An Analysis of Momentum Strategies in Indian Stock Returns

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In this paper we examined the possibility of profit in price momentum strategy in the Indian equity market, which is one of the most promising emerging markets. We also investigated the relationship between momentum profits and historical trading volume. Our sample comprised of the blue-chip stocks represented in BSE-100 index. Our empirical results found strong presence of momentum phenomenon in the Indian market, and also reported that the winners' portfolio contributes more to momentum return in line with the findings of Griffin et al. (2005). To measure the effectiveness of volume-based price momentum strategies, we replicated methodology used by Lee & Swaminathan (2000) and Naughton, Truong, & Veeraraghavan (2008) and found that historical trading volume has no role in boosting the magnitude of momentum return. However, the study revealed that winners' portfolios have higher turnover in comparison to their counterparts.

Keywords: Price momentum strategies, Trading volume, Efficient market hypothesis, Abnormal return, Indian equity market.

1. Introduction

Literature of finance has witnessed several discussions on the subject of 'prior return effect'. Prior return effect in equity market represents that past return can explain the cross-sectional behaviour of succeeding security return. Researchers often reported two basic types of phenomenon regarding the return

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predictability on the basis of prior returns data: "the return continuation" and "return reversal." In order to get a complete knowledge about prior return effect we have to go all the way back to 1985. The pivotal study of De Bondt and Thaler (1985) documented evidence of return reversal (contrarian strategies) from the U.S. equity market. Contrarian strategy is that, investors can generate abnormal returns by buying prior poor-performing equities and taking short position in prior high-performing equities over long-term holding portfolios. They justified their results with investor's overreaction hypothesis, i.e. overreaction of investors to new piece of information and their subsequent correction over long horizon. In a subsequent work, De Bondt and Thaler (1987) found supportive evidence to their earlier findings that the past loser firms significantly outperform past winner's firm in their performance in the market supporting the investor's overreaction hypothesis. Later, in the same direction, Jegadeesh (1990) and Lo & Mackinlay (1990) evidenced successful contrarian strategies for very short-horizon portfolios spanning from a week to three-month period. Following these path-breaking pieces of evidence, Jegadeesh and Titman (1993) analyzed the U.S. market data and documented clear evidence of return-continuation (momentum strategy) and return-reversal (contrarian strategy) investment strategy. Explicitly, for medium-term holding period (3 to 12 months), the 'momentum' strategy was found to give abnormal return and for long-horizon holding portfolios (1 to 3 years), 'contrarian' strategy provided more return to investors.

Many empirical studies have reported that both momentum and contrarian investment strategies provide abnormal return to investors. Subsequent to Jegadeeshand Titman (1993), an early U.S. study, Cornard and Kaul (1998), examined the NYSE and AMEX stocks and found medium-term price continuation. A recent U.S. study by Wang and Wu (2011) also reported significant momentum profit over a medium-term horizon. The reported evidence of momentum profit has not been confined only to the U.S. stock market. Rouwenhorst (1998) and Doukas & McKnight (2005) examined a number of European markets and documented similar findings. Griffin, Ji, & Martin (2003) and Hameed & Kusandi (2002) analyzed Asian stock markets, Richards (1997), Chan, Jegadeesh, & Wermers (2000), and Balvers & Wu (2006) examined a wide range of global markets, and all found significant momentum and contrarian profit over the medium- to long-term horizon. Similarly, Demir, Muthuswamy, & Walter (2004), and Naughton (2008) found strong evidence of momentum return from the Australian and Chinese markets respectively.

There are many academic studies that have assessed the reason why momentum/ contrarian portfolios may exist in security markets. The explanation can be

broadly grouped into two, i.e. risk-based and behavior-based explanations. Chan (1988), Ball & Kothari (1989), and Conard & Kaul (1998) documented risks associated with securities in momentum/contrarian portfolios as the major determinant of above-average returns of these portfolios but the model failed to capture medium-term continuation of price. Whereas, Jegadeesh & Titman (2001, 2002) provided evidence contradicting Cornard & Kaul (1998) hypothesis and documented the robustness of various price-momentum strategies. On the other hand, Barberis, Shleifer, & Vishny(1998); Daniel, Hirshleifer & Subrahmanyam (1998); and Hong & Stein (1999) developed the behavioural models which assume investors' psychological and personal traits to be the reason of the momentum phenomenon. Behaviourists identified either investor-cognitive bias or investor's initial underreaction to new information and later rectification to be the causes of abnormalities. Later, Lee & Swaminathan (2000), Jegadeesh & Titman (2001), and Griffin, Ji, & Martin (2003) substantiated the significance of behavioral models in momentum phenomenon.

