alternative Hypothesis : If any of the above coefficients is not equal to zero.

$H_{A5} : \pi_2 = \pi_3 = \pi_4 = \pi_5 = \pi_6 = \pi_7 \neq 0$

8. Empirical results and interpretation

The results of the study are given in appendices. Appendix I discusses the e.q. (iii) results which is a regression between change in VIX (dependent) and Return on Nifty and Lags of Return on Nifty (independent) . The table is divided into two parts, the first part gives the results of OLS regression while the second part uses Newey West OLS methodology which tries to make adjustment in standard errors by making these heteroscedasticity and autocorrelation consistent (HAC) standard errors. Results of both the regression equations (OLS and NW OLS) show that the Return on Nifty is statistically significant (the absolute value of computed 't' statistics of -23.27828 OLS and-11.41904 NW OLS is higher than the table or 'p' statistics is less than 0.05) we would be rejecting hypothesis no. 1(H_{01}). Also the beta coefficient of Return on Nifty variable is having negative sign. We therefore conclude that One day return (Ret on Nifty$_t$) is an important factor to determine change in volatility of Nifty (ΔVIX_t) which empirically also proves the application of leverage theory in the Indian stock markets. Further since we also find that 1stlag of return on nifty is also significant (OLS computed 't' value is value 4.441845 and 'p' at 0.0, NW 't' value 4.244788 and 'p' at 0.0) we would be rejecting the hypothesis no. 2 (H_{02}) meaning that the concept of cognitive dissonance is applicable in Indian markets.

The second appendix (Appendix II) gives the results of eq.(iv) where return on nifty is regressed on change in VIX and lags of change in VIX.(hypothesis No. 3). Here too table, gives the results of OLS and Newey West Robust OLS and the results of both regression equations are identical; only change in VIX and 1st Lag of change in VIX are statistically significant.(computed 't' values under OLS as -22.60 and -2.28 and NW as -11.34 and -2.14 for ΔVIX_t and ΔVIX_{t-1} respectively). Thus here the Null Hypothesis No. 3 (H_{03}) is rejected reflecting changes in volatility (ΔVIX_t and ΔVIX_{t-1}) are an important factor in determining Ret on Nifty$_t$ which implies that Volatility Feedback theory is also applicable to Indian markets.

The third appendix (Appendix III) gives the results of eq.(v) where change in VIX (i.e. ΔVIX) is regressed on lags of ΔVIX. The results show that only the second lag of change in VIX (i.e. ΔVIX_{t-2}) is statistically significant at 5 percent level of significance while all other lags are not significant. Thus we accept the null hypothesis no. 4 (H_{04}) stating that past volatility changes are insignificant in making an impact on the current change in VIX

showing applicability of the concept of cognitive dissonance (cognitive dissonance concept implies that current volatility cannot be determined by past volatility as dissonance would put a barrier to it.) It is important to add here that such a decision has been taken inspite of ΔVIX_{t-2} being statistically significant, this is so because the first lag of ΔVIX i.e. ΔVIX_{t-1} and all other lags (except ΔVIX_{t-2}) i.e. ΔVIX_{t-3}, ΔVIX_{t-4}, ΔVIX_{t-5} are insignificant.

Appendix IV shows the results of asymmetric relation between volatility and return i.e. between ΔVIX as dependent variable and return on Nifty ,first two lags of Return on Nifty, first two leads on Return on Nifty and absolute value of Return on Nifty (as Independent variables). The results show that variables; return on nifty and its two lags and absolute value of return on nifty are statistically significant while the two lead values are not significant at 5 percent level. Here we are rejecting the Null for all the variables except the first two leads on return on Nifty. According to (Fleming *et.al.,* 1995), the asymmetry would be proved if coefficient π_2 (first lag of Return on Nifty) and π_7 (absolute value of return on nifty) are significant and the sum of the two would measure the asymmetry of the relation between the two variables. Moreover a significant positive π_7 shows that stock market moves independent of direction.

Appendix V and VI are for data diagnostics in terms of stability and stationary of the model and the results clearly show that both our variables viz. Return on Nifty and change in VIX are stationary (at level) . Further both these variables (or the parameters pertaining to these variables) are also stable as depicted by the CUSUM Plot where the curve of both the variables lies within the ± 5 percent level.

