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The Long-Run Return Reversal Effect: A Re-Examination in the Indian Stock Market

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This study evaluates the long-run reversal effect in the Indian stock market. The empirical findings add convincing evidence in favor of the long-run return reversal effect wherein past long-run loser stocks outperform past long-run winner stocks over longer investment periods, suggesting the profitability of a long-run contrarian strategy. The long-run reversal profits in the Indian market were driven by risk differential among past long-run winner and loser portfolios and can be explained by simultaneously controlling for beta, size, value, and liquidity risk. In a nutshell, the long-run reversal anomaly is not robust under a multifactor asset pricing framework, and the excess profits from long-run loser portfolios are nothing but compensation for the risk held.

Keywords: Long-Run Reversal Effect, Overreaction Hypothesis, CAPM, Multifactor Asset Pricing Model, Losers, Winners

JEL Classification: C52, G11, G12, G14

I. Introduction

The long-run reversal effect in stock returns has been a well-established phenomenon in the stock market for more than four decades. Such a long-run reversal effect is generally referred to as a phenomenon where stock returns undergo reversal over a time horizon of more than 18 months, suggesting predictability in long-run stock returns. More specifically, it has been argued that there is a tendency for stocks with past long-term poor performance to outperform past long-term good performance stocks over a longer time horizon. Such a phenomenon is generally regarded as one of the most serious violations of the Efficient Market Hypothesis (EMH) in the literature (Dimson and Mussavian, 2000).

Despite its popularity among academicians and practitioners, the long-run reversal effect has been criticized by academicians in more recent times. Fama and French (2006) argued that such long-run reversal effects, and other similar stock market anomalies, can be related to misspecification of portfolio risk. A number of other explanations have also been put forward in the literature challenging the economic profitability of the long-run reversal effect. However, varying explanations have been found to be successful in different stock markets over different time periods. Such competing views create the need for further study to examine the existence of the long-run reversal effect in various stock markets. In the spirit of these debates, the present study re-examines the performance of the long-run return reversal effect in the Indian stock market.

This study aims to contribute to the academic literature in multiple ways. The study augments the current literature by providing a fresh and comprehensive out-of-sample test of the long-run

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return reversal effect in one of the fastest growing emerging markets. The Indian stock market can be considered as a distinct market in comparison to US and other developed stock markets in terms of institutional structure, liquidity, cultural background, etc. Such differences may affect the pattern in stock returns compared with those observed in other stock markets. Moreover, a recent out-of-sample test is important as the long-run reversal effect is observed to be not so robust over time. Contrary to previous domestic studies, the present study also accounts for varying robustness checks by controlling for seasonality, size, value, and liquidity. Finally, the study tests and compares the profitability of the long-run return reversal effect after simultaneously controlling for market risk, size, value, and liquidity risk using three- and four-factor asset pricing models.

The remainder of the paper is planned as follows: Section II gives a brief review of academic literature. It is followed by Section III, which offers a detailed discussion on the data and methodology employed. Section IV provides various empirical results that are obtained by applying multiple statistical procedures, followed by discussion and conclusion in Section V.

II. Literature Review

A. Empirical Evidence of the Long-Run Reversal Effect

The long-run return reversal effect is commonly known as the 'Overreaction Effect' in academic literature, a term that was first coined by De Bondt and Thaler (1985). They evaluated monthly US stock return data for the period 1926-1982 by focusing on stocks that experienced either extreme capital gains or losses over the past three to five years. They constructed winner and loser portfolios, wherein the winner portfolio consisted of the 35 best performing stocks while the loser portfolio consisted of the 35 worst performing stocks, and analyzed the performance of these portfolios over the next 36 months. They reported superior performance of past loser stocks as compared to past winner stocks over a time horizon of 36 months. Such evidence suggested that abnormal (or excess) returns can be obtained by buying past losers and selling past winners. Such a contrarian stock selection strategy based on stock reversal is commonly known as the 'Contrarian Strategy' (Mun *et al*., 2000). The findings of De Bondt and Thaler (1985) have attracted considerable attention among academicians as the profitability of contrarian strategies represents a strong challenge to the weak form of the EMH, suggesting some predictability in stock returns.

Motivated by the study of De Bondt and Thaler (1985), various scholars re-examined the profitability of the long-run return reversal phenomenon in different stock markets. The results in favor of the long-term overreaction effect were observed in a wide range of stock markets including Stock (1990) for Germany, da Costa (1994) for Brazil, Campbell and Limmack (1997) for the UK, Swallow and Fox (1998) for New Zealand, Fung (1999) for Hong Kong, Ryan and Donnelly (2000) for Ireland, Bildik and Gülay (2007) for Turkey, Dhouib and Abaoub (2007) for Tunisia, Chou *et al.* (2007) for Japan, and Hsieh and Hodnett (2011) for South Africa. In contrast to the prevailing euphoria, Brailsford (1992), Kryzanowski and Zhang (1992), and Chaouachi and Douagi (2014) reported results inconsistent with the long-run overreaction effect in the Australian, Canadian, and Tunisian stock markets, respectively.

Although the long-run return reversal effect is well accepted abroad, empirical evidence in the Indian stock market is mixed. Sehgal and Balakrishnan (2002) were the first to evaluate the presence of the long-run return reversal effect in the Indian stock market. Using monthly stock price data from 364 companies over a sample period from July 1989 to March 1999, they observed weak evidence of return reversal in a longer time horizon. Subsequent studies by Locke and Gupta (2009), Tripathi and Aggarwal (2009), Sehgal *et al.* (2013), and Dhankar and Maheshwari (2014) reported strong evidence of long-run overreaction in the Indian stock market over different sample periods and data. Contrary to these results, Chowdhury (2010) reported no significant long-run contrarian profits for the sample period 1991 to 2006 in the Indian stock market.

B. Alternative Explanation of the Long-Run Return Reversal Effect

Two possible explanations of the long-run return reversal effect have attracted much interest in the literature. De Bondt and Thaler (1985) suggested that the results of their study show the irrationality or irrational behavior demonstrated by investors, wherein investors overreact to both positive and negative information, pushing the prices away from their fundamental values. However, over the next two to three years, prices revert back to their fundamental values generating a reversal in stock returns. Such an explanation is labeled as a behavioral based explanation. A number of other behavioral based explanations for long-run return reversal have been proposed in the academic literature.

