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Momentum, reversals and liquidity: Indian evidence☆

Andy Chui [a], Kavitha Ranganathan [b], Abhishek Rohit [b], Madhu Veeraraghavan [b,*]

[a] School of Accounting and Finance, Faculty of Business, The Hong Kong Polytechnic University, Hunghom, Hong Kong
[b] Accounting, Economics and Finance Area, T A Pai Management Institute, Manipal Academy of Higher Education, Manipal, India

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ABSTRACT

This paper addresses three interesting questions. First, we explore whether price momentum exists for equities listed on the Bombay Stock Exchange (BSE). Second, whether liquidity (measured by turnover ratio) enhances the momentum effect. Third, whether momentum profits exhibit reversals for illiquid stocks. Using a large sample of 3956 stocks for the period 2000 to 2021, we establish three key results. First, we find evidence of significant price momentum (intermediate and long-term) for equities listed on the BSE. Second, when conditioned on liquidity, we find that the momentum returns (short, intermediate, and long-term) are more significant for the most liquid portfolio and exhibit persistence for the next 12 months. Third, although we document evidence of short and intermediate-term reversals among the most illiquid portfolios, we fail to find evidence of persistence. Our results continue to hold after controlling for risk factors related to market premium, firm size, value, and a host of macroeconomic indicators. Taken together, our paper highlights the role of liquidity in amplifying the momentum effect in the Indian market.

If I gave you a list of the 100 best golfers worldwide and asked you to pick who you thought would be in the top 10 at the end of the next quarter, who would you pick? My guess is you would pick the current top ten to be in the top three months from now. Even if I asked you to pick the ones who would be in the top ten after one year, you would probably pick the current top ten. At the end of the contest some would have fallen out and some would have moved up, but the majority would still be in the top ten. This is outperformance. It relates to Newton's Law of motion, which suggests that objects that are in motion tend to stay in motion until an external force acts upon them. We believe that stocks that have good fundamentals, in a market that in general is supporting higher prices, and the chart pattern clearly shows that demand is in control of the stock, tend to continue to do well. Golfers who have good fundamentals, are in good shape, and at the top of their game, tend to continue to do well.

[Tom Dorsey, Funder, Nasdaq Dorsey Wright]

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* Corresponding author.
E-mail addresses: andy.chui@polyu.edu.hk (A. Chui), Kavitha.Ranganathan@manipal.edu (K. Ranganathan), Kumar.abhishek@manipal.edu (A. Rohit), Madhu.Veeraraghavan@manipal.edu (M. Veeraraghavan).

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1. Introduction

In the last three decades, several researchers have documented that cross-sectional returns are predictable based on past returns. In a landmark paper, Jegadeesh and Titman (hereafter JT) (1993) document that stocks that did well (worse) in the recent past continue to perform well (poorly) in the coming six to twelve months. They also find that strategies that buy recent past winners and short recent past losers are highly profitable over the 3 to 12-month holding periods. The literature refers to this phenomenon as the momentum effect. Since JT (1993), extant research has examined the momentum effect and find that it is pervasive in markets around the world (see, for example, Griffin et al., 2003; Chui et al., 2010; Griffin et al., 2010). Although closely aligned with the momentum literature, Lee and Swaminathan (2000) were among the first to show that price movements and trading volume jointly predict cross-sectional returns over the intermediate to longer time horizons.

Motivated by Lee and Swaminathan (2000), who highlight the information role of trading volume in driving the momentum returns, we investigate whether liquidity (proxied by turnover ratio) drives momentum returns for Indian equities. A natural question to ask is why study momentum for Indian equities. We focus on India for several reasons. First, India is the fifth largest economy globally, with the GDP currently estimated at USD 3.5 trillion. In particular, with a 7% growth forecast in 2022, India's stock market capitalization to GDP (%) is at an all-time high of 103.7% in 2022 (Statista, 2023). Second, India has witnessed a series of significant stock market reforms since 2001, including improving the quality of financial disclosures, strengthening transparency and liquidity, and broadening the stock market to attract foreign capital. Among the several reforms initiated by the SEBI, those directly relevant to our paper focus on improving market liquidity. Notably, since 2004, SEBI introduced a formal margin trading system that allows traders to borrow to finance their securities purchases. In a recent paper, using unique features of the margin trading system in India, Kahraman and Tookes (2017) find that stock market liquidity is higher when stocks become eligible for margin trading, and that margin traders' contrarian strategies drive this liquidity enhancement.

Second, economic theory suggests that increased financial disclosure levels and quality improve stock market liquidity (Amihud and Mendelson, 1986; Leuz and Verrecchia, 2000). SEBI's revised Clause 49 listing guidelines and significant corporate governance reforms since 2005 can be viewed as a step in this direction (Chakrabarti and Megginson, 2009). Third, in 2010, SEBI introduced a regulatory amendment that mandated all listed firms (other than government-owned firms) with low-free float to increase the public shareholding to 25% by June 2013. In a recent paper, Jawed and Kotha (2020) argue that this regulatory intervention improved stock liquidity and significantly improved firm value. Against this backdrop, we posit that the interventions by SEBI promote liquidity in the stock market. Hence, we are the first to examine whether and how liquidity affects momentum and reversals in our setting.

Our argument is simple. Liquidity is an essential factor as it is valuable to investors in that it conveys informational value. Early researchers theorized that since investors care about expected holding period returns, assets that are less liquid and more costly to trade need to provide higher gross returns than more liquid assets. In essence, liquidity is valuable to investors. In their seminal paper, Amihud and Mendelson (1986) established this critical link and showed that, in equilibrium, illiquid assets would be held by investors with longer investment horizons. Using the quoted bid-ask spread as a measure of liquidity, they find evidence consistent with the notion of liquidity premium. However, much of the supporting empirical evidence is based on the U.S. or other developed markets.

One of the first papers to study the illiquidity premium globally is Amihud et al. (2015). They find that the Indian market is the most illiquid in the world. The average Amihud illiquidity ratio for India is 3.252 times that for the U.S.; the illiquidity premium and risk-adjusted illiquidity premium are the largest in India. More recently, sorting stocks based on the previous month's return and share turnover, Medhat and Schmeling (2022) find significant short-term reversals among low-turnover stocks, whereas high-turnover stocks exhibit short-term momentum. They also find that the short-term momentum is as profitable as the conventional momentum and is strongest among the largest, most liquid, and most extensively covered stocks. Although some prior work in developed markets establishes that momentum strategies are profitable for liquid stocks and finds evidence of reversals for illiquid stocks, the evidence is mixed and inconclusive. Moreover, there is almost no evidence on whether the developed market findings are generalizable across markets. Given that our paper examines a market consisting of a large sample of liquid and illiquid stocks, this is naturally an interesting question to explore. Although prior research establishes profitable momentum and reversal strategies in liquid and illiquid stocks, respectively, and given the Indian market has seen numerous stock market reforms, it is an open question which strategies are more profitable in India.

Prior research, beginning with Lee and Swaminathan (2000), shows that past trading volume predicts the magnitude and persistence of momentum for a large sample of U.S. stocks. In particular, they show that buying past high-volume winners and selling past high-volume losers outperforms a similar strategy based on price momentum by anywhere between 2 and 7%. Goyal et al. (2022) do not find a significant relationship between the turnover ratio and the momentum effect in developing countries. Given the inconclusive evidence and building on our first question, we investigate whether liquidity (measured by turnover ratio) enhances the momentum effect.

Extant research also documents evidence of short-term reversal around the globe (see Griffin et al., 2010). Short-term reversal indicates that stocks performing the worst (best) in the prior week or month tend to perform well (poorly) in the coming week or month. Griffin et al. (2010) find that the short-term reversal is significant in India. Medhat and Schmeling (2022) report that short-term reversal is strong among the most illiquid stocks. Since liquidity provision is small for illiquid stocks, their finding on short-term reversal is consistent with the fact that the temporary price pressure for illiquid stocks is stronger than for liquid stocks. Finally, we

explore whether reversal is significant among illiquid stocks.

Our results are, in brief, as follows. First, we find evidence of significant price momentum in the intermediate and long-term which is persistent across holding periods until the next 12 months. However, we find limited evidence of short-term price momentum (based on the past 1 to 3 months of formation period). Second, when conditioned on liquidity, measured by turnover ratio, we find evidence of short, intermediate and long-term momentum among high-turnover stocks. However, we find evidence of short and intermediate-term reversals among low-turnover stocks. Whilst we find evidence of momentum for all holding periods until 12 months, reversals persist only in the shorter holding periods and disappear across longer holding periods (6 to 12 months). Third, consistent with Medhat and Schmeling (2022), we find that momentum and reversals co-exist only in the short-term.

Next, we repeat our results by skipping 1-month between the formation and the holding period. In this case, we find evidence of significant short-term price momentum alongside intermediate and long-term momentum. These returns are persistent for holding periods until the next 12 months. As with the results without skipping the month, we find evidence of intermediate and long-term price momentum. Second, when conditioned on liquidity, we report evidence of short-term momentum among high-turnover stocks and short-term reversal among low-turnover stocks. This evidence aligns with the results reported without skipping the month strategy. We argue that our results are qualitatively identical to those without skipping the month strategy.

