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Three Essays on Market Efficiency

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Abstract

The efficient market hypothesis (EMH), the cornerstone of modern finance, conjectures that anomalies in stock returns cannot exist for long because rational investors rectify mispricing and restore equilibrium by way of arbitrage. Whether a stock market provides opportunity for costless arbitrage and whether anomaly in stock returns exist even after the prevalence of costless arbitrage opportunity are important empirical questions. This dissertation includes three essays on the market efficiency. The first essay examines short-sales constraints in the presence of a centralized lendable stock market in Japan while the second and third essays examines the momentum in stock returns based on market conditions. The first essay provides evidence that short-sales are generally unconstrained in Japan in the presence of a centralized lendable stock market. The centralized lendable stock market is found to reduce risks of short-sales as well. Stocks facing high short-sales constrained are not found to underperform compared to unconstrained stocks in the future and the relationship between future returns and short-sales constraints related variables are not found to be significant. This evidence suggests that an unconstrained opportunity for short-sales ensures pricing efficiency in the market. The second and third essays provide evidence for significant momentum profits based on market conditions even when short-sales are allowed. Although results of the first essay provide partial support for the existence of an efficient market, results of the second and third essays challenge the foundation of the efficient market hypothesis that the provision of short-sales cannot restore equilibrium in the market. The findings of the second and the third essay imply that investors' behavior also plays important role in the price formation process.

Keywords: Market efficiency; Short-sales constraints; momentum in stock returns; underreaction to information; overreaction to information.

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CHAPTER 1

Introduction

1.1 Background and Rationale of the Study

This dissertation includes three essays on the efficiency of the stock market. The Efficient market hypothesis (EMH) asserts that information is reflected on market prices instantaneously to represent the true value of securities. Under this circumstance, prediction of stock prices is not possible and deviation of prices from their true investment value will be corrected quickly because of rational investors' arbitrage activities. Although the EMH is one of the highly studied areas in the theoretical as well as empirical finance, it is still not concluded whether the market can truly be efficient. Unlimited arbitrage opportunity is one of the most important assumptions of the EMH, which ensures market efficiency even when stock prices deviates from the equilibrium value. To understand the validity of the EMH, it is worthy to examine whether stock markets indeed offer opportunity for unlimited arbitrage. The EMH also assets that anomalous pattern in stock returns cannot exist for long to offer significant profits as rational investors restore equilibrium by way of arbitrage. Thus, it is also important to examine whether anomalous pattern of stock returns exists to provide opportunity to make abnormal profits consistently.

Broadly, objective of this dissertation is to examine the efficiency of stock market. Specifically, I examine two issues surrounding the EMH such as short-sales constraints and anomalies in stock returns. Unconstrained short-sale and non-existence of anomalies in stock returns can validate the proposition of the EMH. I examine whether short-sales constraints are really binding in the presence of a centralized lendable stock market in Japan. I also examine momentum in Japanese stock returns to observe whether an anomalous pattern of stock returns provides opportunity for making abnormal profits. Along with momentum in Japanese stock

returns, I examine momentum in stock returns in Bangladesh to have international evidence on the stock return anomaly.

This dissertation includes three essays. The first essay discusses whether short-sales constraints are really significant in the presence of a centralized lendable stock market. The second essay discusses market conditions and momentum in Japanese stock returns and the third essay discusses market states and momentum in stock returns in Bangladesh.

1.2 Are Short-Sales Constraints binding when there is a Centralized Lendable Securities Market? Evidence from Japan.

Frictionless short-sale is a precondition for ensuring the pricing efficiency in the stock market. According to the EMH, mispricing of stock cannot exist for long in an efficient market because rational investors rectify the mispricing and restore equilibrium in the market by way of arbitrage. As a result, short-sales constraint could be one of the reasons why the efficient market does not exist in most of the countries. Short-sales constraints restrict reflection of negative information in prices making stock prices overvalued (Miller, 1977; Diamond and Verrecchia, 1987; Duffie et al. 2002). Getting some of the informed investors out of the market by restricting short-sales is also found to reduce the speed of adjustment to private information (Diamond and Verrecchia, 1987). Thus, the test of market efficiency partly depends on whether the market provides opportunity for unconstrained short-sales. Previous studies on short-sales constraints do not provide credible evidence on the actual state of short-sales constraint. The limitations of previous studies come from institutional features of the market and limitations of the data. Most of the previous studies measured short-sales constraint indirectly through the short interest ratio and the ownership structure, which do not provide evidence on the cost of short-sales. In the recent times, D'Avolio (2002), Geczy et al. (2002), Jones and Lamont (2002), and Beneish et al. (2015)

provided evidence of short-sale constraints using the cost of short-sales but, information was collected from few custodian banks that do not represent the whole market. The institutional feature of the market impedes the possibility to get a complete scenario of the market. In most of the countries of the world, short-sales are conducted by individual custodian banks that cannot provide information on the actual cost of borrowing for at least three reasons. First, a complete schedule of the demand for borrowing stocks and the supply of lendable stocks, required to measure actual cost of borrowing, is not possible to get (Kolasisnski et al. 2013), second, an uniform pricing of borrowing fees is absent because borrowing fees are often linked to other brokerage services (Saffi and Sigurdsson, 2011), and third, the search cost is usually higher in a non-centralized market making the cost of borrowing higher. The lack of evidence on the actual state of short-sales constraints and the presence of a centralized lendable stock market in Japan appear as the motivation for this study. The Japan Securities Finance Company (JSFC), the controller of the centralized lending market, acts as the intermediary among the securities firms and outside institutional lenders. The objective of our study is to examine short-sales constraints in the presence of a centralized lendable stock market. In addition to this, we also examine institutional and regulatory features contributing to short-sales constraints, the nature of recall risk and the future return behavior of short-sales constrained stocks in the presence of a centralized lendable stock market.

The sample period of this study ranges from the 12th November, 2015 to the 11th May, 2016. We included all stocks listed on the TSE and JASDAQ but excluded REITs and ETFs. I collected data required to conduct this study from the JSFC and Nikkei NEEDS. At the beginning, stocks are classified into specials and GC following the methodology of D'Avolio (2002) to provide evidence on short-sales constraints. A stock is categorized as special if its

annualized cost of borrowing is more than 1%. General collateral (GC) stocks, on the other hand, have an annualized borrowing cost of less than 1%. OLS regression models where the actual cost of borrowing (COB) is the dependent and the short interest ratio (SIR), institutional ownership (IO), market capitalization (Size), price to book ratio (P/B), and Turnover (TO) are used as explanatory variables are used to examine what affects the cost of borrowing. A logit regression model using the probability of being special as the dependent variable and stock features such as the SIR, IO, size, P/B, and TO as explanatory variables is also used to examine what increases the probability of being specials. An OLS regression model is also used to examine the determinants of the supply of lendable stocks. In the model, supply of lendable stocks is used as the dependent variable and IO, COB, size, P/B, and TO as independent variables. This study provides empirical evidence on recall situations measured as the mismatch between the demand for borrowing stocks and the supply of lendable stocks. This study hypothesizes that the effect of mismatch situations would only have a temporary effect on the subsequent new stock borrowing and return of borrowed stock. Finally, this study tests the overvaluation hypothesis of short-sale constrained stocks. Returns of the short-sales constrained and unconstrained stocks are compared over an observation period of 15-trading days. This study also examines the relationship between short-sales constraints and subsequent stock returns behavior by using regression equations.

Results of this study provide new insight into the evidence of short-sales constraint in the presence of a centralized lendable stock market. Generally, short-sale constraint is not found to be significant in Japan as this study observes that the cost of borrowing is low, demand for short-sale of stocks is also low and institutional ownership is high. However, 4.65% of lendable stocks are found to have annual borrowing fees of more than 1%. This study also finds that high borrowing fees of these stocks continue to be high at least for the next 15 days but gradually

reduces over this period. Overall, the demand for short-sales as measured by the short interest ratio is found to affect the cost of borrowing the most. When examining the mismatch situations, large capitalization and value stocks are often found to have more demand for short-sales compared to the supply of lendable stocks. However, due to the existence of a centralized lendable market, the traditional recall risk is not observed even when the aggregate short position exceeds supply of lendable stocks. This study does not find evidence that short-sales constrained stocks underperform subsequently compared to short-sales unconstrained stocks. Regression analysis also show that the relationship between short-sales constraint related variables and subsequent stock returns is not significantly negative.

This study provides three important contributions to the existing literature on short-sale constraints. First, to the best of my knowledge, this study provides evidence of short-sales constraints in the presence of a centralized lending market under a complete schedule of demand for borrowing stocks and supply of lendable stocks that produce a uniform cost of borrowing. Second, the use of daily data in our study provides an opportunity observe daily scenario of short-sales constraints. Previous studies mostly used monthly data that cannot capture the daily movement of the cost of borrowing stocks, not able to study short term trading strategies, and can exclude some short-sales transactions (Diether et al. 2009; Diether, 2008). Third, we provide evidence on the nature of recall risk in a centralized lending market.

1.3 Market Conditions and Momentum in Japanese Stock Returns

Random movement of stock prices is one of the important phenomena in the efficient market hypothesis. Rational investors cannot make abnormal profits from an efficient market if stock prices move randomly. Mispricing of securities or an anomalous stock return pattern cannot last long in an efficient stock market because rational investors correct the mispricing by way of

arbitrage. Evidence of several stock return anomalies such as day of the week effect, turn of the month effect, January effect and so on have really lost significance across the world, which supports the efficient market hypothesis. However, the momentum effect, a past-performance-based investment strategy, is still found to be significant in most stock markets of the world since its identification in 1993. However, Japan has always been an exception because the momentum effect has never been found in Japanese stock returns. The long-standing evidence of momentum in the major stock markets of the world and the non-existence of momentum in Japanese stock returns make the study of the momentum effect in Japanese stock returns important.

The study of Jegadeesh and Titman (1993) was the first to identify the momentum effect in the U.S. stock market that provided evidence that an investment strategy based on buying the stocks that outperformed the peers and selling short the past worst performing stocks produced significant profits in the short to intermediate term. Since then, a large number of studies have provided evidence for, and causes of, momentum profits across the world (Daniel and Titman, 2000; Jegadeesh and Titman, 2001; Lewellen, 2002; Lee and Swaminathan, 2000; Rouwenhorst, 1998, 1999; Chui et al. 2000; Griffin et al. 2003; Gutierrez and Kelley, 2008). Although the evidence of momentum effect is unanimously supported across the world, what causes the momentum effect is still inconclusive. Both the rational explanations and behavioral explanations are found to explain momentum profits but those explanations are not universally supported. Rational explanations attribute momentum profits to common risks, firm-specific, and industry-specific factors (Conrad and Kaul, 1998; Chordia and Shivakumar, 2002, 2006; Dittmar et al. 2007; Sagi and Seasholes, 2007). Behavioral explanations, on the other hand, attribute momentum profits to investors' behavioral biases such as underreaction and overreaction to information (Barberies et al. 1998; Daniel et al. 1998; Hong and Stein, 1999). Besides rational

and behavioral explanations, culture (Chui et al. 2010), cognitive dissonance (Antoniou et al. 2013), and period of portfolio formation (Novy-Marx, 2012) are found to explain momentum profits.

Japan has always been an exception with regard to momentum effect as the effect has never been documented (Liu and Lee, 2001; Iihara et a. 2004; Chou et al. 2007). Many studies tried to find the evidence of momentum profits using different methodologies but had not been completely successful. Considering that foreign investors are momentum investors, Chui et al. (2000) examined whether momentum profits are evident with the stocks having higher foreign ownership concentration. However, stocks with a higher foreign ownership are only found to have a weak momentum effects. Chou et al. (2007) also studied momentum effect in Japanese stocks returns but could not find its evidence. He argued that lack of overconfidence and self-attribution among Japanese investors due to the culture of collectivism could be the reason for not having momentum effect in stock returns. Chui et al. (2010) also argued that lack of individualism is the reason for the lack of momentum in Japanese stock returns. He also argued that investors of collectivist countries weighed less on private information and more on the consensus of peers, which is quite opposite to the nature of overconfident investors. However, Fama and French (2012) were not convinced by the individualism explanation because low individualism not only deter overreaction but also contribute to underreaction, which could produce momentum. Recently, several studies provided evidence of momentum profits in Japanese stock returns using the hypothesis that momentum profits depend on market conditions (Coopers et al. 2004). Iihara et al. (2016) and Hanauer (2014) found that momentum profits are significant in Japan in a market where investors overreact. Two hypotheses, market states hypothesis (Coopers et al. 2004) and market dynamic hypothesis (Asem and Tian, 2010),

explained differently which market states triggers overreaction among investors. Coopers et al. (2004) argued that investors overreact in the UP market states while Asem and Tian (2010) argued that investors overreact in a continuing market states. According to market states (market dynamic) hypothesis, momentum profits are found to be significant in the UP states (continuing UP and continuing DOWN states) because investors are found to overreact when market exists in the UP states (continuing market states). Investors find their privately acquired information more confirmed with public information in UP market states (continuing market states), which triggers overconfidence and self-attribution, leading to overreaction (Daniel et al. 1998; Gervais and Odean, 2001). However, overreaction to information as a cause of momentum in Japan is questionable because the cultural and psychological traits of Japanese people do not support the assumption that Japanese investors overreact (Kitayama et al. 1997; Chui et al. 2010). The inconsistent evidence and explanation of momentum profits necessitates further study of the evidence and causes of momentum profits in Japan.

In the second essay, I examine whether momentum in Japanese stock returns is evident in Japan on the basis of market conditions. To examine whether momentum profits exist in any particular type(s) of market state(s), I divide market states into UP and DOWN states and then again divide the UP and DOWN states on the basis of the subsequent market movements. This division produces four market states, such as UP-UP, UP-DOWN, DOWN-UP, and DOWN-DOWN, of which UP-UP and DOWN-DOWN represent continuations and UP-DOWN and DOWN-UP represent market reversions. I also examine the long-term performance of momentum portfolios to determine the causes of momentum profits. On the basis of cultural and psychological traits of Japanese people, I hypothesize that investors' underreaction to information causes momentum profits conditioned on market states.

The sample period of this study ranges from November 1984 to November 2014. I used monthly equity data on all Japanese listed stocks from the Nikkei NEEDS database. To revisit momentum in Japanese stock returns, I followed the methodology of Jegadeesh and Titman (1993). Although, I measured momentum profits based on the 6-month formation and 1-month to 60-month observation periods, I used momentum profits based on the 6-month formation and 6-month observation period for other analyses. Risk adjusted momentum profits are measured by using the capital asset pricing model (CAPM) and the Fama and French three-factor (1996) model. To test the hypothesis that momentum profits is evident in market states that supports investors' underreaction, I divide the market following the methodology of Coopers et al. (2004) and Asem and Tian (2010). This study hypothesizes that momentum profits are produced in the reverting UP states because investors tend to underreact in this market states. To test the hypothesis, I measured momentum profits in four market states such as UP-UP, UP-DOWN, DOWN-UP, and DOWN-DOWN states of which UP-UP and DOWN-DOWN states represent continuing markets and UP-DOWN and DOWN-UP states represent reverting markets.

This study provides evidence that momentum profits are not significant when conventional methodology is used. However, significant momentum profits are found in the reverting UP market (UP-DOWN) states that are not followed by long-term reversions. Momentum profits found in the revering UP market states are consistent with investors' under-reaction. I argue that when market conditions suddenly change from UP to DOWN states, investors appear to become cautious and respond conservatively to new information. Investors tend to underreact because they do not find conformity of information. The reverting UP states also trigger investors' conservatism due to cognitive dissonance, which is created when their self-perception about a rising market is challenged by a sudden reversion of the market.

This study contributes in the existing literature in at least two ways. First, to the best of our knowledge, this study provides evidence that momentum profits in the Japanese stock returns are evident only in the reverting UP states and second, this study explains that investor's underreaction causes momentum profits in Japanese stock returns.

1.4 Market States and Momentum: Evidence from the Dhaka Stock Exchange

Emerging stock markets have increasingly been attracting attention in the global marketplace. Besides major emerging nations such as those in the BRICS, small emerging markets, often called as the next 11, are also experiencing tremendous growth in the economy and stock markets. Bangladesh, one of the countries in the next 11, has also been experiencing high economic growth (Goldman Sachs, 2007). Several reforms programs targeted to liberalize the economy and measures taken to open its stock market for foreign investors have attracted foreign investment. Although several studies focused on the international evidence of momentum profits (Rouwenhorst, 1998; Griffin et al. 2003; Chui et al. 2010; Iihara et al. 2004; Liu and Lee, 2001), relatively fewer studies are made on the emerging markets (Rouwenhorst, 1999; Chui et al. 2010). Studies that focused on the emerging markets usually examine large emerging countries because of the large market size and the availability of data. As a result, empirical evidence on momentum in stock returns in relatively smaller emerging countries are still scarce. This study examines momentum in Bangladeshi stock returns to provide an international evidence of momentum effect. This study selects Bangladesh as the sample country for two reasons. First, studying the momentum effect in a country like Bangladesh provides an opportunity to observe the widespread evidence of momentum anomaly in a less studied emerging country. Second, previous studies found that momentum profits in Bangladesh were one of the highest in the world (Chui et al. 2010). Although the momentum effect is found to be evident, its causes are not

still conclusive. The third essay discusses market states and momentum in the Dhaka Stock Exchange (DSE) of Bangladesh. This essay complements the second essay in the way that momentum profits are found both in the developed and emerging countries. Although evidence of momentum profits is found across the world, explanations of momentum profits differ. This study also shows how the explanation of momentum profits differs in two countries. The difference in the explanations suggests that investors' behavioral pattern and culture are strong elements in understanding stock returns behavior.

The third essay examined momentum effect in returns of stocks listed in the DSE. Besides examining momentum profits, this study also explores causes of high momentum profits in Bangladesh. This study hypothesizes that momentum profits are conditioned on the market states and are significant in market conditions that trigger investors' overreaction to information. When market states are divided into UP and DOWN on the basis of the past market performance, significant momentum profits are hypothesized to be evident only in the UP states. Short term momentum in the UP states is also expected to revert in the long term. This study conjectures that investors' overreaction causes momentum profits in Bangladesh. According to the overreaction hypothesis, investors' overreaction originates from the overconfidence and self-attribution (Daniel et al. 1998). In the UP states, investors' become overconfident because they find conformity of their privately acquired information with public information. As a result, momentum is created because investors overreact to information in the UP states and later, reversal is found when the market corrects the overreaction.

Momentum in stock returns are found to be evident in most of the stock markets of the world that is recognized even by the rationalists (Fama and French, 2012) but there is inconclusive evidence on the explanations of momentum profits. Although risk based rational

explanations (Conrad and Kaul, 1998; Chordia and Shivakumar, 2002; Dittmar et al. 2007; and Sagi and Seasholes, 2007) and investors' psychology based behavioral explanations (Barberies et al. 1998; Daniel et al. 1998; and Hong and Stein, 1999) provided explanations of momentum profits, those explanations are not still conclusive. Some other explanations of momentum profits are also found that are considered variations to rational and behavioral explanations. The market condition based explanation asserts that momentum profits depend on market states. Market condition based explanation provides grounds for both rationalists and behaviorists to prove their hypotheses. Cooper et al. (2004) have found momentum profit's dependence on market condition; momentum profit exists in the UP market states only. Sagi and Seashole's (2007) rational explanation of momentum profits also supported findings of Cooper et al. (2004). Sagi and Seasholes (2007) observed that during UP market states momentum profits increase because of a firm's tendency to move closer to exercise growth option. During DOWN market states, firms' susceptibility to financial distress reduces momentum profit. However, Griffin, Ji, and Martin (2005) have not found evidence of significant difference of momentum profitability in UP and DOWN markets for their 40 countries experiment. Instead they found that earnings momentum in different market or economic states is almost equal, and price momentum is insignificantly inclined toward negative market states in Asian countries. Asem and Tian's (2010) study also appeared as a partial contradiction to Cooper et al. (2004). Asem and Tian (2010) found that momentum profit is evident when the market moves in a similar direction, either UP or DOWN. They found momentum profits in the DOWN market too when the market continued to go DOWN. Their UP market explanations are consistent but DOWN market explanations contradict the hypothesis of Cooper et al. (2004).

In this circumstance, I test the hypothesis that momentum profits in the DSE can be explained by the market condition implying that momentum profits are found only in the UP market states. The sample period of this study ranges from January, 1999, to December, 2014. I include all stocks listed with the DSE during this period in this study. This study follows the methodology of Jegadeesh and Titman (1993) to measure momentum profits. Portfolios are formed based on the six-month formation and performances of these portfolios are observed for the next 60 months. This study uses both raw and risk adjusted returns using the CAPM to measure momentum profits. The DSE General index is used to measure the performance of the market. I follow the methodology of Cooper et al. (2004) to divide the market condition into UP and DOWN. A UP market state is used when the previous one years' cumulative market returns are positive ($\sum R_{m,\ t\text{-}1 \text{ to } t\text{-}12} \geq 0$) and when the cumulative returns are negative ($\sum R_{m,\ t\text{-}1 \text{ to } t\text{-}12} < 0$) in the previous one year, the DOWN market state is used. I also used regression models to test the significance of momentum profits in different market states. In the regression model, momentum profits are regressed on the UP and DOWN dummy variables.

This study finds evidence that momentum profits are significant in returns of stocks listed in the DSE. High momentum profits in the DSE are also found to be explained by the market states hypothesis as momentum profits are found only in the UP states. This evidence remains the same even after adjusting risks. Regression coefficients are also found to be significantly positive in the UP states and insignificant in the DOWN states indicating that momentum profits are significant in the UP states. Long term performance of momentum portfolios in the UP states is also measured and found to be significantly negative indicating that short term momentum profits in the UP states revert in the long term. However, a non-linear relationship between momentum profits and market states is found indicating that the most significant momentum

profits are not produced at the top of market performance rather found to be produced at the median market performance. Results of this study support and provide an international evidence for the market states hypothesis. The long term reversion of momentum profits found in the short- to intermediate term suggests that investors' overreaction to information could be the reason of momentum profits in the DSE.

The third essay contributes to the existing literature in at least two ways. First, to the best of my knowledge, this is the first study that provides evidence on momentum profits based on the market conditions in the DSE. Second, this study provides an international evidence of overreaction hypothesis.

The remainder of this dissertation is organized as follows. Chapter 2 provides a discussion on market efficiency, short-sales, and stock return anomalies, chapter 3 describes short-sales constraints in the presence of a centralized lendable stock market, chapter 4 describes market conditions and momentum in Japanese stock returns, chapter 5 describes market states and momentum in Bangladeshi stock returns, and chapter 6 concludes the dissertation.

CHAPTER 2

Market Efficiency, Short-Sales Constraints and Stock Return Anomalies

1. Introduction

The study on the short-sales constraints and stock returns anomalies are important issues in empirical finance because they provide insights into the market efficiency. Although some of the implications of the market efficiency were empirically tested since long, the idea of market efficiency was formalized through a series of studies conducted by Eugene Fama during the 1960s and 1970s. The essential idea of the market efficiency is that securities prices represent the true value of the securities because they incorporate all available information. Whether stock markets are truly efficient is an empirical question, however, at least theoretically, rational investors can ensure market efficiency if arbitrage opportunities are unconstrained. This dissertation includes essays, which examines short-sales constraints and stock returns anomalies to understand the efficiency of the stock markets. This chapter provides theoretical background on the market efficiency, short-sales constraints, and stock returns anomalies by reviewing important studies made previously. This chapter is organized as follows: section 2 provides a general discussion on the assumptions, implications, and empirical evidence of the efficient market hypothesis. Section 3 discusses short-sales constraints and presents empirical evidence on whether they restrict arbitrage opportunities in the market. Finally, section 4 discusses stock returns anomalies.

2. Efficient Market Hypothesis

Efficiency of financial markets is one of the fundamental issues in finance. The central idea of market efficiency is that market prices represent the true value of securities. All relevant

information is immediately reflected in the prices causing abnormal profit making impossible in the market. The efficient market hypothesis further implies that prices will move randomly that makes prediction of prices extremely difficult. Efficient market hypothesis assumes that investors are risk averse, rational and have homogenous expectation. Moreover, the stock market has to ensure unconstrained arbitrage opportunity to the rational investors. Although, efficient market hypothesis came into light after the seminal work of Fama (1965, 1970), Louis Bachelier, a French mathematician, should be considered the pioneer of the conceptual development of the market efficiency. In 1900, he mentioned that the mathematical expectation of the speculator is zero. He found that movement of stock prices is similar to Brownian motion. He also explained the concept of efficient market in terms of martingale. In his words *"The influences which determine fluctuation on the exchange are innumerable; past, present and even discounted future events are reflected in the market price. Besides the somewhat natural causes of price changes, artificial causes also intervene: the exchange reacts on itself, and the current fluctuation is a function, not only of previous fluctuations, but also of the orientation of the current state"*. Until Savage found Bachelier's work and translated it into English in 1955, his contribution in the field of market efficiency was largely ignored.

Several studies during 1920s and 1930s explained stock price movement by the probability theory. Frederick MacCauley (1925) found the similarity between fluctuations of the stock market and the chance curve derived from throwing a dice. Random movement and inability to predict stocks prices is found in a number of studies during 1920s and 1930s. Cowles (1933) analyzed stock price prediction efforts made by 45 professional agencies during 1928 to 1932 and found that forecasters could not forecast movement of stock markets. Several studies in the 1950s documented features of stock market that resembles those of an efficient market.

Kendall (1953), analyzing 22 weekly price series, found that stock prices movement at a close interval moved randomly. He mentioned that prices behaved like wondering series and showed very low serial correlation. Since individual stock price was not found to differ significantly with the average, prediction of stock prices even a week ahead became very difficult. Roberts (1959) also documented that stock price movement follows random walk hypothesis. He examined weekly changes of Dow Jones Index and found that changes behaved like a simple chance model. Osborne (1959) proved the evidence of random movement of stock prices by showing that logarithm of stock prices follow the probability distribution of a particle in Brownian motion.