Another explanation is a risk-based explanation that occurs due to mispricing of risk among the extreme portfolios. It has been argued in the literature (Chan, 1988; Ball and Kothari, 1989) that it is the instability of the risk among past winner and loser portfolios over a longer time horizon that generates excess contrarian profits. The profitability of the long-run return reversal effect is also associated with size risk wherein Zarowin (1990) and others argued that past loser portfolios are dominated by small size stocks with higher risk that generate higher returns in longer time horizons compared to past winner portfolios. Kaul and Nimalendram (1990) and Conrad and Kaul (1993) attempted to show that most of the long-run contrarian profits were caused by measurement errors in prices in the form of bid-ask spreads and non-synchronous trading. Others reported strong seasonality in contrarian profits. Pettengill and Jordan (1990) argued that strong contrarian profits in the US stock market can be attributed entirely to the January effect. Contrary to the above studies, a number of subsequent studies failed to corroborate a relationship between size effect (Alonso and Rubio, 1990; Chopra *et al*., 1992; Albert and Henderson, 1995; Ahmad and Hussain, 2001), seasonality (Alonso and Rubio, 1990; Campbell and Limmack, 1997), time varying risk (De Bondt and Thaler, 1987; Dissanaike, 1997), and bid-ask bias effect (Loughram and Ritter, 1996; Dissanaike, 1997) with the long-run reversal effect, providing additional support in favor of the overreaction effect.[1]

However, proponents of the EMH have proposed that evidence of stock market anomalies such as the long-run reversal effect may be interpreted as shortcomings of the underlying asset pricing model. Elaborating on the same, Fama and French (1996, 2006) claimed that much of the long-run reversal profitability can be captured by their three-factor asset pricing model. The results from their study were found to be consistent with the risk-based explanation of long-run reversal

[1] For detailed discussion on the same refer to literature survey by Maheshwari and Dhankar (2014) on the overreaction effect.

profits, suggesting contrarian profits can be explained within the framework of the multifactor asset pricing model. However, the findings of Fama and French (1996) were challenged by Chiao *et al.* (2005) who argued that the Fama and French risk factors cannot fully explain the long-run reversal effect in markets other than the US. Further research on the capacity of the multifactor asset pricing model to explain long-run contrarian profit is required as Clements *et al*. (2009) argued that recent overreaction studies ignore this work in their methodological approach to the overreaction effect. The present study tries to bridge this gap by exploring the profitability of the long-run return reversal effect even after controlling for multiple risk factors in the Indian stock market.

III. Data and Methodology

A. Data Description

For the empirical investigation, the study makes use of adjusted closing price data available for all the stocks that were continuously trading on the Bombay Stock Exchange (BSE) over a sample period from January 1997 to March 2013. The final sample consists of 470 stocks having 195 monthly observations. The data of monthly adjusted closing prices are extracted from PROWESS, a financial database offered by CMIE (Centre for Monitoring Indian Economy). In addition to the monthly adjusted closing price, the monthly market capitalization, turnover ratio, and price-to-book (P/B) ratio were also collected for each sample stock over the sample period. In agreement with the literature (Sehgal and Balakrishnan, 2002; Tripathi and Aggarwal, 2009; etc.) the implied yield on 91-day treasury bills has been used as a surrogate for the risk-free proxy and the same was collected from the Reserve Bank of India (RBI) website.

B. Methodology

To assess the long-run reversal effect on profitability in the Indian stock market, the study borrows the methodology of De Bondt and Thaler (1985) with a few modifications. Instead of the non-overlapping periods used by De Bondt and Thaler (1985), this study employed overlapping portfolios where portfolios were rebalanced at the start of each year. A similar approach was adopted by Loughran and Ritter (1996), Ahmad and Hussain (2001), Tripathi and Aggarwal (2009), and Locke and Gupta (2009). A detailed discussion on the approach adopted is as follows:

- The BSE sensitive index is used as the proxy for the return on the market portfolio. The stock price data are converted into simple percentage returns as

$$R_{i,t} = \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}} \quad (1)$$

where $R_{i,t}$ is the monthly return, $P_{i,t}$ is the price on month t, and $P_{i,t-1}$ is the price on month t-1.

- The residual return (U_t) for each stock is calculated using the formula:

$$U_{i,t} = R_{i,t} - R_{m,t} \quad (2)$$

where $U_{i,t}$ represents the market-adjusted excess return on stock j for month t, $R_{i,t}$ is the return on stock i for month t, and $R_{m,t}$ is the return on the market index for month t.

- Beginning from January 1997 to 2007, for each stock (i), the cumulative market adjusted excess return (CU_i) is calculated over the 36-month formation period (F) where

$$CU_i = \sum_{t=1}^{36} U_{i,t} \tag{3}$$

- Based on CU_i all the stocks are ranked in descending order. Based on these rankings, the top 20per cent stocks are referred as the 'winner' (W) and the bottom 20per cent as 'loser' (L) portfolios. A similar 20per cent cut to define top and bottom stock portfolios is widely adopted in both domestic and international academic literature (Clare and Thomas, 1995; Sehgal and Balakrishnan, 2002; Mengoli, 2004; Bildik and Gülay, 2007; etc.). This procedure is repeated every year from 1997 to 2007 giving 11 pairs of winner and loser portfolios.

