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Predictable Patterns after Large Stock Price Changes on the Tokyo Stock Exchange

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Abstract

This paper extends to Japanese stocks recent research on short-term stock price adjustment to new information. Using standard methodologies, we find that stock returns of firms included in the Nikkei 300 tend to be significantly positive after large price decreases. This is similar to the pattern observed for American stocks in other research. The pattern remains when returns are adjusted for market movements, and exists independently of the October 1987 market break. We find little evidence of significant patterns following large stock price increases. We also find little evidence that non-transaction prices explain the persistent, significant returns observed following large price decreases on the Tokyo Stock Exchange. We conjecture that broker/dealers and TSE member firms respond to large price decreases not by trading for their own profit, but rather by selectively supplying liquidity to their preferred retail customers. We conclude that ordinary investors probably cannot earn economic profits from these statistically significant patterns.

I. Introduction

There has been a substantial interest in stock price rebounds in recent years. In influential research, De Bondt and Thaler (1985) hypothesize that "extreme movements in stock prices will be followed by subsequent price movements in the opposite direction," and that "the more extreme the initial price movement, the greater will be the subsequent adjustment." In their empirical work, stocks that had experienced abnormally large negative returns tend to experience abnormal positive returns in later periods and stocks with unusually large positive returns experience abnormal negative returns. They conclude this is inconsistent with weak-form market efficiency.

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Subsequent to De Bondt and Thaler's findings, a substantial literature developed that both tested and critically discussed stock market rebounds.[1] Most research, including Ball and Kothari (1989), Chan (1988), Chan and Chen (1991), De Bondt and Thaler (1987), and Zarowin (1989), (1990), focuses on longer-term rebounds where reversals take as long as three to five years. A second category of research by Jegadeesh (1990) and Lo and MacKinlay (1990) found reversals in intermediate (weekly and monthly) return data. This study belongs to a third category of research that focuses on short-run price rebounds and large price movements that reverse over the next few days. This category includes Atkins and Dyl (1990), Bremer and Sweeney (1991), (1996), Brown, Harlow, and Tinic (1988), (1993), Cox and Peterson (1994), Howe (1986), Lehmann (1990), Park (1995), and Renshaw (1984). This paper examines stocks listed on the Tokyo Stock Exchange (TSE) and included in the Nikkei 300 stock market index as of 1993 to determine whether the rebound phenomenon exists in Japan. Therefore, this study answers the question of how the stock price pattern differs from country to country. The existence of ex post stock return patterns following large price changes on the TSE suggests that these patterns are not simply a consequence of institutional practices unique to individual (national) markets, but may result from more basic aspects of trading.

This study of the TSE's rebound phenomenon is interesting for the following reasons: i) Japan is ranked among the world's largest countries in terms of real GDP and real GDP per capita, hence what happens in Japan matters significantly to the world; ii) Japan's stock market, of which the TSE is the most representative, is also among the largest in the world; iii) the value of the Japanese stock market has major implications for the global competitiveness of Japanese firms (since it is directly related to the balance sheet strength of lending institutions through reciprocal share holdings and regulations concerning capital adequacy); and iv) if the reversal patterns on the TSE are similar to those on the New York Stock Exchange (NYSE), they may result from the fundamental behavior of investors/traders rather than from institutional features, which are very different between the two markets.

There is no consensus regarding the implications of price rebounds for market efficiency. Some argue that rebounds are consistent with what Kahneman and Tversky (1973) documented: people tend to give excessive weight to recent experience when revising their expectations. De Bondt and Thaler (1987) confirmed their earlier work on market overreactions. In these cases, the phenomenon is interpreted as evidence of irrational bubbles—market inefficiency with a predictable component in stock price movements. Others believe that rebounds can be reconciled with market efficiency when expected returns are appropriately adjusted for risk (Chan (1988) and Chan and Chen (1991)) or when data and microstructure issues are properly addressed.

