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Are Extreme Returns Followed by Predictable Patterns in the Japanese Stock Market?^{*}

Long Vu Thang Pham[†]

ABSTRACT

This paper examines the post-event price patterns of Japanese stocks that exhibited extreme price changes. Applying daily Fama–French three–factor model, via GMM approach, to measure abnormal returns of 300 firms comprising the Nikkei 300 over the 2001–2005 period, this study confirms findings of previous literature on evidence of short–term price reversals following large price changes. There is stronger evidence supporting the existence of short–term price reversal following large price increases than that following large price decreases. The profits from contrarian investments by exploiting the phenomena of price reversals are not likely after taking into account of transaction costs. This is consistent with the weak form of Fama’s (1969) efficient market hypothesis.

Keywords: Event Studies, Information and Market Efficiency, Overreaction, Price Reversals, Japanese stock market;

JEL classification: G12, G14

1. INTRODUCTION

Fama (1969) proposed well–known efficient market hypothesis (EMH) with three forms: strong form, semi–strong form and weak form. Stock prices at any time fully reflect all available information in the strong form, all public available information in the semi–strong form, and historical information in the weak form of EMH. Two important implications of EMH are future stock prices are unpredictable, and expected stock returns can only be determined by rational asset pricing models.

Evidence from empirical studies has suggested that stock prices do not always accurately reflect available information. In particularly, research in experimental psychology has suggested that “*most*

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people overreact to unexpected and dramatic news” (Debondt and Thaler (1985)). Motivated by this, Debondt and Thaler (1985) develop the overreaction hypothesis which suggests: “*Extreme movements in stock prices will be followed by subsequent price movements in the opposite direction*”, and “*The more extreme the initial price movement, the greater will be the subsequent adjustment*” (Debondt and Thaler (1985)). The overreaction hypothesis implies a violation of weak form of EMH, i.e. future stock prices cannot be predicted from past stock prices.

A great number of studies have assessed whether one-day extreme price movement is followed by subsequent price movements in the opposite direction or price reversals in the short-term period. Some notable papers in this area include Brown, Harlow, and Tinic (1988, 1993), Atkins and Dyl (1990), Bremer and Sweeney (1991), Cox and Peterson (1994), Park (1995) and Bremer *et al.* (1997). Stock prices are generally found to be reversed following one-day sharp declines. Exceptional case is Cox and Peterson (1994), whose study finds that abnormal returns of longer term (4 days to 20 days) are negative after a large one-day decline; a result which is not consistent with the overreaction hypothesis.

It is the aim of this paper to investigate the overreaction in Japanese stock market by examining whether there are predictable short-term patterns of stock abnormal returns i.e. three days following the initially extreme price changes. In addition, firm's longer term abnormal returns, i.e. 4 days to 20 days after the extreme price movements are also considered. Abnormal returns are estimated by comparing realized rates of return to Fama-French's (1993, 1996) three-factor model's expected rates of return using the popular Generalized Method of Moments (GMM) approach.

In particularly, this paper examines returns following one-day price decreases/increases of ten percent or more for all 300 firms comprising the Nikkei 300 index over the five-year period from January 2001 to December 2005. In contrast with the Nikkei 225 – a price weighted index monitoring the level of market and its change, the Nikkei 300 is a value weighted index of the 300 major issues in first section of the TSE. Firms are selected in terms of liquidity, stability and industrial representatives. Hence, the Nikkei 300 is a well balanced index. It not only accurately reflects the overall movements of the first section of the TSE, but also meets the widely diversified needs of investors.¹

Japanese market is appropriate one to choose for the reasons: (a) it is one of the world's largest market that plays an important role in the global economy and draws investors' interests, and (b) to this author's knowledge, no other Japanese work on overreaction and price reversals following large one-day price changes has used Fama-French (FF) model. Bremer *et al.* (1997) also examined price reversals in Japanese market; however in their paper abnormal returns are measured as residuals to an excess form of market model. They find negative abnormal returns following large price decreases and little evidence of significant patterns following large price increases for the period 1981–1991. This study, therefore, should provide an important first step toward investigating whether different measurements of abnormal returns in different time horizons obtain similar results.

¹ This brief description of Nikkei 300 is based on the information published on the Nikkei Net Interactive (http://www.nni.nikkei.co.jp/FR/SERV/nikkei_indexes/nifaq300.html), a website mandated by the Nihon Keizai Shimbun, Inc.

Our approach distinguishes itself from exiting ones in a major way. This study applies the method developed by MacKinlay and Richardson (1991), using GMM to estimate the expected stock returns as described by the FF model. GMM is chosen for its many advantages. It is a general estimator which encompasses many standard econometric estimators including OLS, instrumental variables (IVs), and maximum likelihood. Not only that GMM is valid under weaker assumptions about the normality of data distribution, but it also has the potential to improve the estimation since it allows serially correlated residuals and conditional dependency of residuals on the factors.