However, several studies are also found to provide evidence that stock price do not move randomly and prediction of stock prices is sometimes possible. Mills (1927) provided evidence that the distribution of stock returns is leptokurtic in nature that violated the assumption of normal distribution of returns in the EMH. Although, Alexander (1961) documented that stock prices generally moved randomly over time but sometimes such movements were found to be persistent. He argued that if stock market moved up by a certain extent, it was likely to move up by more than that extent before it moved down by that extent. Cootner (1962) provided evidence that stock market did not follow random walk by examining prices of 45 randomly selected stocks listed with the NYSE. He documented significant positive autocorrelation in the fourteen-week lag and negative autocorrelation in one-week lag. Moreover, he also documented profitability of some investment strategies over a simple buy and hold policy. Although Granger and Morgenstern (1963), by investigating movement of stock prices in the short term and long term, found that stock prices move randomly in the short term as serial correlation was not found to be significant but such an evidence were not found in the long term.

Major development in the study of efficient market hypothesis has been made during 1960s and 1970s. In 1964, Cootner edited the famous book titled "the random character of stock market prices", which included studies on random behavior of stock price movement made by Bachelier, Roberts, Osborne, Moore, Cootner, Kendall, Working, Cowles, Alexander and others. Samuelson (1965) also contributed to the idea of efficient market by providing the proof that properly anticipated prices fluctuate randomly. In 1965, Eugene Fama published his landmark empirical study where he argued that stock prices followed a random walk by examining 30 Dow Jones Industrial Average stocks over the sample period between 1957 to 1962. Fama also explained how the random walk hypothesis challenged the chartists. Using filter rules developed by Alexander (1961), Fama and Blume (1966) examined pricing efficiency of individual stocks included in the Dow Jones Industrial Average and found that filter techniques did not provide significantly higher returns than simple buy and hold policy. Although independence of successive price changes is an essential criterion for pricing efficiency, speed of adjustment of new information in price is also an important aspect of market efficiency. Fama, Fisher, Jensen and Roll (1969) examined speed of adjustment of prices to the arrival of new information regarding dividend and stock split by using event studies. They found evidence that market reacted to the extent of implication of dividend. In 1970, Fama provided a complete idea of efficient market hypothesis, although in the earlier studies he tested several important features of market efficiency. Fama (1970) defined efficient market as "a market in which prices always fully reflect available information is called efficient market" in the most important study toward the development of efficient market hypothesis titled "Efficient Capital Markets: A review of theory and empirical work". He also classified market efficiency into three forms: weak form, semi strong form, and strong from. Weak form of efficiency measures adjustment of historical

information in stock prices while semi strong and strong form of efficiency measures adjustment of public and private information in stock prices. Fama (1970) concluded that, with few exceptions such as specialists of major stock exchanges and corporate insiders who had monopolistic access to some information (Niederhoffer and Osborne, 1966; Scholes, 1969), the efficient market hypothesis was well empirically supported. Fama (1991) reviewed some of the studies on market efficiency made after his seminar work in 1970. He changed the taxonomy of efficient market to make forms of an efficient market more inclusive. In the revised taxonomy of forms of an efficient market, the first category is the test of return predictability using variables such as dividend yields and interest rates. The second and third categories cover event studies and test for private information. He refuted some of the challenges of efficient market hypothesis and concluded that the importance of market efficiency still remains. Following the seminal studies of Fama, several studies were made to find support in favor of efficient market hypothesis. By using 115 open end mutual funds during the 1955-64 period, Jensen (1968) provided evidence that the performance of mutual funds was not found to be superior to a simple buy-the-market-and-hold policy. He further confirmed that the results were not only valid for average performance of mutual funds but also applicable for individual mutual fund. These results hold true even when funds returns were measured gross of management expenses. Findings of Ball and Brown (1968) also supported efficient market hypothesis. They found that a significant portion of the stock return variability was associated with market-wide effects. Market-wide variations of stock returns were found to be affected by the release of information that affected all firms.

Several studies made in the recent decades also provide evidence on the EMH. Malkiel (2003) examined the studies that attacked on the efficient market hypothesis and the belief that

stock markets were often irrational and stock prices were predictable. He concluded that stock markets were more efficient than what opponents believe. He further argued that anomalous pattern in stock returns did not produce significant risk adjusted returns. Malkiel (2005) argued that if stock market were really inefficient and stock prices were really predictable, professional fund managers would have performed better than a passive investment fund. However, he found that professional fund managers were not able to beat index benchmark and concluded that market prices appeared to reflect all available information. Several studies reported that market efficiency or its degree was time-varying. Lim et al. (2013) examined return predictability in three U.S. stock markets and found the time-varying nature of return predictability. Kim et al. (2011) also examined return predictability of U.S. stock market and found that return predictability is affected by market conditions. They found that in aggregate level, market was more efficient after 1980s than the previous periods.

The evidence in favor of market efficiency during 1970s began to face challenge during 1980s and 1990s. Kemp and Reid (1971) argued that randomness of stock price movement had been over-generalized. They found that stock price movement was noticeably non-random. On the ground of the costless information to all investors, Grossman and Stiglitz (1980) argued that it is not possible to have an informationally efficient market in the reality. They argued that if market was efficient, profitability of gathering information was zero that produced no incentive to trade in the market. Equal access to information by all investors is deterred because information is costly in the market; the higher cost of information would make the percentage of informed investors lower. Moreover, return from using information often disappeared because of cost of information causing incentive to gather information in the market unattractive. In addition to cost of information, efficient market hypothesis was also challenged from the view point of

excessive market volatility. LeRoy and Porter (1981) and Shiller (1981) argued that excess volatility in the market made market inefficient. They provided evidence of excessive volatility of stock prices compared to what was expected from the dividend or earnings process. Using 109 years data, Shiller (1981) also provided evidence that stock price volatility was five to thirteen times higher than what was expected from the release of new information. Efficient market hypothesis also faced challenge from the proponents of behavioral finance on the ground of investors' rationality assumption. DeBondt and Thaler (1985) found that return of stock that performed well in the past tend to revert in the next three to five years. He argued that investors' overreaction to information was responsible for such reversion, which also violates the efficient market hypothesis. Haugen (1995) also provided evidence for over-reactive market and argued that short term overreaction may lead to long term reversals that went against the efficient market hypothesis. Shleifer (2000) also questioned the validity of two fundamental assumptions of efficient market hypothesis such as rationality and perfect arbitrage as they contradict with psychological and institutional evidence. He argued that behavioral finance had provided theoretical and empirical evidence about why deviation of security prices from fundamental values exists so long even when arbitrageurs were present in the market. Lo and Mackinlay (1988) also rejected the random walk hypothesis after examining the hypothesis by variance-ratio test using weakly stock data over the 1962-1985 period. Poterba and Summer (1988) provided evidence that stock returns had positive autocorrelation in the short term and negative autocorrelation in the long term period. They came to this conclusion after applying variance ratio test on market returns of the U.S. over the 1871-1986 period and seventeen other countries over the 1957-1985 period. Findings of Lehman (1990) about reversion of weekly stock returns measured by the existence of negative autocorrelation also reject the efficient market hypothesis.

He found that losers and winners of weekly returns experienced return reversals in the next week giving sizable profits to arbitrage even after considering bid-ask spread and transaction costs. Jegadeesh (1990) documented evidence of predictable behavior of security returns and rejected the random walk hypothesis. He found negative first-order serial correlation in monthly stock returns at shorter lags and positive serial correlation in longer lags. Jagadeesh and Titman (1993) found momentum effect in stock returns, which could be used to make significant abnormal profits by buying past winners and selling past losers.

Although we have a plethora of theoretical and empirical evidence for and against the efficient market hypothesis, it is still not concluded whether market can really be efficient. Lo (2007) concluded that the reason for inconclusive state of market efficiency could be the fact that EMH was not a well-defined and empirically testable hypothesis. He argued that rather than measuring the efficiency of a particular market, EMH could be used to measure the relative efficiency between the markets. On the other hand, Fama and French (2008) argued that finding anomalous pattern in the stock returns did not reject the EMH because rational risks could also be responsible for that. Thus, the EMH has to be studied jointly with asset pricing models because it is inconclusive that how much variation in expected returns is caused by risks and how much is caused by mispricing (Fama and French, 2008).

3. Short-Sales Constraints

The EMH assumes that market will provide unconstrained opportunity for short-sales. If short-sales are constrained, negative information will not be reflected in the prices causing stock prices to be overvalued. Thus, unconstrained opportunity of short selling plays a central role in determining stock price. However, legal restrictions and higher costs of short-sales keep some investors out of the market leading the market to continue inefficiently.

Short selling is a trading technique where investors sell stocks without owning them. Typically, short sellers borrow stocks from the brokers and sell them short in anticipation that prices of those stocks will decline. Usually brokers lend stocks from their own inventory or from margin accounts of other investors or by borrowing from another brokerage firms. Under the current regulation in Japan and in most of the countries of the world, uncovered short selling is strictly prohibited meaning that brokers need to locate stocks before lending them to short sellers. Short sellers borrow stocks primarily because of two reasons such as speculation and hedging. If speculators anticipate a price decline they have incentive to sell stocks short and later cover the position when price falls. Hedgers sell stocks short to hedge against their long term investment. Price fluctuation affects long position and short position in investment in opposite manner. As a result, taking short position would reduce risk in long term investment. Across the world, short selling is conceived as a technique of speculation although there is no empirical evidence in favor of such belief. Several instances of speculative short selling across the world have contributed toward the negative perception although hedging is found to be the primary reasons of short selling. In Japan, regulatory measures had been taken to control short selling. A series of regulatory measures made during the 2008-2013 period such as prohibition of uncovered short selling, price regulation, and disclosure of information are targeted to restrict speculation through short selling. In the USA, 'Regulation SHO' and 'Rule 201' were also implemented to restrict speculative short selling. 'Regulation SHO' requires brokers to locate stocks before lending to short sellers while 'Rule 201' restricts short selling when price falls by at least 10%. Although, government agencies enacted restrictive measure to control short selling, there is no unanimous empirical evidence that short selling is responsible for severity of market panic (Bris et al. 2007).

Rather, against the common perception that short selling destabilizes the market, in reality, short selling is found to increase liquidity of the market.

Short selling requires that short sellers keep cash collateral more than the value of stocks. Short sellers are entitled to receive interest on the collateral money. At the same time, short sellers are charged with stock borrowing fee. The difference between interest on collateral and borrowing fee is kwon as rebate. A negative rebate occurs when stock borrowing fee exceeds interest rate on cash collateral making short selling costly. In Japan, short seller needs to pay stock borrowing cost on daily basis that can be renewed up to six months. However, keeping short position open for longer period is costly, particularly for the stocks with high borrowing fees. Lenders of stocks have the right to recall stocks at any time. In such a situation, short sellers need to renegotiate with the broker or cover the position by purchasing stocks. Recall risk is one of the major risks that short sellers face. Several stock features and events can make stocks costly and risky. For example, short sellers need to compensate stock lenders if stock dividend is declared during the short-sales contract. Initial public offering, seasoned equity offering, earnings announcement, and some other events could affect the short selling of stocks. Cost of short-sales can also be increased because of the structure of the market. In most of the countries of the world, short-sales are conducted by individual custodians. In such a market, cost of short-sales is generally higher because of higher search cost. However, in Japan, short-sales are conducted through a centralized lending market, where custodians do not need to search stocks. In such a market, cost of short selling is generally lower. As a result, structure of the market itself can contribute to the short-sales constraint.

Several theories discuss how costless short selling ensures pricing efficiency in the market. Diamond and Verecchia (1987) argue that short-sales constraint reduces adjustment

speed of information. Hong and Stein (2003) argued that short-sales constraint restricts reflection of accumulated negative information on prices until market start declining, which further causes market to decline and lead to a crash. In the divergence of opinion hypothesis, Miller (1977) argued that investors' divergence of opinion determines stock prices but in the presence of short-sales constraint, investors who have the most negative information will not be reflected causing overvaluation of stock prices. Empirical evidence also supports theoretical models that short-sales constraint impedes price discovery. Jones and Lamont (2002), D'Avolio (2002), and Beneish et al. (2015) provided evidence that short-sales constraint caused overvaluation of stock prices.

4. Stock Return Anomalies

Although efficient market hypothesis implies that stock returns anomalies cannot exist in an efficient market, the evidence of stock return anomalies appear as a challenge to the efficient market hypothesis. Anomalies in stock return is a well-documented feature in empirical finance that postulates cross sectional and time series patterns in security returns unexplainable by common risk factors. Stock return anomalies provide an opportunity to earn abnormal profits by forming appropriate trading strategies. Empirical studies provided evidence of anomalies in stock returns based on fundamental properties such as value, size, P/E ratio, and others, seasonal patterns like day of the week effect, monthly effect, turn of the month effect, turn of the year effect, and others, and past performance such as short term momentum and long-term reversal. According to the efficient market hypothesis, anomalies cannot last long in an efficient stock market because rational investors are supposed to restore equilibrium by way of arbitrage. Consistent with this view, some anomalies were indeed found to be very significant in early stages but gradually disappeared with the passage of time. However, other anomalies continued

to exist. Rational finance fails to explain those long-lasting anomalies from the viewpoint of risks and other fundamental factors.

4.1 The size and value effect

The value effect and size effect are two important anomalies reported in the empirical finance. Value effect refers to the positive relationship between stock returns and accounting ratio of book value to market value of securities. Basu (1977) was the first to identify the value effect in the U.S. stock market who provided evidence of significant positive relationship between E/P ratios and returns of stocks that could not be explained by the CAPM. Reinganum (1981) and Rosenberg et al. (1985) also provided evidence of value effect. The size effect refers to the negative relationship between stock returns and size (market capitalization) of stocks meaning that small capitalized stocks outperform large capitalized stocks. Banz (1981) was the first to identify size effect in the U.S. stocks who documented that smaller firms have had higher risk adjusted returns than larger firms. Fama and French (1992, 1993) found that size and value factor have the capacity to explain security returns and thus, included these two factors along with market factor to construct their famous three-factor model.

4.2 Seasonality

Calendar anomalies are evident in a stock market when prices of securities follow a seasonal pattern over a longer period of time. One of the most influential calendar anomalies is the January effect. The January effect indicates that returns generated in January are significantly higher than those of other months of the year. Keim (1983) provided evidence of January effect in an effort to extend the works on size related anomalies in NYSE and AMEX. He found that daily abnormal returns in January were higher compared to other months of the year. He also found that the negative relationship between size and abnormal returns became more pronounced

in January. Berges et al. (1984) documented January effect in Canadian Stock market during the 1973-1980 period. Kato and Schallheim (1985) also provided evidence of January effect in the Japanese stock market. They also documented the June effect in addition to the January effect in Japanese stock returns.

Day of the week effect and its variation such as Monday effect, Friday effect, and week end effect are the calendar anomalies identified on the basis of daily stock returns. Day of the week effect indicates that stock returns are significantly lower on Monday and significantly higher on the Friday. According to the efficient market hypothesis, all days of the week should earn similar returns. If we consider that returns are produced each day, then first trading day should earn higher return than other days because two days before the first trading day also generate profits. If we consider that returns would not be produced during holidays then first trading day should have the similar return as other trading days. Contrary to this fact, it has been evident in many stock markets that Monday, the first trading day, offers significantly lower profit and Friday, the last trading day of the week, offers significantly higher returns even after considering risk. Early studies on the weekend effect were made by Cross (1973) and French (1980). Cross (1973) used S&P 500 index from 1953 to 1973 to find that average Monday return was significantly lower than average Friday return. French (1980) also found the evidence of Monday effect and weekend effect using S&P composite index from 1953-1977. Motivated by these early studies, several studies were made in the next few decades to find the evidence of day of the week effect across the world. Schwert (2003) used Dow Jones index for the period between 1885 and 1927 and S&P composite index for the period between 1928 and 2002 to find the weekend effect. He divided the whole sample period in different sub samples and examined the sign and significance of returns. Results of his study support the findings of French (1980)

for the period of 1953-1977. Moreover, returns on Monday were found to be more negative during 1928–1952 but reduced in magnitude during the 1885-1927 period. However, he found that Monday returns were not statistically different from those of other days of the week since 1978 and during the 1978-2002 period, Monday returns were negative but the magnitude was one fourth of that during the 1953-1977. Berument and Kiymaz (2001) used GARCH model to examine the weekend effect in the US stock market. Over a period of 1973 to 1997, they found lowest average returns on Monday and the highest volatility on Friday. Hui (2005) examined the current state of the day of the week effect in six stock markets from the U.S.A, Japan and some ASEAN market for a sample period between 1998 and 2001. He did not find the evidence of the day of the week effect during this period in any market except for Singapore. While the disappearance of day of the week effect is consistent with the EMH, some authors have provided a different explanation for this effect. Doyle and Chen (2009), using a sample of eleven stock markets during the 1993-2007 period, provided evidence that Monday effect was not fixed rather wandering. They also found that day of the week effect is not conditional on previous week's returns and the effect is not disappearing during their period of study.

According to the efficient market hypothesis, stock returns in all the days of the month should be similar. However, empirical evidence shows that the last trading day of the month and first few trading days of the next month together generate significantly higher profits than rest of the days of the month. This is known as turn of the month effect. One of the early studies to document turn of the month effect was made by Ariel (1987). He found that returns are positive for the last trading day and first half of the month. He also documented that turn of the month effect is independent of January effect. Lakonishok and Smidt (1988) also confirmed the evidence of turn of the month effect using a different trading day window than Ariel (1987) used.

They used last trading day of the month and first three trading days of the next month as the turn of the month and found that average returns in the turn of the month were significantly positive than returns in the rest of the month.

Halloween effect, a form of calendar anomaly, indicates that stock returns differ significantly between the first and second half of the year; the November–April part of the year is found to produce significantly higher returns than the May–October part of the year. This anomaly is also known as sell in May effect. Following this pattern, investors can earn abnormal profits by investing in stocks in November and sell them in May. Bouman and Jacobsen (2002) identified this form of anomaly by providing its evidence in 36 out of 37 developed and emerging countries he examined. Marquering (2002) also provided evidence on the existence of Halloween effect. The reason for such behavior in the market can be explained by the behavior of the investors. May-October part is blessed with many vacations, comfortable weather and natural beauty. This relaxing mood of investors reduces demand for stocks causing returns to decline. There exists country specific variation to Halloween effect. Dekansho-bushi effect in Japan, Gone Fishing effect in China, and Schools out effect in some western countries are some of the anomalies that have similar features as the Halloween effect.

4.3 Reversal and momentum

Reversal in stock returns is a form of anomaly that predicts stock returns on the basis of the past performance of stocks. DeBondt and Thaler (1985) identified reversal effect in stock returns by documenting that stocks that performed well in the past tend to revert in three to five years. Following this findings, a profitable trading strategy can be formed by going long on the losers and short on the winners. Campbell and Limmack (1997), Alonso and Rubio (1990), and others provided international evidence on the reversal effect.

Momentum in stock returns, identified in 1993, is another anomaly based on the past stock return performance. Momentum in stock returns means the continuation of a trend in returns over short to intermediate term. Considering this phenomenon, investors can form momentum investment strategy by taking a long position in recent past winners and a short position in recent past losers to generate abnormal profits. Jegadeesh and Titman (1993) identified this form of anomaly by documenting that past winners outperform past losers over an investment period of three months to one year. After their pioneering work, a number of studies have investigated the evidence and sources of momentum profits across the world. Jegadeesh and Titman (2001) also confirmed the existence of momentum profits over an extended sample period and also refuted some alternative explanations of momentum profits. Daniel and Titman (2000), Lewellen (2002), Lee and Swaminathan (2000), Rouwenhorst (1998, 1999), Griffin et al. (2003), Gutierrez and Kelley (2008) and others provided international evidence on the momentum effect.

4.4 Liquidity

Stock return anomaly is also found on the basis of the liquidity of stock. Amihud and Mendelson (1986) documented a positive association between returns and illiquidity levels indicating that lower liquidity stocks produced significantly higher returns than those of higher liquidity stocks. Amihud and Mendelsen (1991) also provided similar liquidity effect on the US treasury securities. They found that less liquid US treasury notes produced significantly higher returns than those of securities with higher liquidity. With a new measure of illiquidity, Amihud (2002) showed that expected market illiquidity positively affect ex ante stock returns meaning that expected excess returns of stocks partly include illiquidity premium. Brennan and

Subrahmanyam (1996) provided confirming evidence of the liquidity effect of stock returns. Li, Sun and Wang (2011) found liquidity effect in Japanese stock returns.

4.5 Accruals and investment

Accruals are also found to have predictive power for stock returns. The accrual anomaly is one of the important stock returns anomalies that is found to exist in many stock markets of the world. Sloan (1996), using working capital minus depreciation as a measure for accrual, found that firms with relatively high levels of accruals had negative abnormal future returns that were concentrated around future earnings announcement. In an effort to find the explanation of the predictive power of accruals, Fairfield et al. (2003) argued that growth in net operating assets had the similar predictive power as the accruals. They termed the accrual effect as a variation of the growth effect. Zhang (2007) also found that accrual anomaly was associated with employment growth indicating that growth played some roles in accrual anomaly. However, Lewellen and Resutek (2016) argued that a significant portion of the accrual anomaly cannot be explained by investment. Thus, accrual anomaly and investment anomaly are two distinct anomalies that have predictive power for future returns. Capital investment or asset growth is found to have important implication for stock returns. A number of recent studies documented negative relationship between asset growth and stock returns, which is commonly known as the investment anomaly or asset growth anomaly. Titman et al. (2004) pioneered the study showing that capital investment and subsequent stock returns were negatively related. Cooper et al. (2008) and Yao et al. (2011), using asset growth as an alternative measure of investment, provided confirming and international evidence of investment anomaly.

4.6 Mood

Predictable stock returns are also observed on the basis of investors' mood. The landmark study of Howarth and Hoffman (1994) documented that weather condition influences mood. Using this association, Hirshleifer and Shumway (2003) provided evidence on the role of mood, as proxied by weather condition, in influencing stock returns. They examined the influence of morning sunshine in cities of leading stock exchanges on the daily market index returns across 26 countries. Sunshine is found to be strongly correlated with stock returns. The influence of mood on stock returns is also found on alternative proxies of mood. Using soccer results as a proxy for mood, Edmans et al. (2007) provided evidence of a significant market decline after soccer losses. Kourtidis et al. (2016) found that investors with positive mood, as measured by high level of energetic arousal and hedonic tone, low tense arousal, anger and frustration, achieved higher returns than investors with negative mood.

Seasonal affective disorder (SAD) is a psychological condition causing depression to many people because of shortness of days in fall and winter. Kamstra et al. (2003) provided international evidence that amount of daylight during the fall and winter significantly affected stock returns, a result the authors call the SAD effect.

Previous studies on human psychology also found that human behavior and mood could be affected by lunar phases. Dichev and Janes (2003) found strong lunar cycle effect in stock returns. They documented that returns on the 15 days around the new moon were about double the returns on the 15 days around the full moon. The evidence is found to be valid in the USA over the last 100 years and for 24 other countries over 30 years. Yuan et al. (2006) studied the association between lunar phases and stock returns of 48 countries. They found that stock returns

are lower on the days around the full moon and higher on the days around the new moon. The return difference between the phases is significant and independent of other known anomalies.

5. Conclusion

This chapter provides a theoretical background on the short sales constraints, stock return anomalies and market efficiency. The efficient market hypothesis asserts that mispricing of securities cannot exist for long in the financial markets because of rational investors' arbitrage. Rational investors' arbitrage is also supposed to rectify anomalous pattern in stock returns. However, previous studies provide mixed results regarding the existence of stock returns anomalies in major financial markets in the world. Studies supporting the efficient market hypothesis provided evidence that rational investors' arbitrage forced to disappear stock returns anomalies after their emergence. On the other hand, several other studies provided evidence that few types of stock returns anomalies continued to exist even though rational investors were active in the market. The difference of evidence regarding the market efficiency raises the question of the possibility of costless arbitrage in the market. Regulatory restrictions, cost of borrowing securities and market structure often make arbitrage by short selling difficult. Thus, it is important to study stock return anomalies, short sales constraints and market efficiency together.

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CHAPTER 3

Are Short-Sales Constraints Binding When There Is a Centralized Lendable Securities Market? Evidence from Japan[1]

Abstract

This study examines the significance of short-sales constraints in the presence of a centralized lendable securities market in Japan. We find evidence that a centralized lendable securities market experiences lower short sales constraints. The cost of borrowing stock is found to be lower in Japan's centralized lendable securities market compared with a non-centralized lendable securities market. We also find evidence that recall risk is lower in a centralized lendable securities market. Additionally, there is evidence that stocks are not systematically overvalued in the presence of the centralized lendable securities market. These results are robust when alternative measures of short-sales constraints are considered.