The present study examines a group of the most liquid TSE stocks for the existence of short-run price rebounds. The methodology follows that of Atkins and Dyl (1990) and Cox and Peterson (1994). Specifically, we examine the behavior of each stock's rate of return on days after large (positive or negative) changes

[1] See De Bondt and Thaler (1989) for an extensive review of this literature.

in the stock price. These rates of return are compared to expected rates of return using standard statistical methods.

II. Methodology

There are many ways to investigate whether there are predictable patterns of ex post stock returns after large price changes. We attempt to identify patterns using the most simple, yet rigorous, statistical tests possible. Further, the paper focuses on ex post (realized) stock return patterns following (positive or negative) large price changes to facilitate comparison of TSE patterns to previously documented patterns in American stocks.

Consider all daily rates of return for stocks included in the Nikkei 300 that were less (greater) than -10 (+10)% over the period from January 1981 to December 1991; define these rates of return as large price change events. Such events could be caused by unexpected operating results, unanticipated government decisions, or simply bad (good) luck. Daily abnormal returns following these price changes are defined as

$$X_{j,t} = r_{j,t} - E\left(r_{j,t}\right),$$

where $r_{j,t}$ is the rate of return for stock j: $r_{j,t} = (P_{j,t}/P_{j,t-1}) - 1.0$, with $P_{j,t}$ the closing price for stock j on day t. $E(r_{j,t})$ is the stock's normal return conditioned on information unrelated to the large price change event. We consider several different ways to calculate normal returns; the results are very similar across approaches. We present here results for abnormal returns when normal returns are calculated as

$$E\left(r_{j,t}\right) = r_{f,t} + \beta_{j,\text{Average}}\left(r_{m,t} - r_{f,t}\right),$$

where $r_{f,t}$ is the risk-free rate of return on day t (the overnight Tokyo call rate) and $r_{m,t}$ is the market return on day t (the rate of change of the Tokyo Stock Exchange Price Index [TOPIX]).[2] $\beta_{j,\text{Average}}$ is a simple average of the $\widehat{\beta}_j$ coefficients from the following ordinary least squares regression equations estimated over two periods: 105 to six days before event day t (pre-event) and 21 to 120 days after event day t (post-event).

$$r_{j,t} - r_{f,t} = \widehat{\alpha}_j + \widehat{\beta}_j\left(r_{m,t} - r_{f,t}\right) + \epsilon_{j,t}, \quad t \in \text{pre-event, post-event},$$

where $\epsilon_{j,t}$ is a zero mean error term.[3] So, $X_{j,t} = (r_{j,t} - r_{f,t}) - \beta_{j,\text{Average}}(r_{m,t} - r_{f,t})$.

Cumulative abnormal returns are simply summed daily abnormal returns over the specified event window. The mean abnormal return is the sum of individual abnormal returns for the event window divided by the number of events. We calculate t-statistics on the basis of the null hypothesis that the expected abnormal return is zero for each stock for each day and on the assumption that the cumulative

[2]The TOPIX is a value-weighted price index of all stocks listed on the first section of the TSE; there were 1,223 stocks listed as of December 31, 1991.

[3]Trading days near the October 1987 market break are excluded from parameter estimation. No stocks are eliminated because of missing observations in the post-event period.

abnormal returns are independent across events and stocks.[4] Test statistics are based on cross-sectional variances. So, the day-h t-statistic is calculated as

$$t_h = \frac{\overline{X}_h}{S_h},$$

where $\overline{X}_h$ is the average abnormal return for day h and S_h is the cross-sectional standard error across events for day h after the event. Classic simulation research by Brown and Warner (1980), (1985) has shown that this general approach is effective in identifying abnormal returns. Essentially the same method is used by Atkins and Dyl (1990) and Cox and Peterson (1994) and mutatis mutandis by Bremer and Sweeney (1991), (1996).

