Testing the UK stock market overreaction

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The overreaction hypothesis asserts that investors tend to violate the Bayes' rule where they overreact to unanticipated and dramatic news or events in the financial world. This is consistent with the Representativeness Heuristic (Grether 1980) which is used as a basis for testing overreaction in the market. This paper scrutinises the behaviour of the UK stock prices in relation to the financial crisis (credit crunch). An event study is carried out for the period of 2004-2009 for the portfolios of Winners and Losers which have been assigned using quintiles of the best and worst performances of the sampled securities. Monthly data over the period shows clear evidence of stock overreaction behaviour in the UK market. The data is then split into sub-periods for further investigation which analyses the development of the overreaction of the market. The results of the overreaction have also been used as a proxy for the confidence level of investors in the market following global financial health. This provided evidence that in this case as the overreaction in the market decreases, the confidence in the market increased providing an indication of the mean starting to revert to its position.

Keywords: Overreaction Hypothesis, mean reversion, market instability

1. Introduction

Traditional theories assume that agents are able to process the relevant information at their disposal and form biased probability judgment on the basis of the Bayes theorem where investors tend to overweight recent information and underweight base rate (prior) data. Thus, overreaction of the market and investors is inconsistent with the Bayes rule which states that the market and rational investors update their

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beliefs correctly. Therefore, this discrepancy has been at the core of modern financial economics and of particular interest to investors as it allows the opportunity for arbitrage leading to the irrational behaviours. There is now considerable evidence supporting the fact that returns of assets are predictable over long and short period of time for both the market and individual stocks. In this paper emphasis on a potentially crucial aspect of long-run mean reversion in stock returns known as the Overreaction Hypothesis has been scrutinised. This hypothesis, as put forward by De Bondt and Thaler (1985) analysing the US market showed that stocks which have witnessed poor performance (losers) over the past three to five years tend to surpass previous high performance stocks (winners) for the equivalent period length. This study looks at measuring the overreaction of UK stock market during 2007-2009 taking into consideration the financial crisis.

2. Literature Review

Overreaction Hypothesis states that *"extreme movements in stock prices will be followed by subsequent price movements in the opposite direction"* (De Bondt-Thaler 1985). This means that assets which have experienced considerable downfall in relation to the market in their returns over a period of time will surpass the market over the equivalent period of time (normally one to five years). Before deeper analysis of the phenomenon, a clear understanding of the aspect of overreaction in relation to an "appropriate reaction" is required. This distinction is provided by the two important theories in behavioural finance which are Bayes' Theorem and Representativeness Heuristic.

Bayes' theorem is concerns with the conditional and marginal probability distributions of random variables, especially a *priori* with a *posteriori* probabilities:

$$\boldsymbol{P(A \setminus B) = \frac{P(B \setminus A)P(A)}{P(B)}}$$

Bayes' Theorem assumes that investors are rational and therefore update their beliefs correctly with the application of conditional probability in order to weight both current and prior information.

On the other hand, Representativeness Heuristic asserts that investors are insensitive to prior probability of results and do not consider base rate frequencies. The subjective probability of an event, or a sample, is determined by the degree to which it is: firstly similar in essential characteristics to its parent population; and secondly reflects the salient features of the process by which it is generated (Kahneman-Tversky 1979). Therefore, investors tend to underweight prior data and overweight current data. This shows that is assigning probabilities, investors

normally violates the Bayes Theorem which might then leads to an overreaction in the market with the advent of a herding behaviour.

De Bondt and Thaler (1985, 1987) were the first put forward in their paper significant evidence to prove the phenomena of long-run overreaction. They ascertain that the return or prices of the stocks under consideration would adopt temporary swings away from their original fundamental values because of waves of confidence and pessimism in the market. Their findings demonstrated that losers/winners, measured and classified by their performance relative to the aggregate stock market over the past 3 to 5 year period, consistently surpassed or underperformed the market in the following 3 to 5 year period.

There are two main explanations that have been proposed for the overreaction hypothesis which are subject to debates. The first reason is related to the size effect, whereby the portfolio of the losers tends to be smaller and usually the smaller companies outperform large corporations (Zarowin, 1990). The second explanation is that the reversal in the share prices reflects changes in equilibrium required returns (Chan 1988). That is the significant movements in the leverage will lead to high changes in a companies' CAPM beta. Therefore, betas of the extreme losers go beyond the betas of the top winners. Ball and Kothari (1989) found that these changes in betas exceeded by 0.76. These differences in the betas clearly explain large differences in realised returns therefore providing evidence for overreaction.