Another interesting area among financial-market researchers happens to be the investigation on how momentum and contrarian strategies relate to other fundamental factors of a security. Earlier, Blume, Easley, and O' hara (1994) documented that investors can derive valuable information about security returns by analyzing the historical trading volume and historical security prices. Datar, Naik, and Radcliffe (1998) showed that low (high) volume firms earn higher (lower) future returns. Lee and Swaminathan (2000) reported an asymmetric relation between past returns and trading volume; that is, the extreme winners have a higher trading volume than extreme losers. They found that historical trading volume can reconcile medium-term 'underreaction' and long-term 'overreaction' effects and also reported that past trading volume can predict the magnitude and persistence of price momentum. Chui, Titman, & Wei (2000), Hameed & Kusnadi (2002), and Connolly & Stivers (2003) reported supporting evidence from different markets corroborating the findings of Lee and Swaminathan (2000). However, studies from Japanese stock market by Lihara, Kato, and Tokunaga (2003) found contrary results to the findings of Lee and Swaminathan (2000) documenting that trading volume is weakly linked to momentum and reversal effect. The results from the Chinese stock market by Naughton, Truong, and Veeraraghavan(2008) do not suggest volume as an important factor, because they too find no strong link between past volume and momentum return.

Grinblatt and Moskowitz (2004) documented that the loser's portfolios contribute more profit to momentum portfolios. They also subscribe that the loser's portfolios contain small and illiquid securities and the domination of these

securities are ascribed with high transaction cost. Griffin, Xiuqing, and Spencer (2005) analysed momentum phenomenon in 40 markets around the globe and documented that long position in winner's portfolios contribute to momentum return. Later, Ali & Trombley (2006) and Ammann (2010) supported the findings of Grinblatt and Moskowitz (2004).

In Indian context, Sehgal and Balakrishnan (2002) obtained significant evidence of long-term return-reversal tendency and short-term momentum effect in Indian equities. In another study by Sehgal and Balakrishnan (2008) attempted to explain through the Fama-French three-factor model the source of momentum profits in the Indian context which was found to be rational. Rastog, Chaturvedula, and Bang (2009) analyzed momentum and overreaction effect in Indian markets and reported strong evidence of momentum and weak existence for overreaction effect. Joshipura (2011) analyzed the presence of momentum effect using large liquid stocks in Indian markets and reported strong presence of momentum return. Shegal and Jain (2011) assessed the presence of momentum effect in stock and sector returns and the power of the risk-factor model to explain it. However, they found that the pattern of momentum return in the Indian context was not explained through rational models. Ansari and Khan (2012) found a strong presence of momentum profit in the Indian context and pointed out the significance of behavioural factors as sources of momentum profit. Balakrishnan (2012) reported the presence of strong momentum return in Indian markets. Agarwalla, Jacob, and Varma (2013) attempted the combination of Fama-French three-factor returns and momentum-factor returns and found 22 per cent of momentum-factor returns annually.

In the background of this research review, the present study attempted to investigate the momentum trading in India by examining the link between momentum profits and trading volume. Our primary objective is to enquire into the possibility of price-momentum strategy in Indian market and an extended analysis of the contribution made by loser and winner portfolios to momentum profits. The study also investigated the relationship between momentum profits and historical trading volume. We attempted to analyze the immediate-horizon relationship between the historical trading volume and historical security returns. This analysis is aligned with the methodology adopted by Lee & Swaminathan (2000) and Naughton, Truong, & Veeraraghavan (2008) in the U.S. and Chinese equity markets respectively. It is interesting to investigate intermediate-horizon relationship of momentum return for Indian equities, as Indian stock market is considered to be one of the most promising markets among emerging markets, attracting a large number of foreign and domestic

investors. In sum, we indirectly tried to investigate the weak-form market efficiency in Indian equity market with the help of past share price and trading volume.