Tests based on cross-sectional standard errors are simple and powerful, yet do not use all available information on abnormal returns. These abnormal returns are the difference between the security's return over the window of interest and the security's expected return based on a statistical model estimated over a benchmark period. This expected return is estimated and thus contains estimation error; hence abnormal returns contain estimation error. The cross-sectional standard error approach does not adjust for this estimation error in abnormal returns.

Alternative approaches adjust for estimation error. Mikkelson and Partch (1988), Karafiath and Spencer (1991), Salinger (1992), and Sweeney (1991) show that the variance of cumulative abnormal returns for event j over days *start* to *end* is

$$\sigma^2_{\text{CAR,j,Start to End}} = \sigma^2_{\epsilon_j}\left[W + \frac{W^2}{B} + \frac{\sum_{t=\text{Start}}^{\text{End}}\left(r_{m,t} - \overline{r}_m\right)^2}{\sum_{t\in B}\left(r_{m,t} - \overline{r}_m\right)^2}\right],$$

where $\sigma^2_{\epsilon_j}$ is the variance of the residuals from the OLS regression equation estimated over the benchmark observations: $\sigma^2_{\epsilon_j} = \text{var}(\epsilon_{j,t})$ where

$$\epsilon_{j,t} = r_{j,t} - r_{f,t} - \widehat{\alpha}_j - \widehat{\beta}_j\left(r_{m,t} - r_{f,t}\right),$$

for $t \in B$; B is the benchmark period; $\overline{r}_m$ is the average return on the market index over B; and W is the number of days in the observation window for the cumulative abnormal return. This variance adjusts for dependence created by errors in the statistical model's parameter estimates. Statistical tests based on this variance are

$$Z_{\text{CAR,Start to End}} = \frac{1}{\sqrt{N}}\sum_{j=1}^{N}\left[\frac{\sum_{t=\text{Start}}^{\text{End}} X_{j,t}}{\sqrt{\sigma^2_{\text{CAR,j,Start to End}}}}\right],$$

where N is the number of events.

Nevertheless, much of the literature on short-term predictable patterns after large stock price changes has adopted the cross-sectional approach. This is because the large stock price change may indicate substantial changes in the firm's business

[4]In work not reported here, we address the possibility that events are not independent by allowing only one event per day to remain in our analysis. Results did not change significantly.

prospects and thus substantial changes in the parameters of the stock return's distribution. The sample variance of abnormal returns calculated from the benchmark period may not be an unbiased estimate of the abnormal return's new variance after the significant business event that triggered the large stock price change. Tests based on cross-sectional standard errors are a conservative response to potential changes in the variance of abnormal returns, because the cross-sectional approach typically gives smaller t-values. Yet discarding the information captured in $Z_{\text{CAR,Start to End}}$—which is what the cross-sectional approach essentially does—may be too radical a response. We therefore also present statistics based on $Z_{\text{CAR,Start to End}}$ for cumulative abnormal returns over days 1–3 and days 4–20; these values should facilitate comparison with other research. In general, we view statistics based on cross-sectional variances as more reliable.

Because of reasonable concerns regarding potential changes in the distributions of abnormal returns following large price change events, we also present nonparametric statistics to measure the significance of patterns following large price changes. These statistics make minimal assumptions about the distribution of abnormal returns. If there is an equal chance of a success or failure, where success is defined as an abnormal return greater than zero, the variance of such a binomial distribution is $(0.5)^2/N$. A binomial z-statistic can then be calculated as

$$z = \frac{\text{Percent of Abnormal Returns Greater than Zero} - 50\%}{100\%\sqrt{0.25/N}}.$$

If this value is significantly different from zero during the days following large price changes, there is evidence in favor of a predictable pattern of stock returns.

III. Data

The comprehensive daily close-to-close return data on all Nikkei 300 stocks were provided by QUICK Research Institute (QRI), Tokyo, for this study.[5] The data cover the period from January 1981 to December 1991. Problems related to missing observations and potential measurement errors are largely avoided: Nikkei 300 stocks tend to be actively traded and the TSE carefully checks recorded prices. These returns are not based on quoted prices but on actual transaction prices, and thus closing prices represent the last transaction of each trading day. If two consecutive closing prices are not available, daily returns are recorded for neither trading day.