3. Methodology and Data

Definitions of Winners and Losers

For the purpose of this study, winners and losers are being defined as being the best and worst performing stocks over the specific period of time respectively which in this case is from 2007-2009. In this perspective, quintiles method has been used in relation to the performance of the stock returns where the assets were classified into two portfolios. Note that this study considers only the top and bottom quintiles of stocks by their performances. Therefore, portfolios of stocks are formed on the criteria of prior period performance.

In order to test the Overreaction Hypothesis in the UK stock market, event study techniques were applied similar to De Bondt and Thaler (1985). The end of the month dividend adjusted returns of the sampled stocks on the FTSE All Shares were used for the classification of the portfolios. Moreover, the FTSE All Shares was used to represent the market to which the shares' performances were marked to form three different periods which involved 1, 12, 24 and 36 months. Therefore, the market adjusted returns for the end of the month were calculated as follows:

$$U_{it} = R_{it} - R_{mt} \qquad t = 1...n. \qquad (1)$$

where:

n = 1 .. 12, or n = 1 .. 24, or n = 1 .. 36.

$\boldsymbol{U}_{it}$ = the difference between the log return on stock *i* at period *t*

$\boldsymbol{R}_{it}$ = the log return of the individual companies at period *t*

$\boldsymbol{R}_{mt}$ = the log return of the FTSE All Shares at period *t*

Then, for the every stock for the period starting on the 1st of January 2007, we calculate the cumulative excess return which is denoted as $\sum_{t=35}^{t=0} \boldsymbol{U}_{it}$ for the overall 36 months. Hence, the $\boldsymbol{CU}_i$'s are taken into consideration in order to ranked them from low to high performing stocks where the quintile method is applied to form the portfolios. The top 17 companies are therefore classified as being the equally weighted portfolio of winners (*W*) and the companies at the bottom of the quintiles are grouped together to form the loser portfolio (*L*). Moreover, the Cumulative average returns of the portfolio ($\overline{\boldsymbol{ACUR}_p}$) are computed over the post portfolio formation period, this is determined through an average of the $\boldsymbol{CU}_i$ of the stocks from each portfolios. Therefore, there will be the results for the individual cumulative average return of individual returns ($\overline{\boldsymbol{ACUR}_i}$) and also the cumulative average return of the portfolios. The cumulative averages of the portfolio returns for the winner quintile and loser quintile are denoted as $\overline{\boldsymbol{ACUR}_P^W}$ and $\overline{\boldsymbol{ACUR}_P^L}$ respectively. Consequently, by subtracting both cumulative average return we get the $\overline{\boldsymbol{ACUR}_{Dt}}$. Therefore, if the return on the later is insignificantly different from zero then we cannot accept the simple overreaction hypothesis bearing the assumption that differences in transaction costs between both portfolios do not influence the results of $\overline{\boldsymbol{ACUR}_{Dt}}$. On the other hand, a significant positive value for $\overline{\boldsymbol{ACUR}_{Dt}}$ will eventually confirms overreaction for the UK stock market for the period under consideration.

Moreover, the differences in the average cumulative returns also points out one of the most important aspect of overreaction, which is the contrarian strategy. Here the contrarian investor attempts to profit by investing in a manner that differs from conventional wisdom, which is related to the herding behaviour, where the investors try to exploit the mispricing in the security market.

3.1 Test 1

The first test in order to investigate the existence of overreaction in the UK stock market is to compare the means of both portfolios returns (that is, the winner and loser) by regressing $\overline{CUR_{Dt}}$ against a constant:

$$\overline{CUR_{Dt}} = \overline{CUR_P^L} - \overline{CUR_P^W} = \alpha_1 + n_t \qquad \text{t = 1 … n} \qquad (2)$$

where

α_1 is a constant

n_t = white noise error term

t = the period after portfolio formation

n = 1, 12, 24 and 36 months

A *t-test* has been carried out in order to test the significance of the constant α_1 which will provide evidence whether there is a difference in the means of the winner and loser portfolios. As such, a significantly positive result for the constant can be interpreted as being a confirmation for the overreaction hypothesis. This indicates that the average performance of the losers is greater than the average performance of the winners. Consequently, an insignificant result indicates no overreaction hypothesis.