9. Conclusion and scope for further research

The aim of the present study was on empirically testing the concept of cognitive dissonance amongst Indian investors investing on Indian markets. This was achieved by studying the relation between the return on a stock index and its volatility. Different tests were carried out byestablishing different set of hypothesis and the empirical results from these tests could provide enough evidence that the cognitive dissonance seemed to be working on the psyche on Indian investors. It was seen that not only current return i.e. Ret on Nifty$_t$ but also past Ret on Nifty$_t$ i.e. Ret on Nifty$_{t-1}$ impacted change in volatility of Nifty (i.e. ΔVIX_t) which was in line with the concept of dissonance. Similarly it was also found that past volatility changes were not impacting current volatility ΔVIX_t again showing the applicability of the concept of cognitive dissonance in indian markets. The same results could also empirically prove that traditional theories i.e. leverage theory and volatility feedback theory were also applicable in indian markets.

It is not something very rare or strange that psychological theory like cognitive dissonance seemed to be working on the psyche on Indian investors. The feeling of regret and the desire to overcome this regret under cognitive dissonance could also be compared to another behavioural dimension called "loss aversion". Under 'Loss Aversion' principle an investor shall not sell his share at a loss because as a loss averter he is willing to take more losses on the hope that someday he might see the stock moving up. This happens to investors in most markets and Indian Markets are no exception.

Studies have also proved that Indian investors also have emotional attachment to the stocks which was more seen in the times when shares were issued in physical form. Many other behavioural aspects have been impacting the Indian investor like herd mentality where the Indian investors have been noticed to go after the same portfolio of shares which have been purchased by foreign portfolio investors or domestic institutional investors. A classic example of this was seen during the sub prime crisis of 2008, when Indian stock markets starting falling and reached a drastic low levels without any major problem/event in India. This was simply because foreign institutions were selling their shares due to the crisis which was caused on account of housing loan mortgage in US and other developed markets. Other behavioural aspects commonly seen in Indian markets are in the form of different biases including hindsight bias, over-confident bias etc. However even though these

behavioural aspects are proved to be working on psyche of the Indian investor, there have not been much of a research (especially the empirical research) in this direction and more research in this area is needed to correlate different behavioural biases to different stock market patterns and any step in this direction would be a great help in forecasting the market in a better manner.

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Appendices

Appendix I : OLS and Newey West Regression Results between Δ VIX (Dependent) and Return on Nifty and lags of Return on Nifty (Independent).

ORDINARY LEAST SQUARE METHOD				NEWEY WEST METHOD		
Independent Variables	Beta coeff	Computed 't' value	'P' value	Beta coefficient	Computed 't' value	'P' value
Ret on Nifty	-3.114678	-23.27828	0.0000	-3.114678	-11.41904	0.0000
Ret on Nifty (-1)	0.596962	4.441845	0.0000	0.596962	4.244788	0.0000
Ret on Nifty (-2)	0.157263	1.166890	0.2435	0.157263	1.177694	0.2392
Ret on Nifty (-3)	0.160526	1.194435	0.2325	0.160526	1.202083	0.2296
Ret on Nifty (-4)	-0.141377	-1.049966	0.2939	-0.141377	-1.038706	0.2991
Ret on Nifty (-5)	-0.056371	-0.418764	0.6755	-0.056371	-0.306342	0.7594
Ret on Nifty (-6)	-0.145026	-1.077504	0.2815	-0.145026	-0.991035	0.3219
Ret on Nifty (-7)	0.018512	0.137859	0.8904	0.018512	0.142920	0.8864
Ret on Nifty (-8)	-0.064546	-0.479823	0.6314	-0.064546	-0.451429	0.6518
Ret on Nifty (-9)	0.080814	0.601811	0.5474	0.080814	0.602702	0.5468
Ret on Nifty (-10)	0.149895	1.122610	0.2618	0.149895	1.340347	0.1804

AppendixII : OLS and Newey West Regression Results between Return on Nifty (Dependent) and Δ VIX and lags of Δ VIX .