All computed daily returns on these 300 stocks and the TOPIX (the market proxy) are not adjusted for dividends. Nevertheless, the effect of dividend omission on abnormal return computation is minimal because ex dividend days for these stocks and the rest of the TSE's first section stocks are concentrated on the two

[5]The Nikkei 300 was introduced by Nihon Keizai Shimbun-sha (Nikkei) on October 8, 1993. This new index is a value-weighted index; the older, better known, Nikkei 225 is a price-weighted index similar in construction to the Dow-Jones stock averages. The Nikkei 300 was intended to support the new Nikkei futures contract traded on the Osaka exchange. The Nikkei 300's component securities were selected from high liquidity, large firm stocks listed on the first section of the TSE. Some of the stocks in the old Nikkei 225 index had relatively low liquidity. This research uses Nikkei 300 stocks as they were defined at its inception.

calendar days corresponding to the ends of the semiannual fiscal periods in March and September. For example, September 25 (Friday), 1992, was the last day of the 1992 semiannual fiscal period. This day was the ex dividend day for the vast majority of Nikkei 300 firms and most of the other TSE first section companies. Approximately 8 (17)% of large positive (negative) price change events occur at or near the end of these fiscal periods.

Large stock price changes may be associated with daily price movement limits, a feature of the TSE importantly different from the NYSE and many other stock exchanges. The TSE is essentially an auction market but with rules and practices that limit the size and speed of price changes.[6] Three of these rules are potentially important for this study. The first rule is most important and limits the amount of price variation per day: trading of a particular stock is prohibited beyond these price limits (but continued trading is permitted within the limits even after the price limits are touched). The second rule limits the speed of the price change from one transaction or special quote price (defined below) to the next. This limit is the maximum trade-to-trade price variation. The third rule is related to the TSE's minimum tick size. This rule determines the minimum trade-to-trade price variation and acceptable pricing units for limit orders (it does not apply to special quote prices). These price limit rules are positive (step) functions of share price. Daily price limits are rarely hit for stocks on the TSE because: daily price limits are large; the maximum price variation rules reduce the speed of price adjustment; TSE officials (*saitori*) halt trading temporarily and warn all market participants about large order imbalances; and probably most of all, brokerage firms, though not formally responsible for price continuation, often provide liquidity to the market. This is especially true for Nikkei 300 stocks that have high liquidity.[7]

When a major order imbalance exists, a special quote price (*tokubetsu kehai-ne*) is indicated by *saitori* to inform market participants. Once buy and sell orders are matched, the special quote is withdrawn and trading returns to an ordinary two-way, order-matched, single-price continuous auction. If the order imbalance continues for five minutes, the special quote is renewed at a higher or lower price, depending on market conditions. It is quite possible for a stock to end a day's trading with zero transaction volume, yet have its share price reach the daily limit on a special quote basis. Since trading is not terminated for shares whose quoted price reaches the daily limit, transactions at and within the limit are not halted during the rest of the trading session. If trading ended with zero transaction volume at the limit price on a special quote basis, there could have been a very large order imbalance caused by extremely surprising news. On the other hand, the daily limit could be hit by ordinary price changes for genuine transactions.

[6]See Lehmann and Modest (1994) for an excellent discussion of the TSE's rules and procedures. See also Amihud and Mendelson (1989), (1991), (1993), Hiraki and Maberly (1995), Lindsey and Schaede (1992), and especially the section on institutional details in Hamao and Hasbrouck (1995).

[7]NYSE specialists can delay or halt trading when there are large imbalances in their order books. The TSE's *saitori*, on the other hand, are expected to delay trading under such circumstances by sending a signal to market participants in the form of special quotes. They cannot make a market using their own accounts, as NYSE specialists do. Japanese investment bankers who engage in underwriting are implicitly responsible for orderly price formation and continuation of client company stock prices. Japanese investment bankers often do not separate their corporate finance activities from their broker/dealer activities. Hence, they tend to regard informal market making as part of their underwriting activities.