Our results indicate the follows. First, consistent with previous literature, this study finds evidence of price reversals. However, different to Bremer *et al.* (1997), there is stronger evidence supporting the existence of short-term price reversal following large price increases than that following large price decreases. Second, there is no evidence supporting the existence of predictable pattern in longer term i.e. 4 days to 20 days after the extreme price movements. Third, profits from contrarian investments by exploiting the phenomena of price reversals are not likely. This is consistent with the weak form of EMH.

Our main contributions are twofold. First, we investigate the overreaction and price reversals following large one-day price changes in Japanese stock market using FF model. Second, in contrast to Bremer *et al.* (1997) finding of stronger evidence on price reversals after large one-day declines than that after large one-day increases, we find that price following large one-day increases tend to reverse stronger than that following large one-day decreases in the recent period (2001–2005).

The remainder of this paper is organized as follows. Section 2 reviews the methodology for analyzing abnormal returns. Section 3 describes the dataset of variables. In Section 4, the empirical results are presented. Section 5 provides economic significance and policy implications of the empirical findings, and Section 6 concludes the paper.

2. METHODOLOGY

2.1 Event definition

Following Atkins and Dyl (1990), Cox and Peterson (1994), and Bremer *et al.* (1997), 10% or greater increases/decreases in daily rates of return are considered as large price change events to investigate whether there are predictable pattern of stock returns following large price changes. This is also to make our results comparable to them. The method is explained as follows.

The daily realized rate of return (without dividend adjustment)² is calculated as,

$$\tilde{R}_{i,t} = \frac{\tilde{P}_{i,t} - \tilde{P}_{i,t-1}}{\tilde{P}_{i,t-1}} \quad (1)$$

where $\tilde{R}_{i,t}$ denotes realized rate of return on stock i at time t , $\tilde{P}_{i,t}$ denotes the price of stock i at time t , and $\tilde{P}_{i,t-1}$ denotes the price of stock i at time $t-1$.

² Bremer *et al.* (1997) argue that the effect of dividend omission in computing the abnormal return is minimal.

Define all $\tilde{R}_{i,t}$ for 300 stocks included in the Nikkei 300 over the five year period from January 2001 to December 2005 that $\tilde{R}_{i,t} \geq 10\%$ or $\tilde{R}_{i,t} \leq -10\%$ as large price change events. Bremer *et al.* (1997) argue that those events may be due to unexpected operating results, unanticipated government decisions, or merely good or bad luck. They may also be associated with the TSE's three major rules on daily price limitation, trade-to-trade variation and minimum tick size.

Following Bremer and Sweeney (1991) and Cox and Peterson (1994), only one event per day is allowed in order to minimize correlation across sample. The event observations are sorted by date and then orderly by stock code. For the date with more than one event, only the observation appearing first in the ordering sort for that date is retained.

2.2 Measuring expected and abnormal returns

The timeline for analyzing abnormal return is illustrated in Fig.1, where $\tau = 0$ denotes the event date.

The abnormal return $AR_{i,\tau}$ is estimated for a 41-day event window comprised of 20 pre-event days and 20 post-event days, by deducting realized rate of return from the estimated expected return,

$$AR_{i,\tau} = \tilde{R}_{i,\tau} - E(\tilde{R}_{i,\tau}), \quad (2)$$

where $\tilde{R}_{i,\tau}$, $E(\tilde{R}_{i,\tau})$ are the realized rate of return and expected return for stock i on day τ , respectively. For comparison, besides unrestricted Fama-French (1993, 1996) three-factor model, this study uses two other models to measure expected return, namely the unrestricted capital asset pricing model (CAPM) and the market model.

Under the unrestricted FF model,

$$AR_{i,\tau} = \tilde{R}_{i,\tau} - R_f - \bar{a}_i - \bar{b}_i(\tilde{R}_{M,\tau} - R_f) - \bar{s}_i\tilde{R}_{SMB,\tau} - \bar{h}_i\tilde{R}_{HML,\tau} \quad (3)$$

where \bar{a}_i , \bar{b}_i , \bar{s}_i , \bar{h}_i are the simple averages of the a_i intercepts and b_i , s_i , h_i coefficients, respectively, from following GMM regression equations estimated over two periods: 120 to 21 days before the event day $\tau = 0$ (pre-event), and 21 to 120 day after the event day $\tau = 0$ (post-event):

$$\tilde{R}_{i,t} - R_f = a_i + b_i(\tilde{R}_{M,t} - R_f) + s_i\tilde{R}_{SMB,t} + h_i\tilde{R}_{HML,t} + \tilde{\varepsilon}_{i,t} \quad t \in \text{pre-event, post-event} \quad (4)$$