In additional analysis, we test whether firm size proxied by market capitalization impacts the price momentum. We hypothesize that momentum profits are significant in large-sized stocks (top 25% of market capitalization), and reversals occur in small-sized stocks (bottom 25% of market capitalization). Our evidence indicates that short-term momentum profits are significant among large-sized firms for holding periods until the next 12 months. As the formation period increases from 6 to 12 months, the significance of momentum profits in large firms disappears in longer holding periods. Regarding small firms, we find consistent evidence of short-, intermediate, and long-term reversals only in the shorter holding periods.

Our findings hold after controlling for the Fama and French (1993) three-factor model. While the risk-adjusted return for the short-term momentum (around −1% per month) is negative and significant for all stocks, it becomes positive and significant (around 4% per month) when conditioned on liquid stocks for holding periods leading to 6 months. The risk-adjusted return for short-term reversals is negative and significant (around −1% per month) when conditioned on illiquidity, but only for the holding period of 6-months. Next, the risk-adjusted return for the intermediate and long-term momentum is positive and significant for all stocks and liquid stocks, with a maximum return of 5% per month. In contrast, the risk-adjusted return for reversals is negative and significant only for the short and intermediate-term. We conclude that the momentum and reversal effects persist when conditioned on liquidity after controlling for the common risk factors. Turning to Fama-MacBeth regressions, we establish that short (1 month) and intermediate-term (6 months) past returns can predict the cross-section of monthly expected returns in the next period (with one and two lags). These results hold for liquid stocks (top 10% turnover ratio) and illiquid stocks (bottom 10% turnover ratio). When we control for macro factors, we find robust evidence of momentum returns in liquid stocks and mixed evidence in illiquid stocks.

We make two specific contributions to the literature. Our first contribution is to the price momentum literature. While substantial work has been done using data from developed markets, very little is known about the predictability of returns in emerging markets, and in particular, research on momentum effects for a comprehensive cross-section and time series of stocks is almost non-existent in India. Hameed and Kusnadi (2002) highlight that evidence from emerging markets is particularly interesting as it provides a validation test on a sample that is not highly correlated with data in previous papers. We carefully build upon the extensive literature (see, for example, JT, 1993, Chan et al., 1996, Rouwenhorst, 1998, Rouwenhorst, 1999, Lee and Swaminathan, 2000, Hameed and Kusnadi, 2002, Griffin et al., 2003 and Medhat and Schmeling, 2022). We are the first to demonstrate that short-term price momentum may not exist for Indian equities. However, we find robust evidence of intermediate and conventional long-term momentum.

We are also the first to explore how liquidity affects momentum in the Indian market. It is important to note that several interventions in market microstructure and governance reforms by the Indian regulator, SEBI, have impacted liquidity across a broad cross-section of stocks. Therefore, it is interesting to investigate whether liquidity impacts momentum returns in India.

Our second contribution is to the reversal literature. Medhat and Schmeling (2022) find significant short-term reversals among stocks with low share turnover. They find that the short-term reversal strategy generates a negative and significant average excess return of 16.9% per annum. Goyal et al. (2022) state that to pin down the causes of momentum, it is important to explore whether reversals persist in international data. Given the above discussion, we are among the first to examine whether there is any evidence of reversals for Indian equities and mainly test its robustness among illiquid stocks.

The roadmap for the rest of the paper is as follows. Section 2 discusses the institutional features of the Indian stock market. Section 3 presents the data. Section 4 presents the methodology and the findings, and section 5 presents the relation to theoretical frameworks. Section 6 concludes.

2. Institutional background

India's financial market consists of three leading exchanges: The BSE (Bombay Stock Exchange), the National Stock Exchange of India (NSE) and Multi-commodity Stock Exchange (MCX). Unlike the U.S., where equity trading is fragmented across multiple platforms, the BSE and the NSE have the largest share of equity market activity in India. Established in 1875, BSE Ltd. is one of the world's oldest and highest ranked equity markets in terms of the number of transactions. The market capitalization of BSE accounts for about INR 308,813.52 billion (USD 3705.76 billion), of which the top 10 companies recorded a market capitalization of INR 80,527.29 billion (USD 966.33 billion; BSE website as of August 18, 2023). Considered the world's fastest-growing exchange, the BSE equity market is an electronic limit order book market where transactions in all groups of securities in the equity segment listed on the BSE are required to be settled on a T + 1 basis (w.e.f. from January 27, 2023). As of 2023, 5291 companies are listed on the BSE and have a

broad shareholder base comprising retail and institutional investment. Given this discussion, we chose BSE to conduct our study as it has a much larger set of listed companies than the NSE (approximately 2137 companies as on 31st March 2023).[1]

A widely accepted view is that markets are less efficient in emerging economies than in developed markets, making the quality of information environment in emerging markets such as India different from the developed economies. For instance, Indian markets are plagued with weaker corporate governance and enforcement (Claessens and Yurtoglu, 2013), leading to lower quality of arbitrage-based trading based on fundamentals. On the contrary, in emerging markets, sentiment or noise-based trading may be more prevalent (Ansari and Khan, 2012; Brzeszczyński et al., 2015). Given these stylized facts, it is possible that anomalies such as momentum not only exist in emerging markets but are also higher in magnitude compared to developed markets. However, little research is available on India's pervasiveness of momentum and reversals.

Sehgal and Balakrishnan (2002) test for long-term momentum strategies and report a monthly momentum return of 1.26% in India. Similarly, Chui et al. (2010) find a monthly momentum profit of 1.14%. Other studies (Griffin et al., 2003; Naranjo and Porter, 2007; Butt et al., 2021) examine momentum returns globally, including India, and report that momentum returns are lower in emerging markets compared to developed markets.

A small set of studies compare the performance of conventional and alternative momentum strategies in India. For instance, Gupta et al. (2010) document a significant 52-week industry-led momentum in India, dominated by winner portfolios. Narayan et al. (2014) and Narayan et al. (2015) find that investors earn significant momentum profits from the IT sector and the commodity futures markets in India. Campbell et al. (2014) find that accumulating momentum stocks in the portfolio allows novice and experienced Indian investors to achieve high overall returns. More recently, Mohapatra and Misra (2020) provide evidence of long and short-term momentum profits; however, they document a lack of reversal trends during the short-and-long holding periods. Although extant work has attempted to study price momentum in an Indian setting, much of the prior research on India has focused on studying NSE stocks. We differentiate our paper by focusing on a comprehensive sample of BSE stocks (liquid and illiquid), which permits us to examine the impact of liquidity on price momentum and reversals.

3. Data and sample selection

We obtain the data for this study from several sources. Monthly adjusted closing prices, market capitalization, turnover ratio, and the book-to-market equity ratio are obtained from Compustat Global. Data on industry classification and ownership group code is obtained from the Prowess database maintained by the Centre for Monitoring the Indian Economy (CMIE). We obtain data on macroeconomic variables (dividend yield, term spread, 3-month T-bill yield) from Bloomberg and the composite leading indicator of economic activity (measures long-term business cycle) from Refintiv Eikon. The Fama-French factors are obtained from Agarwalla et al. (2014).[2] The sample period of our study is from January 2000 to July 2021 for equities listed on the Bombay Stock Exchange (BSE).

We use the following filtering criteria to arrive at the final sample of firms. First, we exclude micro-cap stocks, i.e., firms whose market capitalization falls in the bottom 10% each year-month. Second, following prior literature, we exclude financial and government firms. Third, we ensure that there are at least 30 stocks in each month for portfolio formation. These criteria lead to the final sample of 3956 firms. For our portfolio aggregation procedure, we compute stock returns as the log change of monthly adjusted closing prices. The monthly returns are winsorized between −95% and 100%. We define average monthly stock turnover as the monthly trading volume of shares divided by the total number of shares outstanding at the end of the month. Table 1 presents the summary statistics of the monthly returns, size (by market capitalization), and turnover for all stocks listed on BSE and the winner ($P10$) and loser ($P1$) portfolios for the period January 2000 to July 2021.

4. Methodology and findings

This section presents the results for the momentum strategies on equities listed on the Bombay Stock Exchange (BSE). We focus our attention on short-term (based on $J = 1$ and $J = 3$) and intermediate-term ($J = 6$) momentum and reversal strategies, though we also report results for long-term strategies ($J = 9$ and $J = 12$).[3] We set the holding period at ($K = 1$, 3, 6, 9 and 12). We also introduce the skipping a month strategy between the formation and holding periods to test for consistency in the momentum and reversal returns. We also test whether the momentum and reversal returns are conditional on liquidity (measured by turnover ratio) and persistent over longer holding periods.

[1] In an earlier draft of this paper, we found a significant momentum effect among stocks listed on the National Stock Exchange (NSE). For instance, the J = 6 and K = 3 strategy provides an average momentum profit of 1.47% per month, and the J = 6 and K = 6 strategy gives an average momentum profit of 1.60% per month. These means are statistically significant at the 1% level. Furthermore, we documented that the momentum effect becomes more substantial after implementing the Minimum Public Shareholding (MPS) regulation. This later finding is consistent with our conjecture that market liquidity strengthens the momentum effect. These findings are not reported for brevity and are available from the authors.

[2] https://faculty.iima.ac.in/iffm/Indian-Fama-French-Momentum/

[3] We define short-term ($J = 1$ and 3), intermediate-term ($J = 6$) and long-term ($J = 9$ and 12) momentum based on the length of the formation period in months.

Table 1
Summary statistics for the Indian stock market.