Moreover, $\overline{CUR_{Dt}}$ is also used to control for possible risk differences which is carried out by regressing it against the market risk premium. This test enables the identify the exposures of the portfolios to systematic risks thus providing explanation for the differences in returns. This is provided in the equation (3):

$$\overline{CUR_{Dt}} = \alpha_2 + \beta(RM_t - RF_t) + \varepsilon_t \qquad \text{t = 1 … n} \qquad (3)$$

where:

α_2 = the Jensen performance index

β = the difference between market beta for returns of the two portfolios

R_f = the risk free rate (UK government month T-Bill rate)

ε = a white noise error term

t = the period after portfolio formation

n = 1, 12, 24 and 36 months

Therefore, if the α_2 has a significantly positive value, this will confirm an overreaction in the UK market. Moreover, if β is significantly different from zero then it can said that systematic risk is responsible for the differences in returns whereby the losers may contain more systematic risk than the winners.

3.2 Test 2

The second test which is used to confirm or reject the conclusions of the first analysis uses the cumulative average returns of the stocks in the portfolios for the 36 months. As such, $\overline{\boldsymbol{CUR}^{\boldsymbol{W}}_{\boldsymbol{Pt}}}$ and $\overline{\boldsymbol{CUR}^{\boldsymbol{L}}_{\boldsymbol{Pt}}}$ (where *t = 1* through *t = 36*) are taken in order to determine the average cumulative returns of both portfolios denoted as $\boldsymbol{ACUR}_{\boldsymbol{W},t}$ and $\boldsymbol{ACUR}_{\boldsymbol{L},t}$. For *t > 0*, if $\boldsymbol{ACUR}_{\boldsymbol{W},t} < 0$ and $\boldsymbol{ACUR}_{\boldsymbol{L},t} > 0$ indicates overreaction in the market, therefore, $\{\boldsymbol{ACUR}_{\boldsymbol{L},t} - \boldsymbol{ACUR}_{\boldsymbol{W},t}\} > 0$. Further analysis to test whether average cumulative return provides indication that there is a statistically significant difference in the investment performance; the pooled population of the cumulative average return are estimated as follows:

$$\boldsymbol{S}_t^2 = [\sum_{n-1}^{N}(\boldsymbol{CUR}_{\boldsymbol{W},n,t} - \boldsymbol{ACUR}_{\boldsymbol{W},t})^2 + \sum_{n=1}^{N}(\boldsymbol{CUR}_{\boldsymbol{L},n,t} - \boldsymbol{ACUR}_{\boldsymbol{L},t})^2] / 2(\boldsymbol{N} - 1). \tag{4}$$

The variances of the two portfolios mean having with two equal sample size *N* is $2\boldsymbol{S}_t^2 / \boldsymbol{N}$ and the t-statistic is as follows:

$$\boldsymbol{T}_t = [\boldsymbol{ACUR}_{\boldsymbol{L},t} - \boldsymbol{ACUR}_{\boldsymbol{W},t}] / \sqrt{2\boldsymbol{S}_t^2 / \boldsymbol{N}} \tag{5}$$

The *t*-statistics can be computed for each of the 36 months however they do not represent independent evidence.

Moreover, tests have been conducted in order to determine whether at any month *t,* the average return makes a contribution to $\boldsymbol{ACUR}_{W,t}$ and $\boldsymbol{ACUR}_{L,t}$. The tests comprise the verification whether the contributions are statistically significant from zero. Therefore, the sample standard deviation of the winner is:

$$\boldsymbol{s}_t = \sqrt{\sum_{n=1}^{N} (\boldsymbol{AR}_{W,n,t} - \boldsymbol{AR}_{W,t})^2 / \boldsymbol{N} - 1} \qquad (6)$$

$\boldsymbol{s}_t / \sqrt{\boldsymbol{N}}$ is the sample estimate of the standard error of $\boldsymbol{AR}_{W,t}$, the *t*-statistics is:

$$\boldsymbol{T}_t = \boldsymbol{AR}_{W,t} / (\boldsymbol{s}_t / \sqrt{\boldsymbol{N}}) \qquad (7)$$

The same procedure is repeated for the analysis of the loser portfolio.