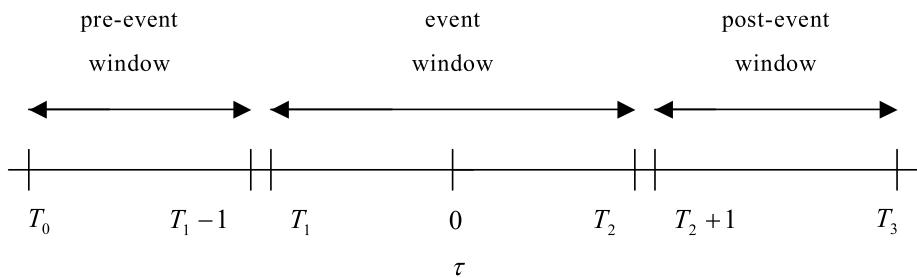


Fig.1: Time line for the event study

where $\tilde{R}_{M,t} - R_f$, $\tilde{R}_{SMB,t}$, $\tilde{R}_{HML,t}$ represent the realized excess return on market portfolio, the realized return on proxy portfolio for size factor and the realized return on proxy portfolio for the book-to-market factor at time τ , respectively.

The GMM approach is relatively similar to that of Faff (2003, 2004). There are four sample moments:

$$1/T \sum_{t=1}^T \tilde{\varepsilon}_{i,t}, 1/T \sum_{t=1}^T \tilde{\varepsilon}_{i,t} (\tilde{R}_{M,t} - R_f), 1/T \sum_{t=1}^T \tilde{\varepsilon}_{i,t} \tilde{R}_{SMB,t}, 1/T \sum_{t=1}^T \tilde{\varepsilon}_{i,t} \tilde{R}_{HML,t},$$

and four parameters a_i, b_i, s_i, h_i to be estimated for each stock. Therefore, the moment conditions in equation (4) are exactly identified, and the associated Hansen's J statistic (1982) is zero.

Under the unrestricted CAPM model,

$$AR_{i,\tau} = \tilde{R}_{i,\tau} - R_f - \bar{a}_i - \bar{b}_i (\tilde{R}_{M,\tau} - R_f) \quad (5)$$

where \bar{a}_i, \bar{b}_i are the simple averages of the a_i intercepts and b_i coefficients, respectively, from following GMM regression equations estimated over two periods: 120 to 21 days before the event day $\tau = 0$ (pre-event), and 21 to 120 day after the event day $\tau = 0$ (post-event):

$$\tilde{R}_{i,t} - R_f = a_i + b_i (\tilde{R}_{m,t} - R_f) + \tilde{\varepsilon}_{i,t} \quad t \in \text{pre-event, post-event} \quad (6)$$

The GMM approach applied here is relatively similar to that of MacKinlay and Richardson (1991).

There are two sample moment $1/T \sum_{t=1}^T \tilde{\varepsilon}_{i,t}$, $1/T \sum_{t=1}^T \tilde{\varepsilon}_{i,t} (\tilde{R}_{M,t} - R_f)$, and two parameter a_i, b_i to be estimated for each stock. Therefore, the moment condition in equation (6) is exactly identified, and the associated Hansen's J statistic (1982) is zero.

Under the market model,

$$AR_{i,\tau} = \tilde{R}_{i,\tau} - \bar{a}_i - \bar{b}_i (\tilde{R}_{M,\tau}) \quad (7)$$

where \bar{a}_i, \bar{b}_i are the simple averages of the a_i intercepts and b_i coefficients, respectively, from following GMM regression equations estimated over two periods: 120 to 21 days before the event day $\tau = 0$ (pre-event), and 21 to 120 day after the event day $\tau = 0$ (post-event):

$$\tilde{R}_{i,t} - R_f = a_i + b_i (\tilde{R}_{M,t}) + \tilde{\varepsilon}_{i,t} \quad t \in \text{pre-event, post-event} \quad (8)$$

There are two sample moment $1/T \sum_{t=1}^T \tilde{\varepsilon}_{i,t}$, $1/T \sum_{t=1}^T \tilde{\varepsilon}_{i,t} (\tilde{R}_{M,t})$, and two parameter a_i, b_i to be estimated for each stock. Therefore, the moment condition in equation (8) is exactly identified, and the associated Hansen's J statistic (1982) is zero.

If less than 100 days of returns are available during the post-event estimation periods, b_i are estimated using however many days of returns are available, provided there are at least ten.