The study reveals a strong presence of momentum pattern in Indian stock return and finds the main determinant of momentum profit to be the winner's securities as the contribution of winner's portfolios are found to be more for hedge portfolio in comparison to loser's portfolios. Furthermore, the study confirms that in the Indian context, past trading volume has no role in increasing the return of momentum strategy. The reminder of the paper is structured as follows. Section 2 deals with the data and research methodology employed. Section 3 presents the results of the empirical work and section 4 concludes this paper.

2. Data and Methodology

2.1 Sample Data

The sample for the present study has been collected from the universe of companies listed on the Bombay Stock Exchange (BSE). Monthly data of companies included in the BSE-100 index comprising adjusted closing prices, trading volume and number of shares outstanding over a period of eight years starting from August 2004 till July 2012 were collected. Adjusted monthly stock price adjusts for all corporate actions such as stock splits, dividend distribution and new offering. We restrict our sample only to the blue-chip stocks of the BSE-100 index, so that the problem of small and illiquid securities could be avoided. This sample-selection criterion was aimed to create low-cost momentum strategies in the equity market of India. The return on BSE Sensex is used as proxy for the return on market portfolio. All constituent stocks with non-missing data for the entire study period were included in the analysis. After avoiding companies with missing data the final sample size was 80 companies. The data were obtained from the CMIE (Centre for Monitoring of Indian Economy) Prowess and BSE database.

2.2 Methodology

The study adopted the methodology of Jegdeesh and Titman (1993) to construct the price- momentum portfolios and approaches of Lee and Swaminathan (2000) to construct the volume-based price-momentum portfolios. These approaches are based on JxK strategy, as explained later. The important steps followed in the study for analysing the portfolio return in both formation and holding period is discussed under.

As the first step, the study converted the entire monthly individual security price into monthly percentage return series. The monthly percentage return is calculated as

$$R_{i,t} = \ln \left[\frac{P_{i,t}}{P_{i,t-1}} \right] \qquad (1)$$

Where, P_i,t= the price of stock i in the period t,

Similarly, the monthly return for the market index also were calculated as:

$$M_{m,t} = \ln \left[\frac{M_{i,t}}{M_{i,t-1}} \right] \qquad (2)$$

Where $M_{i,t}$= closing value of market index in the period t,

After findingthe monthly percentage return, abnormal return of securities were calculated. Here market-adjusted model was used for estimating abnormal return and the model is as follows.

$$AR_{j,t} = R_{i,t} - M_{m,t} \qquad (3)$$

Where AR$j,t$ = abnormal return of security 'i' in the period 't'.

Likewise trading volume was converted into monthly turnover ratio

$$\text{Turnover Ratio} = \frac{\text{Trading volume of stock i}}{\text{Number of shares outstanding for stock i}} \qquad (4)$$

2.2.1 JxK Strategy

It is a strategy that selects securities based on the performance for past 'J' months (i.e. formation period) and holds them for 'K' months (holding period). At the end of every month,'t', the securities are ranked in ascending order, on the basis of past abnormal returns and past trading volume. Then stocks are assigned to one of five portfolios (R_1, R_2, R_3, R_4 and R_5) based on cumulative abnormal return of 'J' months and one of three portfolios (V_1, V_2 and V3) based on the trading volume over the same period (J= 3, 6, 9 and 12 months). The portfolios

are then held for K months (K= 3, 6, 9 and 12 months). This results in each month fifteen momentum–volume portfolios in any combination of JxK and sixteen trading strategies using various combinations of J and K months.

The first (R_1) and last (R_5) portfolios based on past abnormal of stocks are termed as the "loser" and "winner" portfolios respectively. In the holding period, the abnormal performance of securities in the winner and loser portfolios are measured. Returns for holding period are based on equally-weighted abnormal return of every stock in the winner and loser portfolios. This strategy involves, an arbitrage portfolio (zero investment) that implies simultaneous buying of winners and selling the losers and holding this position for next K months (holding period).

(A) Formation Period (J months)

In the formation period, we created two types of portfolios, i.e. price-momentum portfolios based on past abnormal return and volume-based momentum (double-sorted) portfolios based on past abnormal return and turnover ratio. For ranking the securities, cumulative abnormal return (CAR) and cumulative turnover ratio (CTR) at the end of the each formation period were considered. In order to measure CAR and CTR, the following formulae were used:

$$CAR = \sum_{t=J}^{0} AR_{it} \qquad\qquad (5)$$

Where, AR_{it} denotes the abnormal return of ith stock for the tth formation month.

$$CTR = \sum_{t=J}^{0} TR_{it} \qquad\qquad (6)$$

Where, TR_{it} denotes turnover ratio of ith stock for the tth formation month.