Panel A: All Stocks										
	N	Mean	SD	Min	Max	P25	P50	P75	Skew	Kurt
RET	3580	2	19	−95	100	−9	0	10	1.23	4.39
SZ	3580	562.06	3577.53	0.47	205,487.62	5.67	25.01	137.26	19.96	601.52
TURN	3580	5.19	14.03	0.00	952.62	0.42	1.46	4.60	13.58	402.62
Panel B: Winner Portfolio (*P*10)										
	N	Mean	SD	Min	Max	P25	P50	P75	Skew	Kurt
RET	819	15	26	−70	100	−2	9	26	1.16	1.63
SZ	819	514.39	3274.52	0.48	174,903.66	7.49	34.46	156.70	22.02	721.92
TURN	819	9.16	22.05	0.00	677.77	0.78	2.84	8.56	9.08	147.49
Panel C: Loser Portfolio (*P*1)										
	N	Mean	SD	Min	Max	P25	P50	P75	Skew	Kurt
RET	1028	−8	20	95	100	−20	−8	1	0.68	3.46
SZ	1028	147.73	1377.08	0.49	160,222.82	2.73	9.84	42.03	57.43	5458.40
TURN	1028	6.28	18.57	0.00	834.93	0.34	1.47	5.14	12.03	266.28

This table reports the descriptive statistics for the monthly return (RET) in percentage, turnover ratio (TURN), and market capitalization (SZ for stocks listed on the Bombay Stock Exchange (BSE) during the period January 2000 to July 2021. Descriptive statistics include *N* (number of unique firms for the entire sample period), mean, standard deviation (SD), minimum (Min) and maximum (Max), 25th percentile (P25), 50th percentile (P50), 75th percentile (P75), skewness (Skew) and kurtosis (Kurt). Panel A reports the descriptive statistics for all stocks, and Panels B and C provide summary statistics for the winner (*P*10) and loser (*P*1) portfolios.

4.1. Price momentum

Table 2 presents the results of price momentum strategies for stocks listed on the BSE. We present momentum strategies across varying *J*-month/*K*-month combinations, where *J* and *K* vary across 1-month, 3-months, 6-months, 9-months, and 12 months. This generates a total of 25 strategies. Following JT (1993), these strategies include portfolios with overlapping holding periods. That is, in any given month *t*, the strategies hold a series of portfolios selected in the current month t and in the previous *K*-1 months. In all overlapping portfolios, monthly holding period returns are computed as an equal-weighted average of returns from strategies initiated at month *t* and past *K -1* months.

At the beginning of each month, *t*, securities are ranked in ascending order based on their returns in the past *J* months. Based on the rankings, stocks are grouped into deciles based on their returns over the previous *J* months. For instance, for $J = 6$, *P1* represents the *loser* portfolio with the lowest past 6-months return, and *P10* represents the *winner* portfolio with the highest past 6-months return. Price momentum returns are calculated using the zero-cost portfolio approach of buying extreme winners and selling extreme losers, *P10 - P1* (Lee and Swaminathan, 2000).

Table 2, Panel A reports the equal-weighted average monthly returns for the zero-cost portfolios (*P10–P1*) for *J*-month/*K*-month strategies, where *J* and *K* are set at 1, 3, 6, 9, and 12 months. Our core results are as follows. First, we find evidence of significant price momentum in the intermediate ($J = 6$) and long-term formation ($J = 9$ and $J = 12$) periods. In particular, for $J = 6$ and $K = 1, 3, \ldots 12$, we observe average monthly returns of 0.84%, 1.30%, 1.34%, 1.30%, and 1.14%, respectively. Similarly, when we turn our attention to the long-term, where ($J = 12$ and $K = 1, 3, \ldots 12$), we find that the zero-cost portfolios, on average, generate monthly returns of 1.50%, 1.68%, 1.49%, 1.38%, and 1.24%, respectively. Second, we find evidence of short-term price momentum ($J = 1$ and $J = 3$), limited to longer holding periods. For instance, when ($J = 1$) and ($K = 6$, 9, and 12), we find momentum profits of 0.33%, 0.42%, and 0.41% respectively. Finally, we show that momentum profits increase with the formation period in each holding period. For example, when $K = 6$, average monthly momentum profit rises from 0.33% ($J = 1$) to 1.49% ($J = 12$).

Following prior studies (Lehmann, 1990; JT, 1993; Lee and Swaminathan, 2000), we examine the impact of skipping a month strategy on momentum profits. Prior work argues that the break between the formation and holding periods would alleviate potential microstructure biases such as the bid-ask spread, price pressure, and lagged reaction effects. After introducing the skipping-a-month strategy, we present the results in Table 2, Panel B for the zero-cost portfolio (P10 – P1). Our findings reported in Panel B are consistent with those reported in Panel A for the intermediate and long-term formation period. Specifically, we show that for the intermediate period ($J = 6$), the monthly returns are 1.35% (for $K = 1$) and 1.11% (for $K = 12$), respectively. Turning to the long-term period ($J = 12$), we observe that monthly returns are 1.69% (for $K = 1$) and 1.16% (for $K = 12$), respectively. When $J = 3$, the short-term momentum strategies generate positive and significant profits in all holding periods. In sum, we find evidence of price momentum in the intermediate and long term but the short-term momentum strategies ($J = 1$) only have significant profits in a longer holding periods ($K = 6$ to 12).

4.2. Liquidity-based price momentum strategies

A strand of literature (Lee and Swaminathan, 2000; Medhat and Schmeling, 2022) suggests that liquidity enhances momentum, which persists over various holding periods (2 to 12 months). Based on their findings, one would expect momentum to be strongest among high-turnover stocks and find substantial reversals among low-turnover stocks—Table 3 tests this by calculating momentum and reversals conditional on liquidity. We begin with double sorting of stocks (Medhat and Schmeling, 2022). First, for every year-

Table 2
Price momentum returns.

	Panel A: No gap between formation and holding period					Panel B: 1 month gap between formation and holding period				
	$K = 1$	$K = 3$	$K = 6$	$K = 9$	$K = 12$	$K = 1$	$K = 3$	$K = 6$	$K = 9$	$K = 12$
$J = 1$	−0.53%	−0.07%	0.33%	0.42%	0.41%	−0.28%	0.33%	0.49%	0.48%	0.48%
	(−1.33)	(−0.25)	(1.69)*	(2.37)***	(2.49)***	(−0.75)	(1.37)	(2.53)***	(2.72)***	(2.95)***
$J = 3$	−0.27%	0.54%	0.87%	0.88%	0.87%	0.69%	1.05%	1.09%	0.98%	0.91%
	(−0.6)	(1.45)	(2.81)***	(3.07)***	(3.28)***	(1.70)*	(3.09)***	(3.55)***	(3.53)***	(3.48)***
$J = 6$	0.84%	1.30%	1.34%	1.30%	1.14%	1.35%	1.58%	1.42%	1.29%	1.11%
	(1.80)*	(3.01)***	(3.37)***	(3.51)***	(3.26)***	(2.88)***	(3.77)***	(3.62)***	(3.49)***	(3.29)***
$J = 9$	1.12%	1.39%	1.47%	1.31%	1.23%	1.48%	1.55%	1.46%	1.26%	1.19%
	(2.22)**	(2.96)***	(3.31)***	(3.16)***	(3.28)***	(3.08)***	(3.45)***	(3.33)***	(3.13)***	(3.31)***
$J = 12$	1.50%	1.68%	1.49%	1.38%	1.24%	1.69%	1.72%	1.42%	1.31%	1.16%
	(2.80)***	(3.22)***	(3.05)***	(3.12)***	(3.08)***	(3.15)***	(3.42)***	(3.01)***	(3.10)***	(3.01)***

This table presents the average monthly returns for price momentum strategies for stocks listed on the Bombay Stock Exchange (BSE) from January 2000 to July 2021. Panel A presents the results for the strategies in which there is no gap between the formation and holding period whereas panel B presents the results for skipping a month strategy. Average monthly returns are calculated on the zero-cost portfolios formed based on *J*-months, i.e., formation period, and held for *K*-months, i.e., holding period. *t*-statistics are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. Variable definitions are presented in the Appendix.

Table 3
Price momentum returns based on liquidity.

