

Akhter, Tahmina; Othman Yong

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*Corresponding author: Tahmina Akhter, Graduate School of Business, The National University of Malaysia (Universiti Kebangsaan Malaysia), Bangi, Malaysia
E-mail: tahmina_akhter@du.ac.bd

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David McMillan, University of Stirling, Stirling, UK

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FINANCIAL ECONOMICS | RESEARCH ARTICLE

Adaptive market hypothesis and momentum effect: Evidence from Dhaka Stock Exchange

Tahmina Akhter^{1,2*} and Othman Yong¹

Abstract: This paper examines time-varying behavior of momentum and contrarian profits to identify the existence of adaptive market hypothesis (AMH), and whether AMH can provide justification for the presence of such anomalous behavior in the Dhaka Stock Exchange (DSE) of Bangladesh. To investigate the time-varying pattern of momentum/contrarian anomaly, the study uses stock prices of all listed companies on the DSE and values of DSE general index from January 1995 to December 2018. To construct the relative strength portfolios for momentum strategies, the current study employs the portfolio formation methods of Jegadeesh and Titman with minor modifications. The study findings suggest the existence of medium-term momentum profits and the long-term reversal effect that vary over time. Moreover, the empirical evidence of the study shows that the changed market conditions that are considered as the main reasons under AMH for time-varying behavior of market efficiency and by extension the stock market anomalies influence the momentum profits. The findings suggest that although market risk cannot



Tahmina Akhter

ABOUT THE AUTHORS

Tahmina Akhter is a PhD Candidate at Graduate School of Business, Universiti Kebangsaan Malaysia and an Assistant Professor at Faculty of Business Studies, University of Dhaka. Her research interests are in the areas of Corporate Finance, Financial Markets, Behavioral Finance and Applied Economics and Finance. She has published her work in *Cogent Economics and Finance*.

Othman Yong is a Professor at Graduate School of Business, Universiti Kebangsaan Malaysia. His research interests are in the areas of Initial Public Offering, Corporate Finance and Financial Markets. He has published his works in *Pacific-Basin Finance Journal*, *Applied Economics*, *Journal of Islamic Accounting and Business Research*, *Emerging Markets Review*, *Economic Systems*, *Capital Markets Review*, *International Journal of Business and Society*, *Corporate Finance Review*, *Asian Academy of Management Journal*, *Malaysian Management Review* and *UKM Journal of Management*. To date, he has authored, co-authored and edited more than 30 books. He is listed in the *Marquis Who's Who in the World*, *Marquis Who's Who in Asia*, as well as *2000 Outstanding Intellectuals of the 21st Century*.

PUBLIC INTEREST STATEMENT

This study examines the behavior of momentum and contrarian anomalies over time in the Dhaka Stock Exchange (DSE) of Bangladesh to identify the existence of adaptive market hypothesis (AMH), and whether AMH can provide the justification for the presence of these anomalies. The study findings suggest the existence of medium-term momentum profit and the long-term reversal effect in the DSE that vary over time. Moreover, the empirical results show that the changed market conditions influence the momentum and contrarian profits in the DSE. The findings suggest that although market risk cannot always explain the existence of momentum profits, but the bullish stock market condition positively affects the momentum profits. In addition, the momentum profits are not statistically significant during stock market crashes and bubbles, but the normal market condition positively influences the momentum profits. The important finding of this study is that the investors in different markets show deviant adapting behavior towards the changed market conditions.

always explain the existence of momentum profits in the DSE, the bullish stock market condition positively impacts this anomalous profit pattern. In addition, the momentum profits are not statistically significant during stock market crashes and bubbles, but the normal market condition positively influences the momentum profits. The most interesting finding of this study is that the investors from emerging stock markets may not adapt towards changed market conditions like the investors from the developed markets as reported in the AMH literature.

Subjects: Finance; Corporate Finance; Investment & Securities

Keywords: Adaptive market hypothesis (AMH); efficient market hypothesis (EMH); momentum effect; emerging stock market; Dhaka stock exchange

1. Introduction

The predictable return patterns from the momentum and contrarian strategies that are difficult to explain through market fundamentals are among the most controversial issues of the efficient market hypothesis (EMH). Momentum anomaly was first identified in the US stock returns by Jegadeesh and Titman (1993). After the momentum anomaly was identified, the efficient school of finance tried to explain the momentum effect as a phenomenon that arises from time-varying common market risk factor and tried to capture it through the factor models (Carhart, 1997; Fama & French, 1993, 2015). The original multi-factor model (also known as three-factor model) of Fama and French (1993) states that, the outperformance of small-cap¹ and value-stocks² are explained by the excess risk, greater business risk and higher cost of capital. However, no such explanation can be provided for momentum anomaly; hence, according to the proponents of EMH, Fama and French (2012), the multi-factor model cannot fully explain the momentum anomaly. Nevertheless, the behavioral side claims that the over-reaction (DeBondt & Thaler, 1985; Jegadeesh & Titman, 1995) of the investors to the information of stocks is the main reason for the momentum and contrarian profits. However, it is still not clear why investors over-react towards information. Cooper, Gutierrez, and Hameed (2004) tried to explain the momentum profit based on 'up'³ and 'down' market states and they found that significant momentum profits were prevalent mainly during the up market states. Huang (2006) also confirmed this phenomenon in an international context.

The explanations for momentum and contrarian anomaly vary across stock markets and also the statistical significance of the abnormal profits from these strategies vary over time (Asness, Frazzini, Israel, & Moskowitz, 2015). Over the past two decades, the EMH has received significant criticism for failing to explain stock market anomalies (for example momentum and contrarian effects). In recent years researchers became interested to test market efficiency over time and across markets, rather than considering the market efficiency as an all or none phenomenon. In this perspective, Lo (2004) proposed a new theory of market efficiency that allows market efficiency to vary over time and across markets. Stock market anomalies, such as momentum and contrarian strategies, are always considered as departures from market efficiency. The deviation from market efficiency and by extension the changed behavior of stock market anomalies due to the changes in the macro environment of a financial market may provide the justification for the existence of these anomalies. Moreover, in a recent study on calendar anomalies, Urquhart and McGroarty (2014) reported that the seasonal patterns in the US stock market provides the evidence of the existence of AMH and the seasonal effects can be explained by changes in the market conditions.

The main objective of this study is to capture the momentum and contrarian effects on stock returns for the stocks listed on the Dhaka Stock Exchange (DSE) of Bangladesh, to identify the time-varying behavior of the anomaly that can support the existence of AMH in the DSE. In addition, the study also investigates whether the changing market conditions can explain the

existence of momentum and contrarian effects in the DSE. The study applies the model proposed by Jegadeesh and Titman (1993) for forming relative strength portfolios with some modifications to examine the momentum and contrarian effects in DSE. Moreover, to identify the probable reasons for the existence of these anomalies, the abnormal profits are examined separately during the bullish and the bearish stock market conditions, and during the periods of stock market bubbles, crashes and normal periods. The current study has several contributions. *Firstly*, the research findings on momentum and contrarian effects, on different stock markets in different countries, seem to provide a variety of explanations as the reason of existence of the anomaly; especially, the differing explanation of the supporters of EMH and the behavioral school of finance. By introducing AMH, this study aims to bridge the gap between these two schools of thought. *Secondly*, by examining the time-varying behavior of momentum and contrarian anomalies, and whether the statistical significance of these abnormal profits depends on time-variant market conditions, the findings of this study can be used to support the existence of AMH in the DSE. As AMH is still at its developmental stage, the current study will help the theory to flourish further. *Thirdly*, regarding the existence of momentum and contrarian effects in the DSE, there are some ambiguities. Some recent studies found the evidence of short to medium-term momentum profits (Khan, 2017; Khan & Rabbani, 2016), while few other studies reported the existence of short-term contrarian profit in the DSE (Chowdhury, Sharmin, & Rahman, 2015; Khan & Rabbani, 2016). The current study utilizes the most recent and complete data-set on the DSE, which includes stock returns of all companies listed on the DSE (excluding mutual and unit investment trust funds) from January 1995 to December 2018.

The capital market of Bangladesh is one of the smallest markets in Asia but the third largest in the South Asian region. Bangladesh has two automated stock exchanges, namely, the Dhaka Stock Exchange Ltd. (DSE) and the Chittagong Stock Exchange Ltd. (CSE), where the DSE is the main bourse of the country. Through the highly fault-tolerant automated trading system, DSE can offer facilities for smooth, transparent and highly efficient provisions for secondary market activities of shares, debentures and varieties of other securities. All exchanges are self-regulated private sector entities. The operating rules of these exchanges are required to be approved by the Bangladesh Securities and Exchange Commission (BSEC), which is the regulator of the capital market of Bangladesh. DSE at present offers the trading facilities for 533 securities. With a nationwide membership of over 250 brokers and dealers, the DSE supports the shared vision of promoting investment and businesses of the government of Bangladesh. In clearing process, DSE makes payment by credit instruction and delivers share through Central Depository of Bangladesh (CDBL) clearing schedule to brokers with long-position. In the settlement process, DSE receives all charges, receivable-amounts from the selling brokers and allots selling-shares in the selling broker's clearing account through CDBL settlement schedule.