This price will often remain unchanged for the rest of the trading session. In any case, price momentum is probably reduced by the daily price limits.

Our data set is constructed in such a way that large price changes based on special quote prices with no transactions on day 0 (the event day) and regular closing prices with positive trading volume on day 1 will be identified as missing observations. That is, our data set omits large price changes that are not supported by actual trading because the day 0 price adjustment may be slowed by the TSE's price limits and special quote system. However, the majority of large price changes in the Nikkei 300 are not subject to daily price limits. Nikkei 300 stocks during the October 1987 market break are notable exceptions. On October 20 (Tuesday), for example, the majority of Nikkei 300 closing prices were recorded as having transactions; yet in fact, many stocks hit their daily price limits near the market close without having significant volume.[8] As constructed, our data set does not exclude these potentially misleading observations around the market break. In addition, large price changes during this period, for the same stock and across stocks, are not independent of each other. We address this problem by excluding the October 16–23 period from our sample.

IV. Initial Evidence of Price Patterns for TSE and American Stocks

The bottom row of Table 1 shows abnormal returns following +10% price changes for stocks in the Nikkei 300 over the period from January 1981 to December 1991. The table also shows results from some previous empirical studies of patterns following large price increases.[9] Evidence from studies on American ex post patterns following positive price changes is mixed. Atkins and Dyl (1990) find a small, significant negative return pattern. Bremer and Sweeney (1996) find that returns following a large price increase are not importantly different from zero. Brown, Harlow, and Tinic (1988) find small, significant positive cumulative returns following positive price events. Park (1995), using a different approach to identify large price changes, finds day 1 returns not significantly different from zero, but does find evidence of significant price reversal patterns over the short-run. Lehmann ((1990), not shown in Table 1) finds economically small, but statistically significant negative (weekly) returns. The average abnormal return for stocks included in the Nikkei 300 that experienced a 10% or more one-day increase is

[8]Only 68.5% (753 out of 1,100) stocks were traded on the first section of the TSE while the remaining stocks recorded special quotes (non-transaction prices)—they hit their daily price limits with zero trading volume for the day. Even for traded stocks, the vast majority (697 out of the 753) had no transactions until the end of the morning session and had reached their price limits at least once by that time. Later in the afternoon session, these stocks were traded almost exclusively at their limit prices. The closing TOPIX on October 20 was based on market values computed with actual transaction prices for the 753 stocks and closing special quote prices for the rest. Tuesday's 14.62% decrease in the TOPIX represents the approximate maximum possible price decrease or a weighted average of the ratio of price limits to the previous day's closing share prices because the majority of the TSE's stocks hit price limits on either a transaction or special quote basis. The transaction volume of the first section of the TSE was low at 485 million shares, about half the average daily volume for 1987 (947 million shares per day).

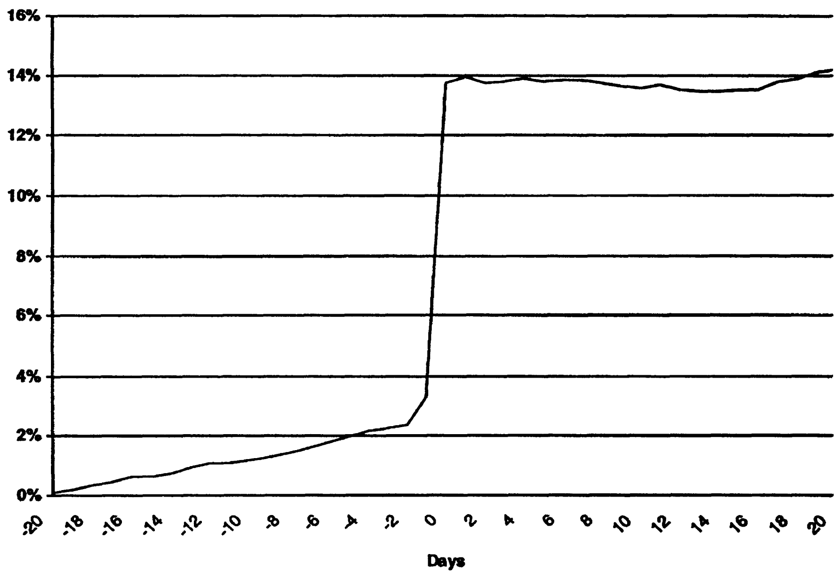
[9]These empirical studies are only approximately comparable. For example, Brown, Harlow, and Tinic (1988) define an event as a market model residual $\geq 2½\%(\leq -2½\%)$. Atkins and Dyl (1990) use a different approach to define events.