Panel A: Liquid Stocks (*Q*10)

	Panel A.1: No gap between formation and holding period					Panel A.2: 1 month gap between formation and holding period				
	$K = 1$	$K = 3$	$K = 6$	$K = 9$	$K = 12$	$K = 1$	$K = 3$	$K = 6$	$K = 9$	$K = 12$
$J = 1$	4.21%	4.45%	3.27%	2.95%	2.65%	5.71%	3.47%	2.83%	2.65%	2.46%
	(4.72)***	(7.50)***	(7.49)***	(7.53)***	(7.14)***	(6.83)***	(6.27)***	(6.41)***	(6.88)***	(6.86)***
$J = 3$	5.66%	4.73%	4.00%	3.83%	3.57%	5.15%	4.07%	3.52%	3.46%	3.28%
	(6.32)***	(7.04)***	(7.13)***	(7.53)***	(7.43)***	(5.84)***	(6.35)***	(6.36)***	(6.68)***	(6.88)***
$J = 6$	4.81%	4.22%	3.60%	3.43%	3.15%	4.64%	3.70%	3.52%	3.15%	2.97%
	(5.49)***	(5.73)***	(5.52)***	(5.59)***	(5.49)***	(5.23)***	(4.81)***	(5.21)***	(4.88)***	(5.19)***
$J = 9$	3.16%	3.25%	3.08%	2.90%	2.82%	3.19%	3.21%	3.10%	2.81%	2.72%
	(3.67)***	(4.34)***	(4.37)***	(4.30)***	(4.50)***	(4.03)***	(4.03)***	(4.32)***	(4.17)***	(4.40)***
$J = 12$	3.80%	3.06%	2.62%	2.60%	2.41%	3.07%	2.41%	2.48%	2.42%	2.34%
	(4.43)***	(3.80)***	(3.58)***	(3.65)***	(3.66)***	(3.32)***	(2.85)***	(3.27)***	(3.39)***	(3.55)***

Panel B: Illiquid Stocks (*Q*1)

	Panel B.1: No gap between formation and holding period					Panel B.2: 1 month gap between formation and holding period				
	$K = 1$	$K = 3$	$K = 6$	$K = 9$	$K = 12$	$K = 1$	$K = 3$	$K = 6$	$K = 9$	$K = 12$
$J = 1$	−0.22%	−1.66%	−0.83%	−0.38%	−0.12%	−2.60%	−1.66%	−0.74%	−0.25%	−0.10%
	(−0.34)	(−3.33)***	(−2.43)***	(−1.41)	(−0.5)	(−3.66)***	(−3.51)***	(−2.29)**	(−0.9)	(−0.44)
$J = 3$	−3.22%	−2.51%	−0.81%	−0.36%	0.06%	−2.28%	−0.90%	−0.12%	0.11%	0.36%
	(−3.67)***	(−4.01)***	(−2.02)**	(−0.97)	(0.19)	(−3.23)***	(−1.65)*	(−0.3)	(0.31)	(1.11)
$J = 6$	−2.14%	−1.04%	−0.55%	−0.30%	−0.07%	−0.79%	−0.45%	−0.07%	0.00%	0.19%
	(−2.86)***	(−1.85)*	(−1.08)	(−0.62)	(−0.15)	(−1.1)	(−0.76)	(−0.13)	(0.00)	(0.43)
$J = 9$	−1.91%	−1.45%	−0.50%	−0.37%	−0.09%	−1.55%	−0.51%	0.05%	0.03%	0.12%
	(−2.53)***	(−2.04)**	(−0.81)	(−0.64)	(−0.18)	(−1.74)*	(−0.7)	(0.08)	(0.05)	(0.24)
$J = 12$	−0.72%	−0.35%	0.13%	0.53%	0.54%	−1.18%	−0.10%	0.49%	0.53%	0.68%
	(−0.77)	(−0.47)	(0.20)	(0.91)	(0.94)	(−1.29)	(−0.13)	(−0.71)	(−0.87)	(−1.15)
Panel C. T-test between Liquid and Illiquid Portfolios										
$J = 1$	4.43%		4.10%			8.31%		3.57%		
(*Q*10-*Q*1)	(4.18)***		(7.95)***			(7.29)***		(6.97) ***		
$J = 6$	6.95%		4.21%			5.43%		3.59		
(*Q*10-*Q*1)	(6.17)***		(5.47)***			(5.03) ***		(4.54) ***		

This table presents the average monthly returns for price momentum strategies for stocks listed on the Bombay Stock Exchange (BSE) from January 2000 to July 2021. Average monthly returns are calculated on the zero-cost portfolios formed based on *J*-months, i.e., formation period, and held for *K*-months, i.e., holding period. Panels A and B report the average monthly returns for the most liquid (*Q*10) and the most illiquid (*Q*1) zero-cost portfolios, respectively. Panel C shows the difference in means (*t*-test) between liquid and illiquid portfolios. *t*-statistics are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. Variable definitions are presented in the Appendix.

month combination, we sort stocks into turnover deciles based on the turnover ratio in that particular month.[4] We allocate them into deciles ranging from *Q1* to *Q10*, where *Q1* is the most illiquid portfolio having the lowest turnover, and *Q10* is the most liquid portfolio with the highest turnover ratio. Second, within the highly liquid (*Q10*) and illiquid deciles (*Q1*), we sort the stocks according to their monthly lagged returns over the past $J = 1, 3, \ldots 12$ months and divide them into deciles ranging from *P1* (loser) to *P10* (winner). For the highly liquid decile (*Q10*), we construct zero-cost portfolios by buying winners (*P10*) and selling loser stocks (*P1*) and holding them across different periods ($K = 1, 3, \ldots 12$). Similarly, for the highly illiquid decile (*Q1*), we repeat the zero-cost portfolios (buying *P10* and selling *P1*) for various holding periods ($K = 1, 3, \ldots 12$). We aim to test whether momentum and reversal strategies exist among the liquid and illiquid portfolios in Indian markets.

Table 3, Panel A demonstrates the results for most liquid zero-cost portfolios (*Q10* with the highest turnover). Panel A.1 presents the results for strategies with no gap between the formation and holding period. First, we document evidence of price momentum across the short-term, intermediate, and long-term formation periods. We find evidence of persistence as we move from a shorter holding period ($J = 1, K = 1$) to a longer holding period ($J = 1, K = 12$), and the momentum profits decrease with the holding period in each formation period. For example, we report returns of 4.21% for ($J = 1$, $K = 1$) and 2.65% for ($J = 1$, $K = 12$).

In Panel A.2 of Table 3, we provide the results for price momentum by skipping a month strategy across the short-term, intermediate, and long-term formation periods. These findings persist as we move from a shorter holding period ($J = 1, K = 1$) to a longer holding period ($K = 12$). In particular, we report returns of 5.71% for ($J = 1, K = 1$) and 2.46% for ($J = 1, K = 12$). As with the results reported in Panel A.1, these results also hold for intermediate and long-term formation periods. Collectively, these findings are consistent with Lee and Swaminathan (2000) and Medhat and Schmeling (2022), who highlight that liquidity enhances short-and-intermediate term momentum, which is strong and largest at shorter holding periods.

Next, we turn our attention to Table 3, Panel B, where we present the results for the most illiquid portfolio (i.e., *Q1* with the lowest turnover). Panel B.1 presents the results for strategies with no gap between the formation and holding period, and in B.2, we present the results for skipping a month strategy. The results in Panel B.1 show evidence of short-term reversals for short holding periods except for ($J = 1, K = 1$). More specifically, for ($J = 1$), the reversals disappear when we increase the holding period to ($K = 9$ and $K = 12$). As we increase the formation period to 6-months ($J = 6$) and 9-months ($J = 9$), reversals are significant only at shorter holding periods ($K = 1$ and 3). We find that long-term reversals are not significant (at $J = 12$), across all holding periods. Panel B.2 presents the results for skipping a month between the holding and formation period. We find that reversals are significant in the short ($J = 1$) and intermediate ($J = 3$) term when the holding period is also short ($K = 1$ or $K = 3$) but are insignificant in the long-term formation period ($J = 12$). A key result we present is that reversals concentrate on short-formation periods and disappear over long-term holding periods.

Several interesting findings emerge from Table 3. First, we find strong short-term momentum among high-turnover stocks and short-term reversal among low-turnover stocks, particularly at shorter holding periods. In essence, we find strong momentum and reversal returns, conditional on liquidity. Second, consistent with Medhat and Schmeling (2022), momentum and reversals co-exist only in the short-term formation periods. To elaborate, while we find the persistence of short-, intermediate, and long-term momentum returns conditional on liquidity, these findings do not hold for reversals. Third, given the holding period (*K*), the momentum returns of the most liquid portfolio are always larger than that of the most illiquid portfolio. We substantiate this result by calculating the difference in momentum premium between liquid and illiquid portfolios. For example, for ($J = 6$, $K = 6$), the difference between momentum and reversal returns is 6.95% per month. This result is consistent with the notion that liquidity improves the profitability of momentum strategies.

We combine the results in Tables 2 and 3 and illustrate it graphically in Fig. 1. This figure shows the annualized average excess momentum and reversals for all stocks, liquid (Q10) and illiquid portfolios (Q1). We find that the return for short-term price momentum ($J = 1$ and $K = 1$) is −10% per annum over the entire sample period. In contrast, when conditioned on liquidity, we find evidence of significant price momentum returns of 65% per annum among stocks with a high turnover ratio.[5] Comparable momentum profits persist for intermediate and long-term formation periods among liquid stocks. That is, a strategy that involves buying the past ($J = 1$, 6 and 12) months' winners and shorting the past months' losers within the most liquid decile (Q10) generates positive annual returns of 65% for short-term, 64% for the intermediate-term and 47% for long-term for the one-month holding period. In contrast, a strategy that involves buying the past ($J = 1$, 6 and 12) winners and shorting the past ($J = 6$) months losers within the most illiquid decile (Q1) generates negative annual returns across all formation and holding periods.

4.3. Market capitalization-based price momentum strategies

Hong and Stein (1999) predict that momentum profits should be larger for small stocks as information flows slowly in these stocks. However, small stocks tend to be illiquid and prior literature suggests that the momentum effect should be less significant among illiquid stocks (Lee and Swaminathan, 2000; Medhat and Schmeling, 2022). Given this discussion, we test whether momentum and

[4] Following Datar et al. (1998), we use stock turnover ratio (number of shares traded as a fraction of the number of shares outstanding) as a proxy for liquidity.

[5] Using a J = 1 and K = 1 strategy, Medhat and Schmeling (2022) found an average short-term momentum profit of 16.44% per annum, among the most liquid stocks in the US. Since the Indian market is three times more illiquid than the US market (Amihud et al., 2015) and short selling is difficult in India, the cost of arbitrage in India is expected to be much higher than that in the US which contributes to the large short-term momentum profits in India.