In an emerging market, like DSE, returns are non-random and prices are mean reverting. Speculative profits and market manipulation are very common phenomena in these markets (Azad, Azmat, Fang, & Edirisuriya, 2014). Therefore, as the sample is collected from an emerging stock market, namely DSE, it has some added significance to the current research. *Firstly*, the emerging stock markets are found to have lower degree of correlation with the developed stock markets and also with other frontier-markets (Harvey, 1995). Hence, empirical evidence from the emerging markets provides validation for a theory or proposition that the results are not only due to high correlation with previous study samples. *Secondly*, AMH suggests that the financial markets should be considered different from each other, as the market conditions that influence the different stock markets' behavior are not also similar (Urquhart & McGroarty, 2015). Therefore, it is reasonable to expect that in DSE the behavior of momentum and contrarian effects over time also would be diverse from any other stock market. *Thirdly*, DSE has been attracting the interests of foreign investors for the past few years. The total foreign portfolio investment in the stock exchange for the year 2016 is increased to taka 13.407 billion, compared to taka 1.855 billion in the year 2015.⁴ However, the number of studies, on momentum and contrarian effects that can unfold the time-varying behavior of the anomaly, is quite a few in number and also inconclusive in

nature. The empirical results of the current study provide the evidence that the momentum anomaly in the DSE is influenced by market conditions and the abnormal profits vary over time. In this situation, this research would be a topic of interest for both local and foreign investors. It will also be beneficial for the regulating bodies to take necessary actions for development of the stock market of Bangladesh.

The rest of the paper is organized as follows: after the introduction section, the next section reviews the existing literature. Data and methodology section discusses the econometric methods of analysis along with the description of the data-set. The next section presents the empirical results and findings. The final section concludes the paper, together with some proposed future research opportunities.

2. Literature review

2.1. Momentum and contrarian effects

After the momentum and contrarian effects were first identified, these anomalies have been tested both in developed and emerging stock markets. Jegadeesh and Titman (1993) have shown that a strategy that simultaneously buys past winners and sells past losers generates significant abnormal profits over holding periods of 3 to 12 months. In a later study, Jegadeesh and Titman (2001) found that the momentum profit continues to exist in the US market throughout the 1990s and it can be explained by delayed overreactions of market participants that are eventually reversed. Gutierrez and Kelley (2008) found that in the US market, extreme weekly returns are followed by a brief reversal and then by an opposing and long-lasting momentum. In developed markets studies have confirmed the existence of stable momentum profits (Chan, Hameed, & Tong, 2000; Moskowitz & Grinblatt, 1999; Richards, 1995, 1997; Rouwenhorst, 1998). Some studies have identified that the under-reaction towards news can lead to momentum or contrarian profits in addition to the overreaction hypothesis under varying assumptions. For example Daniel, Hirshleifer, and Subrahmanyam (1998) showed that momentum effect can be a result of investors' overconfidence and self-attribution bias. On the other hand, Barberis, Shleifer, and Vishny (1998) and Hong and Stein (1999) showed that momentum can be generated by investors' initial under-reaction to information. Nevertheless, momentum is found to be less profound or sometimes non-existent in some emerging stock markets, especially in Asian stock markets (Chui, Titman, & Wei, 2010; Griffin, Ji, & Martin, 2003; Rouwenhorst, 1998).

Hameed and Ting (2000) examined the stock returns from Malaysian market and they observed statistically significant contrarian profit for more actively traded stocks in the portfolio. Ahmad and Hussain (2001) also reported existence of contrarian profit in the Kuala Lumpur Stock Exchange (KLSE) over the 3-year holding period, which according to the authors can be explained by over-reaction theory. Kang, Liu, and Ni (2002) evidenced significant abnormal profits for some short-term contrarian strategies that arise due to over-reaction from intermediate-term momentum strategies, which the authors explained by negative autocorrelation of returns. Antoniou, Galariotis, and Spyrou (2005) found significant short-term contrarian profits in Athens Stock Exchange that can be contributed to both over-reaction and under-reaction, but the later is restricted only to the month of January. Ansari and Khan (2012) found significant momentum profits in the Indian stock market and argued that risk-based models fail to account for this phenomenon. Pan, Tang, and Xu (2013) proposed an alternative momentum strategy and grouped stocks into return intervals rather than percentiles and found economically significant momentum profits in the weekly returns on the China A-share Market stocks. They applied the same method on other Asian equity markets and found significant weekly momentums in Hong Kong, Taiwan, Korea, Thailand and Indonesia. In a comprehensive study on 18 emerging markets Cakici, Fabozzi, and Tan (2013) found that the Asian and Latin American markets generate statistically significant momentum profits. Nevertheless, the momentum profits are not statistically significant in the Eastern European stock markets.

As an emerging stock market, DSE of Bangladesh is dominated by small investors and noise traders. The noise trading can contribute towards the increased risk in the short time horizon (Cuthbertson & Nitzsche, 2005) and the problem of small investors is that their investment decisions are often driven by sentiments and recent historical stock price movements in the market (Shiller, 1989). Chui et al. (2010) used the top and the bottom one third stocks instead of the 10% cut-offs used by Jegadeesh and Titman (1993) with Hofstede's (1983) index of individualism (conducted between 1967 and 1973 to capture cross-country psychological survey of employee values), and the authors found that momentum returns are stronger in cultures that value individualism. However, being a collectivist country the authors reported that Bangladesh (1.677% per month) is in the second place to generate significant momentum profit out of 41 countries they studied. In a recent study, Khan and Rabbani (2016) found evidence of short-term reversal and intermediate-term momentum with a sample of all listed stocks in DSE from the year 1999 to 2014; however, the authors reported that the short-term reversal is not "as consistent and significant" as the medium-term momentum effect. A later study by Khan (2017) reported that only the medium-term momentum profits are statistically significant in the DSE (the sample includes all listed stocks from the year 1999 to 2014), which according the study can be explained by the "up" market states. Whereas, Chowdhury et al. (2015) found the existence of short-run contrarian effect in the DSE by examining the weekly data for the period of 2002 to 2013, which is statistically significant for the holding period of 1 to 8 weeks that can be explained by the time-series patterns.

2.2. Adaptive market hypothesis and momentum effect

One of the contemporary perspectives to Efficient Market Hypothesis (EMH) is to consider the stock markets as efficient, given that the new information are reflected on the stock prices quickly and correctly (Fama, 1970). In the process of taking advantage of new information, the market participants incorporate it in the stock prices and the potential profit opportunity that motivated them to trade in the first place gradually fades away. The fundamental condition for EMH to work is to have active market participants who want to earn profit based on their newly derived information regarding share price movement (Fama, 1965). In an ideal world where trading has no costs, the stock prices fully reflect all available information and abnormal profits cannot be made from these information, which is considered as the strong-form of market efficiency. As the acquisition of information in financial markets is costly, therefore, weak-form of market efficiency is more common as it considers the fact that investors will not have any motivation to incur this cost unless their marginal benefit exceeds the marginal cost of acquiring new information (Grossman & Stiglitz, 1980). According to Fama (1991) the main reason behind the deviation from market efficiency lies in the joint hypothesis problem and the consideration of equilibrium asset pricing model in association with the event studies can solve this issue. However, the existence of stock market anomalies (that are defined as a distortion of price or rate of returns of stocks and are related to the predictive ability of the prices or returns on stocks from the past data) contrast this viewpoint of market efficiency.

According to AMH efficiency and inefficiency can coexist in the same financial market as the investors are not perfectly rational or irrational, but intelligent and future oriented who can learn from their past experience. Empirical studies on AMH have shown that return predictability and its uncertainty vary during changed market conditions, for example bull and bear stock market, stock market bubbles, crashes, etc. (Ito, Noda, & Wada, 2016; Kim, Shamsuddin, & Lim, 2011; Urquhart & McGroarty, 2014, 2015). AMH has opened a new window of opportunity for researchers to provide more pragmatic explanation of deviant stock return behavior from a novel viewpoint. The AMH considers the existence of behavioral biases that may origin from the heuristics and these biases can be adapted to non-financial contexts (Lo, 2004). When investors and market participants take their investment decisions, they make choices that are satisfactory to them (bounded rationality) and these might not be the optimal decisions (rational expectation) (Simon, 1955). Empirical research has shown that the factors related to the investors' personality and the factors related to the investors' specific environmental conditions, which are the major considerations of AMH, can influence their manners to incorporate new information into stock prices to determine how they will behave towards stock market anomalies (Urquhart & McGroarty, 2014). However, when it comes to market efficiency, each market is considered to be unique (Lo, 2004), therefore, it is

possible that the market participants in different stock markets will behave differently towards these anomalies that are considered as the departures from the market efficiency.