positive on day 1, though not statistically significant at the 0.05 level. The day 2 average abnormal return for stocks included in the Nikkei 300 is significantly less than zero, a result similar to Park (1995) and Atkins and Dyl (1990).

Figure 1 shows cumulative abnormal returns 20 days before and after a large price increase for stocks included in the Nikkei 300 over the period 1981 to 1991. Day 0 corresponds to the 10% or greater price rise. Clearly there is a rising trend before day 0, perhaps as a result of trades based on inside information about the pending good news. However, the adjustment appears complete by the end of day 0. There is a small rise on day 1 after the price rise of 10% or more, and a fall on day 2. These stocks rise modestly on average from days 3 to 20 after the large price increase.

FIGURE 1

Cumulative Abnormal Returns within 20 Days of a 10% or Greater Price Increase



Previous research on NYSE data suggests that the ex post patterns following large price decreases tend to be both absolutely larger and more significant than the pattern after large price increases. Table 2 shows abnormal returns after price changes $\leq -10\%$ for stocks in the Nikkei 300 and several other empirical studies. The studies of American stocks are fairly consistent in that they find that the patterns of stock returns following large price decreases tend to be positive for some time after the price change. Notable exceptions are Cox and Peterson (1994) and Park (1995). Cox and Peterson find that the size and significance of the price rebound vary over different subperiods and disappear in the most recent period. Park, using an approach that addresses important data issues (which are discussed below), finds a negative day 1 abnormal return but a positive average abnormal return on day 2.

TABLE 1

Selected Abnormal Returns from the Literature on Short-Term Reversals after Large Price Increases

	Sample	Approach	Day 1	Day 2	Day 3
Atkins and Dyl (1990)	Random selection of NYSE stocks, 1975–1984; $N = 836$	Abnormal returns measured as residuals to a market model	−0.448% (−2.09)*	−0.321% (−1.89)	−0.445% (−2.79)*
Bremer and Sweeney (1996)	Fortune 500 stocks, 1962–1986; $N = 3423$	All one-day returns in excess of 10%; abnormal returns measured as residuals to the stock's mean	0.055% (0.56)	−0.024% (−0.19)	−0.122% (−0.85)
Brown, Harlow, and Tinic (1988)[a]	200 Largest S&P companies; $N = 4788$	All one-day market model residuals in excess of 2½%; abnormal returns measured as residuals to a market model	0.118% (3.69)*	0.035%	−0.058%
Park (1995)	NASDAQ National Market System stocks, Oct. 1984–Jan. 1987; $N = 1276$	All one-day market-adjusted abnormal returns in excess of 10% measured as an average of closing bid and ask prices; abnormal returns measured as the difference between the observed return and the market return	0.042% (0.20)	−0.465% (−2.19)*	−0.424% (−1.99)*
Nikkei 300	TSE, Nikkei 300 stocks, 1981–1991; excluding Oct. 16–23, 1987; $N = 2015$	All one-day returns in excess of 10%; abnormal returns measured as residuals to a market model	0.202% (1.87)	−0.199% (−2.32)*	0.033% (0.40)

[a]The research reports cumulative returns; the daily values shown here are calculated from these cumulative returns.
*Indicates value significantly different from zero at the 0.05 level.