After estimating CAR and CTR, both price-momentum portfolios and volume-based momentum portfolios were created. This was done at the end of every month during the study period. This overlapping study period was expected to ensure more robust results. Jegdeesh and Titman (1993, 2001) had suggested that overlapping portfolios in momentum approaches helps to control bid-ask bounce effect of security prices.

(B) Holding or Testing Period (K months)

In post-formation period, mainly the abnormal performance of two (out of 5) price-momentum portfolios and four (out of 15) price-momentum and volume portfolios were analysed. These portfolios were winners (R_5), losers (R_1) low volume losers (R_1V_1), high-volume losers (R_1V_3), low-volume winners (R_5V_1) and high-volume winners (R5V3). In the first step of the testing period, study estimated the monthly average abnormal returns (AAR) by taking the mean of monthly abnormal returns of portfolio stocks. This step was repeated for each iteration over the study period. In the next step, the MAAR (mean average abnormal return) was calculated by averaging the average abnormal return of 'm' iterations. MAARs for different portfolios were estimated by using the following formulae:

$$MAAR_{W,\,t} = \frac{1}{m}\sum AAR_{w,\,t} \quad MAAR_{L,t} = \frac{1}{m}\sum_{i=1}^{m} AAR_{L,\,t} \qquad (7)$$

$$MAAR_{R1V1,\,t} = \frac{1}{m}\sum AAR_{R1v1,t} \quad MAAR_{R1V3,\,t} = \frac{1}{m}\sum_{i=1}^{m} AAR_{R1V3,\,t} \qquad (8)$$

$$MAAR_{R5V1,t} = \frac{1}{m}\sum AAR_{R5V1,\,t} \quad MAAR_{R5V3,\,t} = \frac{1}{m}\sum_{i=1}^{m} AAR_{R5V3,\,t} \qquad (9)$$

Where, n= number of stocks in each portfolio,

T= 3-12 months (holding period)

m = no iteration.

In order to measure the momentum return, the present study followed an arbitrage strategy (zero-cost strategy), that is simultaneous buying of winner stocks and selling of loser stocks. So price momentum return equals to return of winner stocks minus return of loser stocks (symbolically $MAAR_{R5\text{-}R1}$). Further, attempt was made to analyse the link between historical trading volume and momentum profit. In order to measure the return of zero-cost volume based price-momentum strategy, the following formula was used:

$$(MAAR_{(R5V3-R5V1)}) - (MAAR_{(R1V3-R1V1)}) \qquad (10)$$

After estimating the return of above mentioned portfolios, simple t-test was applied to test the significance. Similar procedure was followed for all sixteen combinations of volume-based momentum portfolios.

3. Results and Discussion

This section reports the returns for different price-momentum and volume-based momentum strategies implemented on the Indian equity market during the period from 2004 through 2012. Our empirical results found strong presence of momentum phenomenon in the Indian context. Interestingly, unlike the U.S. evidence, our results showed that historical trading volume has no role for boosting the magnitude of momentum return.Subsection 3.1 presents themean-average –abnormal-return test (MAAR of winners, losers and momentum portfolios) results of simple price-momentum strategies. Subsection 3.2 presents the results of volume-based price- momentum strategies for the sample firms.

3.1 Return of Simple Price Momentum Strategies

The monthly mean average abnormal returns of all sixteen combinations of winners (W), losers (L) and momentum (W-L) portfolios given in Table 1 indicate the contribution made by winner and loser portfolios to the momentum portfolios during the study period. Figure1 presents the graphical depiction of the MARR for all sixteen price-momentum strategies.