- For both portfolios (W and L) the average residual returns (AR) of all the portfolio securities are calculated for the next 36 month-holding period (H), for each of the 11 overlapping periods. Next, the cumulative average residual return (CAR) for both portfolios for each of the 36 months for the 11 overlapping periods is calculated as shown below:

$$CAR_{W,O,t} = \sum_{m=1}^{t} AR_{w,m} \quad ; O = 1, 2 \ldots 11;\ t = 1, 2, 3 \ldots..36\ months \tag{4}$$

$$CAR_{L,O,t} = \sum_{m=1}^{t} AR_{L,m} \quad ; O = 1,2 \ldots 11;\ t = 1, 2, 3 \ldots..36\ months \tag{5}$$

- Using CARs from all the overlapping test periods (N=11), the average CARs (ACAR) are calculated for both winner and loser portfolios for each of the 36 months.

$$ACAR_{W,t} = \frac{\sum_{j=1}^{N} CAR_{W,j,t}}{N} \ ; t = 1,2,3 \ldots..36\ months \tag{6}$$

$$ACAR_{L,t} = \frac{\sum_{j=1}^{N} CAR_{L,j,t}}{N} \quad ; t = 1,2,3 \ldots..36\ months \tag{7}$$

If the overreaction effect (or long-run return reversal effect) exists in the Indian stock market, then during the holding period (H), the ACAR of losers must be greater than zero while the ACAR of winners must generate negative returns since the overreaction effect predicts reversals in returns of past losing and winning stocks. Hence, by implication if the ACAR of the arbitrage (A) portfolio (ACAR (L) – ACAR (W)) is greater than zero then it suggests the presence of long-run contrarian profits. The profitability of contrarian strategies in the Indian stock market can be explained with the help of the average ACAR of the arbitrage portfolio ($ACAR_{A,t}$). Since contrarian strategy recommends long positions in past losers and short positions in past winners, any positive returns in the arbitrage portfolio suggest the profitability of the contrarian strategy in the Indian stock market.

Hence, to test the long-run reversal effect in the Indian stock market, the following hypotheses were tested:

Null Hypothesis	Alternative Hypothesis
H_{1o}: $ACAR_{W,t} = 0$	H_{1a}: $ACAR_{W,t} < 0$
H_{2o}: $ACAR_{L,t} = 0$	H_{2a}: $ACAR_{L,t} > 0$
H_{3o}: $ACAR_{A,t} = ACAR_{L,t} - ACAR_{W,t} = 0$	H_{3a}: $ACAR_{A,t} > 0$

The above hypotheses are tested using the standard *t*-test at the significance level of 5 per cent. In the case where *t*-statistics are greater than corresponding critical values, the null hypothesis can be rejected.

C. Risk-Adjusted Contrarian Profits

The above method emphasizes market-adjusted returns for long-run extreme (also known as long-run contrarian) portfolios as suggested by De Bondt and Thaler (1985). However, Chan (1988), Ball *et al*. (1995), and others argued that the long-run overreaction effect is due to manifestation of risk among extreme portfolios. Further, Fama and French (1993) argued that it is essential to test stock market anomalies, such as the long-run return reversal effect, in the context of asset pricing models as higher returns from these anomalies may be nothing but compensation for higher risk.

The study initially controls for risk using the capital asset pricing model (CAPM). The excess portfolio returns are regressed on the excess return for the market factor using the market model:

$$R_{pt} - R_{ft} = \alpha_p + \beta_M\left(R_{Mt} - R_{ft}\right) + \varepsilon_t \quad (8)$$

where, R_{pt} is the monthly return of the portfolio (either Winner or Loser), R_{ft} is the risk-free rate of return in time t, R_{Mt} is the market index return in time t, and ε is the error term. For the arbitrage portfolios (L-W) the dependent variable is obtained simply as the difference between loser and winner.

The CAPM implies that excess return on a portfolio should be fully explained by excess market return. If long-run contrarian profits are consistent with the risk explanation, then there will be significant β and insignificant α. Conversely, a positive and significant α of the arbitrage portfolio (L-W) supports the existence of long-run contrarian profits even after risk adjustments.

In addition to the single-factor CAPM, the study also implements the multifactor asset pricing models including the Fama and French (1993) three-factor model and the Chan and Faff (2005) liquidity-augmented four-factor model. The performance of extreme portfolios is considered using the following equations:

Fama and French (1993) three-factor model:

$$R_{pt} - R_{ft} = \alpha_p + \beta_M\left(R_{Mt} - R_{ft}\right) + \beta_s SMB_t + \beta_h HML_t + \varepsilon_t \quad (9)$$

Chan and Faff (2005) liquidity-augmented four-factor model:

$$R_{pt} - R_{ft} = \alpha_p + \beta_M(R_{Mt} - R_{ft}) + \beta_s SMB_t + \beta_h HML_t + \beta_i IMV_t + \varepsilon_t \quad (10)$$

where R_{pt} is the monthly return of the portfolio (Winner/Loser) in month t, R_{ft} is the risk-free rate of return in month t, R_{mt} is the market index return, and SMB_t ,HML_t and IMV_t refer to size, book-to-market ratio, and illiquidity risk factor. The loadings β_M, β_s, β_h and β_i are the slope coefficients in time-series regressions. For the arbitrage portfolios (L-W) the dependent variable is obtained simply as the difference between losers and winners.

All the additional risk factors: size (SMB), value (HML), and liquidity (IMV) are computed using the Chan and Faff (2005) 2x3x3 sort method. Before running the regression, the stationarity of the variables was tested using the Augmented Dickey-Fuller (ADF) and the non-parametric Phillips-Perron (PP) tests. Using the ADF and PP tests, all variables were found to be stationary. The results for the same are presented in Table 1. In addition, the standard errors from the regression were corrected for autocorrelation and heteroscedasticity using Newey-West standard errors.

Table 1: Testing of Stationarity Using ADF and PP Tests

Series	ADF (at level)	PP (at level)
Winner (W)	-10.553 (0.000)*	-10.550(0.000)*
Loser (L)	-11.589 (0.000)*	-11.613 (0.000)*
Arbitrage (L-W)	-10.608 (0.000)*	-10.597(0.000)*
Rm-Rf (market factor)	-12.743 (0.000)*	-11.331 (0.000)*
SMB (size factor)	-12.651 (0.000)*	-11.154 (0.000)*
HML (value factor)	-10.773 (0.000)*	-10.461 (0.000)*
IMV (liquidity factor)	-14.370 (0.000)*	-13.408 (0.000)*
Size-neutral		
Winner (W)	-10.256 (0.000)*	-10.193 (0.000)*
Loser (L)	-11.568 (0.000)*	-11.596 (0.000)*
Arbitrage (L-W)	-11.348 (0.000)*	-11.348 (0.000)*
Value-neutral		
Winner (W)	-10.578 (0.000)*	-10.589 (0.000)*
Loser (L)	-11.562 (0.000)*	-11.558 (0.000)*
Arbitrage (L-W)	-11.198 (0.000)*	-11.232 (0.000)*
Volume-neutral		
Winner (W)	-10.621 (0.000)*	-10.636 (0.000)*
Loser (L)	-11.543 (0.000)*	-11.570 (0.000)*
Arbitrage (L-W)	-11.531 (0.000)*	-11.560 (0.000)*

* Significant at 5 per cent level. Critical values of ADF and PP tests at 5 per cent level is -2.880.
Source: Authors' compilation.