Keywords: Short-sales, centralized securities lending, recall risk, overvaluation, pricing

JEL classification: G14, G17, M4

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1. Introduction

The ability to sell short plays an important role in the process of efficient price determination in stock markets. One of the explanations offered by researchers for apparent mispricing is that constraints on short sales impede the reflection of new information. A market with short-sales constraints may slow recognition of negative information by excluding informed investors from the market (Miller (1977), Diamond and Verrecchia (1987) and Duffie, Gârleanu and Pedersen (2002)). Short-sales constraints also slow the speed of price adjustment to private information (Diamond and Verrecchia (1987)) and may make markets more susceptible to crashes (Hong and Stein (2003)). However, concrete evidence of the negative impact of short-sales constraints is difficult to observe because of the institutional features of stock markets. Previous studies used indirect measures of short-sales constraints, such as the short interest ratio and the ownership structure of securities; these do not consider the actual cost of short sales. Although D'Avolio (2002), Geczy, Musto and Reed (2002), Jones and Lamont (2002) and Beneish, Lee and Nichols (2015) provided evidence on the impact of short-sales constraints using the cost of borrowing, their data were collected from only a few custodial banks that did not represent the whole market. This limitation occurs because individual custodial banks conduct short-sales transactions in non-centralized lendable securities markets. Although the total demand for short sales of stock can be found by summing individual demands from custodian banks, the actual cost of borrowing stocks is difficult to determine for three reasons. First, lack of market-wide data

makes it impossible to characterize the complete schedule of demand and supply (Kolasinski, Reed and Ringgenberg (2013)). Second, consistent pricing of securities borrowing fees might not be possible as the securities borrowing fees could be linked to other services provided to brokers (Saffi and Sigurdsson (2011)). And third, the cost of borrowing could be higher in a non-centralized market because of higher search frictions (Jones and Lamont (2002)). To escape these limitations, we examine the significance of short-sales constraints in the presence of a centralized lendable securities market. The lendable securities market in Japan provides a unique data set upon which to conduct our analysis because the market is centrally controlled by the Japan Securities Finance Company (JSFC). All securities firms and stock lenders are connected to the JSFC to lend and borrow stocks. Although a negotiable securities borrowing system exists (with costs mutually determined by lenders and borrowers), most short sales are conducted with a standardized trading system where the JSFC charges a uniform cost of borrowing to all stock borrowers. We hypothesize that the cost of borrowing securities is low in this centralized lendable securities market because of low search frictions. We also hypothesize that likelihood of borrowed stock being recalled is less in this centralized lendable securities market. Thus, short sales should be less constrained in Japan's centralized lendable securities market. This suggests that superior pricing efficiency will result.

We provide new empirical evidence on the market for lendable securities in Japan. First, short-sales constraints are not generally binding in Japan; the cost of borrowing is low, demand

for short-sale of stocks is also low and institutional ownership is high. Second, a near-direct comparison of the cost of borrowing securities listed on both a centralized (Tokyo Stock Exchange) and a non-centralized (New York Stock Exchange) lendable securities market shows that the cost of borrowing is lower in the centralized market. Third, the demand for lendable securities has a greater impact on the cost of borrowing. Fourth, short sellers demand the stock of large-capitalization firms and value stocks more; demand for these securities often exceeds their supply. Fifth, recall risk, a situation when lenders demand that the shorted securities be returned, is not observed in the centralized lendable securities market even when the aggregate short-sales position exceeds the supply of lendable securities. And finally, the sixth result is that overvaluation of stocks is not observed in the centralized lendable securities market even when the cost of borrowing and the short interest ratio are high.

The most closely related studies to ours are D'Avolio (2002) and Beneish et al (2015). Both studies provided empirical evidence on the market for borrowing stocks and the determinants of the cost of borrowing. Using 18 months of data from a leading custodial bank, D'Avolio (2002) found that evidence of high borrowing cost and recall was rare in the U.S. but that the prevalence of short-sales increased with the divergence of opinion among investors. Beneish et al (2015), on the other hand, provided evidence on the economic determinants of short-sales supply using 114 months of data from Markit Data Explorer (DXL), which provided data on lendable equity from more than 100 institutional investors. They found that the supply

of lendable securities increased with the cost of borrowing and that the supply of lendable securities explained stock returns more completely when the lendable supply was binding.

We contribute to the existing literature on short-sales constraints in at least three ways. First, to the best of our knowledge, this is the first study that provides evidence of short-sales constraints under a centralized lendable securities market. Second, we provide evidence on short-sales constraints using daily data, which provides an opportunity to understand the daily movement of borrowing fees, the demand for borrowable securities and the supply of lendable securities. Moreover, our use of daily data is helpful in the study of short-term trading strategies. Previous studies mostly used monthly data from custodial banks. The use of monthly data fails to capture the daily movements of the cost of borrowing securities and does not permit analysis of short-term trading strategies (Diether, Lee and Werner (2009)). Moreover, it is also likely that some short-sales transactions are omitted from analysis when short sellers cover their positions quickly. Diether (2008) provided evidence that almost half of securities lending contracts close out within two weeks for the New York Stock Exchange. Third, we provide evidence on the behavior of stock returns in Japan's centralized lendable securities market.

The remainder of this study is organized as follows. Section 2 provides a literature review, section 3 describes the theoretical arguments on how a centralized lendable securities system affects the cost of borrowing stocks, section 4 describes the data and the methodology,

section 5 provides empirical facts on the market for borrowing securities in Japan, recall risk, and short-sales constraints, and finally section 6 concludes the paper.

2. Literature Review

Unconstrained short sales are a precondition for most rational asset pricing theories. Short-sales constraints generally refer to the various limits, costs and risks of shorting in addition to legal and institutional restrictions. Previous studies used several methods to measure short-sales constraints. Short interest, measured as the actual short position scaled by the number of outstanding shares, provides a demand-based measure of short-sales constraints (Figlewski (1981), Asquith and Meulbroek (1995) and Desai, Ramesh, Thiagarajan and Balachandran (2002)). However, Chen, Hong and Stein (2002) argued that short interest as a proxy for short-sales constraints is flawed and suggested using breadth of ownership to measure short-sales constraints. Chen et al (2002) used decline in the breadth of ownership as a proxy of short-sales constraints. Nagel (2005) used the variation of the ownership structure of lendable stock as a proxy, noting that large institutional investors are more likely to lend securities. Low institutional ownership thus means fewer securities can be borrowed and hence is a proxy for short-sales constraints. Demand and supply measures have been used to capture the effect of short-sales constraints. Asquith, Pathak and Ritter (2005) defined short-sales constrained stocks as those having a high short interest but low institutional ownership. D'Avolio (2002), Jones and Lamont (2002), Geczy et al (2002) and Beneish et al (2015) used cost of borrowing securities to

measure short-sales constraints. Reed (2015) argued that finding the incremental contribution of these various measures of short-sales constraints is a major challenge for research in this area.

Several theories and hypotheses discuss how short sales affect the pricing of securities and the efficiency of the market. Miller (1977) argued that heterogeneous beliefs among investors under constrained short sales keeps pessimists out of the market, so market prices only reflect optimists' valuations. As a result, stock prices become overvalued when short sales are constrained and the divergence of investors' opinions is high. Diamond and Verrecchia (1987) developed a model to illustrate the effect of short-sales constraints on the distribution and speed of adjustment by prices to private information. They argued that when short sales are constrained, both good news and bad news require more time to be reflected in prices but that bad news requires more time than good news. Since short-sales constraints limit trades by some informed investors, the speed of adjustment to bad news before public release of the news is expected to be less. However, stock price declines sharply when such information is made public. The rational expectations model of Diamond and Verrecchia (1987) also conjectured that stocks are not systematically overvalued in equilibrium when short sales are constrained. Assuming that investors are risk averse, Bai, Chang and Wang (2006) found two possible contradictory valuation outcomes. First, uninformed investors' risk perceptions are changed by the slower price discovery, leading them to expect higher returns that cause lower prices. Second, short-sales constraints could impede investors from taking short positions to hedge risks,

which in turn, could increase the demand for stocks, thus leading to price rises. Hong and Stein (2003) also developed a model based on the heterogeneous beliefs of investors. They argued that accumulated unrevealed negative information held by investors who are prohibited from selling short will not be reflected until prices begin to drop. The revelation of accumulated hidden negative information at the time of declining prices would aggravate market declines and ultimately lead to a market crash.

As was the case for models that attempted to predict the impact of short sales, empirical explorations have also failed to provide unambiguous evidence. In an early empirical study of Miller's hypothesis (1977), Harrison and Kreps (1978) argued that short-sales constraints can push securities prices above the valuation of the most optimistic investors. Since then, several empirical studies have documented that short-sales constraints as measured by high short interest actually lead to lower future returns (Asquith and Meulbroek (1995) and Desai et al (2002)). Short-sales constraints as measured by institutional ownership are also found to be associated with lower future returns (Nagel (2005) and Asquith et al (2005)). Short-sales constrained stocks are not only linked to lower future returns but are also found to be associated with even lower returns when investors' divergence of opinion is high (Boehme, Danielsen and Sorescu (2006) and Blocher, Reed and Van Wesep (2013)). Kato, Singh and Suzuki (2015) examined Japanese seasoned equity offerings (SEO) in the presence of short-sales constraints and found that the SEOs of short-sales constrained stocks have lower returns on both the announcement and the

issue dates. Using a flow-based measure of short-sales constraints, Takahashi (2010) found that stocks with short-sales constraints experience significantly lower subsequent returns in Japan. Lee and Ko (2014) provided evidence that short-sales constrained stocks, as measured by the short interest, have temporary lower returns in the short term. Using the cost of borrowing securities as a measure of short-sales constraints, Beneish et al (2015), Jones and Lamont (2002), D'Avolio (2002), Geczy et al (2002) and Ofek, Richardson and Whitelaw (2004) showed that stocks with substantially higher borrowing costs have lower subsequent returns. Engelberg, Reed and Ringgenberg (2015) documented that short-sales risks constrain further short sales and that stocks with high short-sales risk earn lower returns in the future. Nevertheless, several other studies found no evidence of a relationship between high short interest and subsequent stock returns (Figlewski (1981), Woolridge and Dickson (1994), Brent, Morse and Stice (1990) and Figlewski and Webb (1993)).

Besides the return behavior of short-sales constrained stocks, several studies have examined the distribution and speed of price adjustment to private information of short-sales constrained stocks. These studies also provided evidence on how short-sales constraints restrict the efficiency of the market. Most of the early studies on the effect of short-sales constraints on pricing efficiency used option availability as a proxy of short-sales constraints to report that the introduction of options reduces short-sales constraints and increases informational efficiency (Skinner (1990) and Damodaran and Lim (1991)). However, some of these studies found that

short selling of stocks without options is more informative, suggesting that short-sales constraints might not reduce informational efficiency (Aitken, Frino, McCorry and Swan (1998) and Senchak and Starks (1993)). As the presence of options is an opaque proxy of short-sale constraints, later studies used short interest, ownership structure and the cost of borrowing securities to proxy short-sales constraints. Using monthly short-interest data, Desai et al (2002) and Asquith et al (2005) reported that short sellers improve informational efficiency. Using securities lending fee data, Reed (2007) reported that short-sales constraints reduce the informational efficiency of stock prices in the U.S. Bris, Goetzmann and Zhu (2007) concluded that information is reflected in stock prices quickly in countries where short sales are not constrained. Using low lendable security supply as a measure of the short-sales constraint, Saffi and Sigurdsson (2011) reported that informational efficiency is lower for short-sales constrained stocks. Using shorting flow data, Boehmer, Jones and Zhang (2008) and Diether et al (2009) argued that short sellers help to correct overvaluation and increase the informational efficiency of stock prices. Isaka (2007) also provided similar evidence for Japan; short-sales constraints reduce the speed of adjustment to negative information by stock prices. However, several studies found evidence that short sales can distort stock prices in special situations. Henry and Koski (2010) found that short sales contribute to stock price manipulation and destabilization around the time of seasoned equity offerings. Shkilko, Van Ness and Van Ness (2008) also found that large price reversals are likely to occur when short-sale restrictions are lifted.

3. Theoretical Arguments on How a Centralized Trading System Affects the Cost of Borrowing Securities

The literature has not examined whether the presence of a centralized lendable securities trading system affects the cost and availability of stocks available to short. In non-centralized lendable securities markets when short sales are conducted through individual dealers, the demand for lendable securities from short sellers is met from the broker's own inventory or margin account stock kept with brokers by other investors. If the total demand for lendable securities cannot be satisfied from the broker's own sources, they ask other brokers or may contract with an institutional supplier. The broker's search for lendable securities can be conducted through an electronic location system or by email, telephone or fax (Duffie et al 2002). Locating the appropriate stock could still be hard or it might not be possible to find the desired quantity. As a result, in a non-centralized setup, locating stocks can be time-consuming; demand might not be filled instantaneously and it could be costly if the securities are borrowed from institutional lenders. The cost of borrowing should reflect such frictions. Duffie et al (2002) and Kolasinski et al (2013) argued that the location issue is a part of the short-sale constraint as the time that is required to locate the stock after receiving the short-sale order could be quite long. They further argued that difficulty in locating stocks will logically affect the price of the stock and borrowing fees. Jones and Lamont (2002) also provided evidence that locating a willing lender could be particularly difficult for illiquid, small-market-capitalization stocks with low institutional

ownership. Stock features such as market capitalization, float size, inclusion in an index, ownership concentration, incidents like IPOs, mergers and curve-outs have also been found to affect the level of difficulty of borrowing and locating securities (Duffie et al (2002)).

The centralized lendable securities market in Japan is controlled by the Japan Securities Finance Company. Under this centralized trading system, the terms and conditions are standardized and apply equally to every short seller. We argue that the centralized system for securities borrowing and lending as exists in Japan resolves the frictions described above to a significant degree. Since all brokers have access to the central trading system, any mismatch between the demand and the supply of lendable securities will be quickly mitigated. Individual brokers do not have to locate securities or spend time searching for securities to meet borrower's demands. If a broker fails to supply the desired amount of lendable securities, it can immediately borrow stock from the JSFC, which holds a reserve of lendable securities from the excess balances of other brokers. The only possibility of failing to satisfy a borrower's demand for securities occurs when the total demand for lendable securities exceeds the total supply of lendable securities held within the JSFC. In this situation, the JSFC can borrow securities from outside institutional lenders. As a consequence, we argue that the centralized lendable securities system provides a consistent and reliable supply of lendable securities that significantly reduces search frictions. Since, in most cases, the JSFC satisfies the entire demand for lendable securities from its own inventory, the cost of borrowing stock is negligible. Significant

borrowing costs, however, are incurred when the JSFC needs to borrow from outside institutional investors. We argue that the borrowing costs for most securities are very low because the JSFC fails to fully satisfy lendable demand for only a few securities.

In non-centralized lendable securities trading systems, recall situations arise when supply is less than demand for lendable securities (D'Avolio (2002)). Under recall situations, short sellers need to renegotiate the loan at a higher cost or to close out the position. As a result, we expect to observe higher borrowing fees or the return borrowed stock. The centralized lendable securities market reduces recall risk. We argue that it is less likely that the demand for loanable securities would exceed the supply of lendable securities because the JSFC controls the total supply of lendable securities. Even if a short squeeze occurs, the JSFC can mitigate the imbalance by borrowing securities from outside institutions. Although a temporary increase in the cost of borrowing and the return of borrowed stocks occurs, such situations should not last for long.

Finally, we argue that price efficiency is higher in a centralized lendable securities market. Since the cost of borrowing securities is less in the centralized system because of lower search frictions, there will be fewer short-sale constraints, which in turn, will lead to greater pricing efficiency. As a result, more securities are expected to be priced efficiently.

4. Data and Methodology

To examine the significance of short-sales constraints in a centralized lendable securities market, we study all stocks listed on the Tokyo Stock Exchange (TSE) and the Japan Securities Dealers Association Quotation System exchange, but exclude real estate investment trusts and exchange traded funds. We collect daily data on securities borrowing fees, amount of stock borrowed and the amount of lendable securities from the JSFC. Data on trading volume, the price-to-book ratio, the number of shares outstanding, market value of equity, institutional ownership and stock prices are from the Nikkei NEEDS database. While trading volume, the price-to-book ratio, the number of shares outstanding, market value of equity and stock prices are reported on daily basis, institutional ownership is reported on semi-annual basis. Additionally, Nikkei NEEDS provides information on the top 30 stockholders in each firm, which typically account for 60 to 70 percent of total ownership in Japan. The sample period of our study ranges from November 12, 2015 to May 11, 2016. This period contains no change in regulations on short sales that could directly affect the cost of borrowing of securities.[2]

[2] While we argue that there were no unusual events that impacted the lendable securities market, it is quite true that Japan's central bank was (and still *is*) pursuing a very unusual monetary policy that influenced the stock market during the sample period. The Bank of Japan's (Bank of Japan, 2016) quantitative and qualitative easing monetary policy resulted in massive purchases of Japanese Government Bonds and exchange traded funds. The central bank's aggressive purchases of government bonds even exceeded the amount issued by the government. The central bank purchased bonds on the secondary market at prices in excess of par to create a negative interest rate policy. The Bank of Japan also imposed a negative interest rate on excess reserves held by commercial banks. These policies had a pernicious effect on most financial institutions and as well as caused the secondary market for government

Using this daily data set, we test our hypotheses that a centralized lendable securities market reduces the cost of borrowing and that this in turn reduces short-sales constraints compared to a non-centralized lendable securities market. We initially define short-sales constraints in terms of the cost of borrowing securities. To this end, we classify stocks into specials (short-sales constrained) when the annual cost of borrowing is more than one percent, and general collateral (GC, short-sales unconstrained) when the annual cost of borrowing is less than 1 percent. This approach is consistent with the literature. The cost of borrowing securities in Japan is comprised of the basic interest rate (*kashikabu-ryo*) and the premium charged on the lendable securities (*shinakashi-ryo*). Since the interest paid on the cash collateral kept as security against the borrowed stock is negligible under current Japanese monetary policy, it does not meaningfully reduce the cost of borrowing. The basic interest rate is determined each day by the JSFC and is fixed for all borrowed securities. We use only the premium charged on the lendable securities to measure the cost of borrowing securities.

We examine borrowing costs and supply constraints in a centralized lendable securities market that is defined to be less supply-constrained compared to a non-centralized market, like

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bonds to shrink. While the negative interest rate policy is unprecedented and extremely significant in an historical sense, we argue that it did not cause an unusual disruption in Japan's lendable securities markets. The lendable securities market continued to operate with essentially a zero interest rate; the *kashikabu-ryo* was zero. It did *not* become negative after the Bank of Japan implemented its negative interest rate policy in early 2016. Further, there were no changes in short-sales related regulations such as the uptick rule, rules on uncovered short sales and restrictions on the use of IPO stock during the sample period.

that of the NYSE. To examine the determinants of borrowing costs, we use an OLS regression model with explanatory variables such as the short interest ratio (SIR), institutional ownership (IO), market capitalization (Size), the price-to-book ratio (P/B) and turnover (TO), with the actual cost of borrowing (COB) as the dependent variable. We also estimate a logit regression model where the dependent variable is a dummy variable that assumes the value one for special stocks and zero for GC stocks. We use the same explanatory variables as the OLS equation. The logit model is used to examine the likelihood of the shorted stock being special. We follow the methodology of D'Avolio (2002) and Beneish et al (2015) to select the variables for the OLS and logit regression models. The OLS and logit regression equations are:

$$(1)\ \mathrm{COB} = \alpha_0 + \alpha_1 \mathrm{SIR} + \alpha_2 \mathrm{IO} + \alpha_3 \mathrm{Size} + \alpha_4\, \mathrm{P/B} + \alpha_5 \mathrm{TO} + \varepsilon\ ,\ \text{and}$$

$$(2)\ \text{Prob of Special}\ (0 = GC, 1 = Spec) = \beta_0 + \beta_1 \mathrm{SIR} + \beta_2 \mathrm{IO} + \beta_3 \mathrm{Size} + \beta_4\, {}^{\mathrm{P}}/_{B} + \beta_5 \mathrm{TO} + \varepsilon.$$

In the regression model to examine the short supply constraint, we use the supply of lendable securities as the dependent variable and IO, the predicted value of COB, TO, Size and P/B as the independent variables. We estimate three versions of the model to examine the supply of lendable securities. The dependent variable remains the same in all three specifications. However, we use IO as the only explanatory variable in version 1; IO, COB, TO, Size and the P/B ratio as explanatory variables in version 2; and, the predicted value of COB along with IO, TO, Size and the P/B ratio in the third version of the model. Previous studies suggested that IO

is the most important predictor of the supply of lendable securities (D'Avolio, 2002 and Beneish et al 2015). These studies also found that security features such the COB of securities, turnover, size and the P/B ratio are also related to the supply of lendable securities. Using the predicted value of the COB of securities should reduce the potential endogeneity bias in the coefficients. The general form of the regression model used to explain the supply of lendable securities is:

(3) $\text{Supply of Lendable Securities} = \gamma_0 + \gamma_1 \text{IO} + \gamma_2 \text{COB} + \gamma_3 \text{TO} + \gamma_4 \text{Size} + \gamma_5 \text{P/B} + \varepsilon$.

To test our hypothesis that short-sales constraints are less in a centralized lendable securities market, we compare the cost of borrowing stocks listed on both the TSE and the New York Stock Exchange (NYSE). We used 15 Japanese stocks that are dual-listed on the NYSE for this comparison. We use the premium charged on lendable securities as a measure of the cost of borrowing.

To test our hypothesis that recall risk is less in a centralized lendable securities market, we examine recall events and measure their impact on securities borrowing. In a non-centralized market, recall risk arises when the aggregate short position cannot be covered by the balance of lendable securities (D'Avolio (2002)). As a practical approach, we use the presence of a 'mismatch situation' as a way to measure recall risk. A mismatch situation is defined to occur when the aggregate short position exceeds the inventory of lendable securities. In a non-centralized market, lent securities are usually recalled in such a situation. Short sellers must

either cover their short position by actually buying the stock or renegotiate with the securities lender at a higher cost. We also examine the cost of borrowing securities, the behavior of new stock borrowing and the return of borrowed securities following mismatch situations. We measure short positions as the balance of borrowed securities and the inventory of lendable securities. At the beginning of each trading day, we organize stocks into mismatch and non-mismatch situation categories and then on the basis of the difference between the balance of borrowed securities and the supply of lendable securities. We then match this measure with the security's trading volume (TV), number of outstanding shares (NOS), Size, the P/B ratio, yield, the price earnings ratio (P/E), the price to sales ratio (P/S), the price to cash flow ratio (P/CF) and institutional ownership (IO). We also observe the behavior of the trend of borrowing costs, new borrowings of securities and the return of already borrowed securities following mismatch and non-mismatch events over the next 15 trading days.

Finally, we examine the future return behavior of specials and high SIR-securities to test our hypothesis that these stocks are priced efficiently (not systematically overvalued) in the centralized lendable securities market. The idea is that a lendable securities market reduces the costs of borrowing securities and lowers recall risk to make the short side of the market less constrained. We measure both stock-based and flow-based SIR. The stock-based SIR is measured by the balance of the short position at the end of the day scaled by the number of outstanding shares while the flow-based SIR is measured as the daily short position scaled by the

number of outstanding shares. At the beginning of each trading day, we organize stocks into categories according to the short-sales constraint variables such as specialness of the stock and stocks in the top decile of the SIR. We then observe their returns over the next 15 days. We compare future returns of short-sale constrained and unconstrained stocks by calculating the *t* values of these differences. We also examine this relationship by using regressions. The regression equation used to explain the relationship between short-sales constraints and future stock returns is:

(4) $\text{Return}_{t+1\ to\ t+15} = \alpha + \beta_i Short - Sales\ Constraint\ Variables + \varepsilon$,

where the *Short-Sales Constraint Variables* element in the regression equation represents the specialness of the stock, the short interest ratio and institutional ownership. $\text{Return}_{t+1\ to\ t+15}$ is the observed returns on stocks over the 15 days after organizing the stocks into categories.

5. Empirical Results

5.1 Empirical evidence on the market for borrowing and the cost of borrowing securities

We first describe the market for lendable securities in Japan. Table 1 reports basic descriptive statistics of the short-sales variables. On the basis of 119 trading days ranging from November 2015 to May 2016, the number of lendable securities is 3490. Out of an average of 3490 lendable securities, the actual number of securities sold short is relatively small. On average, only 1218 securities are sold short each day with little inter-month variation. Among the 1218

sold short, 241 securities have positive borrowing cost, most of which is negligible. The number of securities with an annual cost of borrowing greater than 1 percent is 162, which is only 5 percent of all lendable securities. The empirical evidence shows that very few shorted stocks actually have a high borrowing cost. Panel B of Table 1 reports descriptive statistics of the key short-sales variables. The average cost of borrowing during our sample period is 0.0016 percent with a median value of zero. Most stocks do not have significant borrowing fees; yet a few securities have high fees. We also provide evidence on the flow-based and the stock-based measures of the SIR to examine the demand for short sales in Japan. The daily average of flow-based and stock-based SIR is 0.0046 percent and 0.076 percent respectively. We report descriptive statistics of institutional ownership as a measure of short-sales constraints as well. The IO of shorted and non-shorted securities is 45.42 percent and 47.78 percent respectively. Overall, the statistics suggest that short sales are not greatly constrained in Japan.

Table 2 reports features of shorted and non-shorted securities. It shows that TV, NOS, TO, Size, IO and yield are significantly higher, while the P/B, P/E, P/Sales and P/CF ratios are significantly lower for shorted securities. Previous studies, using monthly data, found that non-shorted stocks tended to have low market capitalization, low TV, low IO and low P/B ratios (D'Avolio (2002)). Our results are largely similar to previous studies except for the IO and growth variables. We find that growth variables such as the P/B, P/E, P/Sales and P/CF ratios are significantly higher for non-shorted securities. Our results also suggest that conventional

supply-side constraint measures, such as lower IO and NOS, do not stop short sellers from borrowing securities. We argue that centralized lendable securities markets make supply side constraints less important.

[Insert Table 1 around here]

[Insert Table 2 around here]

Table 3 reports the distribution of the daily cost of borrowing securities. We organize stocks into four categories (>0.5%, >1%, >5% and >10% per annum) of borrowing cost to have a more detailed understanding of securities with higher borrowing costs. On average, only 17 (0.49%) securities have higher borrowing cost than 10 percent, 38 (1.09%) stocks have cost higher than 5 percent, 162 (4.65%) stocks have cost higher than 1 percent and 242 (6.93%) stocks have borrowing cost higher than 0.5 percent. By the most conservative measure of the short-sales constraint, which has an average borrowing cost of 0.1724 percent, only 0.49 percent of securities are short-sales constrained while by the most liberal measure, which has an average borrowing cost of 0.0205 percent, 6.93 percent of securities are short-sales constrained. It is important to note here that the median values of the borrowing cost for all four groups are lower than the mean values, indicating that the borrowing costs of securities are not evenly distributed and that a few stocks have unusually high borrowing costs.