Although in a financial market the existence of behavioral biases is a common phenomena and over time market participants with sound financial knowledge are able to identify the price or return anomalies and can arbitrage away the abnormal profit by analyzing the past price trends (Daniel & Titman, 1999). Like any other stock market anomalies, the profitability and statistical significance of momentum and contrarian anomalies also vary over time (Asness et al., 2015). Therefore, changes in the market conditions, for example bull market, bear market, stock market bubbles, crashes and normal market conditions, etc., might contribute towards the changed investment decisions of the investors, as they try to adapt to the altered environment of the stock market. Using the data from 22 OECD countries Griffin et al. (2003) found that the macroeconomic variables, for example GDP, inflation, term-spread, industrial production and default risk-premium, etc., cannot explain the existence of momentum anomalies in the stock markets under the study. However, Cooper et al. (2004) conditioned market states as *up* and *down* depending on the past one to 3 years' market return and showed that the momentum profits can be explained by the *up* market status. Huang (2006) used the sample of 17 MSCI countries for the period December 1969 to December 1999 and found that the momentum profits are statistically significant in *up* market. Asem and Tian (2010) showed in their study that the momentum profit is higher when the markets moved in the same state (*up* or *down*) compared to when the profits reversed. Antoniou, Doukas, and Subrahmanyam (2013) reported that the optimistic periods in the stock market strengthens the momentum profits.

In addition to *up* and *down* market states, the periods of stock market bubbles and crashes are found to be bad periods for the investments based on historical stock return patterns, like momentum or contrarian strategies. During stock market crashes an extreme degree of uncertainty is associated with return predictability and during fundamental, economic or political crises, the stock returns are highly predictable with a moderate degree of uncertainty (Kim et al., 2011). While, according to Kim et al. (2011) during economic bubbles, the degree of return predictability and the associated uncertainties are smaller than normal times. Dhaka Stock Exchange (DSE) experienced two major bubbles and crashes, the first one in the year 1996 and the second one in 2009 to 2010. In the US stock market the periods of stock market crash, for example, years 2009 and 1932, were the worst periods for momentum profit (Asness et al., 2015). In this light, the current study separated the periods of stock market crashes and bubbles, as compared to the normal periods, to examine whether the predictable return patterns of these strategies still hold in DSE. Therefore, we can expect that the level of significance for momentum and contrarian effects will vary in different market conditions. If the stock market is adaptive in nature as suggested by the AMH, the behavior of the anomalies will change, even though they do not completely fade away over time.

3. Methods of analysis

3.1. Data

The sample of this study comprises the share prices of all listed companies on the DSE and values of DSE general index – DGen and DSEX (DSEX replaced DGen on 27 January 2013) from January 1995 to December 2018⁵. DSE general index is the main index of DSE and it is a price-weighted average of regularly traded stocks on the DSE. The monthly adjusted closing prices for all listed companies of DSE are collected from the Thomson Reuters' DataStream and the DSE general index values are collected from the DSE⁶. For individual shares of stocks, we considered the companies that remained listed until the end of the sample period and have a regular trading history. The relative strength portfolio is rebalanced every month and there are total 302 companies in the last sorting month. The monthly returns of DSE general index and the returns on stocks of the selected listed companies are calculated as follow:

$$r_t = \frac{P_t - P_{t-1}}{P_{t-1}} \quad (1)$$

where,

r_t = the monthly return

P_t = the monthly adjusted closing value/price of index/shares of stock at period t

P_{t-1} = the monthly adjusted closing value/price of index/shares of stock at period $t-1$

3.2. Econometric methods

In this study to form the j - k overlapping relative strength portfolios, the portfolio formation procedure of Jegadeesh and Titman (1993) is followed with a bit modification. First of all, at the end of each month, the companies are sorted in ascending order based on their past j ($j = 1, 2, 3, 4, 5$ and 6) month/s' cumulative returns. As the number of listed companies on the DSE is small, especially in the earlier sample years, the top and bottom 20% of the companies are considered as the winner (w) and loser (l) portfolio stocks, respectively. After that, the returns for the loser and winner portfolios are observed for k ($k = 1, 2, 3, \dots, 60$) number of months. This gives us 360 combinations of j and k months and hence, 360 momentum strategies. Finally, the momentum (contrarian) profit is calculated by taking a long (short) position on winner portfolio stocks and short (long) position on loser portfolio stocks. As DSE is a thinly traded market, 1-month gap is maintained between the time of winner-loser portfolio formation and investment on the stocks to avoid the market microstructure-related issues, liquidity biases and significant trading costs (Asness, 1994). To formulate the j - k overlapping winner-loser portfolios the NumPy package of Anaconda-3 by Python distribution is used and for the rest of the statistical analysis, the Eviews-9.5 is used. After investigating the momentum strategies the profits from the strategies are divided into four 5-year (roughly) sub-samples to identify the underlying time patterns in the returns over different sub-samples.

The market-adjusted momentum profits are calculated from the intercept (ja_p) of the following regression equation:

$$r_{pt} - r_{ft} = ja_p + [\beta_p(r_{mt} - r_{ft})] + \varepsilon_t \quad (2)$$

where,

r_{pt} = return on momentum or contrarian portfolio at month t

r_{ft} = risk-free rate at month t

β_p = beta for the momentum or contrarian portfolio

r_{mt} = return on market at month t

In Equation (2), the return of DSE general index is used as a proxy for market return and the ninety-one (91) days' t-bill rate is used as the proxy for risk-free rate. The 91-day t-bill rates are collected from the Thomson Reuters' DataStream and are converted to monthly yields.

The momentum strategy that generates the highest statistically significant market-adjusted profits is then considered for the 5-year rolling window analysis and to investigate the influence of changed market conditions on the momentum profits. The rolling window analysis enables a more detailed study of the behavior of momentum anomaly. The time-varying framework permits to identify (Lim, Brooks, & Hinich, 2008) the nature and pattern of anomalous behavior in a particular stock market. For rolling window analysis, a fixed-length window of 5 years is used that rolls forward 1-year at a time. A 5-year window has enough observations to generate reliable results to enable a detailed examination of the behavior of calendar anomalies over time (Kim et al., 2011; Urquhart & McGroarty, 2014). By plotting the t -values over time we can find the nature of time varying behavior of momentum profits and whether the behavior patterns support the existence of the AMH. To capture the effects of changing market conditions on the momentum or contrarian profits the following regression equation is estimated:

$$r_{pt} = c + \beta D_t + \varepsilon_t \quad (3)$$

where,
 $t = 1, 2, 3, \dots, T$

In Equation (3), r_{pt} is the return on a momentum or contrarian strategy at period t . D_t is dummy independent variable, where the periods in a specific market condition (for example, the *bull* or *bear* months, the periods of stock market bubbles or crashes) are denoted as '1' and otherwise '0' and ε_t is the error term.

The Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model is used in this study to estimate equation (ii) instead of the ordinary least square (OLS) model. OLS assumes that the volatilities of the error terms are constant (homoskedastic), since OLS aims to minimize the deviations between data points and a fitted regression line. However, if the variances of the error terms are not equal, it can result in selection of an inappropriate econometric model. When we consider the return on the asset as dependent variable in the time series model, some time periods are riskier than others and the risky times are auto-correlated rather than being randomly scattered, which is called volatility clustering that varies depending on the past variance (Engle, 2001). The class of Autoregressive Conditional Heteroskedasticity (ARCH) models by (Engle, 1982) can solve this problem. The variance equation of a simple ARCH (1) model can be defined as follows:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 \quad (4)$$

where,

α_0 = constant.

ε_{t-1}^2 = the ARCH terms that are the volatilities from the previous periods, measured as the lag of the squared residual from the mean equation.

α_1 = the coefficients of the ARCH terms

To capture the time-varying behavior of conditional variance normally a higher order ARCH model is required and the Generalized ARCH (GARCH) model proposed by (Bollerslev, 1986) fulfills this requirement. GARCH allows an infinite number of ARCH specifications and reduces the number of estimated parameters from infinity to two. According to Engle (2001), GARCH (1,1) is the simplest and most robust of the family of volatility models that is also most widely used in literature. The variance equation from the GARCH (1, 1) model can be assumed as follows:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \sigma_{t-1}^2 \quad (5)$$

where,

σ_{t-1}^2 = the GARCH term that is the previous period's (t-1) forecast variance.

α_2 = the coefficient of the GARCH term

To assume the regression models for the above Equation (3) at first the Ordinary Least Square (OLS) models are assumed and the model is checked for the heteroskedasticity and autocorrelation in the error terms. If the variance error terms of the model are found to be not homoskedastic and the error terms are serially correlated then the ARCH (1) model is first applied to Equation (3). Then, the GARCH (1, 1) model is applied to Equation (3) and if the GARCH term is statistically significant at less than 5% level along with an improved Akaike value compared to ARCH(1) model, the GARCH (1, 1) model is finally fitted for the regression analysis.