Denote \overline{AR}_τ as the sample mean abnormal return across event observations at time τ , then \overline{AR}_τ is calculated as,

$$\overline{AR}_\tau = \frac{1}{N} \sum_{i=1}^N AR_{i,\tau} \quad (9)$$

where N is the number of events.

Denote $CAR_i(\tau_1, \tau_2)$ as the cumulative abnormal return for stock i from τ_1 to τ_2 , then $CAR_i(\tau_1, \tau_2)$ is calculated as,

$$CAR_i(\tau_1, \tau_2) = \sum_{\tau=\tau_1}^{\tau_2} AR_{i,\tau} \quad (10)$$

Denote $\overline{CAR}(\tau_1, \tau_2)$ as the sample average cumulative abnormal return across event observations, then $\overline{CAR}(\tau_1, \tau_2)$ is calculated as,

$$\overline{CAR}(\tau_1, \tau_2) = \sum_{\tau=\tau_1}^{\tau_2} \overline{AR}_\tau = \frac{1}{N} \sum_{i=1}^N CAR_i(\tau_1, \tau_2) \quad (11)$$

Denote θ_1 as the cross-sectional test statistic (t-statistic) based on the hypothesis which asserts that:

H_0 : Expected abnormal return is zero for each stock for each day τ . Neither price reversal nor price continuation occurs on day τ .

H_1 : Expected abnormal return is different from zero for each stock for each day τ . Price reversal or price continuation occurs on day τ .

Denote θ_2 as the test statistic (t-statistic) on the basis of the hypothesis which asserts that:

H_0 : Expected cumulative abnormal return is zero for each stock for day τ_1 to day τ_2 . Neither price reversal nor price continuation occurs during day τ_1 to day τ_2 .

H_1 : Expected cumulative abnormal return is different from zero for each stock for day τ_1 to day τ_2 . Price reversal or price continuation occurs during day τ_1 to day τ_2 .

Then the value of θ_1 and θ_2 are calculated based on cross-sectional variances as,

$$\theta_1 = \frac{\overline{AR}_\tau}{\text{var}(\overline{AR}_\tau)^{1/2}} \sim N(0, 1) \quad (12)$$

$$\theta_2 = \frac{\overline{CAR}(\tau_1, \tau_2)}{\text{var}(\overline{CAR}(\tau_1, \tau_2))^{1/2}} \sim N(0, 1) \quad (13)$$

where $\text{var}(\overline{AR}_\tau)$ is the cross-sectional variance of abnormal returns on day τ , whereas $\text{var}(\overline{CAR}(\tau_1, \tau_2))$ is the cross-sectional variance of cumulative abnormal returns from day τ_1 to day τ_2 . These values of test statistics for the event day ($\tau = 0$) and subsequent days provide evidence on whether existing statistically significant price reversals. This is discussed in the next section.

3. DATA

The sample period extends from January 2001 to December 2005 (5 years period). The daily return

Table 1: Summary statistics of daily returns in the sample (2001–2005)

Variable	Observation	Mean (%)	Std. Dev (%)	Minimum (%)	Maximum (%)
Nikkei 300 Stocks	355632	0.0626	2.3082	-33.3333	35.7143

data on all Nikkei 300 stocks, proxy for market return (Tokyo Stock Exchange Price Index (TOPIX)), and proxy for risk free rate (the overnight Tokyo call rate) are obtained from the Nikkei Economic Electronic Databank System (NEEDS). These returns are computed based on the closing price of each trading day. If two successive closing prices are not available, the daily returns are also not recorded. Table 1 shows the summary statistics of the daily returns. Japanese stock return has a rather large standard deviation (2.3082%) from its mean (0.0626%).

Proxies for the time series of FF factors are created utilizing the Daiwa style indexes as follows.³

$$\tilde{R}_{SMB} = \tilde{R}_S - \tilde{R}_L \quad (14)$$

$$\tilde{R}_{HML} = \tilde{R}_V - \tilde{R}_G \quad (15)$$

where $\tilde{R}_S, \tilde{R}_L, \tilde{R}_V, \tilde{R}_G$ represent the returns on Daiwa Small Index (DSI), Daiwa Large Index Daiwa Value Index (DVI), and Daiwa Growth Index (DGI), respectively.