Table 4 reports details on the daily cost of borrowing securities in Japan. Stocks are classified into specials and general collateral (GC) groups on the basis of the annualized cost of borrowing. Special securities have significantly higher borrowing costs than GC securities. The SIR is also significantly higher for specials. Special securities are also associated with higher IO, higher TV, higher NOS, larger size, lower P/B ratios and lower yield, higher P/E ratios, lower P/Sales ratios and higher P/CF ratios. However, the TO of specials and GC securities are not significantly different, which does not support Miller's (1977) divergence of opinion hypothesis and the findings of D'Avolio (2002) and Beneish et al (2015). We argue that under a centralized lendable securities market, the supply side restriction is not binding; rather, the evidence shows that the cost of borrowing is largely driven by the higher demand for borrowed securities.

[Insert Table 3 around here]

[Insert Table 4 around here]

One of the advantages of using daily data is the ability to observe daily trends in the cost of borrowing securities. It is important to observe these trends because the security borrowing contract is renewed on a daily basis and most short positions are closed out fairly quickly. Table 5 shows trends in the daily cost of borrowing securities when they are classified as specials and GC. All securities are ranked in descending order of their cost of borrowing and split into special and GC groups. The daily cost of borrowing of the special and the GC groups is observed over the next 15 trading days. We find a clear decreasing trend in the borrowing cost

of specials, showing that initially high borrowing cost decreases over the next 15 days. However, borrowing cost remains significantly higher for specials than for GC securities.

[Insert Table 5 around here]

We use OLS and logit regression models to examine the determinants of borrowing cost. We regress the daily average cost of borrowing securities on SIR, IO, Size, the P/B ratio and TO. We also estimate logit regressions to examine what increases the probability of being special. In the logit regressions, we use a dummy variable that takes the value one for specials and zero for GC securities. Table 6 reports coefficients for both these OLS and logit regression models. The OLS regression shows that demand for borrowed securities as measured by SIR affect the COB most and that the P/B ratio and TO affect the COB negatively. However, we do not find evidence that IO and Size significantly affect the cost of borrowing. The coefficients of the logit regression show that SIR, IO, Size and TO increase the probability of securities being special while the P/B ratio tends to reduce this. The logit regression suggests that divergence of opinion as measured by TO affects the probability of being special. The SIR is the most significant factor affecting the cost of borrowing in the U.S. (Beneish et al (2015)). However, unlike the U.S., we do not find that lower IO and higher P/B increase the cost of borrowed securities. We argue that the demand for borrowed securities mainly drives the cost of borrowing in Japan's centralized lendable securities market. An impact by supply-side factors such as institutional

ownership is not observed because the centralized market ensures an ample supply of lendable securities.

[Insert Table 6 around here]

Having analyzed the cost of borrowing securities, we next examine supply constraints in a centralized lendable securities market. We use the supply of lendable stock scaled by the number of outstanding shares as the dependent variable and IO, COB, TO, Size and the P/B ratio as the explanatory variables. As in other countries, the supply of lendable securities comes primarily from institutional investors in Japan. The JSFC procures securities from institutional investors when the demand for borrowed stock exceeds the supply. The things that affect the supply in a non-centralized lendable securities market have been the focus of previous research; the evidence suggests a link to several features such as institutional ownership, size, turnover and book to market value (D'Avolio (2002)). We now examine the determinants of the supply of lendable securities in Japan. Table 7 reports the coefficients of three regression models. In version 1, the supply of lendable securities as a percentage of outstanding shares is regressed on IO alone while in version 2, the supply of lendable securities as a percentage of the total number of outstanding shares is regressed on IO, COB, TO, Size and the P/B ratio. The results show that institutional ownership significantly influences the supply of lendable securities even after controlling for other firm features. IO alone can explain 40 percent of the variation in the supply of lendable securities. When the regression includes COB, TO, Size and the P/B ratio, its

explanatory power increases to 72 percent. Besides institutional ownership, these other variables positively affect the supply of lendable securities.

The endogeneity issue is a serious concern when examining the determinants of the supply of lendable securities as we use the COB as an independent variable when it may well be correlated with the error term of the regression. To address this problem, we use the predicted value of the COB from the regression that explains COB by SIR, IO, Size, TO and the P/B ratio. Version 3 of the regression shows the coefficients for the determinants of the supply of lendable securities using this predicted COB. The results show that the COB no longer has significant explanatory power in the determination of the supply of lendable securities. However, the significance of the other variables remains essentially the same.

[Insert Table 7 around here]

To examine the significance of short-sales constraints in the centralized and non-centralized lendable securities markets, we compare the COB of a subset of stocks listed on a centralized market (TSE) and on a non-centralized market (NYSE). A near-direct comparison of these COBs is possible because some securities are listed on both the TSE and the NYSE. The comparison will allow us to understand how the cost of borrowing differs in a centralized and non-centralized lendable securities market. We hypothesize that because of higher search frictions, the COB of securities in a non-centralized market as exists in the U.S. will be higher

than the COB in a centralized market as exists in Japan. However, the difference in the actual trading times between the markets and the liquidity of the concerned securities could also affect the cost of borrowing of securities making it impossible to definitively conclude that market structure alone reduces the cost of borrowing of securities.[3] Nevertheless, we assert that the market structure must, at least, partly affect the cost of borrowing securities. There are 15 stocks that are available for short sale in both Japan and the U.S. We acquired the COB information for these stocks from a leading investment bank. Table 8 reports descriptive statistics for the COB of these securities. Panel A of Table 8 shows descriptive statistics of the stocks categorized as specials and GC securities in Japan and the U.S. Since we could not collect comparable data for our main sample period, we used a more recent sample period. The period ranges from July 19, 2016 to November 24, 2016. In line with our previous analysis, we categorize stocks as specials if their annual COB is more than one percent and as GC otherwise. In the U.S., two stocks

[3] From the perspective of methodical robustness, it is important to note that liquidity and trading times in New York and Tokyo are different. Hence we must moderate our claim that Tokyo's centralized lendable securities market reduces search costs, lowers cost of borrowing and produces superior pricing efficiency compared to New York's non-centralized market. Consider the example of Line Corporation. Line planned to list 22 million depository shares on the New York Stock Exchange and 13 million shares on the Tokyo Stock Exchange with a *greenshoe* option to list an additional 5.25 million shares. (Line Kabushiki Kaisha 2016 and Martin 2016). The additional shares were sold. The relatively larger offering size in New York suggests that search costs and the cost of borrowing should be *less* in New York ceteris paribus. Yet, this was not the case. Further, the two markets are never open at the same instant. New York opens at 9:30am and closes at 4pm. Tokyo opens at 9:30am and closes at 3pm the day before. Figure 1 provides an example that illustrates the trading time difference for Line which started trading on July 14, 2016 in New York and later on July 15, 2016 in Tokyo. Hence, our comparative tests of pricing efficiency and the cost of borrowing are only partial and approximate. In spite of these limitations, we argue that the comparison is informative if not definitive.

(13.33%) are categorized as specials while these same two stocks are categorized as GC in Japan. The rest of the 13 stocks (86.67%) categorized as GC in the U.S. are also categorized as GC in Japan. Panel B of Table 8 shows descriptive statistics of the COB of these stocks. The average daily cost of borrowing these 15 stocks is higher in the U.S. (0.0033%) than in Japan (0.0001%). The small sample size does not permit us to make a strong claim that this difference is statistically significant, yet the large difference is consistent with our argument that a centralized lendable securities market has fewer search frictions. The standard deviation of the COB and the maximum COB during the sample period are also higher in the U.S.

Table 9 provides a more direct comparison of the short-sales constraints of stocks listed on both the TSE and the NYSE. It shows that on the basis of the average daily COB, Fronteo Incorporated and Line Corporation are categorized as special stocks in the U.S. but are categorized as GC stocks in Japan. Fronteo and Line have an average daily COB of 0.03 percent and 0.02 percent, respectively while their COBs in Japan are both zero. More importantly, the COB of these two stocks is significantly higher on all trading days in the U.S. but is never greater than zero in Japan. The remaining 13 stocks are categorized as general collateral on both the TSE and the NYSE. The higher COB in the U.S. is evidence that the COB in a non-centralized lendable securities market is higher. Although our study cannot explore all aspects of why these differences exist and persist, the difference is consistent with our reasoning. We argue that at least part of the inequality in the COB is caused by differences in market structure. In a

country where the securities lending market is not centralized, stock lending and borrowing are usually conducted at the individual custodial bank level. Search cost becomes an important issue particularly when the desired number of shares cannot be easily procured. As a result, the supply of lendable securities in a non-centralized market is constrained (Beneish et al (2015)). We argue that higher search frictions in the presence of supply constraints push the COB up. The Japanese centralized lendable market managed by the JSFC effectively reduces such search frictions and supplies the securities demanded by short sellers.

[Insert Table 8 around here]

[Insert Table 9 around here]

5.2 The behavior of securities facing recall risk in a centralized market

Lenders of securities have the right to recall their stock at any time. Recall could arise if the lender's valuation of the stock differs significantly from that of the short seller or if there is an advantage in actually holding the security. If lenders recall, short sellers either have to renegotiate with lenders to reach a new contract or close out their position by buying the stock and delivering this security to the lender. In either case, recall causes a loss to short sellers (Jones and Lamont (2002) and D'Avolio (2002)). We use the term 'mismatch' to define the situation in which the aggregate short position exceeds the supply of lendable securities. In this situation the JSFC attempts to borrow securities from institutional investors to fill the gap

between demand and supply. However in some situations, the JSFC may not be able to meet the additional demand. The chance that this mismatch could happen is 'recall risk.' Recall risk is real and short squeezes do occur in the United States. However, this situation is less common in Japan; we argue that one reason for this is Japan's centralized lendable security market. This section explores how recall risk influences the behavior of securities in the context of the potentially mitigating influence of Japan's centralized securities market. We also observe the impact of mismatch on borrowing fees, new borrowing of securities (NBS) and the return of borrowed securities (RBS). In a non-centralized lendable securities market with mismatch, the cost of borrowing is expected to increase, NBS is expected to fall and RBS is expected to increase. However, we hypothesize that a centralized lendable securities market reduces the impact on the COB, NBS and RBS because of its superior capacity to supply stock even when mismatch situations arise. We expect to observe only a temporary increase in the cost of borrowing because the JSFC can quickly procure additional securities from outside institutional investors. The increase in the cost of borrowing could have a temporary effect on NBS as well. To test our hypothesis, we measure the mismatch between the aggregate short position and the inventory of lendable securities on each trading day and observe the behavior of NBS and RBS over the next 15 trading days.

Table 10 reports features associated with securities facing mismatch situations. The average COB of stocks having a mismatch is significantly higher; this is an anticipated because

the JSFC needs to procure stocks from outside institutional investors. The table also shows that mismatch situations are not affected by supply-side features such as IO and NOS. Institutional ownership and the number of shares outstanding are actually larger for the mismatch subsample. Investors' divergence of opinion as measured by turnover is higher in non-mismatch situations, indicating that the higher demand for lendable securities is not generated by short sellers' different perceptions of stock value. Contrary to the conventional belief that small capitalization stocks and growth stocks are more likely to have mismatch situations, we find no evidence that small and growth stocks face mismatch situations more than large capitalization and value stocks. Additionally, stocks in mismatch situations tend to have low yield, high price earnings, low price-to-sales and high price-to-cash-flow ratios.

The trends of securities borrowing cost associated with stocks facing mismatch have some notable features. Table 11 reports the trend in cost of borrowing following mismatch situations. The cost of borrowing securities facing a mismatch tends to be higher during the 15 trading days after the initial mismatch. As previously described, a mismatch is mainly driven by the demand, so persistence of a high cost of borrowing may indicate that some firm-specific event motivates short selling. Nevertheless, we observe that the high borrowing fees after mismatches gradually fall over the next 15 trading days. We interpret this to mean that the initial rise in the borrowing fee is due to higher demand that forces the JSFC to borrow from outside institutional investors at higher cost. However, the higher borrowing costs may deter some short

sellers and motivate suppliers to lend more securities, which in turn, will reduce borrowing fees over the following days. This suggests that the JSFC plays an important role in ensuring a smooth supply of lendable securities in mismatch situations that ultimately helps to reduce the cost of borrowing.

[Insert Table 10 around here]

[Insert Table 11 around here]

We also observe the behavior of NBS, RBS and the balance of stock borrowing (BSB) following mismatch situations. Table 12 reports a decline in NBS and an increase in the RBS leading to a decline in the BSB after mismatches take place. On the other hand, a slight increase in NBS, a decrease in the RBS and an increase in BSB are observed in non-mismatch situations. The declining trend of NBS and the increasing trend of RBS after mismatches along with the opposite trend after non-mismatch situations suggest that mismatches lead to a temporary squeeze on NBS and a temporary increase in the RBS. The declining trend of NBS and the increasing trend of the RBS are greater on the first day, but gradually ease over the following trading days. We argue that the decrease in NBS may be due to the higher borrowing fees observed after mismatch situations. When short sellers need to compete with optimistic investors in the market, a short squeeze situation is created, pushing stock price up further. In a short squeeze situation, some short sellers close out their positions anticipating higher stock prices in the future. This could be the explanation for the initial increase in the RBS after

mismatch situations. Although we observe a temporary decrease in NBS and an increase in the RBS, the BSB remains almost the same, suggesting that the JSFC successfully manages the temporary mismatch between the demand for, and the supply of, lendable securities. Since the JSFC is connected with a large number of institutional investors, it can borrow stock from some pessimistic institutional investors even in a short squeeze situation. Our arguments also explain why recall risk is higher in a non-centralized market. It is possible that individual dealers who do not have access to all institutional investors have difficulty finding a supplier in a short squeeze situation leading to a higher risk of recalling stock. When a mismatch situation is anticipated, a dealer usually recalls stock in the U.S. (D'Avolio (2002)), but in a similar situation the JSFC borrows stock from outside institutional investors to fill the gap. As a result, rather than recalling stock, a temporary increase in borrowing cost is observed in a mismatch situation in Japan.

[Insert Table 12 around here]

5.3 Short-sale constraints and stock return behavior in a centralized lendable securities market

The return behavior of securities facing short-sale constraints has been studied intensively in empirical finance. Several theories predict the return behavior of stock facing short-sales constraints. Miller (1977), Harrison and Kreps (1978) and Hong and Stein (2003) conjecture that short-sales constraints restrict reflection of negative information on security prices and cause

short-sales constrained stocks to be overpriced, and therefore to subsequently underperform. Following the divergence of opinion hypothesis of Miller (1977), short-sales constrained stocks are expected to subsequently underperform and this underperformance is accentuated when the divergence of opinion among investors becomes greater. Our research observes the returns behavior of short-sales constrained stocks in a centralized lendable securities market. We find evidence that this centralized market has a lower cost of borrowing and recall risk; as such, the market should be less short-sales constrained and better able to correctly price securities. Table 13 reports the behavior of returns of special and GC securities over a 15-trading day observation period following periods when short-sales constraints are likely to be binding. On each trading day, all stocks are ranked in descending order and classified into special and GC groups. The subsequent return behavior of these special and GC groups is then observed. The results show that although specials underperform compared to GC stocks, the underperformance is not statistically significant. The difference in returns between the GC and special groups is not significant except for weak evidence of underperformance found on the 3rd and 4th trading days.

We also use high short interest ratios as an alternative measure of short-sales constraints. Table 14 reports the behavior of future returns of securities in the highest and lowest SIR deciles. To observe the return behavior of high SIR stocks, we rank stocks in descending order on each trading day and divide them into 10 classes. The return behavior of stocks in the highest and lowest SIR decile is then reported over the next 15 trading days. We find no evidence that short-

sales constrained securities as measured by stocks in the top SIR decile underperform compared to short-sales unconstrained securities. The difference in returns between short-sales unconstrained and short-sales constrained securities is not statistically significant.

The insignificant subsequent underperformance of securities with high borrowing cost and high short interest ratio supports our hypothesis that a centralized lendable securities market faces less short-sales constraints and helps to ensure the correct pricing of securities. To check the robustness of this result, we examine the relationship between the short-sales constraint variables and subsequent return behavior with two regression models. The dependent variable of the regression models is the 15-day mean return after the portfolio construction day and the independent variables are the specialness of the securities and being grouped in the top SIR decile. Table 15 reports the regression coefficients of the short-sales constraint variables. In Model 1, the dependent variable is the 15-day mean return and the independent variable is the cost of borrowing special securities. The results show that the relationship is negative, but insignificant. In Model 2, the dependent variable is the same 15-day mean return and the independent variable is the short interest ratio (SIR) in the top decile. The result is similar to that of Model 1; the SIR coefficient is negative, but insignificant.

The results of the difference in returns between short-sales constrained and unconstrained stock and the regression models suggest that the underperformance of short-sales constrained

stocks is not significant in Japan. We argue that although some stocks have a high cost of borrowing and higher demand, the centralized lendable securities market is able to supply securities smoothly to short sellers. As a result, high cost of borrowing or higher demand does not prevent short sellers from getting their desired amount of securities to sell short; they are more able to act on their negative views about value. In general, the inclusion of the short seller perspective into the price determination process is more complete in a centralized lendable securities market, making the market informationally efficient.

[Insert Table 13 around here]

[Insert Table 14 around here]

[Insert Table 15 around here]

6. Conclusion

This study examines the significance of short-sales constraints in the presence of a centralized lendable securities market. The centralized lendable securities market in Japan provides an opportunity to observe how costs and the demand and supply of lendable securities behave in a market where search frictions are low. Using six months of daily data, we test our hypotheses that the cost of borrowing and recall risk is low in a centralized lendable securities market. This should make the market efficient in the sense that it uses all information. Our results show that short sales are not constrained in Japan; only 4.65 percent of securities have an annual borrowing

cost of more than one percent. A direct comparison of the cost of borrowing stocks listed on both centralized and non-centralized lendable securities markets also suggests that the cost of borrowing in the centralized market is lower than that in the non-centralized market. We also find that the chance of being special is higher for large market capitalization stocks, value stocks and securities with a high divergence of opinion. The supply of lendable securities is affected by institutional ownership, turnover, market capitalization and the price-to-book ratio, but not by the cost of borrowing securities.

We find no evidence of conventional stock recall risk in a Japan. We observe the behavior of stocks facing mismatch situations in a centralized lendable securities market as well. Mismatch means the demand for loanable securities may exceed the supply. In mismatch situations, we observe an increase in the cost of borrowing and a temporary reduction in new securities borrowing compared to stocks in non-mismatch situations. However, we also find evidence that the Japan Securities Finance Corporation can manage mismatch situations. Although the cost of borrowing continues to be high, the balance of borrowed securities remains essentially unchanged.

Finally, we observe the return behavior of short-sales constrained securities in a centralized lendable securities market. We find that short-sales constrained securities do not subsequently underperform compared to unconstrained securities. In tests of robustness, we find

no meaningful relationship between future stock returns and the short-sales constraint related variables. We argue that a centralized lendable securities market helps to ensure a smooth supply of lendable stock at a lower cost by reducing search frictions; this makes markets less short-sales constrained. The main conclusion is that a centralized lendable security market makes the stock market informationally efficient and supports the insights of Kolasinski et al (2013). Policy makers and securities market designers should consider the benefits of adopting a centralized lendable securities market.

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Table 1

Descriptive statistics of the lendable securities market in Japan

This table reports descriptive statistics of the key variables used in this study. These values are for the period from November 12, 2015 to May 11, 2016, which is a representative sample of the Tokyo Stock Exchange and the JASDAQ. Panel A shows average daily observations of lendable securities, number of securities sold short, securities with a positive cost of borrowing and securities with borrowing cost of more than one percent per year (specials). Panel B shows descriptive statistics of the flow-based short interest ratio (SIR) as measured by the daily borrowing of securities as a percentage of the number of outstanding shares, stock-based SIR as measured by the balance of the daily borrowing of securities as a percentage of the number of outstanding shares, the daily cost of borrowing (COB) and institutional ownership (IO) of shorted and non-shorted securities.

Panel A: Average Daily Observations

Month	Trading Days	Number of lendable stocks	Number of securities sold short	Number of securities with a positive borrowing fee	Number of securities with a borrowing fee of more than 1%	Percentage of lendable securities with a borrowing fee of more than 1%
November	12	3478	1177	237	142	4.08
December	21	3485	1199	222	140	4.02
January	19	3493	1194	183	116	3.32
February	20	3487	1215	233	162	4.65
March	22	3490	1229	269	191	5.48
April	20	3501	1278	281	202	5.77
May	5	3507	1215	281	186	5.31
Total/Average	119	3490	1218	241	162	4.65

Panel B: Descriptive Statistics for Short-Sales Variables						
Variable	Mean	SD	Median	Maximum	Minimum	No of obs.
COB (%)	0.0016	0.0259	0.0000	1.2311	0.0000	144,942
Flow based SIR (%)	0.0046	0.0331	0.0000	1.2798	0.0000	144,942
Stock based SIR (%)	0.0760	0.2964	0.0016	6.19	0.0000	144,942
$IO_{\text{shorted stocks}}$	48.2442	0.3309	48.2595	48.8882	47.4330	144,942
$IO_{\text{Non-shorted stocks}}$	46.2085	0.2246	46.2356	46.7154	45.3712	144,942

Table 2

Descriptive statistics of the shorted and non-shorted securities

This table shows descriptive statistics for variables associated with shorted and non-shorted securities. These values are for the period from November 12, 2015 to May 11, 2016, which is a representative sample of the Tokyo Stock Exchange and the JASDAQ. Securities are classified into shorted and non-shorted groups based on the amount of daily borrowing. Stock features such as trading volume (TV), outstanding shares (NOS), turnover (TO), market capitalization (Size), institutional ownership (IO), price-to-book ratio (P/B), Yield, P/E ratio, P/Sales ratio and P/CF ratio are measured for shorted and non-shorted securities.

	Shorted	Non-shorted	Difference
TV	1655846	276697	1379149 (40.33)***
NOS (million shares)	260.25	61.69	198.56 (126.32)***
TO	0.0064	0.0045	0.0019 (13.09)***
Size (million yen)	373336	71214	302122 (86.83)***
IO (percent)	47.8566	45.8352	2.0213 (3.77)***
P/B	1.9387	2.2585	-0.3198 (-12.96)***
Yield (percent)	1.8946	1.7878	0.1068 (6.39)***
P/E	25.8294	30.0933	-4.26 (-20.22)***
P/Sales	1.3326	2.0820	-0.7494 (-33.21)***
P/CF	15.6062	17.7679	-2.1616 (-15.81)***

The numbers shown in parentheses are *t*-statistics for a test of the null hypothesis that the difference in the mean values of the shorted and non-shorted group variables is zero. *, ** and *** indicate statistical significance at the 10, 5 and 1 percent levels, respectively.

Table 3

The distribution of the daily cost of borrowing securities

This table describes the distribution of the daily cost of borrowing securities. These values are for the period from November 12, 2015 to May 11, 2016, which is a representative sample of the Tokyo Stock Exchange and the JASDAQ. To observe short-sale constraints from the viewpoint of borrowing cost, the daily cost of borrowing is categorized into four groups based on the following cut-off annual cost values: 0.5 percent, 1 percent, 5 percent and 10 percent. The number of securities, percentage of securities, mean, median, and standard deviation of the cost of borrowing (COB) for each group are shown. COB, mean and median values are in percent format.

COB	Number of securities	Percent of securities	Mean COB	Median COB	Standard deviation
>0.5%	242	6.93	0.0205	0.0053	0.0945
>1%	162	4.64	0.0255	0.0073	0.1048
>5%	38	1.09	0.0834	0.0271	0.1960
>10%	17	0.49	0.1724	0.0852	0.3005

Table 4

Descriptive statistics for the daily cost of borrowing special and general collateral securities

This table reports features associated with the special (difficult to borrow) and general collateral (GC, easy to borrow) securities. These values are for the period from November 12, 2015 to May 11, 2016, which is a representative sample of the Tokyo Stock Exchange and the JASDAQ. Special stocks are securities that have a borrowing cost of more than one percent per year and GC otherwise. Cost of Borrowing (COB), the short interest ratio (SIR), institutional ownership (IO), trading volume (TV), outstanding shares (NOS), turnover (TO), market capitalization (Size), the price-to-book ratio (P/B), Yield, the P/E ratio, the P/Sales ratio, the P/CF ratio and the percentage of lendable securities are reported for special and GC securities. The differences between special and GC securities groups in terms of these descriptive features are also reported.

	All Stocks	Specials (COB>1%)	GC (COB<1%)	Specials − GC
COB	0.0016	0.0255	0.00005	0.0255 (6.15)***
SIR	0.0045	0.0230	0.0035	0.0195 (9.68)***
IO	4.88	47.95	46.81	1.1372 (9.56)***
TO	0.0058	0.0061	0.0058	0.00032 (1.29)
TV	760810	1095511	747472	348038 (7.59)***
NOS	131	178	129	49 (22.42)**
Size	176534	210633	173963	36670(6.43)***
P/B	2.1511	1.7782	2.1667	-0.3885 (-11.74)***
Yield	1.8233	1.6858	1.8299	-14.40 (-6.87)***
P/E	28.5155	33.4208	28.2919	5.1289 (11.80)***

P/Sales	1.8241	1.2107	1.8529	-0.6422 (-26.25)***
P/CF	16.9738	17.5301	16.9698	-0.5603 (1.31)
Number of Securities	3490	162	3328	
Percent of Lendable Securities	100	4.64	95.36	

The numbers shown in parentheses are *t*-statistics for a test of the null hypothesis that the difference in the mean values of the specials and GC group variables is zero. *, ** and *** indicate statistical significance at the 10, 5 and 1 percent levels, respectively.