IV. Empirical Results

A. Descriptive Statistics of Portfolios

Table 2 presents some statistics describing the characteristics and accounting information of extreme portfolios, i.e., winner and loser portfolios at formation. The past long-run winner portfolio represents an extreme positive return while the loser portfolio represents an extreme negative return during the formation period. Also, securities in the winner portfolio are much more diverse in their characteristics with higher standard deviation as compared to securities in the loser portfolio. The winner stocks are observed to be small in size and low in value as compared to counterpart loser stocks.

Table 2: Descriptive Statistics of the Long-Run Contrarian Portfolios

Long-Run Portfolios with 36 Month Formation Periods		
	Winner	**Loser**
Average Market Adjusted Monthly Return	0.0556*	-0.0181*
Std. Deviation	0.0224	0.0084
Avg. Market Capitalization (in Rs. Millions): Size	19891.47	22565.43
Avg. B/M ratio : Value	0.515	1.604

* Significant at 5 per cent level.
Source: Authors' compilation.

B. Market-Adjusted Returns and the Long-Run Return Reversal Effect

The results presented in Table 3 reflect the reactions of long-run past winner and loser stocks in the Indian stock market. The study evaluates the overreaction effect by studying the market-adjusted abnormal returns during the formation and holding periods. Table 3 reports the average cumulative abnormal returns data for the winner, loser, and arbitrage portfolios at the end of the formation period as well as for the holding period of 3, 6, 9, 12, 18, 24, and 36 months. For the sample of 470 stocks, the past winner portfolio outperformed the past loser portfolio when the portfolios were formed. However, a very dramatic change occurred in the following test/ holding period. As predicted by the long-run reversal effect or overreaction effect, the ACAR of arbitrage (L-W) generated positive returns over the holding period. Even though past loser outperformed past winner stocks for all the holding periods, the contrarian profits were found to be statistically significant only for a holding period of 36 months. The past 36-month loser stocks generated market-adjusted ACAR of 56.63 per cent over the next 36 months as compared to 35.30 per cent generated by past winner stocks. Thus, the arbitrage portfolio (L-W) generated a statistically significant positive ACAR of 21.33 per cent (*t*-statistics: 2.155) over 36 months. In other words, the past loser stocks outperformed past winner stocks by an average 21.33 per cent over 36 months, generating annualized contrarian profits of 7.11 per cent in the Indian stock market. Such findings are similar to the results of earlier US and other developed markets investigations (De Bondt and Thaler, 1985, 1987; Stock, 1990; da Costa, 1994; Bildik and Gülay, 2007, and Hsieh and Hodnett, 2011).

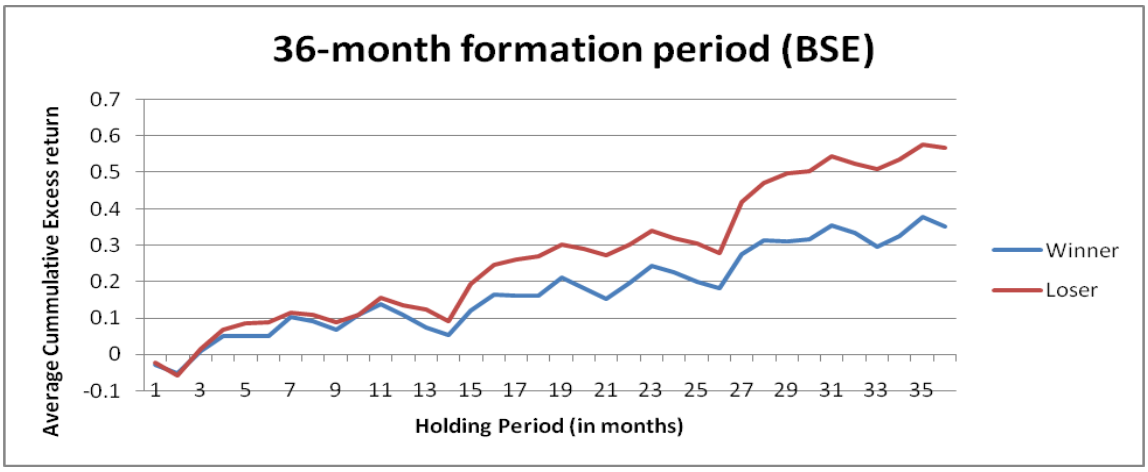
Table 3: ACAR of Long-Run Contrarian Portfolios

Formation Period: 36 Months									
Portfolio	**Cumulative Return Over Formation Period**		**Holding Period (H) Months**						
			H=3	**H=6**	**H=9**	**H=12**	**H=18**	**H=24**	**H=36**
Winner	2.0020	ACAR	0.0100	0.0511	0.0691	0.1101	0.1612	0.2270	0.3530
		Monthly (%)	0.3333	0.8517	0.7678	0.9175	0.8956	0.9458	0.9806
			(0.817)	(0.440)	(0.293)	(0.193)	(0.169)	(0.05)*	(0.02)**
Loser	-0.6530	ACAR	0.0145	0.0896	0.0888	0.1363	0.2690	0.3200	0.5663
		Monthly (%)	0.4827	1.4928	0.9862	1.1361	1.4945	1.3333	1.5731
			(0.665)	(0.161)	(0.172)	(0.055)*	(0.04)*	(0.02)**	(0.00)**
Arbitrage (L-W)	ACAR (mean)		0.0045	0.0385	0.019	0.0262	0.1078	0.0930	0.2133
	Mean Monthly Profits (%)		0.1500	0.6417	0.2111	0.2183	0.5989	0.3875	0.5917
	t-statistics		0.157	0.888	0.348	0.4462	1.4345	1.154	2.150

* Statistically significant at 5 per cent level.
** Statistically significant at 1 per cent level.
The winner and loser portfolios are formed on the basis of market-adjusted returns over the past 36 months and then held for H-holding months. The ACAR along with monthly return of both the portfolios is presented in the table. The corresponding ACAR of the arbitrage (L-W) portfolio along with monthly profits are also presented. Monthly return on the Sensex index is taken as a proxy of the market portfolio to calculate market adjusted returns. The *p*-statistics of winner and loser portfolios are reported in parentheses (). The null hypothesis of *t*-statistics is H_o: ACAR (A) = 0. All the values are rounded to four decimal places.
Source: Authors' compilation.