DLI evaluates the performance of 500 larger companies in the first section of TSE. DSI measures the performance of all other companies in the first section of TSE. Classification of DVI and DGI is basically based on the calculation of Value – Growth Score (VGS), which is a combination of four value and growth factors: actual book to market capitalization, actual earnings to market capitalization, estimated return on equity, and estimated growth rate. In the calculation of the VGS, the consolidated accounting data have been used since the end of June, 1989. The indexes are rebalanced twice a year at the end of June and December.⁴

4. EMPIRICAL FINDINGS

Fig.2 plots the average cumulative abnormal returns around 20 days of 10% or greater price decrease, calculated using FF model and CAPM model. Clearly, two measures of abnormal returns exhibit essentially the same pattern of prices following large price changes. However, on average, cumulative abnormal returns reduce significantly using the FF model. The figure also shows that cumulative abnormal returns keep falling on day 1 after the large price decrease. Price reversals occur on day 2 and 3. In general, there is no clear pattern of cumulative abnormal returns during day 4 to day 20 following large price decrease.

³ We thank Mr. TANAKA Tadanori and Mr. TAMANOUCHI Naoshi at the Investment Analysis Department, Daiwa Institute of Research Ltd for kindly providing the data.

⁴ This description is based on the information published on the website of Daiwa Institute of Research Ltd (<http://www.dir.co.jp/dsi2/about/e100about.html>).

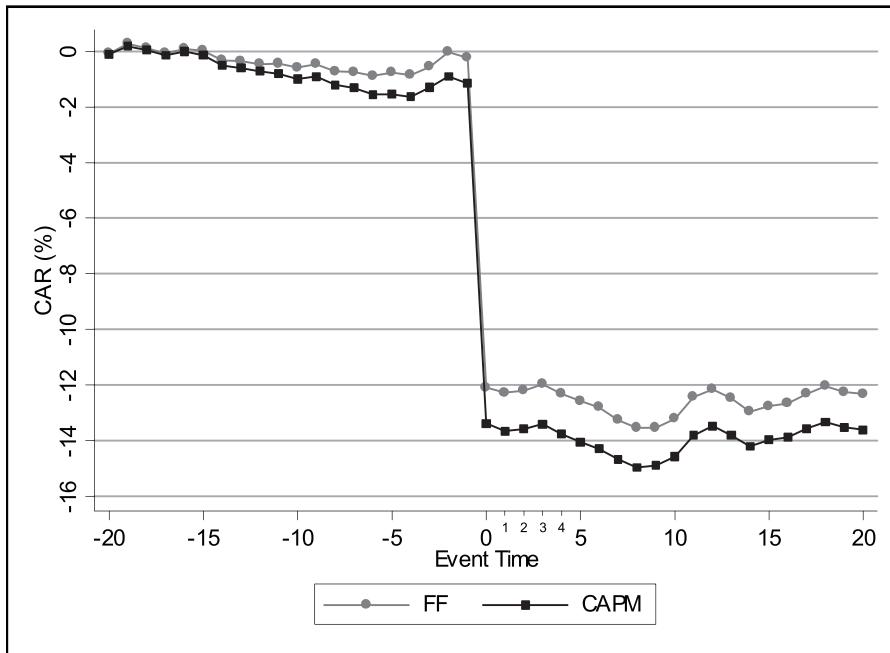


Fig.2: Cumulative abnormal returns for Nikkei 300 stocks that exhibits a 10% or greater price increase at $t = 0$. Abnormal returns are calculated using the FF model with TOPIX and Daiwa value weighted indices and the CAPM model.

Table 2 presents mean abnormal returns of large stock price decrease and increase over the five-year period from January 2001 to December 2005, computed using the three methods described in Section 2.

As shown in Panel A of Table 2, the mean abnormal return is -11.8703 percent on the day of the large price decrease (i.e. day 0), measured using the unrestricted FF model, and of similar magnitude using two other approaches. The mean abnormal return is positive and economically small for day 2 and day 3 of the three trading days following the day of the large price decrease, as indicated by two-tailed test. The total abnormal return i.e. average cumulative abnormal return for these three days is 0.1401 percent, measured using the unrestricted FF model. The average cumulative abnormal return over days 4 through 20 is -0.3648 percent. We interpret these results as little evidence in support of the price reversal and overreaction hypothesis.

Fig.3 plots the average cumulative abnormal returns around 20 days of 10% or greater price increase. The abnormal returns are calculated using FF model and CAPM model. Cumulative abnormal returns fall modestly from day 20 to the day before the event day. This does not concur with finding by Bremer *et al.* (1997) of a rising trend before event day of large price increase, intuitively as a result of “*inside information about the pending good news.*” Following the rise on event day, cumulative abnormal returns decrease significantly on day 1 and day 2, and then rise modestly on average from day 4 to 20.