TABLE 2

Selected Abnormal Returns from the Literature on Short-Term Reversals after Large Price Decreases

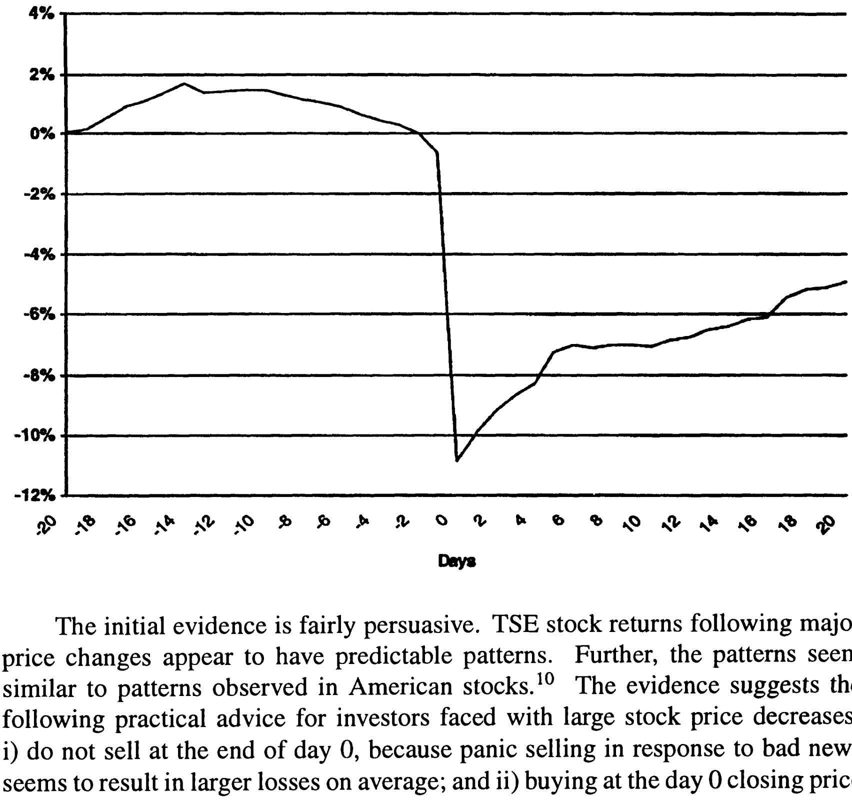
	Sample	Approach	Day 1	Day 2	Day 3
Atkins and Dyl (1990)	Random selection of NYSE stocks, 1975–1984; $N = 835$	Abnormal returns measured as residuals to a market model	1.761% (7.75)*	0.503% (2.56)*	0.040% (0.23)
Bremer and Sweeney (1991)	Fortune 500 stocks, 1962–1986; $N = 823$	All one-day returns less than −10%; abnormal returns measured as residuals to the stock's mean	1.773% (5.86)*	0.442% (2.12)*	0.425% (1.61)
Brown, Harlow, and Tinic (1988)[a]	200 Largest S&P companies; $N = 4317$	All one-day market model residuals less than −2½%; abnormal returns measured as residuals to a market model	0.045% (1.28)	0.067%	0.027%
Cox and Peterson (1994)	NYSE stocks, 1963–1967; $N = 252$	All one-day returns less than −10%; abnormal returns measured as residuals to a market model	1.73% (4.97)*	0.44% (1.76)	−0.31% (−1.43)
	NYSE stocks, Nov. 1987–Jun. 1991; $N = 363$	(Same)	−0.16% (−0.54)	0.08% (0.39)	0.14% (0.66)
Park (1995)	NASDAQ National Market System stocks, Oct. 1984–Jan. 1987; $N = 840$	All one-day market-adjusted abnormal returns less than −10% measured as an average of closing bid and ask prices; abnormal returns measured as the difference between the observed return and the market return	−0.218% (−0.94)	0.534% (2.31)*	0.216% (0.93)
Nikkei 300	TSE, Nikkei 300 stocks, 1981–1991; excluding Oct. 16–23, 1987; $N = 479$	All one-day returns less than −10%; abnormal returns measured as residuals to a market model	0.963% (3.69)*	0.657% (2.85)*	0.546% (2.31)*

[a]The research reports cumulative returns; the daily values shown here are calculated from these cumulative returns.
*Indicates value significantly different from zero at the 0.05 level.