Following the conventional method of testing the influence of market state as proposed by Cooper et al. (2004) the current study examined the impact of lag 'bull' and 'bear' year on the monthly momentum and contrarian profits. To divide the whole sample period into *bull* and *bear* markets, cumulative returns of the benchmark market index (DSE general index) are calculated for each year. Then, the months in year t are considered as *bull* if the cumulative return on market at year $t-1$ is

positive. On the other hand, the months in year t are considered as *bear* if the cumulative return on market in $t-1$ year is negative. Then, the momentum profits are calculated from the alpha of Equation (2) for the *bull* and *bear* market conditions separately. The influences of the *bull* and *bear* market conditions on the momentum (contrarian) profits are determined from Equation (3) with dummy independent variables for the *bull* and *bear* market conditions separately.

To identify the periods of bubble, this study employed the Sup Augmented Dickey-Fuller (SADF) test (Phillips, Wu, & Yu, 2011) and the Generalized SADF (GSADF) test (Phillips, Shi, & Yu, 2015b) from Eviews 9.5 software. Phillips et al. (2011) successfully documented all explosive bubbles on NASDAQ stock index in the 1990s by using the SADF test, which utilizes a forward recursive right-sided unit root test. According to Homm and Breitung (2012) in order to detect multiple bubbles, the right-tailed ADF tests are more robust compared to other bubble detection tests that they utilized in their study. Moreover, the GSADF test has a similar econometric detection mechanism as the SADF test, but according to the authors, the moving window detector of the GSADF test is more reliable compared to the sequential date-stamping method of the SADF test. The SADF test mainly uses the recursive calculations of the ADF statistics with a fixed starting point where the width window is variable. For example, if r_1 is the starting point of the test and r_2 is the end point of the test, then $r_w = r_2 - r_1$ is considered as the window size of the regression. The SADF test requires repeated ADF tests on a forward expanding sample sequence, where the starting point is fixed at r_0 . However, the end point, r_2 , can freely expand from r_0 to 1. The SADF statistics is defined as follow:

$$SADF(r_0) = \sup ADF_0^{r_2}, \quad (6)$$

where,

$$r_2 \in [r_0, 1]$$

In the GSADF test the starting point, r_1 , can vary within the range of 0 to $r_2 - r_0$ and the size of the window-width, r_0 has also the flexibility to vary within r_1 to r_2 . As this modification extends the range of subsample data, the GSADF test is more accurate in detecting multiple bubbles than the SADF test. The GSADF test is defined as follows:

$$GSADF(r_0) = \sup ADF_{r_1}^{r_2} \quad (7)$$

where,

$$r_2 \in [r_0, 1] \text{ and } r_1 \in [0, r_2 - r_0].$$

Both the SADF and the GSADF tests measure the bubble based on the price-dividend ratio (Phillips, Shi, & Yu, 2015a). To calculate the price-dividend ratio the monthly dividend yields for all listed companies on DSE from December 1994 to December 2018 have been collected from Thomson Reuters' DataStream. The total dividend yield is calculated by summing all dividend yields in a particular month and then the monthly index values are divided by the total dividend yields to find out the monthly price to dividend ratios. Normally, stock market bubbles are followed by stock market crashes and to identify the periods of stock market crashes, the current study considered the period t as the market crash when the cumulative monthly returns on the market has been declined at month t by 25% or more compared to period $t-1$ (Greenwood, Shleifer, & You, 2017). Along with the SADF and GSADF tests, the starting and ending points of bubbles and crashes have also been cross-checked with local newspapers.⁷ For example, the starting point of the bubble of 1996 was the month of July, when the DGen value reached at a level of 1,156.18 points compared to the previous month's closing value of 880 points (an increase of 36.36%). This bubble came to an end in December 1996, when the DGen value declined by more than 25% just in the second half of the month. On the other hand, the bubble of 2010 was an asset bubble, which was initiated by the entrance of GrameenPhone in the capital market on 16 November 2009, when the DGen experienced an increase of 21% in a single day. The market started to experience the crash from 6 January 2011. DSE halted the security trading on 10 January 2011 when the DGen

value fell by more than 9% within less than an hour after the day's trading began. After identifying the periods of stock market bubbles, crashes and normal periods (excluding stock market bubbles and crashes) the influences of these market conditions are examined on the momentum (contrarian) profits by employing the dummy independent variables for each of the market conditions separately.

4. Empirical results

4.1. Results for full and sub-sample analysis

The descriptive statistics from the yearly cumulative returns for the companies in each year are presented in Table 1 for the full-sample period of 1996 to 2018. The maximum yearly cumulative return is evident (among the companies used in the dataset) in the year 2010 when the stock market was experiencing a market bubble and the minimum yearly cumulative return can be seen (among the companies used in the dataset) in the year 1997 when the DSE was recovering from a stock market crash. The mean and median returns of the yearly cumulative returns are 22.45% and 15.50%, respectively for the full-sample period. In order to reduce the chances of inclusion of abnormal returns in the dataset, the monthly cumulative returns of the companies that are less than -95.00% are rounded up to -95.00% and except for the period of stock market bubbles the monthly cumulative returns of more than 100.00% are rounded down to 100.00% (Cooper et al., 2004). However, none of the companies in the dataset of this study has monthly cumulative returns of less than -95.00%.

Table 1. The descriptive statistics for the yearly cumulative returns for the full data set

Year	Minimum	Maximum	Median	Mean
1995	-135.11%	264.62%	7.38%	18.39%
1996	-37.17%	465.45%	108.73%	129.51%
1997	-267.22%	32.45%	-51.66%	-53.70%
1998	-149.14%	236.92%	-21.29%	-15.26%
1999	-67.47%	134.44%	-6.00%	0.40%
2000	-103.74%	148.35%	19.53%	24.64%
2001	-84.56%	371.75%	0.28%	8.90%
2002	-40.13%	285.33%	11.66%	18.57%
2003	-76.94%	80.85%	8.84%	9.21%
2004	-93.81%	187.54%	55.32%	56.91%
2005	-127.90%	218.15%	-20.25%	-11.69%
2006	-55.96%	219.93%	1.64%	7.61%
2007	-46.87%	356.97%	62.43%	67.62%
2008	-99.87%	487.33%	49.07%	53.52%
2009	-26.11%	428.34%	82.09%	89.04%
2010	-69.19%	956.19%	76.33%	86.42%
2011	-133.03%	485.19%	-28.24%	-10.08%
2012	-79.34%	131.32%	-21.03%	-17.97%
2013	-86.42%	197.18%	15.67%	24.53%
2014	-79.93%	252.15%	-5.75%	1.97%
2015	-68.21%	116.32%	-7.56%	-1.47%
2016	-55.69%	542.62%	14.45%	23.52%
2017	-66.16%	174.28%	21.08%	28.18%
2018	-8.70%	26.78%	-0.76%	0.02%
1995-2018	-85.78%	283.35%	15.50%	22.45%

Note: The minimum, maximum, median and mean returns are calculated from the yearly cumulative returns for all companies in the dataset in each year from year 1995 to 2018

For the preliminary analysis, one sample *t*-tests are performed on the returns of the momentum strategies from various *j-k* combinations (winner minus loser portfolio returns) using the R 3.5.1 package for Windows to find out whether the momentum profits are significantly different from zero. Table 2 presents the unadjusted momentum profits for some selected *j-k* momentum strategies out of total 360 strategies. The results from the one-tailed *t*-tests indicate that for all of the formation periods (*j*) the medium-term momentum strategies, that is the profits from the strategies with 8 to 12 months' holding period (*k*), generate statistically significant unadjusted profits. The preliminary analysis shows that some of the short-term momentum strategies (*j* = 4, 5 and 6) also generate statistically significant unadjusted momentum profits when the holding periods are 3 to 6 months (*k* = 3, 4, 5 and 6). Moreover, the long-term reversal effects are evident in the DSE when the portfolio holding periods are four to five (*k* = 48 and 60 months) years.

Table 3 presents the profits from the three highest medium-term (6 to 12 months' holding periods) momentum strategies. After adjusting for the market the momentum strategy 5–10 (5-months formation and 10-month holding) generates 0.62% excess average monthly returns for the full-sample period, which is the highest among all of the medium-term momentum strategies. As a robustness check the current study also considered portfolio of stocks with top and bottom 30% companies in the winner and loser portfolios and observed that the medium-term momentum profits are still highly statistically significant (the results are available upon request to the authors). The last two strategies presented in Table 3, strategy 5–48 and 6–48 are the long-term reversal effects.

As it can be found from Table 3, after adjusting for the market only the profits from strategy 5–48 (5 months' formation and 48 months' holding) and 6–48 (6 months' formation and 48 months' holding) are statistically significant at less than 5% level. The long-term contrarian strategy of 6 months' formation period and 48 months' holding period generates the higher monthly mean contrarian profit of 0.88% that is statistically significant at 5% level of significance.

From the results of sub-sample analysis of the momentum and contrarian strategies, as shown in Table 4, it can be seen that for the sub-samples 1996 to 1999 and 2004 to 2007 the momentum profits are statistically significant at less than 5% and 1% levels, respectively. Moreover, for the sub-samples 2008 to 2011 and 2012 to 2015, the momentum profits from the strategy 5–10 are not statistically significant. For the last sub-sample of 2016 to 2018 the momentum profit is positive for the strategy 5–10, although, it is not statistically significant considering the 5% level of significance.