Panel B of Table 2 shows that the mean abnormal return is 11.6482 percent on the day of the large price advance measured using the unrestricted FF model. The mean abnormal return is negative for

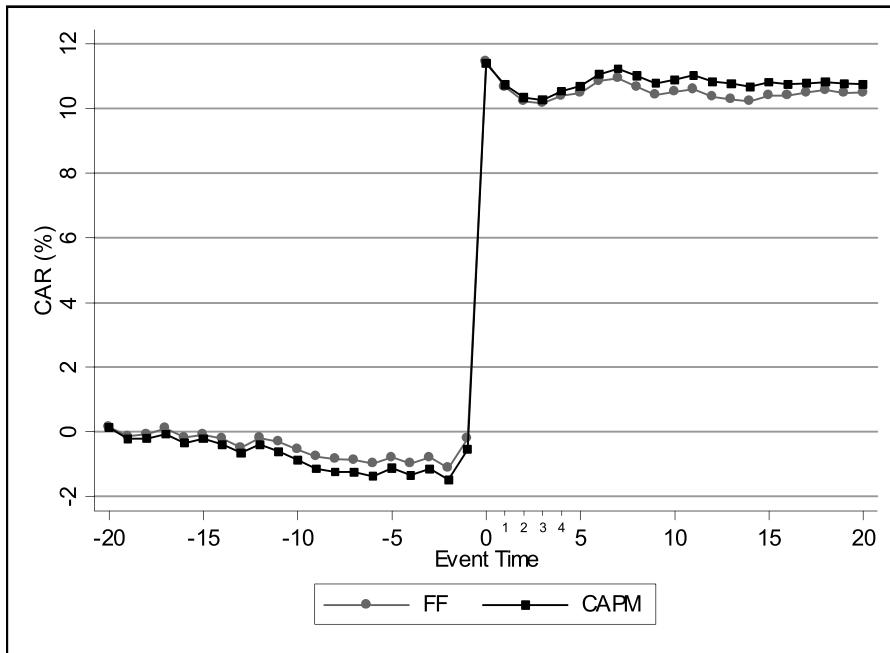


Fig. 3: Cumulative abnormal returns for Nikkei 300 stocks that exhibits a 10% or greater price decrease at $t = 0$. Abnormal returns are calculated using the FF model with TOPIX and Daiwa value weighted indices and the CAPM model.

three trading days following the initial large price change and significantly different from zero on day 1 and day 2, as indicated by two-tailed test. The total abnormal returns over days 1–3 (CAR1–3) is –1.2821 percent and statistically significant. These results support the existence of predictable short-term movements after large price increases. The average cumulative abnormal return over days 4 through 20 is economically small at 0.3261 percent.

To access the consistency of results, Table 3 shows abnormal returns after large price changes of +5 percent or more and –5 percent or less over the period 2001–2005, measured using the unrestricted FF model. The event samples here include 744 price decreases and 949 price increases. If general results are robust, similar ex-post patterns should exist for smaller price changes such as these.

Panel A of Table 3 shows evidence of a statistically significant abnormal return observed only on day 1 following one-day price declines of –5 percent or less. The general pattern is similar to the pattern following changes of –10 percent or less, as shown in Table 2. Panel B of Table 3 also shows that average abnormal returns following one-day price increases of 5 percent or greater are similar to results for days after 10 percent or greater one-day increases (Table 2), i.e. there is evidence of an economically significant short-term price reversal. Thus the results remain robust in different trigger values.

The results are consistent with previous literature (e.g., Dyl (1990), Bremer and Sweeney (1991) and Bremer *et al.* (1997)) i.e. stock price tends to reverse after large price changes. However, different to Bremer *et al.* (1997), we find stronger evidence supporting the existence of short-term price reversal following large price increases than that following large price decreases. We also find that

Table 2: Abnormal returns for Nikkei 300 stocks that exhibited 10% or greater price increases and decreases

	<i>Un-restricted FF</i>	<i>Un-restricted CAPM</i>	<i>Market model</i>
Panel A. Large Price Declines (N=185)			
AR0 (%)	-11.8703(-35.71)***	-12.2346(-38.00)***	-12.2346(-38.00)***
AR1 (%)	-0.1852(-0.43)	-0.2776(-0.64)	-0.2776(-0.64)
AR2 (%)	0.0888(0.25)	0.0810(0.22)	0.0810(0.22)
AR3 (%)	0.2364 (0.86)	0.1685(0.58)	0.1685(0.58)
CAR1–3 (%)	0.1401(0.29)	-0.0281(-0.06)	-0.0281(-0.06)
CAR4–20 (%)	-0.3648(-0.45)	-0.1998(-0.24)	-0.1998(-0.24)
Panel B. Large Price Increases (N=356)			
AR0 (%)	11.6482(54.92)***	11.9320(58.05)***	11.9320(58.05)***
AR1 (%)	-0.7772(-2.72)***	-0.6567(-2.25)**	-0.6567(-2.25)**
AR2 (%)	-0.4446(-2.23)**	-0.3896(-1.94)*	-0.3896(-1.94)*
AR3 (%)	-0.0603(-0.33)	-0.0725(-0.39)	-0.0725(-0.39)
CAR1–3 (%)	-1.2821(-4.75)***	-1.1187(-4.14)***	-1.1187(-4.14)***
CAR4–20 (%)	0.3261(0.60)	0.4749(0.83)	0.4748(0.83)