Table 5

The trend in the daily cost of borrowing securities

This table reports trends in the daily cost of borrowing specials (hard to short) and general collateral (GC, easy to short) securities. These values are for the period from November 12, 2015 to May 11, 2016, which is a representative sample of the Tokyo Stock Exchange and the JASDAQ. All securities are ranked in descending order on each trading day and split into special and GC groups based on the annual cost of borrowing. Securities with an annual cost of borrowing greater than one percent are defined to be special; all other securities are defined as GC. The daily cost of borrowing of special and GC securities is shown over the next 15 trading days. All values are in percent format.

	Days After Group Formation							
	0	1	2	3	4	5	6	7
Specials	0.0259	0.0233	0.0221	0.0195	0.0176	0.0157	0.0172	0.0159
GC Securities	0.0001	0.0006	0.0007	0.0008	0.0008	0.0009	0.0009	0.0009
	8	9	10	11	12	13	14	15
Specials	0.0158	0.0141	0.0130	0.0132	0.0132	0.0131	0.0125	0.0125
GC Securities	0.0009	0.0010	0.0010	0.0010	0.0010	0.0010	0.0011	0.0011

Table 6

The determinants of the cost of borrowing securities

This table reports coefficients of OLS and logit regressions used to model the determinants of the cost of borrowing. These values are for the period from November 12, 2015 to May 11, 2016, which is a representative sample of the Tokyo Stock Exchange and the JASDAQ. In the OLS regression, the daily cost of borrowing is regressed on the short interest ratio (SIR) and a number of security features such as institutional ownership (IO), market capitalization (Size), the price-to-book ratio (P/B) and turnover (TO). The logit model examines the probability of a security being special (hard to short). Its independent dummy variable takes the value one for special securities and zero for general collateral (easy to short) securities. Securities are defined as special when their annual cost of borrowing is greater than one percent.

	OLS	Logit
SIR	1.1394 (0.10)***	1049 (269.61)***
IO	0.0952 (1.61)	4.8037 (1.23)***
Size	0.0043 (0.00)	13.8658 (5.37)***
P/B	-0.0029 (0.00)*	-8.2626 (1.23)***
TO	-0.2478 (0.13)*	762.7507 (258.93)***
Constant	-4.51 (75.48)	-390.6866 (74.91)***
R^2	0.7257	
F	59.79***	
Pseudo R^2		0.9701
LR Chi^2		320.09
Log likelihood		-4.9258
Observations	420,665	420,665

The values shown in parentheses are clustered standard errors. *, ** and *** indicate statistical significance at the 10, 5 and 1 percent levels, respectively.

Table 7

Cross-sectional regressions of security loan supply on institutional ownership

This table reports the coefficients of regressions that model the supply of lendable securities. These values are for the period from November 12, 2015 to May 11, 2016, which is a representative sample of the Tokyo Stock Exchange and the JASDAQ. The supply of lendable securities as a percentage of the total number of outstanding shares is regressed on institutional ownership (IO) in version 1 and further on institutional ownership, cost of borrowing (COB), turnover (TO), Size and the price-to-book ratio (P/B) in version 2. Version 3 uses the same variables as version 2, except that it uses the predicted value of the COB to address the possibility that the COB may be correlated with the error term in version 2. Such a correlation would cause an endogeneity problem.

	Version 1	Version 2	Version 3
IO	1.0782 (0.11)***	0.8936 (0.12)***	0.9190 (0.12)***
COB		0.0084 (0.00)***	0.0069 (0.01)
TO		0.0481 (0.01)***	0.0480 (0.02)***
Size		0.0007 (0.00)**	0.0007 (0.00)**
P/B		0.0005 (0.00)***	0.0007 (0.00)***
Constant	-50.5355 (5.11)***	-43.4670 (5.77)***	-43.1289 (6.00)***
R^2	0.40	0.73	0.72
Observations	420,665	420,665	420,665

The values shown in parentheses are clustered standard errors. *, ** and *** indicate statistical significance at the 10, 5 and 1 percent levels, respectively.

Table 8

Descriptive statistics of Japanese securities listed on the NYSE

This table reports descriptive statistics of the cost of borrowing (COB) securities listed on both the Tokyo Stock Exchange and the New York Stock Exchange. These values are for the period from July 19, 2016 to November 24, 2016. Panel A reports the percent of securities categorized as specials (hard to short) and general collateral (GC, easy to short) on the TSE and NYSE. Stocks are categorized as specials if the annual COB exceeds one percent and GC otherwise. Panel B shows summary statistics of the COB of securities listed on both the TSE and the NYSE. For the purpose of comparability, we report values for common trading days and exclude observations corresponding to national holidays in Japan and the United States.

Panel A: Average Daily Observations of Specials and GC Securities

Markets	Sample Period	% Specials	% GC Securities
U.S.	2016/07/19 to 2016/11/24)	13.33	86.67
Japan	2016/07/19 to 2016/11/24)	0	100

Panel B: Descriptive Statistics of the COB

Variable	Mean	SD	Maximum	Minimum	No of obs.
$COB_{U.S.}$ (%)	0.0033	0.0089	0.0281	0.0000	1305
COB_{Japan} (%)	0.0001	0.0002	0.0006	0.0000	1305

Table 9

A comparison of short-sale securities listed on both the TSE and NYSE

This table lists the Japanese securities listed on both the Tokyo Stock Exchange and the New York Stock Exchange that can be used for short sales over the period from July 19, 2016 to November 24, 2016. Securities are defined as specials (hard to short) when the annual cost of borrowing (COB) the security is greater than one percent and general collateral (GC, easy to short) otherwise. Out of the 15 stocks that are traded on both the TSE and the NYSE, two are specials on the U.S. market.

	TSE	NYSE
Fronteo, Inc.	GC (COB_{daily} = 0.00%)	Special (COB_{daily} = 0.03%)
Internet Initiative Japan Inc.	GC	GC
Line Corporation	GC (COB_{daily} = 0.00%)	Special (COB_{daily} = 0.02%)
Sony Corporation	GC	GC
Kyocera Corporation	GC	GC
Toyota Motor Corporation	GC	GC
Honda Motor Co.	GC	GC
Canon Inc.	GC	GC
Mitsubishi UFJ Financial Group, Inc.	GC	GC
Sumitomo Mitsui Financial Group, Inc.	GC	GC
Mizuho Financial Group, Inc.	GC	GC
Orix Corporation	GC	GC
Nomura Holdings, Inc.	GC	GC
NTT Corporation	GC	GC
NTT DOCOMO, Inc.	GC	GC

Table 10

A description of securities subject to recall risk

This table reports features associated with securities facing mismatch situations. Mismatch arises when the loan for lendable securities demand exceeds the supply. These values are for the period from November 12, 2015 to May 11, 2016, which is a representative sample of the Tokyo Stock Exchange and the JASDAQ. We use the balance of margin selling as a measure of loadable securities demand and the balance of margin buying as a measure of supply. On each day, securities are arranged according to the difference between margin buying and margin selling to classify them as securities facing mismatch and non-mismatch situations. Securities features such as the short interest ratio (SIR), institutional ownership (IO), cost of borrowing (COB), turnover (TO), trading volume (TV), outstanding shares NOS, market capitalization (Size), price-to-book ratio (P/B ratio), Yield, P/E ratio, P/Sales ratio and P/CF ratio are measured for securities facing mismatch and non-mismatch situations.

	Mismatch	Non-mismatch	Difference
SIR	0.0164	0.0025	0.0139 (10.54)***
IO	49.6457	46.5041	3.1417 (67.04)***
COB	0.0091	0.0003	0.0088 (4.29)***
TO	0.0052	0.0059	-0.0006 (-4.29)***
TV	780138	757625	22513 (0.96)
NOS	149	128	20.97 (13.98)***
Size	260507	163187	97319 (26.35)***
P/B	1.9288	2.1787	-0.2499 (-12.46)***
Yield	1.7096	1.8447	-0.1351 (-8.50)***
P/E	31.5705	27.9844	3.5862 (16.71)***
P/Sales	1.3494	1.8917	-0.5423 (-28.31)***
P/CF	18.1685	16.8019	1.3666 (7.87)***

The numbers shown in parentheses are *t*-statistics for a test of the null hypothesis that the difference in the mean values of the variables for mismatch and non-mismatch groups is zero. *, ** and *** indicate statistical significance at the 10, 5 and 1 percent levels, respectively.

Table 11

The trend of securities borrowing fees following mismatch situations

This table reports trends in securities borrowing fees following mismatch situations. These values are for the period from November 12, 2015 to May 11, 2016, which is a representative sample of the Tokyo Stock Exchange and the JASDAQ. Mismatch situations arise when the demand for lendable securities exceeds the supply. On each trading day, securities are arranged on the basis of the difference between the demand for and supply of lendable securities to split them into groups that face mismatch and non-mismatch situations. The borrowing costs of these two groups are observed over the next 15 trading days. Values are in percent format.

	Days after group formation							
	0	1	2	3	4	5	6	7
Mismatch	0.0091	0.0080	0.0073	0.0068	0.0065	0.0059	0.0061	0.0059
Non-mismatch	0.0003	0.0006	0.0007	0.0008	0.0008	0.0009	0.0009	0.0009
	8	9	10	11	12	13	14	15
Mismatch	0.0059	0.0056	0.0054	0.0054	0.0055	0.0053	0.0053	0.0053
Non-mismatch	0.0009	0.0009	0.0009	0.0010	0.0010	0.0010	0.0010	0.0010

Table 12

New borrowings of securities, the return of borrowed securities and the balance of securities borrowings after mismatches

This table reports new borrowing of stock (NBS), the return of borrowed stock (RBS) and the balance of stock borrowing (BSB). These values are for the period from November 12, 2015 to May 11, 2016, which is a representative sample of the Tokyo Stock Exchange and the JASDAQ. On each trading day, securities are arranged on the basis of the demand for and supply of lendable securities to categorize them as stocks facing mismatch and non-mismatch situations. The NBS, RBS and BSB of these securities are observed over the next 15 trading days.

	Days after group formation							
	0	1	2	3	4	5	6	7
Panel A: Mismatch								
NBS	15899	13156	12452	12095	11819	11617	11301	11301
RBS	11962	15129	14036	13567	13235	13137	12794	12691
BSB	435933	433732	432316	434921	433254	431510	430024	428727
	8	9	10	11	12	13	14	15
NBS	11139	10989	10948	10933	10844	10876	10899	11176
RBS	12322	12242	11975	11952	12056	11883	11573	15459
BSB	427786	427087	426572	425644	424892	424185	423947	423287
Panel B: Non-mismatch								
	0	1	2	3	4	5	6	7
NBS	3215	3751	3883	3941	4006	3989	4071	4047
RBS	3724	3276	3547	3637	3685	3765	3761	3767
BSB	32586	33023	33377	33852	34210	34417	34786	34978
	8	9	10	11	12	13	14	15
NBS	4109	4106	4128	4134	4178	4178	4172	4290
RBS	3783	3837	3866	3874	3912	3938	3970	4218
BSB	35321	35596	35816	36145	36325	36545	36669	36815

Table 13

Future returns behavior of specials and general collateral securities

This table shows the returns of short-sales constrained and unconstrained stocks over the future. These values are for the period from November 12, 2015 to May 11, 2016, which is a representative sample of the Tokyo Stock Exchange and the JASDAQ. We examine the future return of stocks with high borrowing cost (specials) to observe whether short-sales constrained stocks underperform subsequently. On each trading day, all stocks are ranked in descending order on the basis of their daily cost of borrowing and classified into special (hard to short) and general collateral (GC, easy to short) groups. Returns of special and GC groups are observed over the next 15 trading days. Returns are shown in percent format.

	Days after group formation							
	1	2	3	4	5	6	7	8
GC	-0.0257	-0.0244	-0.0177	-0.0243	-0.0271	-0.0329	-0.0371	-0.0453
Specials	-0.0680	-0.0618	-0.0698	-0.0867	-0.0726	-0.0825	-0.0794	-0.0909
Difference between GC and Specials	0.0423 (0.85)	0.0371 (1.20)	0.0513 (1.90)*	0.0608 (1.73)*	0.0440 (1.21)	0.0475 (1.34)	0.0402 (1.11)	0.0429 (1.19)
	9	10	11	12	13	14	15	
GC	-0.0430	-0.0482	-0.0476	-0.0503	-0.0575	-0.0581	-0.0608	

	-0.0917	-0.0745	-0.0592	-0.0745	-0.0622	-0.0691	-0.0716
Specials							
	0.0454	0.0243	0.0106	0.0220	0.0042	0.0096	0.0096
Difference between GC and Specials	(1.25)	(0.70)	(0.29)	(0.62)	(0.12)	(0.26)	(0.27)

The numbers shown in parentheses are *t*-statistics for a test of the null hypothesis that the difference of the means of the specials and the GC groups is zero. *, ** and *** indicate statistical significance at the 10, 5 and 1 percent levels, respectively.

Table 14

The future returns behavior of securities with high and low short interest ratio

This table reports the behavior of future returns of securities with the highest and lowest short interest ratio (SIR). These values are for the period from November 12, 2015 to May 11, 2016, which is a representative sample of the Tokyo Stock Exchange and the JASDAQ. We examine future returns of stocks with high and low SIR to observe whether stocks with high demand for short sales subsequently underperform. SIR is measured by dividing the daily new borrowings of securities by the number of outstanding shares. On each day, all securities are ranked in descending order and divided into 10 classes. The return behavior of securities in the highest and lowest decile is observed over the next 15 trading days. Returns are shown in percent format.

	Days after Group Formation							
	1	2	3	4	5	6	7	8
Top SIR	-0.0762	-0.0722	-0.0713	-0.0625	-0.0484	-0.0551	-0.0687	-0.0890
Bottom SIR	0.0042	0.0003	0.0055	-0.0026	-0.0022	-0.0072	-0.0114	-0.0189
Difference between Bottom and Top SIR	0.0804 (1.32)	0.0719 (1.13)	0.0754 (1.14)	0.0584 (0.91)	0.0447 (0.67)	0.0459 (0.69)	0.0543 (0.83)	0.0660 (1.00)

	9	10	11	12	13	14	15
Top SIR	-0.0529	-0.0875	-0.0734	-0.0771	-0.0809	-0.0729	-0.0949
Bottom SIR	-0.0189	-0.0204	-0.0259	-0.0251	-0.0285	-0.0322	-0.0357
Difference	0.0307	0.0621	0.0435	0.0471	0.0469	0.0361	0.0522

between	(0.46)	(0.93)	(0.66)	(0.72)	(0.71)	(0.56)	(0.79)
Bottom and							
Top SIR							

The numbers shown in parentheses are *t*-statistics for a test of the null hypothesis that the difference between the means of the top and bottom SIR deciles is zero on each day. *, ** and *** indicate statistical significance at the 10, 5 and 1 percent levels. None of the trading day/decile differences are statistically significant.

Table 15

Regressions of future returns on short-sales variables

This table reports regression coefficients of future returns on selected short-sales variables. These values are for the period from November 12, 2015 to May 11, 2016, which is a representative sample of the Tokyo Stock Exchange and the JASDAQ. The dependent variable is the 15-trading day mean return after potential short sales constraint situations and the independent variables are two short-sales constraints related variables: specialness and the short interest ratio (SIR). Stocks are classified as specials (difficult to short) when the cost of borrowing exceeds one percent per year. Stocks are classified into deciles based on the SIR. Special stocks and stocks in the top decile of SIR are considered short-sales constrained. None of the coefficients are statistically significant.

	Model 1	Model 2
Specials	-0.9962 (0.63)	
SIR		-0.6638 (0.90)
Constant	-0.0296 (0.03)	0.0002 (0.00)
R^2	0.0182	0.0028
Observations	420,665	420,665

The numbers shown in parentheses are clustered standard errors. *, ** and *** indicate statistical significance at the 10, 5 and 1 percent levels, respectively.

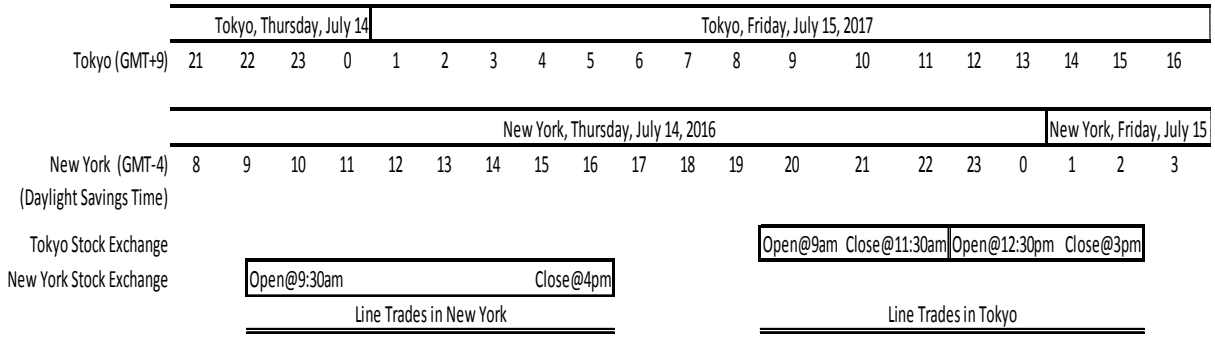

Fig. 1 Time Comparison of Line Corporation Trading in Tokyo and New York

CHAPTER 4

Market Conditions and Momentum in Japanese Stock Returns[4]

Abstract

This study examines the momentum effect in Japanese stock returns on the basis of market conditions. Although previous studies did not find a momentum effect in Japanese stock returns, this study provides evidence that significant momentum profits exist for a particular market condition. When the market is divided into UP and DOWN states, momentum profits are found in the UP market states. A further classification of UP and DOWN market states on the basis of subsequent continuation and reversion (UP-UP, UP-DOWN, DOWN-UP, and DOWN-DOWN) indicates that momentum profits are evident only in the reverting UP states (UP-DOWN). I argue that investors' under-reaction to information causes momentum profits in the reverting UP states in Japan.

Keywords: Momentum Profits, Market Condition, Risk Factors, Under-reaction

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1. Introduction

The efficient market hypothesis suggests that stock prices move randomly and do not offer abnormal profits to investors. This hypothesis also implies that anomalous stock return patterns cannot last long because rational investors' arbitrage activities restore equilibrium. Some anomalous patterns in stock returns were previously found to be significant but eventually disappeared, which supports the efficient market hypothesis. However, the momentum effect, a past-performance-based investment strategy, is still found to be significant in most stock markets of the world. Japan has always been an exception because the momentum effect has never been found in Japanese stock returns. The long-standing evidence of momentum in the major stock markets of the world and the non-existence of momentum in Japanese stock returns make the study of the momentum effect in Japanese stock returns important.

Jegadeesh and Titman (1993) documented the momentum effect in the U.S. stock market by providing evidence that an investment strategy based on buying the past best-performing stocks and selling the worst-performing stocks short produces significant positive returns in the short to intermediate term. After this landmark study, a large number of studies find evidence for, and causes of, momentum profits across the world (Daniel and Titman, 2000; Jegadeesh and Titman, 2001; Lewellen, 2002; Lee and Swaminathan, 2000; Rouwenhorst, 1998, 1999; Chui et al. 2000; Griffin et al. 2003; Gutierrez and Kelley, 2008). Although evidence of momentum is observed across the world, determining its cause is still inconclusive. The proponents of a rational explanation relate momentum to common risks and firm-specific and industry-specific factors (Conrad and Kaul, 1998; Chordia and Shivakumar, 2002, 2006; Dittmar et al. 2007; Sagi and Seasholes, 2007). However, the proponents of behavioral finance explain momentum profits through investors' behavioral biases, such as underreaction and overreaction to information

(Barberies et al. 1998; Daniel et al. 1998; Hong and Stein, 1999). In addition to rational and behavioral explanations, culture (Chui et al. 2010), cognitive dissonance (Antoniou et al. 2013), and period of portfolio formation (Novy-Marx, 2012) are found to explain momentum profits.

Despite the widespread evidence of momentum in the world's major stock markets, Japanese stock returns are found to be devoid of such an effect (Liu and Lee, 2001; Iihara et a. 2004; Chou et al. 2007). Several studies attempt to explain momentum using different methodologies but have not been completely successful. Chui et al. (2000) examine the relevance of foreign ownership concentration to momentum profits, assuming that foreign investors tend to be momentum investors (Choe et al. 1999). Weak evidence of momentum profits is found for stocks with higher foreign ownership concentration. Chou et al. (2007) argue that the unique Japanese culture of collectivism could be the reason for low overconfidence and self-attribution, which in turn impede momentum in stock returns. Chui et al. (2010) also argue that lack of individualism is the reason for the lack of momentum in Japanese stock returns and that investors of collectivist countries put less weight on private information and more weight on the consensus of peers, which is quite opposite to the nature of overconfident investors. However, Fama and French (2012) do not agree with the individualism explanation, on the grounds that low individualism might cause less overreaction but could also cause underreaction, which can produce momentum. Recently, several studies successfully found momentum in Japanese stock returns using different methodologies. Asness et al. (2013) find a significant impact of momentum when combined with the value factor. Because the value effect is very strong in Japan and is negatively related to momentum, significant profits are achieved from the combined strategy of value and momentum. Hanauer (2014) examine the market dynamics hypothesis (Asem and Tian, 2010) and find evidence of significant momentum profits in Japanese stock

returns when the market moves in a similar direction. Iihara, et al. (2016) examine the market state hypothesis (Cooper et al. 2004) and find momentum profits only in UP market states. Investors' overreaction appears to be the primary reason behind momentum profits in UP and continuing states. During UP and continuing market states, investors find their privately and publicly acquired information more confirmed, which induces overconfidence and self-attribution, leading to overreaction (Daniel et al. 1998; Gervais and Odean, 2001). Although previous studies provide evidence that momentum profits based on market conditions in Japan are caused by investors' overreaction, several studies on the cultural and psychological traits of Japanese people seem to contradict the assumption of investors` overreaction in Japan. Kitayama et al. (1997) argued that the personality traits of Japanese people feature 'criticism and subsequent development', which limits self enhancement. Lack of self enhancement restricts self-attribution and overconfidence among Japanese people. Chui et al. (2010) also found that Japan is a country with low individualism, which suggest that Japanese investors are less overconfident. As a result, overreaction that emerges from investors' overconfidence and self-attribution bias as an explanation of momentum profits seems an uncertain explanation. The inconsistent evidence and explanation of momentum profits necessitates further study of the evidence and causes of momentum profits in Japan.

The objective of this study is to examine momentum in Japanese stock returns on the basis of market conditions. To examine whether momentum profits exist in any particular type(s) of market state(s), I measure momentum profits in different market states. Primarily, I divide market states into UP and DOWN states and then again divide the UP and DOWN states on the basis of subsequent market movements. This division produces four market states, such as UP-UP, UP-DOWN, DOWN-UP, and DOWN-DOWN, of which UP-UP and DOWN-DOWN

represent continuations and UP-DOWN and DOWN-UP represent market reversions. This study also examines the long-term performance of momentum portfolios to determine the causes of momentum profits. On the basis of cultural and psychological traits of Japanese people, this study hypothesizes that momentum profits conditioned on market states can be explained by investors' underreaction to information.

This study is related to two previous studies that examine momentum profits conditioned on market states in Japan (Iihara et al. 2016; Hanauer, 2014) but also have important contributions as well. First, hypothesis of this study about the cause of momentum profits in Japanese stock returns are different from previous studies. To the best of my knowledge this is the first study that provides evidence that momentum in Japanese stock returns based on the market condition is caused by investors' underreaction to information. Both Iihara et al. (2016) and Hanauer (2014) explained that investors' overreaction to information was the cause of momentum in Japanese stock returns. However, this explanation seems inconclusive at least for two reasons; first, Hanauer (2014) did not provide evidence that short term momentum profits were followed by a long term reversion to support overreaction hypothesis. Moreover, findings of Hanauer (2014) contradict with Asem and Tian (2010) that did not find evidence of momentum profits in the continuing market states in Japan. Second, previous studies on the cultural and psychological traits of Japanese people do not support the overreaction hypothesis for Japanese investors (Chui, et al. 2010; Kitayama et al. 1997). The inconsistent evidence and inconclusive explanation of market condition based momentum profits in Japanese stock returns require further examination of momentum effect in Japan. Second, this study uses a different methodology in defining market conditions when defining market continuation and reversion. Unlike Hanauer (2014) who defined market continuation (reversion) when short-term market

condition continues (suddenly changed), this study defines market continuation (reversion) when long-term market conditions continue (suddenly changes). The reason for using a different methodology is to find market states that support investors' underreaction.

Using monthly data on all Japanese-listed stocks from November 1984 to November 2014, I reconfirm the prior evidence showing that the momentum effect does not exist in Japanese stock returns. However, momentum profits are found to be significant on the basis of market conditions. When the market is divided into UP and DOWN states, significant momentum profits are found in UP markets and significant losses are found in DOWN markets. When UP and DOWN states are further divided on the basis of subsequent continuation and reversion, significant momentum profits are found only in the reverting UP market (UP-DOWN) states. By considering market continuation and reversion together, momentum profits become insignificant for the entire market. However, momentum profits found in the reverting UP states are not followed by long-term reversions, which does not support the hypothesis that investor overreaction causes momentum profits in Japan. Rather, this study provides new evidence that momentum profits in the revering UP markets are consistent with investors' under-reaction. I argue that when market conditions suddenly change from UP to DOWN states, investors appear to become cautious and respond conservatively to new information. Investors tend to underreact because they do not find conformity of information. Investors' conservatism could also be triggered by cognitive dissonance, which is created when their self-perception about UP states is challenged by a sudden reversion of the market.