Table 1: MAAR Values of Winners, Losers and Momentum Portfolios for Sixteen Strategies

Mean Average Abnormal Returns					
J	K	3	6	9	12
3	W	1.16	0 .83	0.75	O.72
		(5.19)*	(2.45)*	(4.31)*	(5.02)*
3	L	-0.51	-0.44	-0.5	-0.39
		(-3.20)*	(-2.18)*	(-3.12)*	(-2.91)*
3	W-L	1.67	1.27	1.25	1.11
		(5.81)*	(2.49)*	(4.52)*	(5.15)*

| 6	W	1.19	0.99	0.78	0.61
		(6.69)*	(6.56)*	(5.38)*	(4.35)*
6	L	-0.49	- 0.54	-0.4	-0.35
		(-7.34)*	(-7.72)*	(-6.25)*	(-5.09)*
6	W-L	1.68	1.53	1.18	0.96
		(7.36)*	(9.41)*	(6.62)*	(5.46)*
9	W	1.76	1.04	0 .69	0.65
		(2,86)*	(2.11)*	(1.79)*	(2,27)*
9	L	-0.99	-0.43	-0.29	-0.19
		(-1.73)*	(-1.07)	(-0.91)	(-0.94)
9	W-L	2.75	1.47	0.98	0.85
		(2.32)*	(1.65)*	(1.40)**	(1.73)*
12	W	1.05	0.57	0.51	0.51
		(1.91)*	(1.83)*	(2.33)*	(3.12)*
12	L	-0.74	-0.55	-0.48	-0.31
		(-1.55)**	(-2.36)*	(-2.82)*	(-2.16)*
12	W-L	1.79	1.12	0.99	0.83
		(1.74)*	(2.13)*	(2.65)*	(2.97)*

* Significant at 5% level
** Significant at 10% level.
Figures in brackets are the t- statistics of winners, losers and momentum portfolios.

The results indicated strong presence of momentum in Indian equity market as all MAARs were significant. Our findings were in consonance with the findings of Sehgal & Balakrishnan (2002, 2008), Rastog, Chaturvedula, & Bang (2009), Joshipura (2011), and Sehgal & Jain (2011), Ansari & Khan (2012), and Balakrishnan (2012).The monthly MARR value for momentum strategies was significant at 5 per cent level in most of the cases except 9x9 trading strategy which was significant at 10 per cent level. From the sixteen combinations, the monthly MAAR of momentum portfolio ranged from a low 0.83 per cent for 12 months formation and 12 months holding period to a high of 2.75 per cent for 9 months

formation and three months holding period. Such momentum returns have been contributed by both winner and loser portfolios and contribution of winner portfolio was found relatively higher than loser portfolios in most of the cases. It was also noted from the table that momentum return showed the highest monthly return in K=3 and it gradually reduced when the holding period was extended to more than 3 months. In other words, J momentum return (W-L) at K=3 was the best and it slid down as the holding period was extended to 6, 9 and 12 months.

Figure1: MAAR Values of Momentum Portfolios for Sixteen Strategies
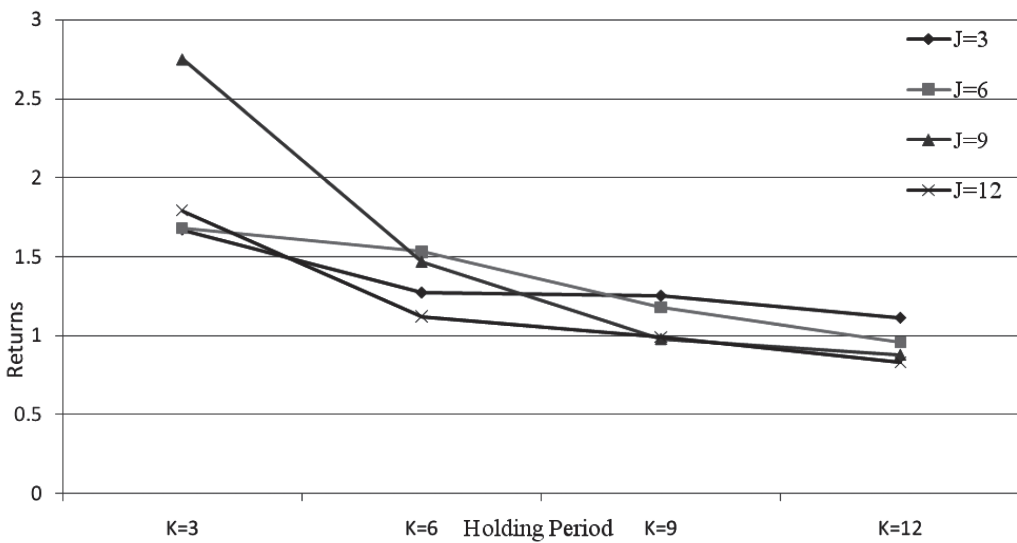
It is clear from Figure 1 that all the formation (J months) periods have the highest MAAR value in their respective three-month holding (K=3) period, which is followed by a steady decline consistently for rest of the higher-order holding periods, i.e. K_6, K_9, and K_{12}. It is further observed that the nine-month formation period gives the highest return when K=3. However, a steep downward sloping trend from left to right is also observed for this formation period.