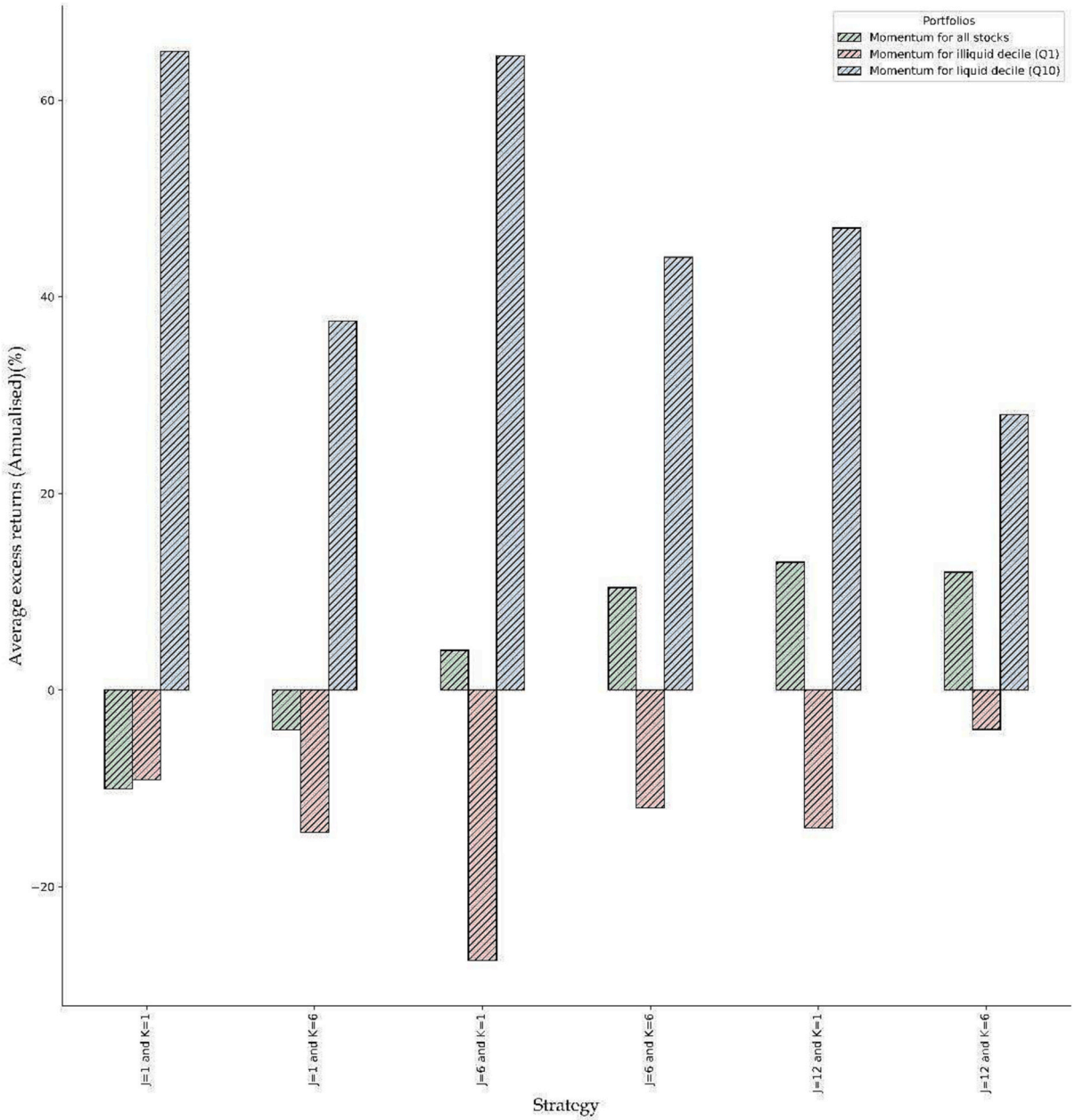

Fig. 1. Annualized average excess momentum and reversal returns from 2000 to 2021.
This figure represents the annualized average excess price momentum returns for the all-stocks portfolio (*Momentum for all stocks)*, the most liquid portfolio (*Momentum for liquid decile Q10*), the most illiquid portfolio (*Momentum for illiquid decile Q1*). Data are at the monthly frequency and cover the period from January 2000 to July 2021 for the stocks listed on the Bombay Stock Exchange (BSE).

reversals are related to firm size. To begin, we select stocks that belong to the top quartile (*M*4) (i.e., top 25 percentile) and bottom quartile (*M*1) based on the market capitalization for each year-month. Within *M*4 and *M*1, we sort stocks by their monthly lagged returns over the past $J = 1, 3, \ldots 12$ months and divide them into deciles ranging from *P1* (loser) to *P10* (winner). We then construct zero-cost portfolios (buying *P*10 and selling *P*1) within *M*4 and *M*1.

Table 4, Panel A documents results for stocks with the highest market capitalization (top 25% of market capitalization). Panel A.1 presents the results without a gap between the formation and holding periods. The results show that short-term momentum returns ($J = 1$) are persistent across all holding periods (up to 12 months). We find similar results for $J = 3$. When we turn our attention to intermediate ($J = 6$) and longer ($J = 9$ and $J = 12$) formation periods, we find, for the intermediate period, evidence of momentum returns that persist until ($K = 6$). As we move to the long-term ($J = 12$), we find limited evidence of momentum among large-sized stocks. These results are broadly consistent with those reported in Panel A.2, where we skip a month between the formation and

Table 4
Price momentum returns based on market capitalization.

Panel A. Top 25% by market capitalisation

	Panel A.1: No gap between formation and holding period					Panel A.2: 1 month gap between formation and holding period				
	$K=1$	$K=3$	$K=6$	$K=9$	$K=12$	$K=1$	$K=3$	$K=6$	$K=9$	$K=12$
$J=1$	0.76%	0.76%	0.64%	0.54%	0.44%	0.01%	0.67%	0.59%	0.45%	0.38%
	(1.71)*	(2.86)***	(3.13)***	(2.85)***	(2.61)***	(1.61)	(2.68)***	(2.90)***	(2.53)***	(2.31)**
$J=3$	0.96%	0.97%	0.92%	0.69%	0.52%	1.01%	1.00%	0.83%	0.62%	0.00%
	(2.11)**	(2.64)***	(2.86)***	(2.36)***	(1.87)*	(2.47)***	(2.85)***	(2.59)***	(2.11)**	(1.39)
$J=6$	1.07%	1.21%	0.86%	0.01%	0.00%	1.15%	1.02%	0.76%	0.00%	0.00%
	(2.24)**	(2.72)***	(2.11)**	(1.65)*	(1.09)	(2.33)**	(2.37)***	(1.82)*	(1.30)	(0.69)
$J=9$	0.95%	0.84%	0.01%	0.00%	0.00%	0.91%	0.01%	0.01%	0.00%	0.00%
	(1.90)*	(1.77)*	(1.51)	(0.98)	(0.79)	(1.89)*	(1.60)	(1.23)	(0.67)	(0.58)
$J=12$	0.01%	0.01%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.00%	0.00%
	(1.46)	(1.25)	(0.72)	(0.39)	(0.36)	(1.35)	(1.02)	(0.34)	(0.22)	(0.25)

Panel B. Bottom 25% by market capitalization

	Panel B.1: No gap between formation and holding period					Panel B.2: 1 month gap between formation and holding period				
$J=1$	−2.84%	−2.18%	−0.92%	−0.38%	−0.21%	−2.42%	−1.15%	−0.43%	−0.07%	0.04%
	(−5.4)***	(−6.87)***	(−4.54)***	(−2.32)**	(−1.36)	(−5.01)***	(−4.02)***	(−2.28)**	(−0.43)	(0.25)
$J=3$	−4.41%	−2.36%	−0.71%	−0.22%	0.12%	−2.12%	−0.60%	0.15%	0.37%	0.48%
	(−7.53)***	(−5.47)***	(−2.41)***	(−0.85)	0.51	(−4.03)***	(−1.66)*	(0.56)	(1.45)	(2.01)**
$J=6$	−3.35%	−1.32%	−0.08%	0.22%	0.35%	−1.20%	0.11%	0.64%	0.64%	0.65%
	(−6.09)***	(−3.00)***	(−0.23)	(0.69)	(1.16)	(−2.36)***	(0.29)	(1.86)*	(1.99)**	(2.22)**
$J=9$	−2.18%	−0.73%	0.21%	0.35%	0.47%	−0.73%	0.44%	0.66%	0.68%	0.65%
	(−4.04)***	(−1.52)	(0.50)	(0.89)	(1.30)	(−1.25)	(0.97)	(1.61)	(1.76)*	(1.82)*
$J=12$	−1.60%	−0.42%	0.24%	0.42%	0.58%	−0.18%	0.44%	0.57%	0.73%	0.73%
	(−2.89)***	(−0.85)	(0.54)	(1.03)	(1.48)	(−0.34)	(0.90)	(1.34)	(1.79)*	(1.91)*

This table presents the average monthly returns for price momentum strategies for stocks listed on the Bombay Stock Exchange (BSE) from January 2000 to July 2021. Average monthly returns are calculated on the zero-cost portfolios formed based on *J*-months, i.e., formation period, and held for *K*-months, i.e., holding period. Panels A and B report the average monthly returns for portfolios that are constructed using large-size firms (i.e., stocks that belong to the top quartile based on market capitalization, *M*4) and small-size firms (i.e., stocks that belong to the bottom quartile based on market capitalization, *M*1). *t*-statistics are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. Variable definitions are presented in the Appendix.

holding periods.