For the long-term contrarian strategy, the contrarian profits are positive and significant for the sub-samples 2008 to 2011 and 2012 to 2015. Therefore, the sub-sample analysis of the returns from momentum and long-term contrarian strategies indicates the existence of abnormal profits in the DSE that varies among different sample periods. However, if the stock market was efficient the excess market-adjusted returns from momentum strategies would not be statistically significant and we could infer that there is no significant difference between investing in the market portfolio and the momentum (contrarian) portfolio.

4.2. Rolling window analysis

The Figures 1 and 2 present the *t* values of market risk-adjusted momentum and contrarian profits for strategies 5–10 (5-months formation and 10 months' holding period) and 6–48 (6-months formation and 48 months' holding period). For the rolling window analysis fixed 5-year length windows is used with 1-year rolling forward at a time, to have a closer look on the time-varying pattern of the profits from the momentum/contrarian strategies.

In Figures 1 and 2, the areas outside the red dotted lines indicate *t* values that are more than 1.96 and statistically significant at less than 5% level of significance. The graphical presentation of the *t*-values indicates that the momentum profits are statistically significant for the sample period of 2004 to 2009. The medium-term momentum profits are not statistically significant for the

Table 2. Winner minus loser returns from the j-k momentum strategies

Formation period (j) of portfolios (in month)	Holding period (k) of portfolios (in month)										
	One	Three	Six	Nine	Ten	Eleven	Twelve	Twenty-four	Thirty-six	Forty-eight	Sixty
One	-0.92% (-1.50)	-0.64% (-0.76)	0.63% (0.57)	1.79% (1.38)	2.84%** (2.08)	4.51%*** (3.06)	4.18% (2.68)	2.15 (0.10)	-4.13 (-1.56)	-7.54%*** (-2.62)	-9.22** (-2.56)
Two	-0.98% (-1.63)	-0.59% (-0.70)	1.19% (1.04)	3.43%** (2.45)	5.81%*** (3.77)	6.64%*** (4.04)	6.74%*** (3.75)	1.48% (0.71)	-3.92% (-1.54)	-6.21%** (-2.06)	-7.87%*** (2.10)
Three	-0.47% (-0.80)	-0.01% (-0.01)	2.13* (1.77)	6.59%*** (4.39)	8.16%*** (5.05)	9.47%*** (5.27)	9.35%*** (4.71)	0.95% (0.43)	-4.38%* (-1.73)	-7.17%** (-2.29)	-8.29%** (-2.13)
Four	-0.51% (-0.92)	0.47% (0.59)	3.24%*** (2.83)	8.24%*** (5.51)	9.66%*** (5.52)	10.75%*** (5.57)	10.12%*** (4.88)	1.56% (0.71)	-3.93% (-1.61)	-7.93%*** (-2.64)	-10.04%*** (-2.74)
Five	-0.34% (-0.60)	1.14% (1.40)	4.74%*** (4.15)	10.41%*** (6.67)	11.93%*** (6.58)	12.37%*** (6.26)	11.32%*** (5.39)	0.68% (0.31)	-6.99%*** (-2.83)	-9.14%*** (-2.93)	-11.96%*** (-3.25)
Six	0.11% (0.20)	1.81%** (2.14)	6.25%*** (5.08)	10.48%*** (6.54)	11.34%*** (6.31)	11.38%*** (5.76)	10.09%*** (4.82)	0.81% (0.37)	-6.80%*** (-2.77)	-8.90%*** (-2.78)	-12.18%*** (-3.23)

Notes: 1. *, ** and *** indicate that the values are significant at less than 10%, 5% and 1% level of significance, respectively.

2. The corresponding t values are in parentheses.

3. To form the winner and loser portfolios, at the end of each month the companies have been sorted in descending order based on their past j (j = 1, 2, 3, 4, 5 and 6) month/s' cumulative returns, where the top 20% companies with highest returns are considered as the winner (w) company stocks and the bottom 20% of the companies are considered as the loser (l) company stocks. To calculate portfolio returns all the stocks in each w and l portfolios have been assigned equal weights at the formation based on the number of the companies in the portfolio in each month t. Then, the winner and loser companies' returns are observed for k (k = 1, 2, 3, ..., 60) number of months, and the winner minus loser portfolio returns are calculated by going long on winner stocks and short on loser stocks.

Table 3. Mean monthly momentum profits from selected momentum strategies

Momentum strategies (j-k)	Winner		Loser		Winner-Loser	
	Unadjusted	Market adjusted	Unadjusted	Market adjusted	Unadjusted	Market adjusted
5-9	3.09%*** (8.62)	2.45%*** (7.17)	1.54%** (6.01)	0.99%*** (3.84)	1.16%*** (6.67)	0.58%*** (3.51)
5-10	3.19%*** (8.37)	2.57%*** (6.91)	1.55%*** (6.54)	1.00%*** (4.19)	1.19%*** (6.58)	0.62%*** (3.53)
6-9	3.17%*** (8.06)	2.54%*** (6.64)	1.57%*** (6.00)	1.02%*** (3.87)	1.16%*** (6.53)	0.59%*** (3.45)
5-48	2.98%*** (10.26)	3.18%*** (8.64)	5.09%*** (8.12)	4.53%*** (7.17)	-1.35%*** (-3.21)	-0.85%** (-2.03)
6-48	3.72%*** (10.21)	3.17%*** (8.59)	5.11%*** (8.36)	4.55%*** (7.39)	-1.38%*** (-3.44)	-0.88%** (-2.21)

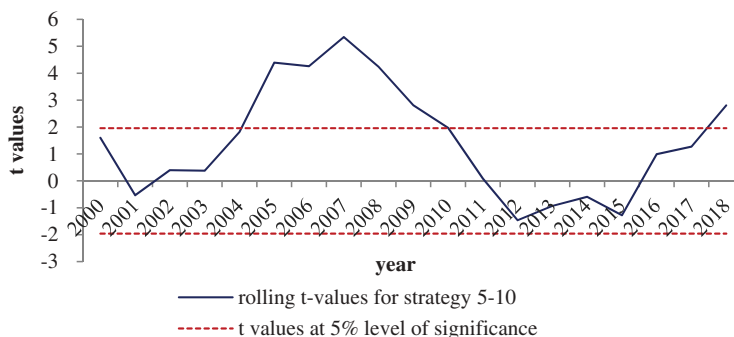
Note: 1. *, ** and *** indicates the values are significant at less than 10%, 5% and 1% level, respectively.
 2. The corresponding t values are in parentheses.

Table 4. Sub-sample analysis for highest profit-generating momentum and contrarian strategies

Sub-samples	5-10	6-48
1996-1999	1.64%** (2.40)	-
2000-2003	0.08% (0.26)	-0.09% (-0.95)
2004-2007	2.18%*** (5.95)	-1.47%*** (-5.04)
2008-2011	-0.32% (-0.85)	6.04%*** (3.64)
2012-2015	-0.06% (-0.28)	1.62%*** (4.09)
2016-2018	0.53%* (1.87)	-0.05% (-0.31)

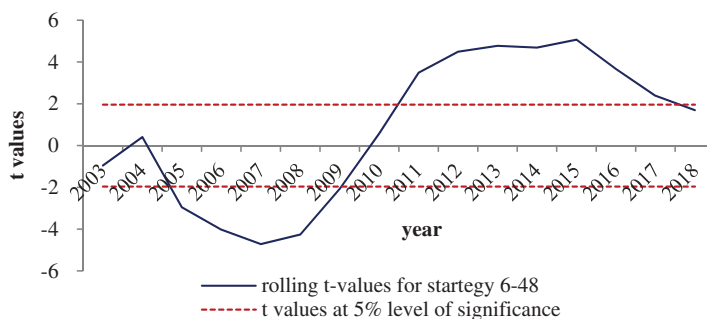
Note: 1. *, ** and *** indicates the values are significant at less than 10%, 5% and 1% level, respectively.
 2. The corresponding t values are in parentheses.

Figure 1. Rolling window t values for momentum strategy with 5 months' formation and 10 months' holding period.



sample period of 2010 to 2017. However, the interesting fact is that within the period of 2010 to 2017, there are 5 (out of 8 years) bear years and the DSE faced the second stock market bubble and crash in its history. Nevertheless, the momentum profit has become statistically significant again in the last sample year (2018) of the study. On the other hand, the rolling window t-values for the long-term contrarian strategy show that the contrarian profits are positive and significant

Figure 2. Rolling window t values for long-term contrarian strategy with 6 months' formation and 48 months' holding period.



for the period of 2010 to year 2017. Therefore, the sub-sample analysis and the rolling window analysis confirm the presence of AMH in DSE in the form of time varying behavior of the medium-term momentum and long-term contrarian profits; which also confirms the existence of the time-varying efficiency in DSE.