3.2 Return of Immediate Horizon Volume-Based Price Momentum Portfolios

In volume-based price momentum strategy, the queries like whether there is any significant connection between future security returns and historical trading volume for securities in Indian equity market has been investigated. This

subsection analyses the returns of double-sorted portfolios created on the basis of historical return and historical trading volume. The study created momentum portfolios on a monthly basis. Hence, at the end of every month, all eligible stocks based on their previous J-month cumulative abnormal return were arranged in ascending order and were assigned to five equal size and equally weighted portfolios (R_1 to R_5). R_1 is the loser's portfolio stocks and R_5 is winner's portfolio stocks. In each portfolio, stocks again were sorted in ascending order based on their cumulative trading volume over the formation (J) period and were assigned to three-volume portfolios from V_1 to V_3. V_1 representing lowest volume portfolio and V_3 is highest volume portfolio. Thus sixteen combinations of volume-based price momentum strategies could be created using the trading volume and return of previous J months (J=3, 6, 9, and 12) and the intersection of trading volume and return resulting 15 price momentum-volume portfolios for every combination of J months. In order to assess the performance of extreme winners and loser portfolios, the portfolio returns were evaluated over the next K (holding period) months, where K= 3, 6, 9, and 12 months. Table 2 presents the holding period MAAR values of all sixteen combinations of volume-based momentum strategies. It may be noted that formation-period volume of portfolios is nothing but the mean monthly turnover during the formation period.

An analysis of the results presented in Table 2 interestingly revealed a positive relation between formation-period return and trading volume. The result in column 3 (volume) indicated that winners portfolio (R_5) have higher average monthly turnover than losers portfolio (R_1) for every J-month formation period. As it can be seen that at 6 months formation period (J=6), the average monthly turnover of R_1 and R_5 portfolios were 0.72 per cent and 0.92 per cent respectively. This result finds supports from the study of Lee & Swaminathan (2000), which documented that extreme winners (R_5) have higher turnover (trading volume) than extreme losers (R_1) during the formation period.

Table 2 also reports the MAAR values of volume-based price-momentum portfolios during the holding (K) period (where, K=3, 6, 9 and 12) which indicate that most of the low volume zero-cost portfolios (R_5V_1-R_1V_1) have performed better than high volume zero-cost portfolios (R_5V_3-R_1V_3) except 3x3, 6x3, 6x6, 6x9, 12x9 and 12x12 holding-period portfolios. Lee and Swaminathan (2000) had argued that price momentum returns are more pronounced among higher turnover securities. But we did not find such a pattern during the period of study. From all the sixteen combinations under

Table 2: MAAR Values of Portfolios Sorted on the Basis of Past Returns and Trading Volume for the Period of 2004-2012

J	Portfolio	Volume	K=3 V_1	K=3 V_3	K=3 V_3-V_1	K=6 V_1	K=6 V_3	K=6 V_3-V_1	K=9 V_1	K=9 V_3	K=9 V_3-V_1	K=12 V_1	K=12 V_3	K=12 V_3-V_1
3	R_1	0.3537	0.15	-1.02	-1.17	0.16	-0.74	-0.91	-0.08	-0.78	-0.7	-0.03	-0.69	-0.67
			(0.09)	(-0.59)	(-0.67)	(0.76)	(-2.54)*	(-2.22)*	(-0.28)	(-2.72)*	(-2.17)*	(-0.12)	(-3.03)*	(-2.48)*
	R_5	0.4766	2.07	0.98	-1.09	1.54	0.57	-0.97	1.27	0.45	-0.82	1.08	0.37	-0.71
			(1.2)	(0.57)	(-0.63)	(4.42)*	(1.45)**	(-4.22)*	(4.32)*	(1.62)**	(-3.52)*	(4.06)*	(1.59)**	(-3.06)*
	R_5-R_1		1.92	2.00	0.08	1.37	1.31	-0.06	1.35	1.23	-0.13	1.11	1.06	-0.04
			(1.11)	(1.16)	(0.05)	(2.77)*	(2.15)*	(-0.12)	(3.54)*	(2.37)*	(-0.32)	(3.58)*	(2.67)*	(-0.15)
6	R_1	0.7208	0.16	-1.35	-1.51	-0.05	-1.33	-1.28	-0.03	-1.12	-1.08	-0.08	-0.92	-0.84
			(0.09)	(-0.78)	(-0.87)	(-0.24)	(-8.31)*	(-6.20)*	(-0.18)	(-7.48)*	(-4.23)*	(-0.50)	(-6.98)*	(-3.58)*
	R_5	0.9157	1.77	0.58	-1.19	1.37	0.45	-0.93	1.30	0.21	-1.09	1.12	0.21	-0.91
			(1.02)	(0.33)	(-0.69)	(4.93)*	(1.98)*	(-3.49)*	(6.47)*	(1.15)**	(-5.21)*	(6.70)*	(1.37)**	(-4.83)*
	R_5-R_1		1.60	1.93	0.32	1.42	1.78	0.36	1.33	1.33	0.00	1.20	1.13	-0.07
			(0.93)	(1.11)	(0.19)	(14.40)*	(5,09)*	(1.13)	(14.62)*	(4.22)*	(-0.01)	(15.98)*	(4.35)*	(-0.25)