4. Discussion

The results of the tests are illustrated in tables 1 and 2. They provide evidence to support the assumption of Overreaction Hypothesis. Over the period analysed for the UK stock market, the results show that prior losers subsequently earn positive risk-adjusted excess returns and prior winners subsequently earn negative risk-adjusted excess return. Referring to the $\boldsymbol{ACUR}_{C,t}$ which provides an indication of stock market overreaction and contrarian strategies adopted by investors, clearly points out that the market have been overreacting during the whole three years. Moreover, as a measure of contrarian, the $\boldsymbol{ACUR}_{C,t}$ suggests a herding behaviour on behalf of investors to take advantage of the mispricing or chaos in the financial market. For the individual period of months (1, 12, 24 & 36), $\boldsymbol{ACUR}_{W,t} < 0$ and $\boldsymbol{ACUR}_{L,t} > 0$, further indicates overreaction in the UK securities in relation to the market, thus $\{\boldsymbol{ACUR}_{L,t} - \boldsymbol{ACUR}_{W,t}\} > 0$ and the accompanying *t*-statistics statistically support the hypothesis of overreaction in the UK market. Consequently, in line with the work of De Bondt and Thaler (1985), the results shows that the portfolio of prior losers are found to outperform the portfolio of prior winners by about 60% for the first month. These facts prove that investors violate the Bayes' theorem where they tend to overweight current information and underweight prior

information. These have been described as the Representativeness Heuristics where investors move away from the use of conditional probabilities in their strategies for portfolio assignment.

Table 1. Overreaction Hypothesis Test

Nature of the portfolios (Test 2)	**ACAR (t-statistics) into the test periods**			
	Number of months into the test periods			
	1	**12**	**24**	**36**
Loser	**0.14487**	**0.51236**	**1.37967**	**1.41962**
Winner	**-0.09771**	**-1.27111**	**-3.34595**	**-2.38167**
$ACUR_{C,t}$	**0.24259**	**1.78347**	**4.72562**	**3.80129**
S_t^2	**0.24431**	**15.0258**	**104.791**	**61.5013**
$2S_t^2 / N$	**0.02874**	**1.76775**	**12.3283**	**7.23545**
$t-statistics$	**1.43095****	**1.34139****	**1.34588****	**1.34139****
$S_{t,W}$	**0.13058**	**0.15585**	**0.14063**	**N/A**
$S_{t,L}$	**0.31954**	**0.03653**	**0.01816**	**N/A**
$s_{t,W} / \sqrt{N}$	**0.03167**	**0.03780**	**0.03410**	**N/A**
$s_{t,L} / \sqrt{N}$	**0.07750**	**0.00886**	**0.00440**	**N/A**
$T_{t,W}$	**-2.12800**	**-1.44864**	**-2.0452**	**N/A**
$T_{t,L}$	**1.25091**	**1.48558**	**5.90915**	**N/A**

** Significant at 95% level

Source: own creation

The *t*-statistics from table 1 shows that the performances of the different portfolios are statistically significant at 95% confidence level. That is, investors focus on securities that are involved with extreme return experiences. However, for the mean-reversion, it is not to be in line with the works of De Bondt and Thaler (1985), where they showed that greater the mispricing in the market, quicker will be the reversion of the mean. In this case, due to the nature of the crisis, slow reversion has been observed as the overreaction will take longer to revert back to its original position. The crisis is of a global phenomenon where there is a high interdependence of stock markets. This element makes the recovery of the market to be more painful which huge consequences to the economy.

The next section of the analysis is related to measure the degree of the overreaction in the UK market. It has already been specify that there has been evidence of overreaction in the market; however it is crucial to measure the extent or gravity of the overreaction. These provide an indication on the investors' sentiment in relation to the financial instability. It has also been used as a proxy for measuring the riskiness of the market or the confidence of investors to the reliability in the market.