AR0: Abnormal return on a large one-day decline or advance;

AR1, AR2, and AR3: Abnormal returns on days 1, 2, and 3 after a large one-day decline or advance;

CAR1–3: 3-day cumulative abnormal return after a large one-day decline or advance;

CAR4–20: Cumulative abnormal return from day 4 through day 20 after a large one-day decline or advance;

Cross-sectional t-values in parentheses;

*** Significantly different from zero at the 0.01 level (two tailed test);

** Significantly different from zero at the 0.05 level (two tailed test);

* Significantly different from zero at the 0.1 level (two tailed test).

there is no evidence supporting the existence of predictable pattern in longer term i.e. 4 days to 20 days after the extreme price movements.

5. ECONOMIC SIGNIFICANCE AND POLICY IMPLICATIONS

5.1 Can investors benefit from the patterns following large price changes?

This section discusses the economic significance, i.e. whether there exists opportunities for investors to earn excess profit from the observed patterns.

As reported in table 2, the average cumulative abnormal return for three trading days following large price decrease and increase are 0.1401 percent and -1.2821 percent, respectively. Taking into account of transaction costs (roundtrip commission plus tax on trade, and bid-ask spread),⁵ these amounts, however, are clearly not worth exploiting by any active trading strategy i.e. buy low sell high to exploit the trend following large price decrease, or short sale at high price and buy later at low price to exploit the trend following large price increase.

Table 3: Abnormal returns for Nikkei 300 stocks that exhibited 5% or greater price increases and decreases

<u>Panel A. Large Price Declines (N=744)</u>	
AR0 (%)	-6.3978(-54.81)***
AR1 (%)	0.2881(2.22)**
AR2 (%)	0.0902(0.80)
AR3 (%)	-0.1396(-1.38)
CAR1–3 (%)	0.2387(1.57)
CAR4–20 (%)	0.1225(0.39)
<u>Panel B. Large Price Increases (N=949)</u>	
AR0 (%)	6.5448(70.69)***
AR1 (%)	-0.4874(-4.23)***
AR2 (%)	-0.2317(-2.58)**
AR3 (%)	-0.0921(-0.98)
CAR1–3 (%)	-0.8112(-6.72)***
CAR4–20 (%)	-0.4106(-1.53)

Notes: See Table 2

5.2 The efficiency of TSE's trading rules

The Tokyo Stock Exchange is an order–driven stock market where stock prices are determined by *Itayose* method (for opening and closing prices), and *Zaraba* method (for other trading prices) on real time basis when achieving equilibrium between bids and asks.

Three trading rules including daily price limitations, trade–to–trade variations (quote parameters) and minimum tick size are implemented in order to prevent the extremely wild price fluctuations and to enhance market liquidity. Table 4 presents the details of daily price limitations, trade–to–trade variations (quote parameters), and minimum tick size applied in the TSE as of 29th August, 2003. In general, these current trading rules are efficient in capturing the price fluctuations. Most of the large price changes are well within the daily price limits.

6. CONCLUSIONS

This paper investigates whether there are predictable short–term patterns of stock abnormal returns i.e. three days following the initially extreme price changes in the Japanese stock market. In addition, firm's longer term abnormal returns, i.e. 4 days to 20 days after the extreme price movements are also considered. Abnormal returns are residuals to Fama–French's (1993, 1996) three–factor model, measured using the popular Generalized Method of Moments (GMM) approach.

⁵ Statistics from study of Bremer *et al.* (1997) show that roundtrip commission ranged from 0.3% to 2.4% and the transaction tax on trade was 0.3% over the ten year period from January 1981 to December 1991. For details of bid–ask spread; see Hee *et al.* (2005).