In Panel B.1, we focus on small-sized stocks (bottom 25% of market capitalization). In this panel, we present the results for momentum returns without skipping a month between the formation and holding periods. We show that short-term reversals (J = 1) persist until ($K=9$). As the formation period increases to $J=3$ and $J=6$, reversals are evident only in holding periods ranging from 1 to 6 months. Long-term reversals ($J=9$ and 12) are evident only during the immediate 1-month holding period. When we account for skipping a month between the formation and holding period (B.2), we find that the short-term reversal ($J=1$ and $J=3$) is significant only for a shorter holding period. As the formation period increases to $J=6$, we find evidence of reversal only for shorter holding periods and little or no reversals for long-term formation periods ($J=12$).

In summary, our core evidence implies that price momentum is present only among large-sized firms in short and intermediate formation periods. As far as small firms are concerned, we find evidence of short-, intermediate, and long-term reversals that do not persist for longer holding periods ($K=12$). While these findings are inconsistent with the slow information diffusion hypothesis of Hong and Stein (1999), they are in line with the liquidity-based explanation of momentum suggested by Lee and Swaminathan, 2000; Medhat and Schmeling, 2022.

4.4. Momentum returns and common risk factors

In this section, we provide additional evidence on the source of excess returns for various momentum strategies, including liquid and illiquid portfolios. In Table 5, we regress excess momentum returns (adjusted for the risk-free rate that is 91-day T-bill) on the Fama and French (1993) three-factor model as shown in eq. (1). The model reports robust standard errors that are adjusted for heteroscedasticity and autocorrelation.

$$\left(r_{p,t}-r_{f,t}\right)=a_p+b_p\left(r_{m,t}-r_{f,t}\right)+s_pSMB_t+h_pHML_t+e_{p,t} \tag{1}$$

where $r_{p,t}$ is the monthly return for the zero-cost portfolio p in time t; $r_{f,t}$ is the monthly return on a 91-day T-bill obtained from the Reserve Bank of India (RBI) at time t; $r_{m,t}$ is the return of the market portfolio estimated as the value-weighted portfolio of all stocks at time t; SMB_t is the mimic portfolio for the size factor at time t; and HML_t is the mimic portfolio for the book-to-market (value) factor at time t. b_p, s_p and h_p are the corresponding factor loadings and a_p is the intercept or the alpha of the portfolio. We obtain the above

Table 5
Momentum Returns and Fama-French Three Factors.

	(Short-term)		(Intermediate-term)		(Long-term)	
	($J = 1$, $K = 1$)	($J = 1$, $K = 6$)	($J = 6$, $K = 1$)	($J = 6$, $K = 6$)	($J = 12$, $K = 1$)	($J = 12$, $K = 6$)
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: All Stocks						
Intercept	−0.01	−0.00	0.01	0.01	0.02	0.02
	(−2.69)***	(−0.81)	(1.67)*	(3.54)***	(3.11)***	(3.25)***
SMB	0.00	−0.00	−0.00	−0.00	−0.00	−0.00
	(0.03)	(−2.19)**	(−1.72)*	(−2.64)***	(−2.20)**	(−1.88)*
HML	0.00	−0.00	−0.00	−0.00	−0.00	−0.00
	(0.32)	(−3.25)***	(−2.46)**	(−4.49)***	(−4.15)***	(−4.97)***
MF	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00
	(−2.01)**	(−1.61)	(−2.95)***	(−2.76)***	(−2.25)**	(−1.33)
N (months)	235	235	235	235	223	223
Adj. *R*-sqd.	0.01	0.14	0.11	0.20	0.17	0.17
Panel B: Liquid Stocks (Q10)						
Intercept	0.04	0.03	0.05	0.04	0.04	0.02
	(4.65)***	(6.20)***	(5.27)***	(5.54)***	(4.52)***	(3.51)***
SMB	0.00	0.00	0.00	0.00	0.00	−0.00
	(0.32)	(1.15)	(1.65)*	(0.62)	(1.14)	(−0.64)
HML	0.00	−0.00	−0.00	−0.00	−0.01	−0.01
	(1.75)*	(−0.47)	(−1.40)	(−3.73)***	(−3.73)***	(−4.61)***
MF	−0.00	0.00	−0.00	−0.00	0.00	0.00
	(−1.88)*	(−1.02)	(−1.47)	(−0.61)	(−0.53)	(1.06)
N (months)	230	235	229	235	217	221
Adj. *R*-sqd.	0.01	0.01	0.02	0.06	0.06	0.09
Panel C: Illiquid Stocks (Q1)						
Intercept	−0.01	−0.01	−0.02	−0.01	−0.01	−0.00
	(−0.83)	(−3.54)***	(−3.28)***	(−1.83)*	(−1.07)	(−0.23)
SMB	−0.00	0.00	−0.01	0.00	−0.01	−0.00
	(−1.63)	(−2.59)***	(−4.34)***	(−3.72)***	(−2.52)**	(−1.75)*
HML	−0.00	0.00	0.00	0.00	0.00	−0.00
	(−1.22)	(−0.79)	(−2.99)***	(−0.10)	(−2.04)**	(−2.05)**
MF	−0.00	0.00	0.00	0.00	0.00	0.00
	(−0.46)	(−2.67)***	(0.86)	(−1.75)*	(−0.02)	(0.01)
N (months)	234	235	234	235	219	223
Adj. *R*-sqd.	0.02	0.08	0.12	0.08	0.05	0.03

This table shows time-series regressions for short-term momentum ($J = 1$, $K = 1$ and 6) in columns (1) and (2), intermediate-term momentum ($J = 6$, $K = 1$ and 6) in columns (3) and (4) and long-term momentum ($J = 12$, $K = 1$ and 6) in columns (5) and (6). The explanatory variables are the Fama and French (1993) three-factor model that includes the size factor (SMB), the value portfolio (HML) and the market premium (MF). The data for these factors have been sourced from the data library for the Indian market (http://www.iimahd.ernet.in/~iffm/Indian-Fama-French-Momentum). Data are at the monthly frequency and cover the period from January 2000 to July 2021 for the stocks listed on the Bombay Stock Exchange (BSE). Standard errors are adjusted for heteroskedasticity and autocorrelation, and *t*-statistics are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. Variable definitions are presented in the Appendix. Panels?

factors from the Fama French and Momentum Factors: Data Library for the Indian market (Agarwalla et al., 2014).

For parsimony, in Table 5, we report results for combinations of short, intermediate, and long term portfolio formations and holding periods across three panels. Columns (1) and (2) report the results for short-term ($J = 1$; $K = 1$ and 6), columns (3) and (4) for the intermediate-term ($J = 6$; $K = 1$ and 6), and columns (5) and (6) for the long-term ($J = 12$; $K = 1$ and 6). Panel A demonstrates the results for all stocks, and Panels B and C show the results for liquid ($Q10$) and illiquid ($Q1$) stocks.

In Panel A, column (1), we find that the intercept is negative and significant for the short-term ($J = 1$) across a holding period of 1-month. As holding period increases to 6-months in column (2), we find the intercept to be negative but insignificant. In columns (3) and (4), we find the intercept to be positive and significant for the intermediate price ($J = 6$), and these results hold in columns (5) and (6) for the long-term. We summarise that the risk-adjusted return is negative in the short-term, which turns positive in the intermediate, and long-term. In other words, after adjusting for risks, there is a strong short-term reversal and significant intermediate and long-term momentum.

In Panel B, the intercept becomes positive and significant when conditioned on liquidity ($K = 1$ and $K = 6$) for short, intermediate and long-term momentum strategies. In essence, buying and selling highly liquid winners and losers, respectively, generates a significant risk-adjusted return, implying that liquidity enhances the momentum effect. Turning our attention to illiquidity in Panel C, we find evidence of significant short-term reversal but only when the holding period is 6-months ($K = 6$) in column (2). Turning to the intermediate term, we find significant reversals for the 1-month and 6-month holding period. However, these reversals are not significant in the long-term ($J = 12$). After controlling for the Fama-French three factors, we conclude that the momentum effects persist when conditioned on liquidity, whereas reversals do not persist beyond the short-term when conditioned on illiquidity. In other words, liquidity strengthens the momentum effect even after controlling for the common risk factors.

Table 6
Fama-MacBeth Regressions: Cross-sectional approach.