The presence of the long-run return reversal effect in the Indian stock market suggests that the simple contrarian strategy, i.e., buying past 36-month loser stocks and selling past 36-month winner stocks, generates statistically significant profits of 24.6 per cent over the next 36 months in the Indian stock market. The evidence of the overreaction effect in the Indian stock market is also reported by Locke and Gupta (2009), Tripathi and Aggarwal (2009), and Sehgal *et al.* (2013), although the magnitude of the contrarian profits for the Indian stock market in recent years is observed to be smaller than reported in the previous studies by Locke and Gupta (2009) and Tripathi and Aggarwal (2009), suggesting that the impact of the long-run return reversal effect has slightly decreased in recent years.

Figure 1: ACAR of the Past Long-Term Winner and Loser Portfolios in the Indian Stock Market



The current figure plots the ACAR of the winner and loser portfolios in 1 to 36-month post formation period.

There are several findings from the study that are worth reiterating. The study documents the asymmetric overreaction effect in the Indian stock market where the loser's reversal is the major source of contrarian profits. The performance of the loser's portfolio is strongly consistent with the predictions of the 'long-run return reversal effect' as a strong reversal pattern can be observed in the returns of the loser portfolio in the post formation period. The loser portfolio earned a huge positive cumulative excess return of over 56.3 per cent over the 36-month post formation period as compared to a negative cumulative return of 65.3 per cent during the 36-month formation period. In contrast, the winner portfolio exhibits a strong continuation pattern over the long horizon contradicting the prediction of a long-run return reversal effect. The overreaction hypothesis predicts a strong reversal effect in stock returns of losing as well as winning stocks. However, in the Indian stock market, past winning stocks continue to generate positive returns post formation, although a decline in returns is observed in the winner portfolios' post formation period. The huge positive cumulative return of more than 200 per cent over the 36-month formation period got reduced to a cumulative return of 35.5 per cent at the end of the holding period of 36 months in the Indian stock market. Such an asymmetric overreaction effect in the Indian stock market was also observed by Locke and Gupta (2009) and Tripathi and Aggarwal (2009). As shown in Figure 1, the ACAR of both the winner and loser portfolios is positive and increasing during the test period, although the ACAR of the loser portfolio is increasing at a higher rate as compared to the winner portfolio, generating a return differential among these extreme portfolios. Nam *et al*. (2001) also argued that reversals in stock returns are asymmetrical in nature as negative returns reverse to positive returns more quickly than positive returns reverse to negative returns. They attributed such asymmetry to the mispricing behavior of investors who overreact more to negative information. Similar conclusions can be drawn for the Indian stock market wherein investors react pessimistically to negative information.

C. Seasonality in Long-Run Contrarian Profits

The study further broadened the analysis to investigate the behavior of a long-run contrarian portfolio for all the calendar months of the year. The main rationale behind expanding the test is

to identify any January seasonality in long-run contrarian profits in the Indian stock market as documented in the US literature.

As can be observed from Table 4, the average monthly long-run contrarian profits for each of the 12 months appear to fluctuate considerably. Unlike the US stock market, no strong long-run contrarian profits are observed in the month of January. The highest long-run contrarian profits are observed in the months of April and June in the Indian stock market. The high contrarian profits in the month of April suggest a strong reversal effect during the month immediately after the Indian financial year end (i.e. March), providing initial support in favor of the tax-loss hypothesis. However, the tax year end is not the only possible event that may trigger a strong reversal in stock returns as the highest contrarian profits are observed in the month of June. Moreover, the difference among the monthly contrarian profits is found to be statistically non-significant as suggested by high ANOVA F-test *p* values. Hence, it can be concluded that the type of seasonal patterns observed in the US long-run contrarian profits cannot be observed in the Indian stock market.

Table 4: Average Monthly Contrarian Profits in Calendar Months

Month	**January**	**February**	**March**	**April**	**May**	**June**
Return	0.1451	0.8596	-0.0058	2.1143	1.0486	2.5478
Month	**July**	**August**	**September**	**October**	**November**	**December**
Return	0.5285	-1.1038	0.6905	1.2407	-1.6658	0.3767
F-stat(ANOVA)	0.882 (0.559)					

Source: Authors' compilation.

D. Risk-Adjusted Long-Run Contrarian Profits

D.1 Returns Using One-Factor CAPM

The previous results suggest the presence of long-run contrarian profits in the Indian stock market using market-adjusted returns. However, it is important to calculate the risk-adjusted return of the extreme portfolios. The study applies various techniques to adjust for risk. Initially, the study independently controls for four types of risk (beta, size, value, and liquidity) in a univariate approach. The study further extends to a multivariate approach using multifactor asset pricing models.