Table 4: TSE's daily price limits, trade-to-trade variations, and minimum tick size

Price	Daily limit		Trade-to-trade limit		Tick size	
	Value	Range (%)	Value	Range (%)	Value	Range (%)
1≤P<100	30	30.00% ~ ∞	5	5.00% ~ ∞	1	1.00% ~ ∞
100≤P<200	50	25.00% ~ 50.00%	5	2.50% ~ 5.00%	1	0.50% ~ 1.00%
200≤P<500	80	16.00% ~ 40.00%	5	1.00% ~ 2.50%	1	0.20% ~ 0.50%
200≤P<1000	100	10.00% ~ 20.00%	10	1.00% ~ 2.00%	1	0.10% ~ 0.20%
1000≤P<1500	200	13.33% ~ 20.00%	20	1.33% ~ 2.00%	1	0.07% ~ 0.10%
1500≤P<2000	300	15.00% ~ 20.00%	30	1.50% ~ 2.00%	1	0.05% ~ 0.07%
2000≤P<3000	400	13.33% ~ 20.00%	40	1.33% ~ 2.00%	5	0.17% ~ 0.25%
3000≤P<5000	500	10.00% ~ 16.67%	50	1.00% ~ 1.67%	10	0.20% ~ 0.33%
5000≤P<10000	1000	10.00% ~ 20.00%	100	1.00% ~ 2.00%	10	0.10% ~ 0.20%
10000≤P<20000	2000	10.00% ~ 20.00%	200	1.00% ~ 2.00%	10	0.05% ~ 0.10%
20000≤P<30000	3000	10.00% ~ 15.00%	300	1.00% ~ 1.50%	10	0.03% ~ 0.05%
30000≤P<50000	4000	8.00% ~ 13.33%	400	0.80% ~ 1.33%	50	0.10% ~ 0.17%
50000≤P<70000	5000	7.14% ~ 10.00%	500	0.71% ~ 1.00%	100	0.14% ~ 0.20%
70000≤P<100000	10000	10.00% ~ 14.29%	1000	1.00% ~ 1.43%	100	0.10% ~ 0.14%
100000≤P<150000	20000	13.33% ~ 20.00%	2000	1.33% ~ 2.00%	1000	0.67% ~ 1.00%
150000≤P<200000	30000	15.00% ~ 20.00%	3000	1.50% ~ 2.00%	1000	0.50% ~ 0.67%
200000≤P<300000	40000	13.33% ~ 20.00%	4000	1.33% ~ 2.00%	1000	0.33% ~ 0.50%
300000≤P<500000	50000	10.00% ~ 16.67%	5000	1.00% ~ 1.67%	1000	0.20% ~ 0.33%
500000≤P<1000000	100000	10.00% ~ 20.00%	10000	1.00% ~ 2.00%	1000	0.10% ~ 0.20%
1000000≤P<1500000	200000	13.33% ~ 20.00%	20000	1.33% ~ 2.00%	10000	0.67% ~ 1.00%
1500000≤P<2000000	300000	15.00% ~ 20.00%	30000	1.50% ~ 2.00%	10000	0.50% ~ 0.67%
2000000≤P<3000000	400000	13.33% ~ 20.00%	40000	1.33% ~ 2.00%	10000	0.33% ~ 0.50%
3000000≤P<5000000	500000	10.00% ~ 16.67%	50000	1.00% ~ 1.67%	10000	0.20% ~ 0.33%
5000000≤P<10000000	1000000	10.00% ~ 20.00%	100000	1.00% ~ 2.00%	10000	0.10% ~ 0.20%
10000000≤P<15000000	2000000	13.33% ~ 20.00%	200000	1.33% ~ 2.00%	10000	0.07% ~ 0.10%
15000000≤P<20000000	3000000	15.00% ~ 20.00%	300000	1.50% ~ 2.00%	10000	0.05% ~ 0.07%
20000000≤P<30000000	4000000	13.33% ~ 20.00%	400000	1.33% ~ 2.00%	50000	0.17% ~ 0.25%
30000000≤P<50000000	5000000	10.00% ~ 16.67%	500000	1.00% ~ 1.67%	100000	0.20% ~ 0.33%
P≥50000000	10000000	up to 20.00%	1000000	up to 2.00%	1000000	up to 2.00%

Source: Tokyo Stock Exchange Website: <http://www.tse.or.jp/english/faq/index.html#general>

The results based on 300 firms comprising the Nikkei 300 over the five-year period from January 2001 to December 2005 indicate the followings. First, in line with previous literature, this study finds evidence of price reversals following large price changes. Different to Bremer *et al.* (1997), there is stronger evidence supporting the existence of short-term price reversal following large price increases than that following large price decreases. Second, there is no evidence supporting the existence of predictable pattern in longer term i.e. 4 days to 20 days after the extreme price movements. Third, profits from contrarian investments by exploiting the phenomena of price reversals are not likely after taking into account of transaction costs. This is consistent with the weak form of EMH.

To conclude, the contributions of this study are using daily FF model to investigate the overreaction and price reversals following large one-day price changes in Japanese stock market, via popular GMM approach. In contrast to Bremer *et al.* (1997) finding of stronger evidence on price reversals after large one-day declines than that after large one-day increases, this study find that price following large one-day increases tend to reverse stronger than that following large one-day decreases in the recent period (2001–2005).

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