	(1)	(2)	(3)	(4)
Panel A: All Stocks				
$RET_{1,1}$	0.03			
	(2.25)**			
$RET_{1,2}$		0.02		
		(1.46)		
$RET_{6,1}$			0.01	
			(2.18)**	
$RET_{6,2}$				0.01
				(1.95)*
BM_1	0.00	0.00	0.00	0.00
	(0.94)	(1.06)	(1.1)	(0.86)
SZ_1	−0.00	−0.00	−0.00	−0.00
	(−3.39)***	(−3.42)***	(−3.61)***	(−3.51)***
$TURN_1$	−0.00	−0.00	−0.00	−0.00
	(−0.97)	(−0.26)	(−0.8)	(−1.01)
Intercept	0.05	0.05	0.05	0.05
	(4.64)***	(5.03)***	(4.71)***	(4.73)***
N (months)	229	229	229	229
Adj. *R*-sqd.	0.12	0.11	0.15	0.15
Panel B: Liquid Stocks (*Q*10)				
$RET_{1,1}$	0.06			
	(3.78)***			
$RET_{1,2}$		0.05		
		(4.24)***		
$RET_{6,1}$			0.02	
			(2.62)***	
$RET_{6,2}$				0.01
				(2.35)***
BM_1	0.00	0.00	0.00	0.00
	(0.88)	(1.12)	(0.35)	(0.49)
SZ_1	−0.02	−0.02	−0.02	−0.02
	(−9.47)***	(−9.48)***	(−8.38)***	(−8.61)***
$TURN_1$	−0.03	−0.03	−0.03	−0.00
	(−6.61)***	(−6.56)***	(−7.41)***	(−6.96)***
Intercept	0.25	0.26	0.25	0.24
	(10.59)***	(10.80)***	(10.72)***	(10.57)***
N (months)	139	139	139	131
Adj. *R*-sqd.	0.18	0.17	0.18	0.18
Panel C: Illiquid Stocks (*Q*1)				
$RET_{1,1}$	−0.06			
	(−3.15)***			
$RET_{1,2}$		0.00		
		(0.07)		
$RET_{6,1}$			−0.02	
			(−3.52)***	
$RET_{6,2}$				−0.02
				(−2.59)***
BM_1	0.00	0.00	0.00	0.00
	(0.08)	(0.44)	(0.69)	(0.33)
SZ_1	−0.01	−0.01	−0.00	−0.00
	(−3.49)***	(−3.21)***	(−1.91)*	(−1.95)*
$TURN_1$	−0.00	−0.00	−0.00	−0.00
	(−1.70)*	(−1.83)*	(−1.89)*	(−1.46)
Intercept	0.01	0.01	−0.01	0.00
	(0.68)	(0.59)	(−0.69)	(0.06)
N (months)	108	108	95	72
Adj. *R*-sqd.	0.15	0.15	0.17	0.16

This table shows the Fama and MacBeth (1973) cross-sectional regressions of monthly expected returns on the past 6-months and one-month returns while controlling for the previous month's book-to-market ratio (BM_1), lagged size captured by market capitalization (SZ_1), and lagged turnover ($TURN_1$). Regressions are estimated using weighted least squares (WLS) with market capitalization as the weight. Independent variables are trimmed at the 1st and 99th percentiles. Columns (1) and (2) present the results of past one-months returns lagged by one period ($RET_{1,1}$) and two periods ($RET_{1,2}$), respectively. Columns (3) and (4) show the results of the past six-months return lagged by one period ($RET_{6,1}$) and two periods ($RET_{6,2}$), respectively. Panel A is for all stocks, and Panels B and C present liquid (top 10% turnover, *Q*10) and illiquid stocks (bottom 10% turnover, *Q*1). Data are at the monthly frequency and cover the period from January 2000 to July 2021 for the stocks listed on the Bombay Stock Exchange (BSE). Standard errors are adjusted for heteroskedasticity and autocorrelation, and *t*-statistics are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. Variable definitions are presented in the Appendix.

4.5. Cross-sectional regression analysis

So far, we have established evidence of price momentum in liquid stocks and reversals in illiquid stocks using the portfolio aggregation approach. We perform the Fama and MacBeth (1973) regressions to validate our core evidence to confirm if our main findings hold cross-sectionally at the firm level. The results are presented in Table 6 across three panels (Panels A to C) and four columns. Columns (1) and (2) present the regression results of expected monthly returns on the past one-month return lagged by one period ($RET_{1,1}$) and two periods ($RET_{1,2}$), respectively. Columns (3) and (4) show the regression results of expected monthly returns on the past 6-months returns, lagged by one period ($RET_{6,1}$) and two periods ($RET_{6,2}$). Panel A reports the results for all stocks, whereas Panels B and C present the results for liquid (top 10% turnover, *Q*10) and illiquid stocks (bottom 10% turnover, *Q*1), respectively. We control for book-to-market ratio (BM_1), firm size (SZ_1), and turnover ratio ($TURN_1$), all lagged by one month.

Our results reported in Panel A show that the coefficient of ($RET_{1,1}$) is positive and significant in column (1), and that of ($RET_{1,2}$) is insignificant in column (2). This result implies that the past 1-month return predicts the cross-section of monthly expected returns when lagged by one period. Similarly, in columns (3) and (4), we find the coefficients of ($RET_{6,1}$) and ($RET_{6,2}$) are positive and significant. This finding implies that the past 6-month returns predict the cross-section of monthly expected returns when lagged by one and two periods. In essence, we find that the short-and-intermediate term past-returns (1 and 6 months) can predict the subsequent month's expected returns. These findings are consistent with our portfolio results and indicate that the intermediate-term momentum effect is strong in the Indian market, while the short-term momentum effect is substantial when there is no one-month gap between past and current returns.

Next, we switch to testing the Fama-MacBeth regression on liquid stocks (top 10% turnover, *Q*10) and illiquid stocks (bottom 10% turnover, *Q*1). We present the results in Panel B (liquid stocks) and Panel C (illiquid stocks) of Table 6. Our results in Panel B (columns 1 and 2) show that the past short-term (one-month) returns, lagged by one-period and two-periods, predict the cross-section of monthly expected returns with a positive and significant slope. In columns (3) and (4) of Panel B, we continue to find that the past six months' return (lagged by one and two periods) predicts the cross-section of monthly expected returns with a positive and significant slope. These findings indicate that both short-term and intermediate-term momentum effects are substantial among liquid stocks.

We present the results for illiquid stocks across columns (1) to (4) of Panel C. As expected, we find evidence that the past month (columns 1 and 2) and the past six months (column 3) can predict the cross-section of monthly expected returns with a negative and significant slope. These findings display that the short-term and intermediate-term reversal effects are strong among illiquid stocks. Overall, the findings from the Fama-MacBeth regressions at firm level are consistent with our results using the portfolio approach. Besides, we find that firm size and liquidity premiums are significant in the Indian market.

4.6. Momentum returns and macroeconomic factors

In this section, we continue to examine the sources of momentum profitability. We investigate whether common macroeconomic variables explain the momentum effect. A strand of literature beginning with Chordia and Shivakumar (2002) provides a possible role for time-varying expected returns as an explanation of momentum profits. Liu and Zhang (2008) further establish the association between momentum returns and growth in industrial production. Maio (2013) reports a significant relationship between momentum returns and CPI inflation.

Following Fama and French (1989) and Chordia and Shivakumar (2002), we examine the relation between time-series momentum returns and dividend yield (DIV), composite leading indicator of economic activity (ECO), term spread (TERM), and the 3-month Treasury bill rate (YLD). We use DIV as a proxy for the underlying risk premium; TERM, defined as the difference between the yield of a 10-year treasury bond and a 3-month T-bill, as a proxy for the short-term business cycle; YLD as an indicator of forthcoming macro-financial development and ECO as an indicator which captures long-term business cycles.[6] We obtain the data for DIV, TERM, and YLD from Bloomberg and ECO from Refinitiv Eikon. We present the estimation approach in eq. (2).

$$r_t = Intercept + \beta_1 \Delta DIV_{t-1} + \beta_2 \Delta TERM_{t-1} + \beta_3 \Delta YLD_{t-1} + \beta_4 \Delta ECO_{t-1} + e_t \quad (2)$$

where r_t refers to the monthly momentum returns adjusted for risk-free rate for zero-cost portfolio, *Intercept* can be interpreted as the momentum returns adjusted for macroeconomic factors, and β_1, β_2, β_3, and β_4 are the coefficients for the four macroeconomic variables described above. We present the results in Table 7 across three panels. Panel A reports the regression results for all stocks, Panel B for the most liquid decile (Q10), and Panel C for the most illiquid decile (Q1). In columns (1) and (2) of the three panels, we report the results for short-term momentum ($J = 1$), in columns (3) and (4), we present the results for intermediate-term momentum ($J = 6$) and in columns (5) and (6) for long-term momentum ($J = 12$), across holding periods of one-month ($K = 1$) and 6-months ($K = 6$).

In Panel A, column (2), we find that the intercept is positive and significant for the short-term ($J = 1$, $K = 6$) in columns (3) and (4) for the intermediate-term and in columns (5) and (6) for the long-term. This finding suggests that despite controlling for macroeconomic factors, there is significant evidence of price momentum. In Panel B, we focus on momentum returns generated in the most liquid portfolio (*Q*10). We find that the intercept is positive and significant across all six columns, indicating significant momentum returns after controlling for the macroeconomic factors. Among the macroeconomic factors, we find that only DIV has predictive power in explaining momentum returns. Our results in Panel C show that the intercept is negative and significant for $J = 1$, $K = 6$, and $J = 6$, K

[6] Chordia and Shivakumar (2002) use default spread (DEF) as a proxy for long-term business cycle. Given the limited development of bond market in India, we use composite leading indicator of economic activity (ECO) as an indicator of long-term business cycles.

Table 7
Time Series regression of momentum returns on macroeconomic factors.