Table 2. Market Overreaction

	N=12	N=24	N=36
Return on Loser	**0.013163**	**0.094011**	**0.02176**
Return on Winner	**-0.05476**	**-0.01961**	**-0.03667**
TEST 1			
$\overline{CUR_{Dt}}$ =	**0.067921**	**0.113623**	**0.058431**
Annualised Return Difference	**120%**	**200%**	**64%**
Systematic Risk			
α_2	**-0.001**	**0.022**	**0.042**
Significant F	**Sig F <0.05**	**Sig F <0.05**	**Sig F <0.05**
β	**0.71**	**1.01**	**1.00**

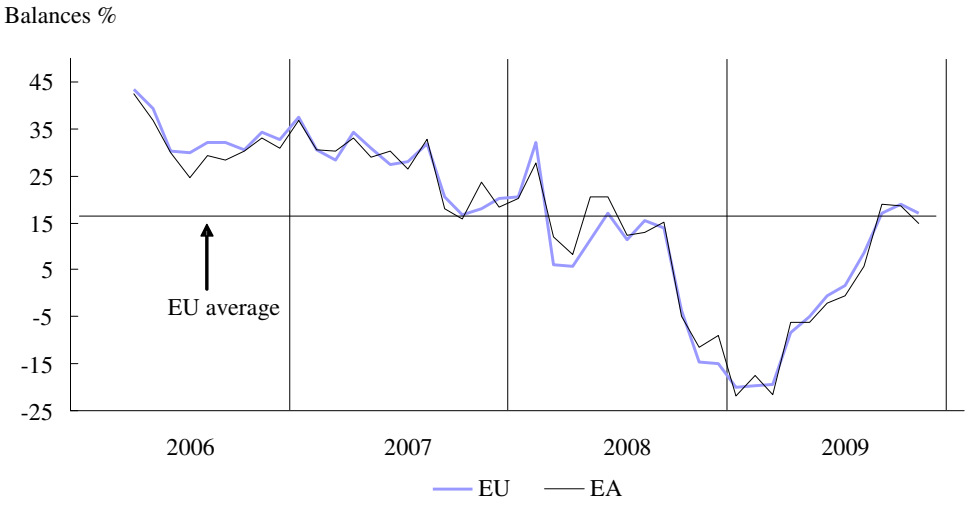
Source: own creation

The systematic risk analysis shows that as all the significant F < 0.05, so the null hypothesis that there is no evidence of overreaction in the UK market is rejected. Moreover, the β clearly points out that much of the overreaction in the market is mainly due to the volatility in the market which is a result of the subprime crisis. Table 2 also shows that during the first 12 months (i.e. in 2007), the overreaction amounted to 120% indicating a herding behaviour of investors due to the dramatic news events in the world and local market. In 2008, the overreaction escalated to a 200%. This can be explained by the several events on a global level leading investors to be pessimistic about the market. In September 7th 2008, the world witnessed a historic US mortgage bailout where two large American mortgage lending companies, Fannie Mae and Freddie Mac were rescued by the US government. Another blow came from Lehman Brothers on September the 15th of 2008 where the company filed for bankruptcy. On the same day, Merrill Lynch was saved by another huge American bank. This was the worst period for the Wall Street and the risk premium on the bank's debt soared, as the solvency concerns increased resulting with alarming funding issues for vulnerable banks. Moreover, in

October 8th of 2008, the UK government in turn announced a £500 billion rescue package for the banking sector. However, even all the measures taken by the US and UK governments to save the financial system, these did not reassured or restored the confidence of investors resulting into an overreaction in the market both in UK and the US.

On the other hand, in 2009 the UK financial sector witnessed a surge of the confidence level in the market leading to a fall of the overreaction to 64%. Even though the world financial health was still in jeopardy with the advent of the UK economy falling into a recession on the 23rd of January 2009 and with a fall in the GDP by 0.8% in July 2009; investors were better prepared which did not led into frantic mania in the financial world. The Economic Sentiment Indicator (ESI) showed that the European businesses and consumers demonstrated an increased in their level of optimism about the economy. In November 2009, the ESI rose to 87.9 (+1.9) in the EU and 88.8 (+2.7) in the European area (European Commission 2009). Even though the European economies' indicator suggest that they are still below the long-term average, nonetheless there have been an improvement in the sentiment level to the upward direction which is a sign of the investors regaining back their confidence over the financial system. Refer to figure 1:

Figure 1. Financial Services Confidence Indicator

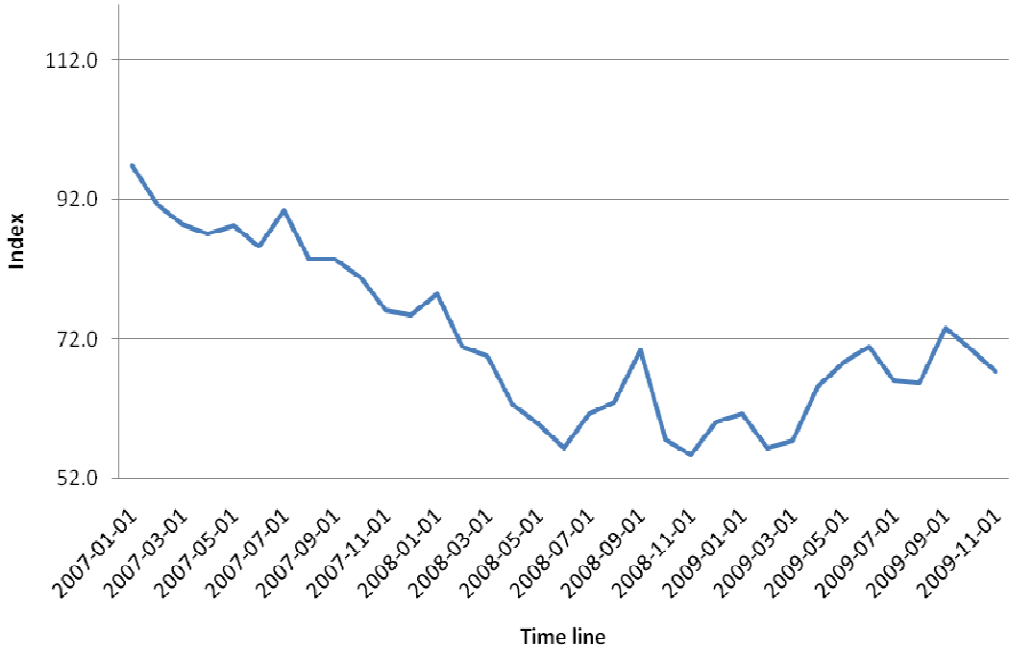


Source: European Commission 2009

Figure 1 clearly illustrates that the confidence over the financial sector is improving which confirms the fact that the degree of overreaction went down to 64% in 2009. This change in the confidence level can also be attributed to the fact that various member states in the European Union reported an increase in their economic sentiment. In Netherlands the sentiment rose sharply to a +6.3, France (+2.2) and Germany (+1.7). Even though UK did not witnessed a rise in their sentiment, the general improvement in the EU sentiment resulted into a fall in the overreaction in the UK market.

On a world level, the Michigan Consumer Sentiment Index can be used to reflect the level of sentiment gained in the financial system. Refer to figure 2 for an indication of the confidence level in the world market:

Figure 2. Consumer Sentiment Index for 2007-2009



Source: Derived from data collected from Michigan Consumer Sentiment Index

Figure 2 is in line with the findings in table 2 where the US confidence level can be taken as a proxy for the UK sentiment degree over the financial system as both markets are highly correlated. It can observed that during the first 12 months the confidence level fell by significant level of 22% which led to a huge overreaction

level of 160% in 2007. However, for the 24 months the sentiment index has been fluctuating nonetheless the herding behaviour of investors resulted into a figure of 200% due to the reasons already mentioned above. On a positive note, in 2009 the sentiment index started to take an upward movement which led to a significant improvement in the confidence level in the UK financial system.

5. Conclusions

The research conducted provided evidence that investors tend to overreact to unexpected and dramatic news events which in this case is the financial crisis initiated from a housing bubble. This kind of investors' behaviour is crucial to investigate as it constitutes a main determinant to the financial health of the market.

The results is in line with the Overreaction Hypothesis and also with the Representativeness Heuristics relating mainly to the behaviours of investors at the advent of an extreme event. The paper showed that the losers outperformed prior winners which mean that investors have been underweighting prior information and overweighting recent information or data applying subjective probability distribution.

The evidence of the evolution of the overreaction in the UK market has also been used in this paper as a proxy to analyse the confidence or sentiment level of the market. The research showed that as the herding behaviour in the market went down, the confidence level went up even through in is below the long-term average level of confidence. This has been further justified through the analysis of Financial Services Confidence Indicator and the Michigan Consumer Sentiment Index.

Consequently, the behaviour of investors constitute a crucial role in identifying the predictability of the market. However, the research showed that the identification of this arbitrage opportunity or looking for the period where the mean will revert back to its position is not evident.

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