4.3. Impact of changing market conditions on the momentum profit

The current study examines the impact of major changes in the DSE that can affect the macro-environment of the market, which can influence the level of efficiency of the stock market by influencing the momentum and contrarian anomalies in the stock market. After dividing the months based on the lagged *bull* and *bear* years, there are 11 years in *bull* market and 13 years in *bear* market condition. The SADF and GSADF tests to identify the stock market bubbles have been applied on the *price to dividend ratio*. The test results are provided in the supplemental material section A-3.

The SADF and GSADF statistics obtained from the sample data are greater than the critical values at less than 1, 5 and 10% levels of significance. Therefore, we can reject the null hypothesis of no bubbles for the observed sample period of the study. Figures 3 and 4 clearly indicate the existence of two major periodically collapsing bubbles (presented by the blue lines of forward ADF sequence, which crossed the 95% critical levels as shown by the red lines) at DSE for the periods from

Figure 3. The date-stamping of multiple bubble periods in DSE from modified price to dividend ratio from SADF test.

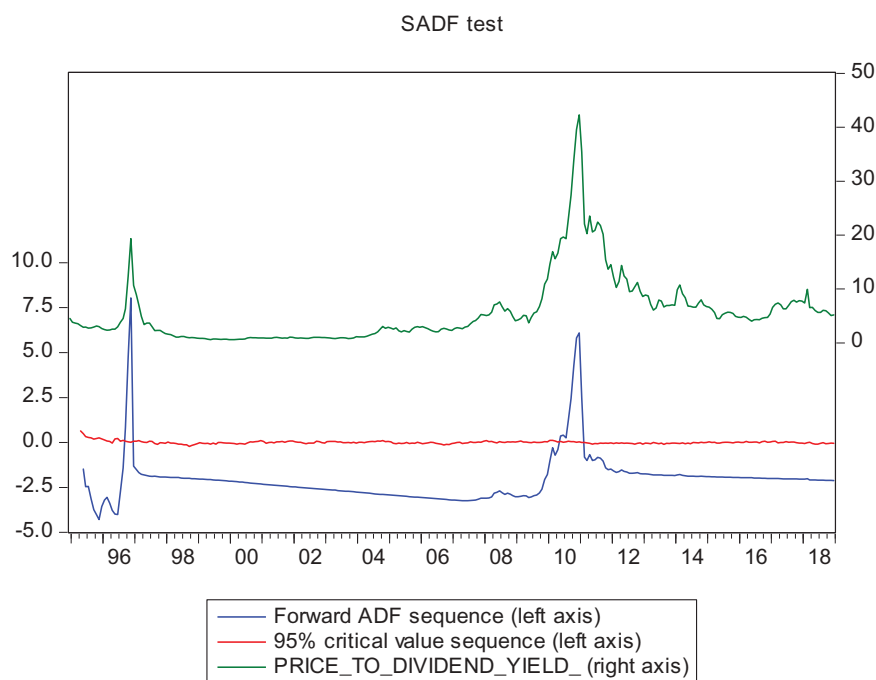
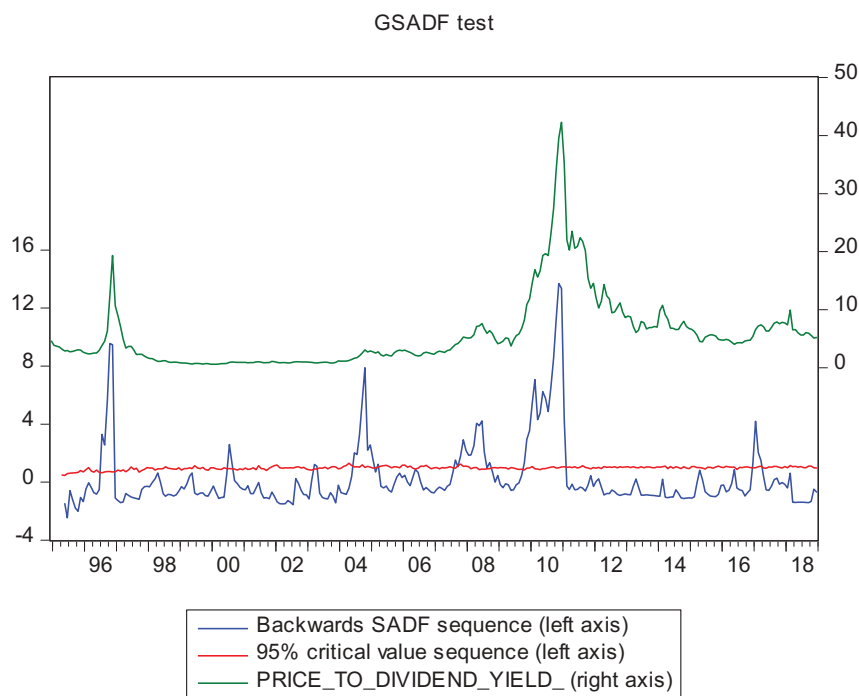


Figure 4. The date-stamping of multiple bubble periods in DSE from modified price to dividend ratio from GSADF test.



June 1996 to November 1996 and from November 2009 to December 2010. In Figure 3 the GSADF test also indicates two minor bubbles within the period of 2003 to 2008. The study considered 21 months in the stock market crashes and 20 months in the stock market bubbles after taking the cumulative returns of the market into account, in addition to the results from SADF and GSADF tests.

Table 5 presents the medium-term momentum and long-term contrarian profits during different stock market conditions of the DSE. It can be found from Table 5 that the medium-term momentum profit is statistically significant at less than 1% level of significance when the market condition is bullish following by one year's and two years' bull market states in

Table 5. The market adjusted excess mean returns during different market conditions for momentum strategy 5–10 and contrarian strategy 6–48

Market conditions	5–10	6–48
Bull market following one year up market	1.23%*** (4.20)	-0.19% (-0.37)
Bull market following two years' up market	0.84%*** (3.76)	-0.21% (-0.42)
Bear market following one year down market	0.01% (0.04)	2.29%*** (3.81)
Bear market following two years' down market	0.05% (0.20)	0.21% (0.98)
Period of stock market bubble	2.89%* (2.04)	4.11% (0.97)
Period of stock market crash	-0.96%* (-1.82)	16.24%*** (10.59)
Normal months (except for months during stock market bubbles and crashes)	0.51%*** (3.39)	0.02% (0.18)

Note: 1. *, ** and *** indicates the values are significant at less than 10%, 5% and 1% level, respectively.
 2. The corresponding t values are in parentheses.

the DSE. However, the momentum profit is not statistically significant in the *bear* market conditions following by one year's and two years' down market states. On the contrary, the profit on the long-term reversal is positive and statistically significant when the market condition is bearish following by one year's down market state. However, the contrarian profit is negative and statistically insignificant in the *bull* market condition. During the stock market bubbles, the market adjusted excess average monthly returns are not statistically significant for either the momentum or the contrarian strategies considering 5% level of statistical significance. On the other hand, the excess average monthly market-adjusted return is statistically significant during the stock market crashes for the long-term contrarian strategy of 6–48 and the medium-term momentum profit is statistically significant during the stock market crashes. Moreover, in the normal market condition (months excluding stock market bubbles and crashes) the medium-term momentum profit is statistically significant and the profit from long-term contrarian strategy is statistically insignificant.

Table 6 presents the impact of *bull* and *bear* market conditions, and stock market bubbles and crashes on the momentum profits. As it can be seen from the β -coefficient of GARCH (1,1) mean equation in Table 6, the impact of *bull* market condition (following by one year's bull market condition) on the medium-term momentum profit is positive and statistically significant at less than 1% level of significance. On the other hand, the influence of the *bear* market condition (following by one year's bear market condition) has a positive and statistically significant impact at less than 5% level of significance on the profit from long-term contrarian strategy 6–48. These outcomes support the fact that the momentum and contrarian profits are influenced by the *bull* and *bear* market conditions. We can also observe from Table 6 that for the momentum profits the β -coefficients of the mean equations from the GARCH models statistically insignificant during the stock market bubbles; whereas, the β -coefficients are negative and statistically significant at less than 1% level during the market crash period. In addition, the period of stock market bubbles and crashes positively influence the profit from the long-term contrarian strategy that is statistically significant at less than 1% level. The normal market condition of the DSE (excluding stock market bubble and crash) has a positive impact on the medium-term momentum profit that is significant at less than 5% level and a negative impact on the long-term contrarian profit that is significant at less than 1% level.