	(Short-term)		(Intermediate-term)		(Long term)	
	($J = 1$, $K = 1$)	($J = 1$, $K = 6$)	($J = 6$, $K = 1$)	($J = 6$, $K = 6$)	($J = 12$, $K = 1$)	($J = 12$, $K = 6$)
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: All Stocks						
Intercept	0.00	0.00	0.01	0.02	0.02	0.02
	(1.20)	(2.1)**	(2.73)***	(3.67)***	(2.88)***	(3.12)***
DIV	−0.04	−0.02	−0.05	−0.01	−0.00	0.01
	(−1.07)	(−1.18)	(−1.11)	(−0.2)	(−0.07)	(0.28)
YLD	0.00	0.00	0.00	0.00	0.01	0.02
	(0.16)	(0.43)	(0.09)	(0.32)	(0.72)	(0.95)
TERM	−0.01	−0.02	−0.04	−0.02	−0.03	−0.02
	(−0.56)	(−2.18)**	(−1.84)*	(−1.35)	(−1.25)	(−0.82)
DEF	0.00	0.00	0.00	0.00	−0.01	−0.00
	(0.35)	(1.00)	(1.28)	(1.17)	(−1.45)	(−1.2)
N (months)	193	196	193	196	196	196
Panel B: Liquid Stocks (Q10)						
Intercept	0.04	0.03	0.04	0.04	0.03	0.023
	(4.93)***	(6.92)***	(4.91)***	(5.53)***	(3.85)***	(2.89)***
DIV	−0.14	−0.03	−0.20	−0.11	−0.20	−0.13
	(−2.04)**	(−0.87)	(−2.67)***	(−2.01)**	(−2.75)***	(−1.96)**
YLD	−0.01	0.00	−0.01	0.00	−0.01	−0.01
	(−0.24)	(0.11)	(−0.47)	(0.17)	(−0.18)	(−0.19)
TERM	−0.02	−0.02	−0.04	−0.01	0.01	−0.02
	(−0.57)	(−1.30)	(−1.11)	(−0.36)	(0.14)	(−0.71)
ECO	0.00	0.00	0.00	0.00	0.00	−0.00
	(1.63)	(0.8)	(0.2)	(1.34)	(0.2)	(−0.2)
N (months)	193	196	193	196	192	196
Panel C: Illiquid Stocks (Q1)						
Intercept	0.00	−0.01	−0.02	−0.01	−0.01	−0.00
	(0.11)	(−2.83)***	(−2.21)**	(−1.11)	(−0.8)	(−0.1)
DIV	−0.11	−0.05	0.00	−0.04	−0.08	−0.04
	(−1.77)*	(−1.89)*	(0.07)	(−0.9)	(−0.99)	(−0.69)
YLD	0.03	0.01	0.00	−0.01	−0.04	0.01
	(1.4)	(0.97)	(0.01)	(−0.49)	(−1.30)	(0.31)
TERM	0.02	0.00	−0.01	−0.02	−0.08	−0.01
	(0.79)	(0.43)	(−0.52)	(−1.02)	(−2.18)**	(−0.46)
ECO	0.00	0.00	−0.01	0.00	0.00	−0.00
	(0.43)	(1.90)*	(−2.58)***	(1.13)	(0.33)	(−0.02)
N (months)	196	196	195	196	195	196

This table shows time series regressions of monthly momentum returns on macroeconomic factors such as equity market dividend yields (DIV), term spread (TERM), 3-month Treasury bill rate (YLD), and composite leading indicators of economic activity (ECO). All independent variables are in first difference and have been lagged by one period (month). J refers to the formation period, and K refers to the holding period. Columns (1) and (2) present the results of the regression for short-term momentum ($J = 1$) with a holding period of one month ($K = 1$) and 6-months ($K = 6$), and columns (3) and (4) show results for intermediate-term momentum ($J = 6$) with holding period of one-month ($K = 1$) and 6-months ($K = 6$). Panel A is for all stocks, and Panels B and C present liquid (top 10% turnover, $Q10$) and illiquid stocks (bottom 10% turnover, $Q1$). Data are at the monthly frequency and cover the period from January 2000 to July 2021 for the stocks listed on the Bombay Stock Exchange (BSE). Standard errors have been adjusted for heteroskedasticity and autocorrelation, and t-statistics are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. Variable definitions are presented in the Appendix.

$= 1$, suggesting limited evidence of long-term reversals in illiquid stocks. Overall, we find robust evidence of momentum returns in liquid stocks and mixed evidence of reversals in illiquid stocks after controlling for macroeconomic factors.

5. Relation to existing behavioral frameworks

A set of studies (see, for example, Daniel et al., 1998) state that prices initially overreact to news about fundamentals and continue to move further away before reverting to fundamentals. Therefore, in Daniel et al. (1998), the positive autocorrelation in intermediate-horizon returns is due to a market overreaction. In contrast, another set of studies (for example, Hong and Stein (1999)) predict that momentum profits should be larger for stocks with slower information diffusion. If we are to posit that less turnover would lead to insufficient diffusion of information, then the Hong and Stein (1999) model would predict a greater momentum effect among low-volume stocks.

Since our results show that price momentum strategies perform better among high-turnover stocks, our findings are inconsistent

with the information diffusion hypothesis of Hong and Stein (1999). This paper sits neatly within the Daniel et al. (1998) framework, as we show that our proxy for liquidity (high turnover ratio) drives momentum. Lee and Swaminathan (2000) call this the fuelling hypothesis. In essence, overconfidence leads to excess trading and thus DHS (1998) predicts greater momentum among high-volume stocks.

This notion aligns with Lee and Swaminathan (2000), who show that trading volume declines when a stock is out of favor. Conversely, when a stock is in favor, its trading volume increases. Given this, Lee and Swaminathan (2000) conclude that trading volume provides information on the degree of investor favouritism (or neglect) in a stock. To summarise, our findings align with the liquidity-based explanation of DHS (1998) and Lee and Swaminathan (2000) rather than the diffusion hypothesis of Hong and Stein (1999).

6. Conclusions

Fama and French (2008) term momentum as the premier anomaly in equity returns. While extant research provides several possible explanations (such as data mining, behavioral patterns, etc.), there is no consensus on why the momentum effect exists around the globe. Prior literature indicates that stock returns exhibit reversal at short horizons of 1 month (Jegadeesh, 1990) but momentum at longer horizons between 2 and 12 months (JT, 1993, 2001). More recently, Medhat and Schmeling (2022) report that while the previous month's thinly traded stocks exhibit a strong short-term reversal effect, the previous month's heavily traded stocks exhibit an almost equally strong continuation effect, which they refer to as short-term momentum.

This paper addresses three interesting questions. First, we explore if price momentum exists for equities listed in the BSE. Second, we examine the role of liquidity (measured by turnover ratio) in enhancing the momentum effect, and finally, we investigate if reversals are significant among illiquid stocks. Our results are as follows. First, we show evidence of positive and significant price momentum for equities listed on the BSE. We report average annualized excess returns of 10% and 12% for intermediate and long-term momentum, respectively. Second, when we perform a double sort on turnover ratio and returns, we report that momentum returns are greater for liquid stocks, i.e., the top decile ($Q10$) in terms of the turnover ratio. Specifically, the short-term momentum on the liquid portfolio reports the highest average annualized excess returns of 65%. Third, we find evidence of reversals for illiquid stocks ($Q1$) and report average annualized excess negative returns of −9% for short-term, −28% for intermediate-term, and − 14% for long-term, with holding period of one-month. Importantly, these results continue to hold even after controlling for the overall market factor, factors related to firm size, book-to-market ratio, and a host of macroeconomic factors in the spirit of Chordia and Shivakumar (2002).

Appendix

Variable definitions

Variables	Definition and source
Variables used in Table 1	
RET	Monthly log returns calculated using adjusted closing prices. Source: Compustat Global
SZ	Market capitalization in millions of USD. Source: Compustat Global
TURN	The turnover ratio is calculated by dividing the monthly trading volume of shares by the total number of shares outstanding at the end of the month. Source: Compustat Global
Additional variables used in Table 5	
SMB	Mimic portfolio for firm size. Source: Data library for the Indian market (http://www.iimahd.ernet.in/~iffm/Indian-Fama-French-Momentum/).
HML	Mimic portfolio for the book-to-market (value) factor. Source: Data library for the Indian market (http://www.iimahd.ernet.in/~iffm/Indian-Fama-French-Momentum/).
MF	Market premium. Source: Data library for the Indian market (http://www.iimahd.ernet.in/~iffm/Indian-Fama-French-Momentum/).
Additional variables used in Table 6	
$RET_{6,1}$	Past six months' returns lagged by one period. Source: Calculated using adjusted closing prices from Compustat Global
$RET_{6,2}$	Past six months' returns lagged by two periods. Source: Calculated using adjusted closing prices from Compustat Global
$RET_{1,1}$	Past month's returns lagged by one period. Source: Calculated using adjusted closing prices from Compustat Global
$RET_{1,2}$	Past month's returns lagged by two periods. Ssource: Calculated using adjusted closing prices from Compustat Global
BM_1	Book-to-market ratio lagged by one period. Source: Compustat Global
SZ_1	Market capitalization lagged by one period. Source: Compustat Global
$TURN_1$	Turnover ratio lagged by one period. Source: Compustat Global
Additional variables used in Table 7	
DIV	Equity market dividend yields. Source: Bloomberg
YLD	3-month Treasury bill rate. Source: Bloomberg
TERM	Term spread is calculated as the difference between the yield of 10-year treasury bonds and 3-month T-bills. Source: Bloomberg
ECO	Composite leading indicator of economic activity. Source: Refinitiv Eikon

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