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9	R₁	1.0992	-1.01	-0.89	0.12	-0.33	-0.68	-0.35	-0.26	-0.47	-0.21	-0.23	-0.43	-0.21
			(-0.58)	(-0.51)	(0.07)	(-0.56)*	(-2.71)*	(-0.95)	(-0.62)*	(-1.63)*	(-0.59)	(-0.78)	(-2.20)*	(-0.77)
	R₅	1.2893	2.10	1.29	-0.81	1.77	0.48	-1.29	1.43	0.26	-1.18	1.36	0.26	-1.10
			(1.21)	(0.75)	(-0.47)	(5.61)*	(0.67)	(-3.04)*	(5.14)*	(0.51)	(-3.81)*	(6.46)*	(0.71)	(-4.57)*
	R₅-R₁		3.11	2.19	-0.64	2.10	1.16	-0.94	1.7	0.73	-0.97	1.59	0.7	-0.89
			(1.80)*	(1.26)	(-0.37)	(2.35)*	(1.22)	(-5.25)*	(2.60)*	(0.97)	(-3.27)*	(3.51)*	(1.31)**	(-3.91)*
12	R₁	1.5151	-0.65	-0.76	-0.15	-0.34	-0.90	-0.57	-0.28	-1.01	-0.74	-0.12	-0.98	-0.86
			(-0.37)	(-0.46)	(-0.08)	(-1.14)	(-2.90)	(-1.91)*	(-1,33)*	(-4.38)*	(-3.43)*	(-0.63)	(-5.67)*	(-3.78)*
	R₅	1.6574	1.44	0.8	-0.65	0.92	0.29	-0.63	0.87	0.23	-0.64	0.86	0.29	-0.57
			(0.83)	(0.46)	(-0.37)	(2.91)*	(0.77)	(-3.37)*	(4.03)*	(0.89)	(-4.53)*	(5.17)*	(1.43)**	(-5.76)*
	R₅-R₁		2.09	1.59	-0.50	1.26	1.20	-0.06	1.14	1.25	0.10	0.98	1.27	0.29
			(1.21)	(0.92)	(-0.29)	(2.19)*	(2.18)*	(-0.19)	(2.91)*	(3.21)*	(0.45)	(3.10)*	(4.65)*	(1.25)

**Significant at10% level, *Significant at 5% level.
Figures in brackets are the t- statistics of winners, losers and momentum portfolios.

observation, most of $(R_5V_3-R_5V_1) - (R_1V_3-R_1V_1)$ portfolios were followed with negative returns except 3x3, 6x3, 6x6, 6x9, 12x9 and 12x12 holding-period portfolios. A closer examination reveals that these negative returns are because of the outperformance of low volume zero-cost portfolios $(R_5V_1-R_1V_1)$ over high volume zero-cost portfolios $(R_5V_3-R_1V_3)$. At J=9 and K=6, the MARR values of $(R_5V_3-R_1V_3)$ and $(R_5V_1-R_1V_1)$ were 1.16 and 2.10, respectively, the difference of -0.94 per cent per month was statistically significant. Though, a few volume-based price momentum $(R_5V_3-R_5V_1) - (R_1V_3-R_1V_1)$ portfolios showed positive returns, they were not statistically significant. Therefore, the findings suggest that, price momentum return is not that very pronounced among high trading volume stocks.