In summary, the time-varying behavior and the magnitude of the changes of the momentum profits during different market conditions support the existence of the AMH in DSE. In addition, the

Table 6. β -coefficients from the conditional mean equations for momentum strategy 5–9 and contrarian strategy 6–48 in different market conditions

Market conditions	5–10	6–48
Bull market following one year's up market	0.0054*** (3.08)	–
Bull market following two years' up market	0.0004 (0.19)	–
Bear market following one year's down market	–	0.0056*** (3.80)
Bear market following two years' down market	–	0.0017* (1.83)
Stock market bubble	0.0005 (0.17)	0.0751*** (4.72)
Stock market crash	–0.0276*** (–15.19)	0.1643*** (10.31)
Normal market condition	0.0138** (2.21)	–0.1361*** (–3.71)

Note: 1. *, ** and *** indicates the values are significant at less than 10%, 5% and 1% level, respectively.
 2. The corresponding t values are in parentheses.

changed market conditions, for example: bullish and bearish stock market conditions provide the justification for the existence of the medium-term momentum and long-term reversal effects at the DSE of Bangladesh; where, the abnormal profits from these technical anomalies cannot always be explained by the market risk. This study considered the periods of stock market *bubbles* and *crashes*, compared to the normal periods to explain the behavior of the momentum profits, as these periods are found to alter the level of market efficiencies under the theory of AMH. The study results reveal that the momentum profits are not statistically significant during stock market bubbles and crashes. This finding is also supported by Kim et al. (2011), where they found predictable stock return patterns during stock market crash with moderate degree of uncertainty and a more efficient stock market during the stock market bubbles. Moreover, the period of stock market bubble and crash are found to be a bad time for momentum investing in the DSE as suggested by Asness et al. (2015). According to the AMH, the level of market efficiency may evolve over time for the changes in the macro-factors of a financial market (Lo, 2012); and when the market environment evolves, it is quite normal that the financial market will not go back to its previous level of efficiency. As the technical anomalies, namely momentum and contrarian effects are considered to be a departure from the market efficiency; hence, the changes in the macro environment of a stock market provide the justifications for the existence of such abnormal profits.

5. Conclusion

In the literature of market efficiency technical anomalies, for example: contrarian and momentum strategies are the stock market anomalies that are always considered as tricky to be completely explained by the EMH. The current study investigates the momentum and contrarian effects in the DSE through full and sub-sample analyses, in order to investigate the time-varying behavior of the anomalous profit patterns from these anomalies. The current study also examines the impact of changing market conditions, which are considered as the main reason for the time-varying efficiency in the theory of AMH, on the momentum and contrarian profits and whether these different market states can provide the justification for the existence of these anomalies. The study results provide evidence of the existence of statistically significant unadjusted and market-adjusted medium-term momentum profits for the holding period of seven to 12 months and long-term contrarian profits for the holding period of 48 months. A 4-year sub-sample analysis reveals that the statistically significant momentum profits at DSE vary over time for the observed sample period, although it did not completely disappear over time. The results of fixed 5-year length rolling window analysis (with 1 year rolling forward at a time) also confirm the time-varying nature of the momentum and contrarian anomalies. Hence, the empirical findings of the current study support the existence of AMH in the DSE in the form of time-varying market efficiency.

Therefore, this study will encourage researchers to consider the AMH as a viable explanation for the time-varying efficiency and the existence of stock market anomalies. Moreover, the current research is especially beneficial for both local and international investors to identify the arbitrage opportunities from the momentum and reversal strategies in the DSE. The results indicate that a long position in the winner stocks and short position in loser stocks based on past 5 months' cumulative returns and holding the portfolio for 10 months generate the highest excess market-adjusted mean monthly profit from the medium-term momentum strategy. On the other hand, the long-term reversals are profitable when the contrarian portfolio is formed by considering past 6 months' cumulative return and then the portfolio is held for 48 months. Moreover, for momentum and contrarian investment the investors should always consider the *bull* and *bear* market conditions in the DSE, as statistically significant abnormal profits from momentum strategies are normally observed during *bull* years and the contrarian profits are statistically significant usually during the bear market condition. Also, investors should not implement the momentum strategies during stock market bubbles and crashes, as during these crisis periods the momentum profits are not statistically significant. The regulatory bodies of the DSE should also consider the market conditions to implement rules and regulations in the stock market to correct market turmoil. However, one of the limitations of this study is that there can be other market conditions that might also contribute towards and influence the momentum and contrarian profits in the DSE, which are not examined in this research. As the theory of AMH is at its early development stage and market conditions can influence the level of stock

market efficiency are also not well defined; therefore, future studies can focus on other stock market conditions that can have impacts on abnormal profits from momentum and contrarian strategies.

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Supplemental material

Supplemental data for this article can be accessed [here](#).

Author details

Tahmina Akhter^{1,2}

E-mail: tahmina_akhter@du.ac.bd

Othman Yong¹

E-mail: othmanyong@ukm.edu.my

¹ Graduate School of Business, The National University of Malaysia (Universiti Kebangsaan Malaysia), Bangi, Malaysia.

² Department of Finance, Faculty of Business Studies, University of Dhaka, Dhaka, Bangladesh.

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Notes

1. Stocks that have a market capitalization of \$300 million to \$2 billion and these stocks often have high prices.
2. Stocks that have lower prices compared to their fundamentals, for example: high dividend yields, low price-to-book ratio and/or low price-to-earnings ratio.
3. An 'up' ('down') market state is defined as the scenario where year t is considered as 'up' ('down') if the cumulative return for the past 12 months was positive (negative) for the benchmark market index.
4. Retrieved at: <http://www.dsebd.org>.
5. The selection of sample study period is based on the availability of data and also the availability of continuous data set without significant number of missing values.
6. The data have been collected from the library of DSE; the data is also available at the website of DSE, www.dsebd.com, but only from June 2004.
7. Retrieved at the financialexpress.com.bd/?date=12-10-2012.

References

- Ahmad, Z., & Hussain, S. (2001). KLSE Long run overreaction and the Chinese New-Year effect. *Journal of Business Finance & Accounting*, 28(1-2), 63–105. doi:10.1111/1468-5957.00366
- Ansari, V. A., & Khan, S. (2012). Momentum anomaly: Evidence from India. *Managerial Finance*, 38(2), 206–223. doi:10.1108/03074351211193730
- Antoniou, A., Galariotis, E. C., & Spyrou, S. I. (2005). Contrarian profits and the overreaction hypothesis: The case of the Athens stock exchange. *European Financial Management*, 11(1), 71–98. doi:10.1111/eufm.2005.11.issue-1
- Antoniou, C., Doukas, J. A., & Subrahmanyam, A. (2013). Cognitive dissonance, sentiment, and momentum. *Journal of Financial and Quantitative Analysis*, 48(1), 245–275. doi:10.1017/S0022109012000592
- Asem, E., & Tian, G. Y. (2010). Market dynamics and momentum profits. *Journal of Financial and Quantitative Analysis*, 45(6), 1549–1562. doi:10.1017/S0022109010000542
- Asness, C. S. (1994). *Variables That Explain Stock Returns* (PhD Dissertation). University of Chicago. doi:10.3168/jds.S0022-0302(94)77044-2
- Asness, C. S., Frazzini, A., Israel, R., & Moskowitz, T. J. (2015). Fact, fiction and momentum investing. *Journal of Portfolio Management*, 42(1), 34–52. doi:10.3905/jpm.2015.42.1.034
- Azad, A. S., Azmat, S., Fang, V., & Edirisuriya, P. (2014). Unchecked manipulations, price-volume relationship and market efficiency: Evidence from emerging markets. *Research in International Business and Finance*, 30(1), 51–71. doi:10.1016/j.ribaf.2013.05.003
- Barberis, N., Shleifer, A., & Vishny, R. (1998). A model of investor sentiment. *Journal of Financial Economics*, 49(3), 307–343. doi:10.1016/S0304-405X(98)00027-0
- Bollerslev, T. (1986). Generalized autoregressive conditional heteroskedasticity. *Journal of Econometrics*, 31(3), 307–327. doi:10.1016/0304-4076(86)90063-1
- Cakici, N., Fabozzi, F. J., & Tan, S. (2013). Size, value, and momentum in emerging market stock returns. *Emerging Markets Review*, 16, 46–65. doi:10.1016/j.ememar.2013.03.001
- Carhart, M. M. (1997). On persistence in mutual fund performance. *The Journal of Finance*, 52(1), 57–82. doi:10.1111/j.1540-6261.1997.tb03808.x
- Chan, K., Hameed, A., & Tong, W. (2000). Profitability of momentum strategies in the international equity markets. *Journal of Financial and Quantitative Analysis*, 35(02), 153–172. doi:10.2307/2676188
- Chowdhury, S. S. H., Sharmin, R., & Rahman, M. A. (2015, January). *Presence and sources of contrarian and momentum profits in Bangladeshi stock market returns*. Paper presented at the 15 th EBES conference, Lisbon, Portugal.
- Chui, A. C., Titman, S., & Wei, K. J. (2010). Individualism and momentum around the world. *Journal of Finance*, 65(1), 361–392. doi:10.1111/j.1540-6261.2009.01532.x
- Cooper, M. J., Gutierrez, R. C., & Hameed, A. (2004). Market states and momentum. *Journal of Finance*, 59(3), 1345–1365. doi:10.1111/j.1540-6261.2004.00665.x
- Cuthbertson, K., & Nitzsche, D. (2005). *Quantitative financial economics: stocks, bonds and foreign exchange*. UK: John Wiley & Sons.
- Daniel, K., Hirshleifer, D., & Subrahmanyam, A. (1998). Investor psychology and security market under- and overreactions. *The Journal of Finance*, 53(6), 1839–1885. doi:10.1111/0022-1082.00077
- Daniel, K., & Titman, S. (1999). Market efficiency in an irrational world. *Financial Analysts Journal*, 55(6), 28–40. doi:10.2469/faj.v55.n6.2312
- DeBondt, W. F., & Thaler, R. (1985). Does the stock market overreact? *Journal of Finance*, 40(3), 793–805. doi:10.1111/j.1540-6261.1985.tb05004.x
- Engle, R. (2001). GARCH 101: The use of ARCH/GARCH models in applied econometrics. *The Journal of Economic Perspectives*, 15(4), 157–168. doi:10.1257/jep.15.4.157
- Engle, R. F. (1982). Autoregressive conditional heteroskedasticity with estimates of the variance of United Kingdom inflation. *Econometrica: Journal of the Econometric Society*, 50(4), 987–1007. doi:10.2307/1912773
- Fama, E. F. (1965). The behavior of stock-market prices. *The Journal of Business*, 38(1), 34–105. doi:10.1086/jb.1965.38.issue-1
- Fama, E. F. (1970). Efficient capital markets: A review of theory and empirical work. *Journal of Finance*, 25(2), 383–417. doi:10.2307/2325486
- Fama, E. F. (1991). Efficient capital markets: II. *The Journal of Finance*, 46(5), 1575–1617. doi:10.1111/j.1540-6261.1991.tb04636.x