[Insert Table 1 around here]

The remainder of this study is organized as follows. Section 2 describes the data and the methodology, section 3 reconfirms the findings of prior studies, section 4 describes the main

empirical findings, section 5 provides an explanation of momentum profits, section 6 discusses the robustness tests, and section 7 concludes the paper.

2. Data and Methodology

This study uses monthly data on all Japanese listed stocks from November 1984 to November 2014 from the Nikkei NEEDS database. Financial securities such as mutual funds and real estate investment trusts (REITs) are not included. As a selection criterion for consideration in momentum portfolios, a stock must have trading records during the formation periods. To control for extreme values, stock returns with values higher than two standard deviations from the mean were excluded. The Nikkei 225 index was used to measure market performance.

I follow the methodology of Jegadeesh and Titman (1993) to form momentum portfolios. At the beginning of the month (t), stocks are ranked on the basis of the last six months' cumulative returns (t–1 to t–6) to form five equal portfolios. The top 20% of the stocks comprise the winner and the bottom 20% of the stocks comprise the loser portfolios. The performances of these winner and loser portfolios are observed over the subsequent 60 months (t + 1 to t + 60). Momentum profits are found by going long on the winner and short on the loser portfolios. Non-overlapping portfolios are formed by skipping one month between formation and observation periods to avoid bid–ask spreads and other microstructure problems (Jegadeesh and Titman, 1993).

Portfolio returns are measured using both raw and risk-adjusted stock returns. The capital asset pricing model (CAPM) and the Fama and French three-factor (1996) model are used to measure risk-adjusted returns:

$$R_t^{adj} = R_t - \beta_p (R_{mt} - R_{ft}) \quad (1)$$

$$R_t^{adj} = R_t - \beta_1 (R_{mt} - R_{ft}) - \beta_2 SMB_t - \beta_3 HML_t \quad (2)$$

where R_t is raw momentum profits, R_{ft} is the risk free rate, R_{mt} is the market return, SMB is the size risk premium, and HML is the value risk premium. β_1, β_2, and β_3 are the estimated loadings from a regression of the time series of raw profits on the risk premiums and a constant.

The UP and DOWN states are measured using past market returns. If the previous 36 months' cumulative market returns are positive ($\sum R_{m,t-1 \text{ to } t-36} \geq 0$), the UP market state is defined. For negative cumulative returns ($\sum R_{m,t-1 \text{ to } t-36} < 0$) in the previous 36 months, the DOWN market state is defined. Market states are also measured using 24-month cumulative performance to ensure that the results are not affected by the definition of market performance. I further divide UP and DOWN states according to subsequent continuations and reversions of the market. Market returns in the portfolio formation month are considered to measure continuations and reversions of the market. If market returns in the portfolio formation month are positive (negative) when the previous market condition is UP (DOWN), the market is considered to be in continuation. Returns of momentum portfolios are measured in the UP-UP, UP-DOWN, DOWN-UP, and DOWN-DOWN states. UP-UP and DOWN-DOWN states represent continuing markets and UP-DOWN and DOWN-UP states represent reverting markets.

Among the studies of market conditions and momentum profits, Cooper et al. (2004) used the most comprehensive definition of market states by defining UP and DOWN states based on the last 36-month and 24-month market performance. Asem and Tian (2010) defined market conditions based on the last 12-month market performance and categorized market conditions into continuation and reversion by comparing the last 12-month's cumulative market performance to the current month's market performance. In this study, I have defined market conditions based on the last 36-month and 24-month cumulative market performance. The reason for using a longer horizon is to define market conditions in a way that is consistent with the

hypothesis used in this study. This study hypothesizes that investors underreact in a market condition when their long lasting perception is challenged by opposite information. To support long lasting perception about market conditions, this study defines market condition using a longer horizon of market performance.

3. Is Momentum Evident in Japan?

I use the methodology of Jegadeesh and Titman (1993) to examine whether momentum is evident in Japanese stock returns. Table 2 shows the monthly profits of the winner, loser, and momentum portfolios. With few exceptions, all portfolios produce negative returns in the observation periods ranging from one month to 60 months. Momentum profits are not evident in the first year after forming the portfolios. However, from the second to the fifth years, momentum portfolios produce significant profits. Although the absence of the momentum effect in the intermediate term is similar to the previous findings, the presence of positive long-term returns on momentum portfolios contradict other studies that primarily find long-term reversals (Liu and Lee, 2001; Iihara et al. 2004; Chou et al. 2007).

To examine whether evidence of long-term momentum is compensation for risks, this study measures risk-adjusted portfolio returns. Both the CAPM and the Fama–French three-factor model are used to measure risk-adjusted returns. Table 2 also reports the risk-adjusted returns of the portfolios. Although the market factor is found not to explain momentum portfolio returns, the Fama–French three-factor model explains momentum portfolio returns to some extent. Positive momentum profits in the second year no longer exist in the risk-adjusted returns, indicating that such profits are compensation for either size or value factors. Furthermore, the magnitude of the momentum profits in the third, fourth, and fifth years is reduced. In short, no

evidence exists of short- to intermediate-term momentum profits; however, long-term profits are observed even after adjusting for risks.

[Insert Table 2 around here]

4. Market Conditions and Momentum

To examine the momentum profits conditioned on the market states, the market is divided into UP and DOWN states. The market-states hypothesis (Cooper et al. 2004) conjectures that momentum profits are significant in UP states and insignificant in DOWN states because investors tend to overreact in UP states. Significant momentum profits in the short-term followed by a long-term reversion will provide evidence for the overreaction hypothesis in the Japanese market.

Table 3 indicates the monthly profits in the UP and DOWN states. Momentum profits are measured for the first six and 12 months, whereas long-term performance is measured using 13- to 60-month returns. Panel A shows the average monthly profits for the entire market. Momentum profits appear not to exist; however, long-term profits from momentum portfolios are evident.

Panel B shows monthly momentum profits in the UP and DOWN states when market states are defined by the 36-month market performance. Strong momentum profits are observed in the first six and 12 months, but a long-term reversal is not found. In the DOWN states, a significant reversal is found in the first six months that becomes insignificant in subsequent months. The long-term performance of the momentum portfolios is found to be significantly positive. Panel C shows monthly momentum profits in the UP and DOWN states when market states are defined by the 24-month market performance. The momentum portfolio performance following the 24-month UP and DOWN states is quite similar to the findings in Panel B. Significant momentum

profits are observed in the first six and 12 months but no long-term reversion is found. In the DOWN states, a significant reversal is found in the first six months that becomes insignificant in the 12-month performance. However, unlike DOWN states defined by the 36-month market performance, evidence of long-term momentum profits is not found.

It is important to confirm that the evidence previously found is not compensation for risks. Investors' behavior would be responsible for momentum profits in the UP states that survive even after adjusting for risks. Risk-adjusted returns are measured using the CAPM and the Fama–French three-factor model. Table 3 also reports the risk-adjusted momentum profits in the UP and DOWN states. The risk-adjusted momentum profits also show patterns similar to the raw momentum profits. Momentum profits are significantly positive in the first six and 12 months following 36-and 24-month UP markets but do not revert in the long term. Similarly, significant reversal is found for DOWN states in the first six months that becomes insignificant in subsequent months. However, long-term positive momentum portfolio returns in DOWN states are inconsistent and evident in the 36-month DOWN states but not in the 24-month DOWN states. Both the CAPM and the Fama–French three-factor model for the adjusted momentum profits following UP and DOWN states produce similar results. The results of the risk-adjusted momentum profits indicate that significant momentum profits (loss) found in the UP (DOWN) states are not compensation for known risk factors.

However, momentum profits found in the UP states do not revert in the long-term, which suggests that investor overreaction does not cause momentum profits in Japan. Previous findings that Japanese investors tend to underreact (Chui et al. 2010) support the findings of this study. As a result, further division of the market states is required to explain momentum profits in the UP

states. To this end, I divide UP and DOWN states according to subsequent continuations and reversions.

[Insert Table 3 around here]

Table 4 indicates momentum profits in the UP and DOWN states when the market moves in a similar direction or reverts. Momentum profits are not evident in the continuing UP (UP-UP) states but are evident in the reverting UP (UP-DOWN) states. In the DOWN market, momentum profits do not exist in either the continuing or the reverting states. The evidence of momentum profits in the reverting UP (UP-DOWN) states needs confirmation that they are not compensation for risk. To measure the risk-adjusted momentum profits, the CAPM and the Fama–French three-factor model are used. Table 4 also indicates the risk-adjusted momentum profits in the UP-UP, UP-DOWN, DOWN-UP, and DOWN-DOWN states. The implication of the results remains the same, except that the statistical significance of the momentum profits and losses changes to some extent. Similar to the results for the raw returns, risk-adjusted returns do not provide any evidence of momentum profits in continuing UP or DOWN states, but significant momentum profits are evident in reverting UP markets. Both raw and risk adjusted returns provide evidence that short term momentum profits are quite significant in reverting UP states.

[Insert Table 4 around here]

5. What Explains Momentum Profits in Japan?

This study finds that market conditions provide important insights into momentum profits in Japanese stock returns. The evidence of momentum profits only in reverting UP states explains why momentum is not evident in Japan when a conventional methodology is used. Momentum profits in reverting UP states are offset by negative momentum profits in DOWN states, leaving

no significant momentum profits for the entire market. The strength of momentum profits in reverting UP states is not strong enough to produce momentum profits for the entire market, offsetting momentum losses in DOWN states. This result occurs partly because the appearance of UP states is comparatively less frequent than that of DOWN states and partly because momentum profits are not evident in all UP states but are instead evident only in reverting UP (UP-DOWN) states. The situation contrasts with that in the United States, in which the appearance of UP states is more frequent than that of DOWN states. The percentage of UP states in the total sample period is 84.5% in the United States (Cooper et al. 2004), whereas that in Japan is only 52.54%. The market continues in a similar direction in 54% of the UP-state cases and reverts in 46% of these cases. As a result, momentum-producing market states appear in only 24.16% of cases in Japan. These results suggest that the long-lasting recession since the collapse of the bubble economy and infrequent market reversion in the UP states are the reasons why momentum profits are not observed in Japanese stock returns when a conventional methodology is used.

The evidence of momentum profits in reverting UP states found in this study is consistent with the under-reaction hypothesis. Barberies et al. (1998) argue that a conservatism bias makes investors slow to react to new information that causes momentum. When market conditions suddenly change from UP to DOWN states, investors appear to become cautious and respond conservatively to new information. Investors' conservatism could be triggered by cognitive dissonance, which is created when their self-perception is challenged by information. Cognitive dissonance can result in avoidance of contradictory information or in limitations to the ability to evaluate information (Nofsinger, 2011, p. 41). As a result, investors tend to underreact to information in reverting UP markets. Antoniou et al. (2013) also argue that strong momentum is

produced through optimism because investors underreact to contradictory information. Assumptions related to the overreaction hypothesis also suggest why investors might underreact in reverting UP states. Investors tend to overreact in a market in which they become overconfident because of self-attribution. In UP and continuing market states, investors find that their own information conforms with public information, which induces self-attribution and causes them to overreact (Daniel et al. 1998; Gervais and Odean, 2001). In reverting UP states, investors tend to underreact because they do not find conformity of information. Following this line of reasoning, investors are expected to underreact more when they face larger reversion in the market because in this situation investors will have higher cognitive dissonance. I test this conjecture by dividing reverting UP market states into maximum reverting UP states and minimum reverting UP states. Maximum (minimum) reverting UP states are measured by the highest (lowest) deviation between the last three years' cumulative market performance and the current month's market performance. Table 5 shows momentum profits in these maximum and minimum reverting UP states. Supporting the conjecture, I find that momentum profits in the maximum reverting states are significantly higher, but those in minimum reverting states earn only normal profits.

[Insert Table 5 around here]

6. Robustness Checks

6.1 Seasonality and Momentum

Several studies document seasonality in stock returns some of which are still significant in many stock markets of the world (Banz, 1981; Blume and Stambaugh, 1983; Keim, 1983; Bauman and Jacobsen, 2002; Andrde et al. 2013). Although the January effect was found to be significant in past decades, its strength is diminished in most developed stock markets in recent times. In

unreported analysis, I also find that the January effect is not evident in Japanese stock returns. As a result, I did not report the January effect in conditional momentum profits in Japan. The sell in May effect, which shows evidence of higher returns in the November-April period compared to the May-October period of the year, is found to be significant in most of the stock markets of the world including Japan (Bauman and Jacobsen, 2002; Andrde et al. 2013). Since the sell in May effect is found to be significant in Japan, I examine whether momentum in the Japanese stock returns found in the reverting UP states are influenced by the sell in May effect. To examine this, momentum profits during the November-April and May-October periods are measured separately to observe if they are equal in both periods of the year.

Table 6 reports momentum profits in the November-April and May-October period of the year. I do not find any evidence that momentum profits in the reverting UP market states are influenced by the sell in May effect. The November-April period in the whole sample period earns similar momentum profits as the May-October period when market states are defined by their performance over the last 36-months. The amount and significance of momentum profits in the November-April and the May-October period do not materially change when market states are defined by the last 24-month format.

Sakakibara et al. (2013) report a different seasonal pattern in Japanese stocks in that the January-June period of the year produces significantly higher returns than the July-December period, which they term as 'Dekansho-busi effect'. Taking this country specific phenomenon into consideration, I also examine whether momentum profits are affected by the Dekansho-busi effect. To examine the Dekansho-bushi effect in the momentum profits, I measure momentum profits in the January-June and July-December periods separately to observe if they are different.

Table 6 also reports momentum profits divided into the January-June and July-December periods. Like the sell in May effect, there is no evidence of the Dekansho-bushi effect in the momentum profits. During the whole sample period, the January-June period earns higher momentum profits than the July-December period in the reverting UP states when market states are defined by the last 36-month. However, the evidence reverses when market states are defined by the last 24-month format.

Although there is evidence that the January effect does not affect momentum profits in the USA (Jegadeesh and Titman, 1993, 2001), previous studies do not examine the effect of the sell in May effect or the Dekansho-bushi effect in momentum profits. The results of Table 6 suggest that momentum profits found in the reverting UP states are not affected by the sell in May effect or the Dekansho-bushi effect.

[Insert Table 6 around here]

6.2 Short-sales Constraints and Momentum

Short-sale constraints appear to be important to the momentum of stock returns because previous studies find that momentum profits are more pronounced for short-sale constrained stocks (Ali and Trombley, 2006). Short-sale constraints limit the capacity of the rational investor to arbitrage short-term price continuations. As a result, significant momentum is produced for short-sale constrained stocks. Japan has a centralized system of stock borrowing and lending, which suggests that short-sales can be done relatively easily. Rather than being controlled by the broker, Japanese stock borrowing and selling are controlled by a centralized institution called Japan Securities Finance Company. Stocks that are allowed for short sales are called taishaku stocks. Because non-taishaku stocks face constraints in selling short, I hypothesize that significant momentum profits are produced for non-taishaku stocks. As a result, it is possible that

momentum profits found in the reverting UP states are caused by the short-sale constraint. To test the hypothesis, I measure momentum profits for taishaku and non-taishaku stocks for different states of the market. In March of each year, I sort stocks into taishaku and non-taishaku classes. I also independently sort stocks on the basis of their last six months' cumulative returns to form three equally weighted portfolios called winner (top 30%), neutral (middle 40%), and loser (bottom 30%). The interaction of these two independent sorts produces six portfolios. Momentum profits for taishaku and non-taishaku stocks are found by going long on winner and short on loser portfolios. Table 7 reports momentum profits for taishaku and non-taishaku stocks in continuing and reverting UP states. Momentum profits are neither significant in reverting UP states nor in continuing UP states. Although, contrary to the hypothesis, taishaku stocks produce a little higher momentum profits than non-taishaku stocks both in continuing and reverting UP states, they are not statistically significant. This result suggests that momentum profits in reverting UP states are not caused by short-sale constraints.

[Insert Table 7 around here]

6.3 Sub-period Analysis

In recent history, the Japanese stock market has gone through two distinct long term market trends. One is the booming market trend that persisted till 1990 and the other is the recession that starts from 1991 (Alexander, 2000). Since I examine momentum profits based on market conditions, it is important to observe whether the shift in market trends affect the results of the study. To examine this, the whole sample is divided into two sub–periods, from November, 1984 to December, 1990 and January, 1991 to November, 2014. Table 8 shows momentum profits in the UP and DOWN states during the 1984–1990 and 1991–2014 periods. No patterns are observed in UP states during the 1984–1990 period. Although momentum profits in reverting UP

states are higher than continuing UP states, they are not statistically significant. However, this study provides evidence for significantly higher momentum profits in reverting UP states than continuing UP states in the 1991-2014 period.

[Insert Table 8 around here]

6.4 Market Conditions and Momentum Profits based on an alternative Index to measure market conditions

While measuring momentum profits based on the market conditions, I used Nikkei 225 index to define market condition. Although Nikkei 225 is a widely used index, it is also possible that market conditions could be differently categorized when an alternative index is used. To check whether results of this study are robust against the use of an index to define market conditions, I used TOPIX as an alternative index to measure market condition. TOPIX is a market capitalization weighted index that includes all domestic stocks in the first section of the Tokyo Stocks Exchange. Table 9 reports momentum profits in the continuing and reverting UP and DOWN states as measured by using TOPIX. The number of months in the continuing and reverting UP and DOWN states are almost similar indicating that both the indices measure market condition quite similarly. Although some differences are found in categorizing market as continuing and reverting UP and DOWN states, those differences do not change the implication of the results of this study. The reverting UP states is found to produce significantly positive momentum profits in the short term when market conditions are defined by both 36-month and 24-month cumulative market performance although the level of significance reduce to a small extent. The short term momentum profits in the reverting UP states are not found to revert in the long term. Overall, results suggest that the choice of index to define market conditions do not affect the findings of this study.

[Insert Table 9 around here]

7. Conclusion

This study examines the momentum effect in Japanese stock returns based on market conditions. I provide evidence of significant momentum in Japanese stock returns in reverting UP states, even after adjusting for risks. When the market condition is divided into UP and DOWN states, significant momentum profits are found only in UP markets but long-term reversion is not found, which does not support the hypothesis that momentum profits in the UP states are caused by investors' overreaction. Considering the cultural and psychological traits of Japanese people, I conjecture that momentum profits are caused by investors' underreaction to information. To that end, I further divide UP and DOWN states on the basis of subsequent continuation and reversion. Significant momentum profits are found only in reverting UP states but not in continuing UP states. I argue that when market conditions suddenly change from UP to DOWN states, investors appear to become cautious and respond conservatively to new information. Investors' conservatism is also triggered by cognitive dissonance, which is created when their self-perception about UP states is challenged by sudden reversion of the market. Evidence of momentum profits only in reverting UP states also explains the non-existence of momentum profits in Japanese stock returns when a conventional methodology is used. More prevalent DOWN states in Japan attributable to the long-standing recession offset momentum profits produced in reverting UP states.

I also check the robustness of the momentum profits found in reverting UP states. Seasonality such as the sell-in-May effect and the Dekansho-bushi effect, and short-sale constraint do not significantly affect momentum profits in reverting UP states. Use of an alternative index to define market conditions also does not change the findings of this study.

However, sub-period analysis shows that momentum profits in reverting UP states are more pronounced during the 1991–2014 period.

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Table 1

Summary of related studies

Table 1 reports comparison of this study with three of the related studies made on Japan with regard to sample period, hypothesis, and findings.

	Sample Period	Hypothesis	Findings
Iihara et al. (2016)	1977-2005	Overreaction hypothesis	Momentum is found in UP states
Hanauer (2014)	1986-2012	Overreaction hypothesis	Momentum is found in UP-UP and DOWN-DOWN states
Asem and Tian (2010)	1985-2005	Overreaction hypothesis	Momentum is found in UP-DOWN, DOWN-UP and DOWN-DOWN states
This study (2016)	1984-2014	Underreaction hypothesis	Momentum is found in UP-DOWN states

Table 2

Monthly portfolio returns

Table 2 reports monthly returns of the winner, loser, and momentum portfolios. At the beginning of the portfolio construction month, stocks are ranked on the basis of the last six months' cumulative returns, skipping the last month's performance. Portfolio performance is observed over the subsequent 60 months. Momentum portfolios are formed by going long on the winner and short on the loser portfolios. Both raw and risk-adjusted returns are presented. The CAPM and the Fama–French three-factor model are used to measure the risk-adjusted returns. K represents the number of months in the observation period.

		Winner (W)	Loser (L)	W – L
K = 1	Raw returns	-.0024 (-0.39)	.0011 (0.10)	-.0035(-0.52)
	CAPM Alpha	-.0021 (-0.54)	.0015 (0.23)	-.0036 (-0.59)
	FF three-factor alpha	-.0042 (-1.22)	-.0048 (-1.11)	.0006 (0.11)
K = 3	Raw returns	-.0045 (-0.90)	-.0043 (-0.66)	-.0002 (-0.06)
	CAPM Alpha	-.0043 (-0.99)	-.0041 (-0.75)	-.0002 (-0.08)
	FF three-factor alpha	-.0053 (-1.15)	-.0060 (-1.06)	.0006 (0.21)
K = 6	Raw returns	-.0029 (-0.79)	-.0022 (-0.46)	-.0007 (-0.35)
	CAPM Alpha	-.0028 (-0.84)	-.0021 (-0.48)	-.0007 (-0.37)
	FF three-factor alpha	-.0018 (-0.52)	-.0019 (-0.44)	.0001 (0.05)
K = 9	Raw returns	-.0021 (-0.76)	-.0036 (-1.08)	.0014 (1.03)
	CAPM Alpha	-.0020 (-0.81)	-.0035 (-1.18)	.0014 (1.03)
	FF three-factor alpha	-.0013 (-0.50)	-.0026 (-0.83)	.0012 (0.83)
K = 12	Raw returns	-.0015 (-0.63)	-.0029 (-1.09)	.0015 (1.21)
	CAPM Alpha	-.0014 (-0.66)	-.0029 (-1.18)	.0014 (1.22)
	FF three-factor alpha	-.0014 (-0.62)	-.0028 (-1.09)	.0013 (1.08)
K = 24	Raw returns	-.0015 (-0.86)	-.0027 (-1.48)	.0012 (1.77)*
	CAPM Alpha	-.0015 (-0.86)	-.0027 (-1.50)	.0012 (1.76)*
	FF three-factor alpha	-.0011 (-0.60)	-.0022 (-1.13)	.0011 (1.42)
K = 36	Raw returns	-.0012 (-0.87)	-.0025 (-1.64)	.0013 (2.53)**
	CAPM Alpha	-.0012 (-0.86)	-.0025 (-1.63)	.0013 (2.50)**
	FF three-factor alpha	-.0010 (-0.70)	-.0023 (-1.37)	.0012 (2.14)**
K = 48	Raw returns	-.0012 (-0.97)	-.0024 (-1.77)*	.0011 (2.58)**
	CAPM Alpha	-.0012 (-0.97)	-.0024 (-1.77*)	.0012 (2.56)**
	FF three-factor alpha	-.0010 (-0.79)	-.0021 (-1.44)	.0010 (2.07)**
K = 60	Raw returns	-.0011 (-1.04)	-.0023 (-1.99)*	.0011 (2.81)***
	CAPM Alpha	-.0011 (-1.04)	-.0023 (-1.98)*	.0011 (2.78)***
	FF three-factor alpha	-.0011 (-0.97)	-.0022 (-1.79)*	.0011 (2.44)**

Figures within parenthesis show t values. ***, **, and * are equivalent to significance levels of 1%, 5%, and 10%, respectively.

Table 3

Momentum profits in the UP and DOWN states

Table 3 reports raw and risk-adjusted momentum profits in the UP and DOWN states. The risk-adjusted momentum profits are estimated from the regression of raw momentum profits on the CAPM and Fama–French three factors. Momentum profits are measured on the basis of the six-month formation and 60-month observation periods. Panel A indicates the raw and risk-adjusted momentum profits for the entire market. Panel B and Panel C indicate the momentum profits following UP and DOWN states when market states are defined by the last 36-month and 24-month cumulative market returns.

Panel A: Momentum profits for the entire market (n = 354)			
Months	1-6	1-12	13-60
Monthly profits	-.0008 (-0.35)	.0015 (1.21)	.0009 (2.22)**
CAPM alpha	-.0008 (-0.37)	.0014 (1.22)	.0009 (2.22)**
FF Three Factor alpha	.0001 (0.05)	.0013 (1.08)	.0008 (1.78)*
Panel B: Momentum profits following 36-month UP markets (n = 186)			
Monthly profits	.0050 (2.22)**	.0045 (2.90)***	.0004 (0.74)
CAPM alpha	.0049 (2.20)**	.0045 (2.97)***	.0004 (0.72)
FF Three Factor alpha	.0053 (2.22)**	.0041 (2.45)**	.0003 (0.44)
Momentum profits following 36-month DOWN markets (n = 168)			
Monthly profits	-.0068 (-2.06)**	-.0017 (-1.00)	.0013 (2.11)**
CAPM alpha	-.0069 (-2.18)**	-.0018 (-1.06)	.0015 (2.39)**
FF Three Factor alpha	-.0053 (-1.67)	-.0013 (-0.72)	.0013 (2.02)*
Panel C: Momentum profits following 24-month UP markets (n = 200)			
Monthly profits	.0053 (2.67)**	.0044 (3.05)***	.0007 (1.61)
CAPM alpha	.0020 (2.55)**	.0014 (2.93)***	.0008 (1.67)
FF Three Factor alpha	.0058 (2.94)***	.0041 (2.80)***	.0008 (1.62)
Momentum profits following 24-month DOWN markets (n = 154)			
Monthly profits	-.0087 (-2.44)**	-.0024 (-1.35)	.0010 (1.38)
CAPM alpha	-.0035 (-2.35)**	-.0023 (-1.25)	.0009 (1.35)
FF Three Factor alpha	-.0092 (-2.28)**	-.0020 (-0.89)	.0007 (0.86)

Figures within parenthesis show t values. ***, **, and * are equivalent to significance levels of 1%, 5%, and 10%, respectively.