The results also revealed that at immediate horizon the MAAR values of low volume stocks were greater than MAAR values of high volume stocks and this result was consistent with the findings of Datar, Naik, & Radcliffe (1998), which argue that higher monthly MAAR value of low volume stocks generates negative return to the V_3-V_1 portfolios. For example, for J=3 and K=6, the monthly MAAR values of R_1V_1 and R_1V_3 are 0.16 per cent and -0.74 per cent respectively and this in turn gave negative return of -0.91 per cent per month with a t-statistic of -2.22 for V_3-V_1 portfolio. The study found similar return pattern for almost all JxK strategies except the 9x3 month strategy, where high volume winners were outperforming low volume winners by 0.12 per cent per month. It was also observed that, after adjusting past trading volume into momentum portfolios, the price momentum premiums either were negative or got reduced. This may be because, after creating volume-based portfolios the MAAR values of R_5 (V_3-V_1) portfolios were found lower than the MAAR value of R_1 (V_3-V_1) portfolios. The result was more explicit for the 9x9 month strategy, where average monthly abnormal return of R_5 (V_3-V_1) and R_1 (V_3-V_1) portfolios are -0.21 per cent and -1.18 per cent respectively and this, in turn, results in a negative return of -0.97 per cent per month with a t-statistic of -3.27 for momentum portfolios $(R_5 -R_1)$. Most of the other cells showed more or less the same pattern of momentum return in the immediate horizon. Results also indicate that once price momentum is controlled, the low volume stocks portfolios outperformed high volume stocks portfolios. But this effect was found more pronounced among winner portfolios. Therefore, momentum portfolios were seen with continuous negative returns over the one year period. From the above observation inference was drawn in the line that there was no dominant and consistent link between past trading volume and price momentum return in Indian equity market over the immediate horizons.

4. Concluding Remarks

In this study, we investigated the presence of momentum phenomenon in Indian scenario. We also analysed various volume-based momentum strategies for Indian equities. In order to analyse these objectives, we used blue-chip stocks contained in BSE-100 index over the period of 2004- 2012. We followed Jegadeesh & Titman (1993) and Lee & Swaminathan (2000) approaches and formulated sixteen JxK combinations of momentum portfolios with overlapping formation and holding periods. We estimated the MAAR values of winner, loser and momentum portfolios and found economically and statistically significant abnormal return from momentum strategies indicating strong presence of momentum pattern in security returns in Indian equity market for a medium-term holding period.

However, when compared to the contribution of winners and losers, it was observed that winners are contributing more to momentum portfolio. These empirical findings lead to two inferences for Indian equity market scenario: first, winners' portfolio mostly contribute to momentum return, and the second, small and illiquid stocks may prove to be the main driver of returns generated by losers' portfolio. As we had excluded illiquid securities from losers' portfolios, it did not contribute much to the momentum return and, had there been illiquid security in the sample, there was possibility of return in losers' portfolio. Our results were consistent with the findings of Grinblatt & Moskowitz (2004), Griffin, Xiuqing, & Spencer (2005), Ali & Trombley (2006), and Ammann (2010).

In the later part of the analysis, we studied the immediate-horizon relationship of historical trading volume with historical security returns along with the performance of low and high trading volume stocks. Our analysis exhibited that in Indian market, high-performing stocks have higher turnover than low-performing stocks during the formation period. This result gets support from the findings of Lee and Swaminathan (2000) for the U.S. markets, which had documented that extreme winners' portfolios have high trading volume than extreme losers' portfolios. We also found that there is no role for historical trading volume in boosting the magnitude of momentum profits in Indian equity market. Therefore, it can be concluded that the results were not strong enough to establish the relationship between trading volume and stock return as were evidenced in previous studies like Lee & Swaminathan (2000) and Connolly & Stivers (2003).

Through this analysis, the presence of momentum phenomenon in Indian markets has been re-established, in line with a few earlier studies conducted for Indian market. Even though two informational apparatus of technicians i.e. security price and trading volume were not found working together for determining the magnitude of the momentum effect, this study indirectly repudiate the existence of weak-form market efficiency of Indian market.

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