- Fama, E. F., & French, K. R. (1993). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics*, 33(1), 3–56. doi:10.1016/0304-405X(93)90023-5
- Fama, E. F., & French, K. R. (2012). Size, value, and momentum in international stock returns. *Journal of Financial Economics*, 105(3), 457–472. doi:10.1016/j.jfineco.2012.05.011
- Fama, E. F., & French, K. R. (2015). International tests of a five-factor asset pricing model. *Fama-Miller Working Paper*.
- Greenwood, R., Shleifer, A., & You, Y. (2017). Bubbles for Fama. *Journal of Financial Economics*, Forthcoming.131(1), 20–43. doi:10.1016/j.jfineco.2018.09.002
- Griffin, J. M., Ji, X., & Martin, J. S. (2003). Momentum investing and business cycle risk: Evidence from pole to pole. *Journal of Finance*, 58(6), 2515–2547. doi:10.1046/j.1540-6261.2003.00614.x
- Grossman, S. J., & Stiglitz, J. E. (1980). On the impossibility of informationally efficient markets. *The American Economic Review*, 70(3), 393–408.
- Gutierrez, R. C., & Kelley, E. K. (2008). The long-lasting momentum in weekly returns. *Journal of Finance*, 63(1), 415–447. doi:10.1111/j.1540-6261.2008.01320.x
- Hameed, A., & Ting, S. (2000). Trading volume and short-horizon contrarian profits: Evidence from the Malaysian market. *Pacific-Basin Finance Journal*, 8(1), 67–84. doi:10.1016/S0927-538X(99)00029-3
- Harvey, C. R. (1995). Predictable risk and returns in emerging markets. *Review of Financial Studies*, 8(3), 773–816. doi:10.1093/rfs/8.3.773
- Hofstede, G. (1983). The cultural relativity of organizational practices and theories. *Journal of International Business Studies*, 14(2), 75–89. doi:10.1057/palgrave.jibs.8490867
- Homm, U., & Breitung, J. (2012). Testing for speculative bubbles in stock markets: a comparison of alternative methods. *Journal of Financial Econometrics*, 10(1), 198–231. doi:10.1093/jfinec/nbr009
- Hong, H., & Stein, J. C. (1999). A unified theory of underreaction, momentum trading, and overreaction in asset markets. *Journal of Finance*, 54(6), 2143–2184. doi:10.1111/0022-1082.00184
- Huang, D. (2006). Market states and international momentum strategies. *The Quarterly Review of Economics and Finance*, 46(3), 437–446. doi:10.1016/j.qref.2004.07.009
- Ito, M., Noda, A., & Wada, T. (2016). The evolution of stock market efficiency in the US: a non-Bayesian time-varying model approach. *Applied Economics*, 48(7), 621–635. doi:10.1080/00036846.2015.1083532
- Jegadeesh, N., & Titman, S. (1993). Returns to buying winners and selling losers: Implications for stock market efficiency. *Journal of Finance*, 48(1), 65–91. doi:10.1111/j.1540-6261.1993.tb04702.x
- Jegadeesh, N., & Titman, S. (1995). Overreaction, delayed reaction, and contrarian profits. *The Review of Financial Studies*, 8(4), 973–993. doi:10.1093/rfs/8.4.973
- Jegadeesh, N., & Titman, S. (2001). Profitability of momentum strategies: An evaluation of alternative explanations. *Journal of Finance*, 56(2), 699–720. doi:10.1111/0022-1082.00342
- Kang, J., Liu, M.-H., & Ni, S. X. (2002). Contrarian and momentum strategies in the China stock market: 1993–2000. *Pacific-Basin Finance Journal*, 10(3), 243–265. doi:10.1016/S0927-538X(02)00046-X
- Khan, M. S. R. (2017). Market states and momentum: Evidence from the Dhaka stock exchange. *Review of Pacific Basin Financial Markets and Policies*, 20(2), 1–19. doi:10.1142/S0219091517500114
- Khan, M. S. R., & Rabbani, N. (2016). Momentum in stock returns: evidence from an emerging stock market. *Macroeconomics and Finance in Emerging Market Economies*, 10(2), 191–204. doi:10.1080/17520843.2016.1223730
- Kim, J. H., Shamsuddin, A., & Lim, K.-P. (2011). Stock return predictability and the adaptive markets hypothesis: Evidence from century-long US data. *Journal of Empirical Finance*, 18(5), 868–879. doi:10.1016/j.jempfin.2011.08.002
- Lim, K.-P., Brooks, R. D., & Hinich, M. J. (2008). Nonlinear serial dependence and the weak-form efficiency of Asian emerging stock markets. *Journal of International Financial Markets, Institutions and Money*, 18(5), 527–544. doi:10.1016/j.intfin.2007.08.001
- Lo, A. W. (2004). The adaptive markets hypothesis: Market efficiency from an evolutionary perspective. *Journal of Portfolio Management*, 30 th anniversary issue, 15–29. doi:10.3905/jpm.2004.442611
- Lo, A. W. (2012). Adaptive markets and the new world order (corrected May 2012). *Financial Analysts Journal*, 68(2), 18–29. doi:10.2469/faj.v68.n2.6
- Moskowitz, T. J., & Grinblatt, M. (1999). Do industries explain momentum? *Journal of Finance*, 54(4), 1249–1290. doi:10.1111/0022-1082.00146
- Pan, L., Tang, Y., & Xu, J. (2013). Weekly momentum by return interval ranking. *Pacific-Basin Finance Journal*, 21(1), 1191–1208. doi:10.1016/j.pacfin.2012.06.001
- Phillips, P. C., Shi, S., & Yu, J. (2015a). Testing for multiple bubbles: Historical episodes of exuberance and collapse in the S&P 500. *International Economic Review*, 56(4), 1043–1078. doi:10.1111/iere.12132
- Phillips, P. C., Shi, S., & Yu, J. (2015b). Testing for multiple bubbles: Limit theory of real-time detectors. *International Economic Review*, 56(4), 1079–1134. doi:10.1111/iere.12131
- Phillips, P. C., Wu, Y., & Yu, J. (2011). Explosive behavior in the 1990s Nasdaq: When did exuberance escalate asset values? *International Economic Review*, 52(1), 201–226. doi:10.1111/j.1468-2354.2010.00625.x
- Richards, A. J. (1995). Comovements in national stock market returns: Evidence of predictability, but not cointegration. *Journal of Monetary Economics*, 36(3), 631–654. doi:10.1016/0304-3932(95)01225-7
- Richards, A. J. (1997). Winner loser reversals in national stock market indices: Can they be explained? *Journal of Finance*, 52(5), 2129–2144. doi:10.1111/j.1540-6261.1997.tb02755.x
- Rouwenhorst, K. G. (1998). International momentum strategies. *Journal of Finance*, 53(1), 267–284. doi:10.1111/0022-1082.95722
- Shiller, R. (1989). *Market Volatility*. Cambridge Mass: MIT Press.
- Simon, H. A. (1955). A behavioral model of rational choice. *The Quarterly Journal of Economics*, 69, 99–118. doi:10.2307/1884852
- Urquhart, A., & McGroarty, F. (2014). Calendar effects, market conditions and the adaptive market hypothesis: Evidence from long-run US data. *International Review of Financial Analysis*, 35(2015), 154–166. doi:10.1016/j.irfa.2014.08.003
- Urquhart, A., & McGroarty, F. (2015). The adaptive market hypothesis and stock return predictability: Evidence from major stock indices. Retrieved from <https://ssrn.com/abstract=2640934>



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