Table 4

Momentum profits in continuing and reverting UP and DOWN states

Table 4 reports the raw and risk-adjusted momentum profits in continuing and reverting UP and DOWN states. Momentum profits are measured on the basis of the six-month formation and the one to 60-month observation periods. UP and DOWN states are measured using the last 36-month and 24-month cumulative market returns. Market continuation (reversion) is used when UP state is followed by positive (negative) current month returns and DOWN state is followed by negative (positive) current month returns. Panels A to Panel H show raw and risk-adjusted returns of momentum portfolios in continuing and reverting UP and DOWN states.

Panel A: Momentum profits following 36-month UP-UP markets (n = 97)			
	1-6 Months	1-12 Months	13-60 Months
Monthly profits	.0006 (0.34)	.0019 (0.00)	.0001 (0.00)
CAPM alpha	-.0002 (-0.36)	.0052 (1.74)	.0000 (0.07)
FF Three Factor alpha	-.0001 (-0.16)	.0049 (1.21)	-.0004 (-0.36)
Panel B: Momentum profits following 36-month UP-DOWN markets (n = 89)			
Monthly profits	.0088 (2.38)**	.0068 (2.75)**	.0004 (0.67)
CAPM alpha	.0026 (2.91)**	.0080 (2.04)*	.0011 (1.15)
FF Three Factor alpha	.0049 (2.66)**	.0074 (1.74)*	.0010 (0.98)
Panel C: Momentum profits following 36-month DOWN-UP markets (n = 90)			
Monthly profits	-.0069 (-1.66)	-.0014 (-0.79)	.0012 (1.58)
CAPM alpha	.0004 (0.13)	.0018 (1.29)	.0002 (0.30)
FF Three Factor alpha	.0006 (0.20)	.0018 (1.22)	.0003 (0.43)
Panel D: Momentum profits following 36-month DOWN-DOWN markets (n = 78)			
Monthly profits	-.0068 (-1.21)	-.0022 (-0.64)	.0010 (1.35)
CAPM alpha	.0015 (0.12)	-.0032 (-0.43)	.0013 (0.82)
FF Three Factor alpha	-.0021 (-0.15)	-.0041 (-0.47)	.0013 (0.72)
Panel E: Momentum profits following 24-month UP-UP markets (n = 114)			
Monthly profits	.0016 (0.92)	.0023 (1.54)	.0004 (1.04)
CAPM alpha	.0017 (0.63)	.0047 (2.11)*	.0006 (0.90)
FF Three Factor alpha	.0026 (0.87)	.0052 (2.15)*	.0005 (0.73)
Panel F: Momentum profits following 24-month UP-DOWN markets (n = 86)			
Monthly profits	.0089 (2.64)**	.0065 (2.68)**	.0039 (1.22)
CAPM alpha	.0146 (2.63)**	.0071 (1.70)	.0014 (1.35)
FF Three Factor alpha	.0143 (2.79)**	.0064 (1.53)	.0015 (1.28)
Panel G: Momentum profits following 24-month DOWN-UP markets (n = 73)			
Monthly profits	-.0104 (-2.24)**	-.0027 (-1.40)	.0011 (1.16)
CAPM alpha	.0039 (0.77)	.0045 (3.27)***	-.0016 (-1.36)
FF Three Factor alpha	.0000 (0.01)	.0036 (1.99)*	-.0011 (-0.74)
Panel H: Momentum profits following 24-month DOWN-DOWN markets (n = 81)			
Monthly profits	-.0070 (-1.23)	-.0023 (-0.68)	.0005 (0.72)
CAPM alpha	-.0026 (-0.29)	-.0024 (-0.45)	.0003 (0.32)
FF Three Factor alpha	-.0073 (-0.66)	-.0010 (-0.14)	-.0003 (-0.27)

Figures within parenthesis show t values. ***, **, and * are equivalent to significance levels of 1%, 5%, and 10%, respectively.

Table 5

Momentum profits in maximum and minimum reverting UP states

Table 5 shows raw and risk-adjusted momentum profits in maximum and minimum reverting UP states. Momentum profits are measured on the basis of the six-month formation and the six-month observation periods. Market states are denoted as reverting UP when the last 36-month positive cumulative market returns is followed by negative current-month returns. Maximum (minimum) reverting UP states are measured by the highest (lowest) difference between the last 36-month positive cumulative market returns and current-month returns.

Momentum profits maximum and minimum reverting UP states			
	UP-DOWN	UP-DOWN (Maximum)	UP-DOWN (Minimum)
Raw	.0088 (2.38)**	0.0090 (3.97)***	.0090 (1.23)
CAPM alpha	.0026 (2.91)**	.0134 (5.49)***	.0181 (1.57)
FF three-factor alpha	.0049 (2.66)**	.0125 (4.76)***	.0153 (0.92)

Figures within parenthesis show t values. ***, **, and * are equivalent to significance levels of 1%, 5%, and 10%, respectively.

Table 6

Seasonality and momentum profits

Table 6 reports the sell in May and the Dekansho-bushi effect in momentum profits. To examine the sell in May effect, momentum profits have been classified into the November–April and May–October periods. To examine the Dekansho–bushi effect, momentum profits have been classified into the January–June and July–December periods. Panel A and Panel B show momentum profits in the November–April and May–October periods following 36-month and 24-month UP and DOWN markets. Panel C and Panel D show momentum profits in the January-June and July-December periods following 36-month and 24-month UP and DOWN markets.

Panel A: Momentum profits in the November - April and May - October periods following 36-month UP and DOWN markets			
	UP	UP-UP	UP-DOWN
November – April	.0025 (1.28)	.0009 (0.38)	.0066 (2.02)*
May – October	.0077 (1.85)*	.0001 (0.04)	.012 (2.02)*
Panel B: Momentum profits in the November - April and May - October periods following 24-month UP and DOWN markets			
Panel B: Momentum profits following 24-month UP and DOWN markets			
November – April	.0009 (2.17)**	.0015 (0.92)	.0084 (2.95)**
May – October	.0004 (0.71)	.0010 (0.55)	.0095 (2.69)**
Panel C: Momentum profits in the January - June and July - December periods following 36-month UP and DOWN markets			
Panel C: Momentum profits following 36-month UP and DOWN markets			
January – June	.0035 (1.10)	.0014 (0.32)	.0086 (1.81)*
July – December	.0026 (0.75)	-.0015 (-0.32)	.0057 (1.06)
Panel D: Momentum profits in the January - June and July - December periods following 24-month UP and DOWN markets			
Panel D: Momentum profits following 24-month UP and DOWN markets			
January – June	.0003 (0.72)	-.0020 (-2.54)**	-.0007 (-1.08)
July – December	.0010 (1.81)*	.0007 (1.38)	.0009 (0.96)

Figures within parenthesis show t values. ***, **, and * are equivalent to significance levels of 1%, 5%, and 10%, respectively.

Table 7

Short-sale constraints and momentum profits

Table 7 reports momentum profits for taishaku (T) and non-taishaku (NT) stocks following 36-month and 24-month UP and DOWN markets. In March of each year, stocks are sorted into taishaku and non-taishaku groups. Stocks are also sorted into three groups based on the last six months performance. The top 30% comprise winners (W), the middle 40% comprise neutral (N) and the bottom 30% comprise losers (L). Interaction of these two independent sorts makes six portfolios such as TW, TN, TL, NTW, NTN, and NTL. Momentum profits are measured for taishaku and non-taishaku groups by going long on winners and short on losers.

Momentum profits of Taishaku and Non-Taishaku stocks following 36-month UP and DOWN markets			
	UP	UP-UP	UP-DOWN
Taishaku	.0049 (0.69)	-.0016 (-0.28)	.0102 (0.84)
Non-Taishaku	-.0010 (-0.17)	-.0062 (-1.02)	.0031 (0.34)
Momentum profits of Taishaku and Non-Taishaku stocks following 24-month UP and DOWN markets			
	UP	UP-UP	UP-DOWN
Taishaku	.0018 (0.27)	.0023 (0.40)	.0015 (0.12)
Non-Taishaku	-.0053 (-1.06)	-.0022 (-0.37)	-.0079 (-0.99)

Figures within parenthesis show t values. ***, **, and * are equivalent to significance levels of 1%, 5%, and 10%, respectively.

Table 8

Market conditions and momentum profits: Sub-period analysis

Table 8 shows momentum profits for the whole sample period and for two equally divided sub-periods, 1984–1990 and 1991–2014. Momentum profits, using the six-month formation and the six-month observation periods, are measured in continuing and reverting UP states following 36-month and 24-month UP and DOWN markets.

Panel A: Momentum profits following 36-month UP and DOWN markets			
	UP	UP-UP	UP-DOWN
1984 – 2014	.0049 (2.22)**	.0006 (0.34)	.0087 (2.38)**
1984 – 1990	.0020 (1.09)	-.0002 (-0.14)	.0047 (1.45)
1991 - 2014	.0066 (1.99)*	.0012 (0.43)	.0105 (2.06)*
Panel B: Momentum profits following 24-month UP and DOWN markets			
	UP	UP-UP	UP-DOWN
1984 – 2014	.0053 (2.66)**	.0015 (0.92)	.0089 (2.64)**
1984 – 1990	.0020 (1.09)	-.0003 (-0.14)	.0048 (1.45)
1991 - 2014	.0070 (2.48)**	.0026 (1.05)	.0106 (2.32)**

Figures within parenthesis show t values. ***, **, and * are equivalent to significance levels of 1%, 5%, and 10%, respectively.

Table 9

Momentum profits in continuing and reverting UP and DOWN states using a different index to measure market conditions

Table 9 reports the raw and risk-adjusted momentum profits in continuing and reverting UP and DOWN states when market conditions are measured by using a different Index called TOPIX. Momentum profits are measured on the basis of the six-month formation and the one to 60-month observation periods. UP and DOWN states are measured using the last 36-month and 24-month cumulative market returns. Market continuation (reversion) is used when UP state is followed by positive (negative) current month returns and DOWN state is followed by negative (positive) current month returns. Panels A to Panel H show raw and risk-adjusted returns of momentum portfolios in continuing and reverting UP and DOWN states.

Panel A: Momentum profits following 36-month UP-UP markets (n = 101)			
	1-6 Months	1-12 Months	13-60 Months
Monthly profits	-.0014 (-0.62)	.0022 (1.08)	.0003 (1.30)
CAPM alpha	-.0019 (-0.76)	.0032 (1.67)	-.0003 (-0.91)
FF Three Factor alpha	.0000 (0.00)	.0018 (1.54)	.0000 (0.01)
Panel B: Momentum profits following 36-month UP-DOWN markets (n = 88)			
Monthly profits	.0097 (2.16)**	.0051 (2.23)**	.0005 (0.80)
CAPM alpha	.0046 (2.66)**	.0071 (2.19)**	.0012 (1.65)
FF Three Factor alpha	.0021 (2.14)**	.0039 (1.79)*	.0013 (1.46)
Panel C: Momentum profits following 36-month DOWN-UP markets (n = 84)			
Monthly profits	-.0059 (-1.29)	-.0011 (-0.61)	.0009 (0.95)
CAPM alpha	.0012 (1.63)	.0038 (1.19)	-.0011 (-1.68)
FF Three Factor alpha	.0013 (1.71)	.0029 (1.08)	-.0017 (-1.91)*
Panel D: Momentum profits following 36-month DOWN-DOWN markets (n = 81)			
Monthly profits	-.0072 (-1.47)	-0.0009 (-0.28)	.0012 (1.87)*
CAPM alpha	.0003 (0.04)	.0035 (0.79)	.0014 (1.38)
FF Three Factor alpha	.0008 (0.10)	.0019 (0.39)	.0009 (0.76)
Panel E: Momentum profits following 24-month UP-UP markets (n = 108)			
Monthly profits	.0011 (0.57)	.0024 (1.20)	.0007 (1.91)*
CAPM alpha	.0032 (1.32)	.0039 (1.71)	.0008 (1.38)
FF Three Factor alpha	.0041 (1.47)	.0013 (1.44)	.0005 (0.83)
Panel F: Momentum profits following 24-month UP-DOWN markets (n = 88)			
Monthly profits	.0088 (2.64)**	.0065 (2.69)**	.0039 (1.22)
CAPM alpha	.0141 (2.53)**	.0068 (1.91)*	.0014 (1.30)
FF Three Factor alpha	.0139 (2.68)**	.0062 (1.82)*	.0014 (1.24)
Panel G: Momentum profits following 24-month DOWN-UP markets (n = 77)			
Monthly profits	-.0085 (-1.76)	-.0028 (-1.47)	.0014 (1.66)
CAPM alpha	.0030 (0.52)	.0023 (1.29)	-.0002 (-0.20)

FF Three Factor alpha	.0012 (0.15)	.0034 (1.22)	-.0003 (-0.18)
Panel H: Momentum profits following 24-month DOWN-DOWN markets (n = 81)			
Monthly profits	-.0055 (-1.23)	.0007 (0.19)	.0009 (1.52)
CAPM alpha	-.0028 (-0.35)	.0005 (0.07)	.0014 (1.40)
FF Three Factor alpha	-.0059 (-0.62)	.0016 (0.22)	.0011 (1.04)

Figures within parenthesis show t values. ***, **, and * are equivalent to significance levels of 1%, 5%, and 10%, respectively.

CHAPTER 5

Market States and Momentum: Evidence from the Dhaka Stock Exchange[5]

Abstract

This study examines the momentum effect in the Dhaka Stock Exchange (DSE) listed stock returns on the basis of market states. Momentum profits are found to be significantly positive in UP market states but insignificant in DOWN market states. Momentum profits evident in UP market states are also found to revert in the long term. The evidence of short term momentum and long term reversal hold true even after adjusting for risks. In addition to short term momentum and long term reversal, regression coefficients also provide evidence for a positive but nonlinear relationship between momentum profits and market states. The maximum momentum profits are found at the median market performance and not at the peak. The findings of this study suggest that investors' overreaction causes momentum profits in the DSE.

Keywords: Momentum profits; Market states; Risk factors; Overreaction hypothesis.

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1. Introduction

The study of stock returns predictability has been an important area in the field of empirical finance. According to the efficient market hypothesis, stock returns must be random, unpredictable and must not offer abnormal profits to investors. Return anomalies that are found from persistent patterns in returns violate the efficient market hypothesis. Stock return anomalies based on fundamental properties and seasonality are observed in many stock markets of the world. The efficient market hypothesis posits that anomalies cannot last for long in an efficient stock market because arbitrage activities by rational investors restore equilibrium. Some anomalies were indeed very significant at the early stage but gradually disappeared, which supports the efficient market hypothesis. However, some anomalies have been found long before and continue to exist. Rational finance fails to explain those anomalies from the viewpoint of risks and other fundamental factors. Momentum in stock returns is one such anomaly that was identified in the early 1990s and still exists in many stock markets of the world.

Momentum in stock returns indicates the continuation of trend in returns over short to intermediate periods. Based on this phenomenon, investors can form momentum portfolios by taking a long position in the recent past winners and short position in the recent past losers to generate significant profits. Jegadeesh and Titman (1993) identify the momentum effect by documenting that past winners outperform past losers over an investment period of three months to one year. After their pioneering work, several studies have been conducted across the world to find the evidence and sources of momentum profits.

Although momentum is evident in most of the stock markets of the world, its causes are still not conclusive. Both rational and behavioral finance provide inadequate explanation for momentum profits. Rational finance fails to explain momentum profits by risk and other

fundamental factors. Fama and French (2012) admit that the momentum effect is probably the only anomaly that cannot be explained by their multifactor model. Behavioral finance mainly explains momentum profits using the underreaction and overreaction hypotheses. However, what causes investors to underreact or overreact is still inconclusive. Cooper, Gutierrez and Hameed (2004) introduce a new approach to explain the sources of momentum profits. As a manifestation of overreaction hypothesis, they use the market states hypothesis to explain the short-term momentum and the long-term reversals of stock returns. Their findings show that momentum profits are conditioned on the market states. Monthly momentum profits are positive for UP market states and negative for DOWN market states. Cooper, Gutierrez and Hameed (2004) also find the evidence of long term reversals to support the overreaction hypothesis.

The objective of this study is to examine momentum profits in the DSE-listed stock returns based on the market states. Both short-term and long-term performance of momentum portfolios are measured to provide evidence and causes of momentum profits. This study hypothesizes that momentum profits are conditioned on market states. When market states are divided into UP and DOWN based on past market performance, significant momentum profits are hypothesized to be evident only in UP states. Short-term momentum in UP states is also expected to revert in the long-term, as investors' overreaction is assumed to cause momentum profits. According to the overreaction hypothesis, the momentum in stocks returns is generated from the investors' overreaction, which originates from overconfidence and self-attribution (Daniel et al. 1998). Investors' overconfidence becomes stronger in UP market states when investors find more conformity of their information. Thus, momentum profits are hypothesized to be evident only in UP market states.

The DSE, the main stock exchange of Bangladesh, is an emerging stock market that has been growing fast in recent years. Although the DSE started its operation in 1954, it has only been able to attract several domestic as well as foreign investors since the early 2000s, after making a series of policy reforms. The increased flow of funds along with investor-friendly policies has contributed to the market growth. Like most of the stock markets of the world, the DSE also evidently has high momentum profits (Chui et al. 2010), but the causes have not been studied extensively. However, unlike many developed stock markets, short sales are strictly prohibited in the DSE, which restricts arbitrage activities of rational investors to restore equilibrium in the market. Thus, the feature of being a growing market along with its restriction on short sales makes the market condition-based study of momentum effect important in the case of the DSE.

This study contributes to the existing literature in at least two ways. First, this study provides a comprehensive study on the evidence and causes of momentum profits in the DSE. Most of the previous studies include the DSE along with other markets, so a comprehensive study on momentum profits of DSE-listed stocks was missing. Second, it provides international evidence of the overreaction hypothesis. Chui et al. (2010) provide evidence that investors from individualistic countries overreact more. Therefore, this study provides an opportunity to observe whether Bangladeshi investors, as being in a collectivist country, really overreact to information.

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature, section 3 discusses how market condition explains momentum profits, section 4 describes the data and methodology, section 5 presents empirical results, and section 6 concludes the paper.

2. Literature Review

Since the introduction, momentum strategy has been one of the highly studied areas in empirical finance. Past performance based investment strategies such as mean reversion of stock returns (De Bondt and Thaler, 1985) is believed to form the foundation of the momentum strategy. The predictable behavior of stock returns based on past performance is also documented by Jegadeesh (1990), Lehman (1990) and others. Jegadeesh and Titman (1993) first document the momentum effect in the U.S stock market. They find that an investment strategy based on buying the past best performing stocks and selling the poorly performed stocks produced significantly positive returns over a 3–12-month holding period even after considering transaction costs. Jegadeesh and Titman (2001) also present confirming evidence to their previous findings and provide an elaborate discussion on the causes of momentum profits. Their findings suggests that the positive holding period returns are consistent with the underreaction but the negative post holding period returns are more related to the delayed overreaction to information.

After publishing a series of papers on the evidence and causes of momentum profits by Jegadeesh and Titman, many other researchers replicated the study to find the momentum effect in U.S markets. Daniel and Titman (2000) find momentum profits in the U.S. market over the 1963-1997 period and identify investors' overconfidence as the reason for momentum profits. Lewellen (2002) find the evidence of momentum effect, which is not influenced by the industry, size or book to market factors. He argues that the firm or industry specific factors cannot explain momentum rather excess covariance among stocks is responsible for the momentum. Lee and Swaminathan (2000) also find the momentum effect in the U.S market and attempt to relate it with the volume of transaction.

The convincing evidence of the momentum effect in the U.S. market has motivated many other researchers to find its international evidence. Rouwenhorst (1998) find evidence of momentum profits for the 12 European stock markets. Rouwenhorst (1999) also examine the momentum effect for the emerging countries using a sample of 20 emerging countries over the 1982–97 period. He finds that 17 out of 20 countries exhibit the evidence of momentum profits. Gutierrez and Kelley (2008) use weekly returns instead of the commonly used monthly returns to test the momentum effect and find its strong presence over the next 52 weeks although reversal is found in the first week. Chui et al. (2000) find the presence of momentum profits for large Asian stock markets except for Japan. Griffin et al. (2003) provided the evidence for momentum profits across the world (e.g., Afirca, Asia, the Americas without the U.S., Europe, and the U.S.). They find the highest and lowest monthly momentum profits in the African and Asian countries, respectively although momentum profits are found to be significant in all the regions. Several other studies also document that momentum effect is less evident in the major Asian stock markets. Liu and Lee (2001) study the strength of momentum effect in Japan. Over the 1975–97 period, they do not find any evidence of the momentum effect, rather they find reversals in the medium term. Iihara et al. (2004) also examine the momentum and the winner-loser effect in the Japanese market but do not find any evidence over the 1975-97 period. However, they find the presence of short term reversal in the stock returns. Wu (2011) finds the evidence of short term reversion in the Chinese stock market. Wang et al. (2012) also do not find the robust evidence of momentum profits in the Taiwan stock market.

The explanation of the momentum effect is still not conclusive. Both rational and behavioral finance provide some models and theories to explain momentum profits. The rational explanations consider momentum profits as a compensation of risks. However, the behavioral

explanations consider the momentum profits as an outcome of investors' behavioral bias such as underreaction or overreaction to the information.

Notable contributions to the rational explanations to momentum profits come from Conrad and Kaul (1998), Chordia and Shivakumar (2002), Dittmar et al. (2007), Sagi and Seasholes (2007) and others. Conrad and Kaul (1998) argue that momentum profits can entirely be explained by the cross-sectional variation of expected returns. However, Jegadeesh and Titman (2001) and Grundy and Martin (2001) refute that over the longer horizon the momentum portfolios earned negative returns that contradicts with the Conrad and Kaul hypothesis. Chordia and Shivakumar (2002) argue that common macroeconomic factors related to business cycles can explain momentum profits. Chordia and Shivakumar (2006) also relate price momentum with earnings momentum in an effort to analyze if the systematic component of earnings momentum can explain the price momentum, and find affirmative evidence to their enquiry. Dittmar et al. (2007) provide further evidence that momentum is not an anomaly rather can be explained by the cross section of returns. Sagi and Seasholes (2007) identify some firm-specific variables such as revenue, costs, and growth options' ability to explain the momentum profits.

One of the shortcomings of the rational explanations is the inability to suggest a unique asset pricing model that can capture momentum profits. Fama and French (1993) introduce the three-factor model by extending the capital asset pricing model (CAPM) to include two more systematic factors including size and value. Fama and French (1996) find that their multifactor model could explain some anomalies in the stock returns such as earnings to price, cash flow to price, sales growth, and long-term return reversals but not the short-term momentum. Fama and French (2012) also use the three-factor model to investigate the size, value and momentum in the four regions: North America, Europe, Asia Pacific and Japan. They conclude that the global

CAPM, three-factor model and four-factor model have failed to capture momentum profits across the world.

The behavioral explanation attributes investors' psychological bias such as underreaction or overreaction to information as the reason for momentum profits. The most persuasive behavioral models have been proposed by Barberies et al. (1998), Daniel et al. (1998), and Hong and Stein (1999). Daniel et al. (1998) propose a model based on overconfidence from the self-attribution bias. Investors often overreact because of the self-attribution bias and become asymmetric in responding to public news: they react differently to public and private news. Generally, they overreact to private information and underreact to public information. However, they may overreact to public information as well if it matches with privately acquired information. Thus, the confirming news triggers overconfidence and causes short-term momentum. The overreaction in price will eventually be corrected and will cause long-term reversals. Barberies, Shleifer and Vishny (1998) propose another behavioral model to explain the anomalous pattern in the cross section of security returns. They argue that conservatism bias is responsible for the momentum and the post earnings announcement drift. Because of the conservatism bias, investors become slow to react to new information that causes the continuation in either direction. Hong and Stein (1999) also developed a behavioral model that focused less on the cognitive biases but more on the interaction between news-watchers and the momentum traders who are assumed to have bounded rationality. Hong and Stein argue that private information diffuses gradually among news-watchers that causes the underreaction and creates an arbitrage opportunity for early momentum traders. The early momentum traders' action further increases the price that invites more momentum traders and the process continues to generate overreaction. Hur and Singh (2014) also argue that investors' underreaction to

information is the primary cause of the momentum effect although overreaction plays some role as well.

There are some other explanations to momentum profits that are manifestation to rational and behavioral explanations. Chui et al. (2010) find that individualism across the countries can capture cross country differences in momentum profits. Countries having a more individualism scores are evident with higher momentum profits. Yeh and Li (2011) argue that sentiment of loser groups contribute to momentum profits while sentiment of winner groups contribute to contrarian returns. Novy-Marx (2012) argues that momentum is conceived in the intermediate past period. He finds that recent winners that were intermediate horizon losers significantly underperformed the recent losers that were intermediate horizon winners.