ORDINARY LEAST SQUARE METHOD				NEWEY WEST METHOD		
Independent Variables	Beta coefficient	Computed 't' value	'P' value	Beta coefficient	Computed 't' value	'P' value
ΔVIX	-0.098415	-22.60592	0.0000	-0.098415	-11.34256	0.0000
ΔVIX(-1)	-0.009938	-2.283464	0.0226	-0.009938	-2.142219	0.0324
ΔVIX(-2)	-0.000413	-0.094327	0.9249	-0.000413	-0.076961	0.9387
ΔVIX(-3)	-0.000888	-0.203033	0.8391	-0.000888	-0.186970	0.8517
ΔVIX(-4)	0.005988	1.368577	0.1714	0.005988	1.292433	0.1965
ΔVIX(-5)	0.000987	0.225607	0.8215	0.000987	0.237822	0.8121
ΔVIX(-6)	0.001144	0.261459	0.7938	0.001144	0.266864	0.7896
ΔVIX(-7)	-0.002841	-0.649625	0.5161	-0.002841	-0.555023	0.5790
ΔVIX(-8)	-0.001257	-0.287336	0.7739	-0.001257	-0.294651	0.7683
ΔVIX(-9)	-0.001569	-0.360346	0.7187	-0.001569	-0.283139	0.7771
ΔVIX(-10)	-0.001348	-0.309659	0.7569	-0.001348	-0.300777	0.7636

AppendixIII : OLS and Newey West Regression Results between Δ VIX (Dependent) and lags of Δ VIX (as independent) .

ORDINARY LEAST SQUARE METHOD				NEWEY WEST METHOD		
Independent Variables	Beta coefficient	Computed 't' value	'P' value	Beta coefficient	Computed 't' value	'P' value
ΔVIX(-1)	0.028761	1.000367	0.3173	0.028761	0.906113	0.3651
ΔVIX(-2)	-0.114084	-3.971147	0.0001	-0.114084	-3.558380	0.0004
ΔVIX(-3)	-0.006864	-0.237501	0.8123	-0.006864	-0.146266	0.8837
ΔVIX(-4)	-0.036894	-1.276680	0.2020	-0.036894	-1.338916	0.1808
ΔVIX(-5)	-0.013009	-0.449956	0.6528	-0.013009	-0.432167	0.6657
ΔVIX(-6)	-0.015533	-0.537356	0.5911	-0.015533	-0.437137	0.6621
ΔVIX(-7)	-0.015266	-0.528331	0.5974	-0.015266	-0.488102	0.6256
ΔVIX(-8)	0.026587	0.919603	0.3580	0.026587	0.814708	0.4154
ΔVIX(-9)	0.050436	1.755213	0.0795	0.050436	1.687591	0.0917
ΔVIX(-10)	0.013980	0.486105	0.6270	0.013980	0.492003	0.6228

Appendix IV : OLS and Newey West Regression Results between Δ VIX (Dependent Variable) and Return on Nifty , and first two lags of Return on Nifty and first two leads on Return on Nifty and absolute value of return on nifty (as Independent variables).

ORDINARY LEAST SQUARE METHOD				NEWEY WEST METHOD		
Independent Variables	*Beta coeff*	*Computed 't' value*	*'P' value*	*Beta coefficient*	*Computed 't' value*	*'P' value*
Ret on Nifty	**-3.018539**	**-23.12082**	**0.0000**	**-3.018539**	**-13.48943**	**0.0000**
Ret on Nifty (-1)	**0.569067**	**4.370971**	**0.0000**	**0.569067**	**4.016839**	**0.0001**
Ret on Nifty (-2)	**0.263971**	2.026566	0.0429	**0.263971**	2.020644	0.0435
Ret on Nifty (+1)	-0.114806	-0.881570	0.3782	-0.114806	-0.931670	0.3517
Ret on Nifty (+2)	0.069613	0.535841	0.5922	0.069613	0.515997	0.6060
| Ret on Nifty |	**1.397802**	**7.386092**	**0.0000**	**1.397802**	**4.359488**	**0.0000**

Appendix V : Testing of the Stationary of Variables : Unit root ADF test

Null Hypothesis	*Computed 't' value (level)*	*Corresponding 'p' value*
Return on NSE Nifty has a unit root	*-31.71942*	*0.000*
Change in VIX has a unit root	*-16.81746*	*0.000*

Critical 't' value at 5 % level for ADF is -2.883753

Appendix VI: CUSUM Stability Polots (a) Return on Nifty and (b) Δ VIX