The study initially controls for beta risk by employing one-factor CAPM. The extreme portfolio returns are regressed on the excess return for the market factor using the CAPM, and the results of the same are presented in Panel A of Table 5. The one-factor CAPM failed to explain the abnormal long-run contrarian profits in the Indian stock market. The alpha values are statistically significant and higher for loser portfolios as compared to winner portfolios over a longer time horizon. The loser portfolio formed on the basis of the past 36-month return generates an extra-normal risk-adjusted monthly return of 1.24 per cent over the next 36 months as against non-statistically significant risk-adjusted monthly return of 0.53 per cent by winner portfolios over the same period. The intercept term for the arbitrage portfolio over the same contrarian strategy is found to be significantly positive with a risk-adjusted return of 0.70 per cent per month in the Indian stock market, suggesting positive risk-adjusted contrarian profits. Looking at the beta values of the winner and loser as well as the arbitrage portfolios, it is clear from the tables that the beta values of the winner portfolio is higher when compared to the loser portfolio. Hence, the extra risk-adjusted return earned by the loser portfolio over a longer time horizon does not seem to be a

compensation for carrying higher risk as measured by CAPM. Hence, it can be argued that past long-run losers significantly outperformed past long-run winners over the subsequent 36 months, and such return discrepancy cannot be explained by a beta risk differential in the Indian stock market. Such findings do not support the earlier findings of Chan (1988), Ball and Kothari (1989), and Conrad and Kaul (1993) who attributed long-term contrarian profits to risk differential among long-term winner and loser portfolios. However, results from the Indian stock market provide support to De Bondt and Thaler (1987), Zarowin (1990), Chopra *et al*. (1992), Tripathi and Aggarwal (2009), and others, that beta risk differential alone cannot explain the long-run reversal effect.

D.2 Other Sources of Risk

In addition to beta risk, the study further controls for size, value, and liquidity risk by following the Mengoli (2004) approach. To control for size, value, and liquidity effects, the past winner and loser portfolios are matched by size, value, and volume by forming size-neutral, value-neutral and liquidity- or volume-neutral portfolios. The proxy used for measuring size, value, and liquidity is market capitalization, the book to market (B/M) ratio, and the monthly turnover ratio respectively. To form a size- (value- or volume-) neutral portfolio, at the end of each formation period (F) stocks were ranked in ascending order on their average market capitalization (B/M ratio or turnover ratio). Based on the average market capitalization (B/M ratio or turnover ratio), the stocks were divided into three equally sized (value- or volume-) small, medium, and large sub-samples. The stocks within each sub-sample were further sorted on the basis of past cumulative returns over the past F months. The top 20 per cent stocks were grouped together into 'winner' and the bottom 20 per cent were referred as 'loser' portfolios. The size-neutral (value-neutral or volume-neutral) portfolios were formed by picking the stocks from the winner (loser) quintile from each size (value or volume) sub-group. Using this methodology, both winner and loser portfolios end up containing the same number of stocks from each size (value or volume) group, and are in that case size- (value- or volume-) neutral. The risk-adjusted momentum profits are calculated for size-neutral, value-neutral and volume-neutral portfolios by regressing the excess returns on the market factor using the CAPM over the holding period of 36 months.

Panel B of Table 5 presents the risk-adjusted profits of size-neutral long-run portfolios using one-factor CAPM. As is evident from the table, both long-run loser and arbitrage portfolios (L-W) generate statistically significant risk-adjusted returns. Such results suggest that both long-run good performance of loser stocks and long-run contrarian profits cannot be completely explained by size differential in the Indian stock market. These results are in line with Chopra *et al*. (1992), Albert and Henderson (1995), and Ahmad and Hussain (2001) who also suggested that both the long-run overreaction effect and the size effect are distinct phenomena.

Panel C of Table 5 presents the risk-adjusted profits of value-neutral long-run portfolios using one-factor CAPM. Even though long-run value-neutral loser portfolios generate statistically significant risk-adjusted returns, value-neutral arbitrage portfolios (L-W) generate statistically non-significant contrarian profits. Such results suggest that long-run contrarian profits are not completely independent of the value effect in the Indian stock market.

Such results are in accordance with the existing literature (Lakonishok *et al.*, 1994) that closely relates the long-run reversal effect to the value effect.[2]

Panel D of Table 5 presents the risk-adjusted profits of volume-neutral portfolios using one-factor CAPM. Similar to the value effect, liquidity risk partially explains the excess contrarian profits in the Indian stock market. After adjusting for liquidity, only long-run losers generate risk-adjusted excess returns while long-run contrarian profits are observed to be statistically non-significant. The influence of liquidity on the long-run reversal effect was also observed by Bailey and Gilbert (2007) for the South African stock exchange.

Table 5: Risk-Adjusted Monthly Contrarian Profits Using One-Factor CAPM

Portfolio	Alpha (α)	T(α)	Beta (β)	T(β)	Adj R^2
PANEL A: Risk-Adjusted Returns Using CAPM					
Winner (W)	0.0053	0.855	1.1530	14.862*	0.576
Loser(L)	0.0124	2.278*	0.9758	13.425*	0.536
Arbitrage(L-W)	0.0070	1.989*	-0.1772	-3.334*	0.061
PANEL B: Risk-Adjusted Returns of Size-Neutral Portfolio Using CAPM					
Winner (W)	0.0024	0.410	0.8803	12.422*	0.471
Loser(L)	0.0127	2.270*	0.9766	13.024*	0.521
Arbitrage(L-W)	0.0103	2.713*	0.0963	1.902**	0.016
PANEL C: Risk-Adjusted Returns of Value-Neutral Portfolio Using CAPM					
Winner (W)	0.0060	0.950	1.1579	14.918*	0.574
Loser(L)	0.0125	2.301*	0.9706	13.364*	0.533
Arbitrage(L-W)	0.0070	1.807	-0.1891	-3.584*	0.071

[2] The long-run reversal effect is generally associated with the value effect as value stocks are typically observed to be long-run loser and growth stocks as long-run winners. Moreover, Lakonishok *et al.* (1994) also argued that the extra return of the value effect is associated with investors' overreaction and not with excess risk.

Table 5: Risk-Adjusted Monthly Contrarian Profits Using One-Factor CAPM: Continues

Portfolio	Alpha (α)	T(α)	Beta (β)	T(β)	Adj R^2
PANEL D: Risk-Adjusted Returns of Volume-Neutral Portfolio Using CAPM					
Winner (W)	0.0065	1.095	1.1515	14.412*	0.571
Loser(L)	0.0130	2.373*	0.9851	13.408*	0.535
Arbitrage(L-W)	0.0067	1.714	-0.1679	-3.188*	0.05

* Statistically significant at 5 per cent level.
The period analyzed is from January 1997 to March 2013. The returns of winner, loser, and arbitrage portfolios (L-W) are regressed on the following regression: $R_{pt} - R_{ft} = \alpha_p + \beta_m (R_{Mt} - R_{ft}) + \varepsilon$. The monthly return of the Sensex index is used as a proxy for the market portfolio. The monthly equivalent on 91-day Treasury bills has been used as a proxy for the risk-free rate of return.
Source: Authors' compilation.