3. Can Market Condition Explain Momentum Profits?

Many researchers contribute to the market dynamics based explanation of momentum profits. Market dynamics can influence behavioral traits of investors as well as the fundamental features of stocks. The market states hypothesis (Cooper et al. 2004) emphasizes the role of market states in explaining momentum profits. They find that momentum profits exist only in UP market states. Investors' overreaction to information is found to increase in UP market states that cause short term momentum. An investors' psychology based explanation is found in Antoniou et al. (2013), who also relate market condition with momentum profits. They hypothesize that when information contradicts with investors' sentiment, a cognitive dissonance is created, which slows down the diffusion of information. Hence, losers (winners) become underpriced in the optimistic (pessimistic) time. As short sales of the losing stocks are not easy, strong momentum is produced in an optimistic time. In particular, momentum profits arise from losing stocks in optimistic periods. The explanation of Antoniou et al. (2013) contradicts with the market states hypothesis

in the way that momentum is produced in the booming market condition not for the overreaction but for the underreaction to information emerging from cognitive dissonance. The study by Asem and Tian (2010) also appears as a partial contradiction to the market states hypothesis. Asem and Tian (2010) find that momentum profits are evident when the market moves in the similar direction. They find the evidence of momentum profits in DOWN states along with UP states when markets continue to move in the similar direction. Their findings are more consistent with the overreaction hypothesis, which conjectures that overreaction occurs when investors find similarity of their information in markets moving in similar directions. The role of market dynamics in explaining momentum profits is found in rational explanations too. Sagi and Seashole's (2007) rational explanation of momentum profits asserts that during UP market states, momentum profits increase because of a firm's tendency to move closer to exercise the growth options. During DOWN market states, firms' inclination to financial distress reduces momentum profits. However, Griffin et al. (2005) do not find any evidence of significant difference of momentum profits in UP and DOWN markets in their study of 40 countries.

It appears from the previous discussion that differences exist in the evidence and explanations of momentum profits even under the market dynamics based explanations. While the evidence of significant momentum profits in UP markets are largely established in developed markets, the relationship is less tested in emerging markets. Moreover, the causes of high momentum profits in UP markets are still not conclusive even in developed markets. Thus, the study of the market states hypothesis in the DSE provides an opportunity to observe additional evidence from an emerging market.

4. Data and Methodology

The sample period of this study ranges from January, 1999, to December, 2014. All the stocks listed with the DSE during the sample period are included in this study. Financial securities such as mutual funds or unit certificates have not been considered. As a selection criterion, a stock has to have trading records in both the formation and observation periods. Thus, stocks must have a trading history of at least six months to be eligible for being considered in the momentum portfolio. Monthly closing prices of the stocks have been used to calculate the raw returns. The DSE general index (DGEN) has been used to measure the market performance. This index is the most comprehensive index in the DSE and is widely used as a measure of market performance. The DGEN is a price weighted index that includes stocks having regular trading history. However, from January 2013, a new index called DSEX that replaced the DGEN has been used to measure the market performance. For ensuring the robustness of the results, the study also uses the All-Share Price Index to measure market performance. This Index includes lowest rated stocks that are not considered in the DGEN calculations.

For calculating momentum profits, this study follows the standard methodology used by Jegadeesh and Titman (1993). Minor modifications to this methodology have been made to reconcile the issue of a small number of securities in the market. This study uses the momentum strategy based on 6-month formation and 60-month observation periods to test the market state hypothesis. At the beginning of each month, stocks are ranked based on their last 6-month cumulative returns to form winner and loser portfolios. The top 20% and bottom 20% of the stocks comprise the winner and looser portfolios, respectively. The performances of these winner and loser portfolios are observed for the next 60 months. Momentum profits are measured by going long and short on winner and loser portfolios, respectively. This study calculates

momentum profits using a 1-month lag between the formation and the observation periods to avoid bid-ask spread and market microstructure issues. To represent intermediate-term momentum profits for testing market states hypothesis, this study uses the 6x9 strategy because this strategy produces the most significant momentum profits in the DSE[6].

I use both raw and risk-adjusted returns to measure momentum profits. Raw returns are measured by using the natural logarithm of the difference between the current and the previous months' closing prices. Market risk-adjusted momentum profits are measured from the intercept of the following regression of raw momentum profits on the market risk premium:

$$R_{pt} - R_{ft} = \alpha_p + \beta_p \left(R_{mt} - R_{ft}\right) + \varepsilon_t \quad (1)$$

where, R_{pt} is the raw momentum profit, R_{ft} is the risk free rate and R_{mt} is the market return. A one-month Treasury bill rate is used as a proxy for the risk free rate while calculating the risk premiums.

Finally, the market performance is measured using the market returns from the DGEN index. If the previous 1-year cumulative market returns are positive ($\sum R_{m,\ t\text{-}1 \text{ to } t\text{-}12} \geq 0$), the UP market state is used and for negative cumulative returns ($\sum R_{m,\ t\text{-}1 \text{ to } t\text{-}12} < 0$) in the previous one year, the DOWN market state is used. Although Cooper et al. (2004) used three different time horizons for measuring the market states (i.e., one year, two years, and three years), this study uses one year as the base case and two years for checking the robustness of the results. The reason for using a different time horizon is the relatively short sample period used in this study and less variation in the market states when three years' performance benchmark is used. The performances of momentum portfolios are measured in UP and DOWN market states to test the market states hypothesis. Furthermore, to test the significance of momentum profits in different

[6] In an unreported calculation, I find positive momentum profits in all observation periods ranging from one month to twelve months but the absolute size and statistical significance of momentum profits in 6x9 strategy is higher than other strategies.

market states, they are regressed on the UP and DOWN dummy variables, and to test the equality of momentum profits in different market states, they are regressed on the UP market dummy with an intercept. The regression equations used to test the significance of momentum profits and the equality of the momentum profits across market states are as follows:

$$Mom_t = \beta_h UP_t + \beta_k DOWN_t + \varepsilon_t \quad (2)$$

$$Mom_t = \alpha + \beta_l UP_t + \varepsilon_t \quad (3)$$

5. Empirical Results

5.1 Momentum profits conditioned on market states

Table 1 reports the average monthly momentum profits based on the 6-month formation and 60-month observation period for the period between January 1999 and December 2014. I use the 9-month observation period to measure short-term momentum profits as momentum profits are the highest for this observation period. However, momentum profits are also significant in the 6-month and 12-month observation periods. The performances of momentum portfolios are measured using a 1-month lag between the formation and observation periods. To check the robustness of the results, I also measure momentum profits without considering a 1-month lag. As the momentum profits without the 1-month lag are not significantly different from those with the 1-month lag, the results are not shown in the tables.

Panel A shows that the average monthly momentum profits for the whole sample period are significantly positive for both the raw and the risk adjusted returns. Raw monthly momentum profits are 0.963% and risk adjusted momentum profits are 0.924%, which are both significant at the 1% level of significance. The results also provide a weak evidence of the long-term reversion following an intermediate-term momentum. Panel B shows the average monthly momentum profits when the market state is UP following a 1-year lagged market performance. The raw and

risk-adjusted monthly momentum profits are 1.253% and 1.107%, respectively. The raw and risk adjusted momentum profits in UP states are found to be large compared to the whole sample period. The results support the market states hypothesis that UP market states produce larger momentum profits. Significant reversion is found in the long-term performance of momentum portfolios in UP states. Panel C reports raw and risk adjusted momentum profits in DOWN market states. Insignificant momentum profits are found for both the raw and risk-adjusted returns. The size and significance of momentum profits are lower compared to those found in the whole sample and UP market states. Long-term reversion is also not reported in DOWN market states.

I also use a 2-year lagged market performance to measure market states to ensure that the results are robust. Panel D shows that UP market states following the 2-year lagged market performance also produce significantly positive momentum profits. The average monthly momentum profits are 1.192% and 1.098% using raw and risk-adjusted returns, respectively. Long-term reversion followed by an intermediate-term momentum is also found to be significant for both raw and risk adjusted returns. Panel E reports the average monthly momentum profits in DOWN market states. The monthly momentum profits are -0.328% and -0.892% for raw and risk-adjusted returns, respectively, which are not statistically significant. Long-term reversion is also not found to be evident in DOWN market states.

[Insert Table 1 around here]

The results of Table 1 also explain why momentum profits are so high in the DSE. The DSE has been experiencing rapid growth in the last decade. The general economy is also growing quite steadily over the years. Consequently, the stock market is also experiencing more UP states in recent times. Figure 1 reports the number of months in UP and DOWN market states.

It is evident that the number of DOWN states is significantly lower than UP states. Moreover, the numbers of DOWN states decrease as the market states are defined by the two years performance. The percentage of DOWN states using the one year market performance is 21% (30 out of 142 months) and the size reduces to 10.8% (16 out of 147 months) when the two years market performance is used to define the market states.

[Insert Figure 1 around here]

The findings of this study support the market states hypothesis that momentum profits are found only in UP market states. A closer look into the results also reveals that both the winner and loser portfolios continue to achieve positive returns under the UP market condition. However, the winner portfolios generate larger profits than the loser portfolios causing momentum portfolios to achieve significantly positive returns. The positive momentum profits come largely from the performance of the winner portfolios. The evidence of momentum profits only in the UP states can be explained by the overreaction hypothesis. Investors tend to overreact more under the UP market states because of overconfidence and self-attribution. In UP market states, investors find private information more confirmative to publicly acquired information. The positive outcome from the ability to use information triggers self-attribution that causes overconfidence. Thus, overconfidence triggered overreaction causes momentum profits in UP market states.

5.2 Regression coefficients in UP and DOWN market states

Table 2 reports the coefficients of the regression models used to test significance and equality of momentum profits in UP and DOWN states. UP market beta (β_h) is found to be highly significant and DOWN market beta (β_k) is found to be insignificant, which confirms that momentum profits are significant only in UP market states. The results are consistent with Table 1, which reports

significant momentum profits in UP market states and insignificant momentum profits in DOWN market states. Alpha (constant) and beta UP (β_l) coefficients shows the equality of momentum profits in UP and DOWN market states. The coefficients show that momentum profits in UP and DOWN market states are different. Panel B reports the results of the regression coefficients when market states are measured by the last two years performance. Higher momentum profits in UP states are also found when market states are measured by the two years performance. Thus, the results are robust as they do not change when different periods are used to define UP and DOWN states.

[Insert Table 2 around here]

5.3 Nature of relationship between market states and momentum profits

This study also examines the relationship between lagged market performance and momentum profits considering market performance as a continuous variable. The regression model uses momentum profits as a dependent and 12-month lagged market returns and square of 12-month lagged market returns as independent variables. Beta coefficient of the lagged market returns indicates the relationship between momentum profits and lagged market returns, and beta coefficient of the square of lagged market returns indicates the linearity of the relationship between momentum profits and lagged market returns. Table 3 reports the regression coefficients. The beta coefficient of the one year lagged market returns is found to be significantly positive implying that momentum profits increase (decrease) when market returns increase (decrease). However, the beta coefficient of the squared lagged market returns is significantly negative, indicating that the positive association between momentum profits and market returns are not linear. Momentum profits do not increase monotonously with the increase in market performance. Panel B shows regression coefficients when market states are measured by two years lagged

market performance. The results are found to be quite similar to those when market states are defined by one year market performance.

To examine the non-linear relationship between lagged market performance and momentum profits, I sort momentum profits by one year lagged market performance. One year cumulative market returns are arranged in descending order and classified into five groups. Momentum profits are measured for each of those market performance sorted groups. Table 4 shows momentum profits sorted on the market performance. It appears that momentum profits are low and insignificant at the lowest level of market performance. It continues to increase from the lowest group, reaches its peak at the median group, and then starts falling. It is interesting to find that momentum profits at the second highest and highest groups are still positive but weak in strength. The reason for the decrease in momentum profits after reaching its peak at the median level could be caused by the overreaction to information that reaches its peak at some point, then starts reverting. In addition to the reversion of initial overreaction as an explanation for the nonlinear relationship, Cooper et al. (2004) also argue that investors might receive less private information to overreact at the highest level of market performance.

[Insert Table 3 around here]

[Insert Table 4 around here]

5.4. Robustness checks

To check the robustness of the results, an alternative index is used to measure the market states. So far, all measurements of market performance are based on the DGEN index. A different index called DSE all-share price index is used to measure market performance. Table 5 reports the raw momentum profits in different market states when they are defined by one year lagged market performance. Changing the measure of market performance does not change the implication of

the results found earlier. The monthly momentum profits in UP states are highly significant but those in DOWN states are insignificant. The momentum profits in UP states are also followed by long-term reversion. The coefficients of the regression models used to test the significance of momentum profits in UP and DOWN market states are found to be largely same as before. The UP state beta coefficient is found to be significantly positive, while the DOWN state beta coefficient is found to be insignificant.

[Insert Table 5 around here]

6. Conclusion

This study examines the momentum in the DSE-listed stock returns based on the market states and provides evidence of the role of market states in explaining high momentum profits. The market states hypothesis conjectures that momentum profits would be evident only in the UP market states because investors tend to overreact more in UP market states. Momentum profits are found to be significant in UP market states, but insignificant in DOWN market states. The evidence holds true even after adjusting for risks. The regression models are used to test the significance and equality of momentum profits in UP and DOWN market states. Regression coefficients are found to be significantly positive at UP market states but insignificant at the DOWN market states. This study also provides evidence that momentum profits in the UP market states are followed by long term reversion. Finally, the study finds a positive but non-linear relationship between momentum profits and market states. The most significant momentum profits are found at the median market performance after which momentum profits begin to fall.

The findings of this study provide an international evidence of the market states hypothesis. The evidence of intermediate term momentum profits followed by the long term

reversion is also consistent with the overreaction hypothesis. Investors' overreaction to information is found to be the reason for high momentum profits in the DSE.

Nevertheless, this study has a limitation in measuring risk-adjusted momentum profits. I used the CAPM as a measure for risk adjusted returns but could not show risk adjusted momentum profits using Fama-French three-factor model because of the limitations of data: the size and value factor data are not available in the DSE database. While calculating the size and value factors following the methodology of Fama and French (1993), I had to rely on annual reports and information published in the DSE website. However, the data collected from these sources were found to be incomplete and less reliable. Despite this limitation, the study contributes to the existing literature by providing recent evidence on and sources of high momentum profits in the DSE.

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Table 1

Average monthly momentum profits

The table reports average monthly momentum profits for the DSE-listed stocks for the period between January, 1999 and December, 2014. At the beginning of each month, stocks are ranked in descending order based on their last 6-month cumulative returns. Top 20% and bottom 20% of the stocks comprise winner and loser portfolios, respectively. Momentum profits are found by going long on the winners and short on the losers. Raw as well as risk adjusted returns are reported following one year and two years UP and DOWN market.

	1–9 Months	13–60 Months
Panel A: Average monthly profits (%) for the whole market		
Average monthly profits (Raw)	0.963	-0.472
	(3.98)***	(-1.41)
Average monthly profits (Risk-adjusted)	0.924	-0.523
	(3.72)***	(-1.50)
Panel B: Average monthly profits (%) following 1 year UP markets		
Average monthly profits (Raw)	1.253	-0.867
	(4.59)***	(-3.49)***
Average monthly profits (Risk-adjusted)	1.107	-0.916
	(4.15)***	(-2.52)**
Panel C: Average monthly profits (%) following 1 year DOWN markets		
Average monthly profits (Raw)	0.256	-0.094
	(0.56)	(-0.12)
Average monthly profits (Risk-adjusted)	0.215	0.116
	(0.43)	(0.16)
Panel D: Average monthly profits (%) following 2 years UP markets		
Average monthly profits (Raw)	1.192	-0.702
	(4.52)***	(-2.75)**
Average monthly profits (Risk-adjusted)	1.098	-0.864
	(4.12)***	(-3.31)***
Panel E: Average monthly profits (%) following 2 years DOWN markets		
Average monthly profits (Raw)	-0.328	-0.074
	(-0.53)	(-0.54)
Average monthly profits (Risk-adjusted)	-0.892	-0.117
	(-1.13)	(-0.89)

Figures within parenthesis show t values. ***, **, * are equivalent to significance level of less than 1%, 5% & 10%.

Table 2

Regression coefficients in UP and DOWN markets

The table shows coefficients of the regression models used to test the significance and equality of momentum profits in UP and DOWN market states. Beta UP (β_h) and Beta DOWN (β_k) show the significance of momentum profits in UP and DOWN states. Alpha and Beta UP (β_l) show the equality of momentum profits in UP and DOWN states. Panel A and Panel B show regression coefficients when market states are defined by one year and two years lagged market performance, respectively.

	1–9 Months	13–60 Months
Panel A: Regression coefficients when market states are defined by 1 year performance		
Beta UP (β_h)	0.113	-0.096
	(4.32)***	(-2.93)**
Beta DOWN (β_k)	0.011	-0.009
	(0.23)	(-0.89)
Alpha	0.009	0.018
	(0.24)	(0.36)
Beta UP (β_l)	0.124	-0.118
	(1.91)**	(-2.05)**
Panel B: Regression coefficients when market states are defined by 2 years performance		
Beta UP (β_h)	0.091	-0.087
	(4.32)***	(2.14)**
Beta DOWN(β_k)	-0.047	-0.035
	(-0.76)	(-0.64)
Alpha	-0.047	0.001
	(-0.76)	(0.29)
Beta UP (β_l)	0.138	-0.109
	(2.11)**	(-2.21)**

Figures within parenthesis show t values. ***, **, * are equivalent to significance level of less than 1%, 5% & 10%.

Table 3

Momentum profits and lagged market returns

The table reports the regression coefficients to understand how lagged market returns are related to momentum profits. Both lagged market performance and square of lagged market performance have been used as independent variables. Panel A and Panel B reports the coefficients of regression models when market states are defined by one year and two years performances, respectively.

	Intercept	LagMarket	LagMarket^2	Adj. R^2
Panel A: 1 year lagged market returns as a measure of market performance				
Momentum profits	0.092	0.515	-0.801	0.091
	(3.62)***	(2.98)***	(-3.11)***	
Panel B: 2 years lagged market returns as a measure of market performance				
Momentum profits	0.082	0.229	-0.302	0.079
	(2.62)**	(2.29)**	(-2.93)***	

Figures within parenthesis show t values. ***, **, * are equivalent to significance level of less than 1%, 5% & 10%.

Table 4

Momentum profits sorted by one year lagged market performance

The table reports momentum profits sorted by one year lagged market performance. One year cumulative market returns are sorted in descending order and divided into five groups. Momentum profits in these five groups are measured to understand the relationship between market performance and momentum profits.

Panel A: Momentum profits (%) sorted by one year lagged market performance					
	High	2	3	4	Low
Momentum Profits (Raw)	0.885 (1.98)*	1.519 (2.79)**	2.731 (4.25)***	1.212 (3.49)***	0.039 (0.49)
Momentum Profits (Risk Adjusted)	0.704 (1.86)*	1.249 (2.61)**	2.561 (3.89)***	1.104 (3.21)***	0.032 (0.44)

Figures within parenthesis show t values. ***, **, * are equivalent to significance level of less than 1%, 5% & 10%.

Table 5

Momentum profits in UP and DOWN markets

The table shows momentum profits in UP and DOWN market states using an alternative index to measure market performance. Panel A shows the average monthly raw and risk adjusted momentum profits and Panel B shows the beta coefficients to measure the significance of momentum profits in UP and DOWN states.

	1–9 Months	13–60 Months
Panel A: Average monthly profits (%) following 1 year UP markets		
Average monthly profits (Raw)	0.916	-0.763
	(3.61)***	(-2.87)**
Average monthly profits (Risk Adjusted)	1.381	-0.843
	(3.87)***	(-2.79)**
Panel B: Regression coefficients when market states are defined by 1 year performance		
Beta UP	0.109	-0.102
	(4.27)***	(2.39)**
Beta DOWN	0.048	-0.051
	(0.79)	(-0.96)

Figures within parenthesis show t values. ***, **, * are equivalent to significance level of less than 1%, 5% & 10%.

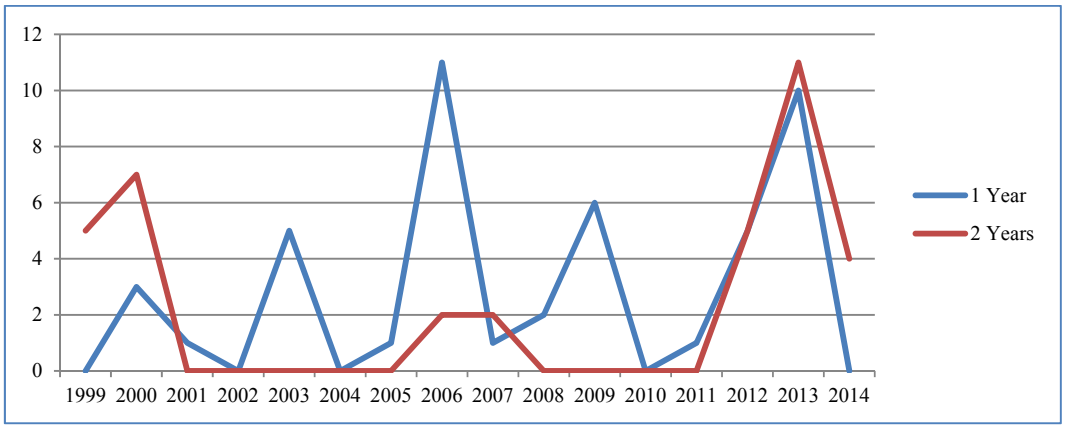

Fig. 1 Number of months in DOWN market states

CHAPTER 6

Conclusion

The fundamental idea of the market efficiency is that stock prices move randomly. Since new information is reflected in the prices instantaneously, using the past, public and private information hardly provide any opportunity to make abnormal profits. Mispricing of stocks is a rare phenomenon in the efficient market, which is corrected immediately by rational investors' arbitrage activities. As a consequence, anomalous pattern in stock returns is not believed to exist in an efficient market. However, the efficient market hypothesis depends on several assumptions such as investor's rationality, homogenous expectation, unlimited arbitrage opportunity, and others. In recent decades the paradigm of the efficient market hypothesis has been severely challenged on the ground of these assumptions. Several studies document that investors' often behave irrationally giving rise to a predictable pattern of stock returns and rational investors cannot rectify such anomalous pattern because of limited arbitrage opportunity. Under this circumstance, I studied short-sales constraints and stock returns anomalies to understand whether the efficient market hypothesis really holds true in reality.

This dissertation includes three essays surrounding market efficiency. The first essay discusses short-sales constraints in the presence of a centralized lendable stocks market. We measured short-sales constraints by the high cost of borrowing stocks, the high short interest ratio and the low institutional ownership. Using six-month daily data from the JSF, we provide new empirical evidence on the market for borrowing stocks in Japan. First, the short-sale is not generally strictly binding in Japan; the cost of borrowing is low, demand for short-sale of stocks is also low and institutional ownership is high. Second, 4.65% of lendable stocks have high borrowing fees of more than 1% per annum. These stocks are usually categorized as value stocks,

large capitalization stocks and stocks with low trading volume. Third, a direct comparison of cost of borrowing of stocks listed both in the Tokyo Stock Exchange and New York Stock Exchange also show that cost of borrowing in Japan is lower than that in the U.S. Fourth, the cost of borrowing is found to be affected largely by the demand for borrowing stocks. Fifth, large capitalization and value stocks are often found to have higher short positions compared to the supply of lendable stocks. Sixth, recall risk, a situation when lenders recall stocks, is not observed in the centralized lending market even when the aggregate short position exceeds supply of lendable stocks. Seventh, stocks facing short-sales constraints, as measured by the high cost of borrowing and high short interest ratio (SIR), are not found to underperform subsequently. Moreover, regression analysis shows that the relationship between short-sales constraints and subsequent stock returns is not significantly negative.

The second essay discusses market conditions and momentum in Japanese stock returns. As previous studies did not find the evidence of momentum effect in Japanese stock returns using conventional methodology, I examined the momentum effect in Japanese stock returns based on the market condition. Iihara (2004, 2016) found that momentum profits were significantly positive in the UP states while Hanauer (2014) found that momentum profits were significantly positive in the continuing markets. Both of their findings provided support for the hypothesis that investors' overreaction to information causes short term momentum in Japan. However, they did not find long term reversion in support of the overreaction hypothesis. Previous studies on the cultural traits of Japanese people revealed that they are collectivists and have lack of overconfidence. These cultural traits do not support investors' overreaction as the cause of momentum profits in Japanese stock returns. Taking Japanese people's cultural and behavioral traits into account, I hypothesized that investors' underreaction to information could

be attributed to momentum profits in Japanese stock returns. Momentum profits would be evident in market states that triggered investors' to underreact. In support of the hypothesis, I provided evidence that momentum profits are significantly positive in the reverting UP states. However, there was no evidence of long term reversion. Evidence of short-term momentum profits but no long term reversion is consistent with underreaction hypothesis. I argue that investors tend to underreact in the reverting UP states when they do not find conformity of information in a suddenly changed market. Investors also face cognitive dissonance because of sudden change in market states causing them to underreact. Findings of this study are robust against the way market states are defined, short-sales constraints and known seasonal anomalies.

The third essay discusses market states and momentum in the DSE listed stock returns. Although previous studies found high momentum profits in the DSE, the causes of momentum profits were unexplored (Chui et al. 2010). In the third essay, I examined momentum profits in the DSE listed stocks based on the market states. Market states hypothesis (Cooper et al. 2004) conjectured that momentum profits are evident only in the UP market states because investors' overreaction, the hypothesized cause of momentum profits, is found only in the UP states. I provided evidence that momentum profits are high in the DSE over the short- to intermediate term. The most significant momentum profits are found when momentum portfolios are formed based on the past six months' return and profits are measured over the next nine months observation period. To examine the causes of momentum profits according to the market states hypothesis, I divide market states into UP states and DOWN states on the basis of the last 1 year's (and 2 years') cumulative market return. Momentum profits are found to be significant only in the UP market states. OLS regression models are also used to test the significance of momentum profits in the UP and DOWN market states. Regression coefficients also show that

momentum profits are significant only in the UP market states. I also measure the long term performance of momentum portfolios to test overreaction hypothesis. Results show that short- to intermediate term momentum profits revert significantly in the long term. The short- to intermediate term momentum profits followed by the long term reversion provides evidence that momentum profits in the DSE can be attributed to investors' overreaction to information.