D.3 Multivariate Risk-Adjusted Approach

The study further evaluates the profitability of the long-run reversal effect within a multivariate risk-adjusted framework that simultaneously controls for different sources of risk. Fama and French (1993) proposed a framework to simultaneously control for market, size, and value risk using their three-factor model. Their three-factor model was further enhanced by Chan and Faff (2005) who augmented the model with the liquidity risk factor. The study implements both the Fama and French (1993) three-factor model and the Chan and Faff (2005) four-factor model to evaluate the risk-adjusted long-run contrarian profits in the Indian stock market.

Table 6 suggests that the Fama and French (1993) three-factor model does an excellent job in successfully explaining the long-run reversal effect. The return behavior of long-run contrarian portfolios is completely explained under the risk-return framework of the three-factor model. Prominently, the value factor in the three-factor model seems to explain the excess returns of long-run contrarian portfolios. The long-run loser portfolio loads heavily and positively on both the size and value factors, while the long-run winner portfolio loads positively on size but negatively on the value factor. These findings suggest that the long-run loser portfolio consists of small and distressed stocks as compared to the winner portfolio. Differently put, the results suggest that long-run past loser stocks are riskier as compared to long-run past winner stocks, and hence generate higher returns.

Table 6: Risk-Adjusted Long-Run Contrarian Profits Using the Three-Factor Model

Portfolio	Alpha(α)	β_M	β_S	β_h	Adj R^2
PANEL A: Risk-Adjusted Returns Using the Three-Factor Model					
Winner (W)	-0.0001	1.1172	1.1306	-0.4603	0.751
	(-0.018)	(16.251)*	(9.484)*	(-1.771)	
Loser (L)	0.0032	0.9235	0.0789	0.1104	0.847
	(1.024)	(22.108)*	(13.934)*	(2.514)*	
Arbitrage (L-W)	0.0333	-0.1937	-0.0303	0.5708	0.172
	(0.938)	(-3.881)*	(-0.3082)	(3.019)*	
PANEL B: Risk-Adjusted Returns of Size-Neutral Portfolio Using the Three-Factor Model					
Winner (W)	-0.0024	0.8480	1.0286	-0.4281	0.673
	(-0.492)	(12.792)*	(8.876)*	(-1.614)	
Loser (L)	0.0031	0.9217	1.1542	0.1175	0.854
	(0.952)	(20.941)*	(13.792)*	(0.888)	
Arbitrage (L-W)	0.0056	0.0737	0.1225	0.5456	0.220
	(1.528)	(1.437)	(1.294)	(2.646)*	
PANEL C: Risk-Adjusted Returns of Value-Neutral Portfolio Using the Three-Factor Model					
Winner (W)	0.0002	1.1205	1.1383	-0.4210	0.753
	(0.053)	(16.064)*	(9.763)*	(-1.598)	
Loser (L)	0.0035	0.9189	1.1016	0.0933	0.844
	(1.055)	(21.523)*	(13.544)*	(0.731)	
Arbitrage (L-W)	0.0032	-0.2016	-0.0367	0.5143	0.154
	(0.795)	(-3.439)*	(-0.382)	(2.475)*	
PANEL D: Risk-Adjusted Returns of Volume-Neutral Portfolio Using the Three-Factor Model					
Winner (W)	0.0005	1.1128	1.1541	-0.4005	0.759
	(0.1008)	(16.642)*	(10.480)*	(-1.608)	
Loser (L)	0.0039	0.9327	1.0191	0.1009	0.843
	(1.1553)	(20.525)*	(13.068)*	(0.760)	
Arbitrage (L-W)	0.0036	-0.1817	-0.0468	0.5080	0.137
	(0.923)	(-3.152)*	(-0.519)	(2.605)*	

* Statistically significant at 5 per cent level.

The period analyzed is from January 1997 to March 2013. The returns of winner, loser, and arbitrage portfolios (L-W) are regressed using the following regression: $R_{pt} - R_{ft} = \alpha_p + \beta_m (R_{mt} - R_{ft}) + \beta_s SMB_t + \beta_h HML_t + \varepsilon$.The monthly return of the Sensex index is used as a proxy for the market portfolio. The monthly equivalent on 91-day Treasury bills has been used as a proxy for the risk-free rate of return. SMB represents the small minus big size factor and HML represents the high minus low B/M ratio factor. *t*-statistics are given in ().

Source: Authors' compilation.

In addition, Table 7 also presents liquidity-augmented four-factor regression results for long-run contrarian portfolios. Since the long-run reversal effect in stock returns stands explained by the Fama and French (1993) three-factor model, the liquidity-augmented four-factor model does not have an additional role to play. Nevertheless, the long-run loser portfolio loads heavily on all the three risk factors, including the liquidity factor as compared to the long-run winner portfolio (Panel A of Table 7). These results suggest that long-run losers act as small, distressed, and illiquid stocks.

Importantly, the study also provides support in favor of the multifactor asset pricing model (both three- and four- factor models) over the one-factor CAPM in explaining the Indian stock returns. The substantial differential in the coefficient of determination (adj-R^2) suggests supremacy of multifactor model over CAPM. The adj-R^2 for the loser portfolio is observed to be 0.847 for the three-factor model, up from 0.536 obtained from CAPM. Similarly, the adj-R^2 increases from 0.576 obtained from CAPM to 0.751 from the three-factor model for the past long-run winner portfolio.

Table 7: Risk-Adjusted Long-Run Contrarian Profits Using the Four-Factor Model

Portfolio	**Alpha(α)**	**β_M**	**β_S**	**β_h**	**β_i**	**Adj R^2**
PANEL A: Risk-Adjusted Returns Using the Four-Factor Model						
Winner (W)	0.0046	1.0894	1.1675	-0.4780	-0.1647	0.751
	(0.0870)	(14.644)*	(9.131)*	(-1.796)	(-0.759)	
Loser (L)	0.0031	0.9323	1.0887	0.1160	0.0517	0.846
	(0.958)	(19.652)*	(12.884)*	(2.531)*	(0.393)	
Arbitrage (L-W)	0.0026	-0.1570	-0.0788	0.5940	0.2164	0.177
	(0.629)	(-2.562)*	(0.694)	(2.767)*	(2.592)*	
PANEL B: Risk-Adjusted Returns of Size-Neutral Portfolio Using the Four-Factor Model						
Winner (W)	-0.0015	0.8041	1.0868	-0.4559	-0.2594	0.675
	(-0.306)	(11.112)*	(8.680)*	(-1.688)	(-1.129)	
Loser (L)	0.0027	0.9414	1.1281	0.1300	0.1164	0.854
	(0.794)	(18.847)*	(12.185)*	(0.976)	(0.855)	
Arbitrage (L-W)	0.0043	0.1373	0.0412	0.5859	0.3759	0.251
	(1.167)	(2.621)*	(0.418)	(2.836)*	(2.717)*	

Table 7: Risk-Adjusted Long-Run Contrarian Profits Using the Four-Factor Model: Continues

Portfolio	Alpha(α)	β_M	β_S	β_h	β_i	Adj R^2
PANEL C: Risk-Adjusted Returns of Value-Neutral Portfolio Using the Four-Factor Model						
Winner (W)	0.0008	1.0918	1.1763	-0.4392	-0.1695	0.752
	(0.159)	(14.781)*	(9.228)*	(-1.629)	(-0.813)	
Loser (L)	0.0032	0.9329	1.0830	0.1022	0.0831	0.843
	(0.988)	(19.521)*	(12.723)*	(0.857)	(0.627)	
Arbitrage (L-W)	0.0023	-0.1589	-0.0935	0.5414	0.2526	0.163
	(0.570)	(2.634)*	(-0.877)	(2.569)*	(1.697)	
PANEL D: Risk-Adjusted Returns of Volume-Neutral Portfolio Using the Four Factor Model						
Winner (W)	0.0010	1.0871	1.1882	-0.4168	-0.1519	0.758
	(0.218)	(15.959)*	(9.793)*	(-2.451)*	(-0.804)	
Loser (L)	0.0036	0.9483	1.0884	0.1108	0.0922	0.842
	(1.009)	(17.680)*	(11.689)*	(0.828)	(0.615)	
Arbitrage (L-W)	0.0028	-0.1402	-0.1018	0.5344	0.2454	0.145
	(0.700)	(-0.023)	(-1.032)	(2.730)*	(1.639)	

* Statistically significant at 5 per cent level.

The period analyzed is from January 1997 to March 2013. The returns of the winner, loser, and arbitrage portfolios (W-L) are regressed using the following regression: $Rpt - Rft = \alpha p + \beta M\ (RMt - Rft\ ) + \beta s\ SMBt + \beta h\ HMLt + \beta_i IMV_{t+}\varepsilon$.The monthly return of the Sensex index is used as a proxy for the market portfolio. The monthly equivalent on 91-day Treasury bills has been used as a proxy for the risk-free rate of return. SMB represents the small minus big size factor, HML represents the high minus low B/M ratio factor, and and IMV represents the illiquid minus very liquid liquidity factor. *t*-statistics are given in ().

Source: Authors' compilation.

V. Conclusion and Implications

This study revisits the long-run reversal anomaly in the Indian stock market. Identifying the causes of the long-run reversal effect has important implications for understanding the market efficiency limits and hence is considered as the core of the current study. Even though a few earlier studies have documented the profitability of the long-run reversal effect in the Indian stock market, it is still not clear what drives such profits in the Indian market. The current study sheds new light on the long-run reversal effect by focusing on long-run contrarian profits within the paradigm of various risk frameworks.

While the current study provides support in favor of the long-run reversal effect, the study does not produce risk-adjusted significant contrarian profits in the Indian stock market. The analysis was conducted in multiple steps. First, the *t*-test was used to test the statistical significance of the long-run reversal effect. Providing support to previous studies, the results support the asymmetrical long-run reversal effect in the Indian stock market. Unlike the US stock market, no strong January anomaly was observed in long-run Indian contrarian profits. Further, to evaluate

the economic profitability of the long-run reversal effect, the long-run contrarian portfolio's returns were tested using one-factor CAPM. The one-factor CAPM failed to completely explain excess long-run contrarian profits even after controlling for size, value, and liquidity independently, although both value and liquidity were found to contribute to the long-run contrarian profits. Motivated by these findings, the study simultaneously controlled for various risk factors by adopting the multivariate risk framework of the Fama and French (1993) three-factor model and the Chan and Faff (2005) liquidity-augmented four-factor model. Both the three-factor and the four-factor asset pricing models were observed to be successful in completely explaining the excess long-run reversal profits in the Indian stock market. Perhaps the most interesting finding of the study is that past long-run loser stocks load positively on size, value, and liquidity risk factors while long-run winner stocks load negatively on value and liquidity risk factors. These findings suggest that past long-run loser stocks are small, distressed, and illiquid stocks that have higher risk as compared to their counterparts. Such a risk differential among past loser and winner stocks is responsible for generating return differentials among long-run contrarian portfolios and long-run contrarian profits.

The results from the study have strong implications from both the theoretical and the practical perspectives. Institutional investors, portfolio managers, and stock market analysts, as well as retail investors, should not employ a long-run contrarian strategy in the Indian stock market despite evidence in favor of the long-run reversal effect. The long-run contrarian profits obtained from the portfolios based on the long-run contrarian strategy are nothing but compensation for bearing higher risk. The study also provides support in favor of using a multifactor risk framework as compared to traditional CAPM for considering investment decisions. From an academic point of view, the study provides support in favor of a risk-based explanation of the long-run reversal effect. In a nutshell, the long-run reversal effect cannot be regarded as a true anomaly to the EMH as the effect can be completely explained within the multifactor risk framework.

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