The result for stocks included in the Nikkei 300 is similar to results for American stocks. As seen in the bottom row of Table 2, these stocks have significant, positive average abnormal returns after a $\leq -10\%$ price change. Figure 2 shows cumulative abnormal returns 20 days before and after $\leq -10\%$ price changes for stocks included in the Nikkei 300 over the period 1981 to 1991. Day 0 corresponds to the 10% or greater stock price fall. The figure shows a substantial rebound during the three days after the price fall. Cumulative average abnormal returns continue to rise during the 20 days after the price fall.

FIGURE 2

Cumulative Abnormal Returns within 20 Days of a 10% or Greater Price Decrease



The initial evidence is fairly persuasive. TSE stock returns following major price changes appear to have predictable patterns. Further, the patterns seem similar to patterns observed in American stocks.[10] The evidence suggests the following practical advice for investors faced with large stock price decreases: i) do not sell at the end of day 0, because panic selling in response to bad news seems to result in larger losses on average; and ii) buying at the day 0 closing price *might* be worthwhile.

[10]These results are also consistent with findings by Engle and Ng (1993), who document asymmetric conditional responses to lagged good and bad news measured in terms of positive and negative price changes, by applying non-linear time-series models to TOPIX daily returns. Bae and Karolyi (1994) and Hiraki, Maberly, and Taube (1997) also document greater conditional volatility responses to negative "shocks" on the TSE. These studies use market index returns, while the present study examines daily returns of individual stocks and focuses only on large price changes.

V. Problems and Complications

The initial evidence in favor of a predictable pattern of ex post stock returns following major price changes on the TSE is compelling. Still, researchers must exercise extreme caution when analyzing the significance of these patterns. There are several theoretical, methodological, and market microstructure issues that complicate interpretation of these patterns and mitigate the investment advice suggested in the last section. Most of these points have already been discussed by Bremer and Sweeney (1991), (1996), Atkins and Dyl (1990), Cox and Peterson (1994), and Park (1995). Therefore, we will discuss briefly here only the issues that are likely to be especially important for the TSE. The issues can be summarized as problems involving: economic significance, period of observation, price movement limits, and sample selection bias.

A. Economic Significance

The existence of statistically significant abnormal returns following major price changes, while academically intriguing, is not inconsistent with the general concept of market efficiency. To be interesting from the standpoint of practical finance, the pattern must be worth exploiting—it must offer risk-adjusted profits beyond any costs incurred. This is economic significance.

Consider the following naive trading strategy. Buy (sell short) X amount of any Nikkei stock that experienced a 10% or greater price decrease (increase) on the day of the price change at the closing price. Sell (buy) the same stock at the closing price three days later. What is the profit after commissions and securities transactions taxes from such a strategy for retail investors? What is the profit for members of the TSE who pay no commissions at all? The round trip commissions that apply for most of the period examined here are large and (mostly) non-negotiable; they range from 2.4% of the securities' value on the smallest transactions to 0.3% for the largest transactions. There is also a securities transaction tax of 0.3% for any sale.

Table 3 shows average abnormal returns following one-day price increases (decreases) of 10% or more (-10% or less) in various subperiods. Consider now the column that shows average abnormal returns over 1981 to 1991 after price increases. The horizontal block labeled Days 1–3 reports the average cumulative abnormal return over the three days after 10% or greater price increases (decreases). Clearly, for large price increases, there is no profit in this strategy: transactions costs are much larger than the small gain of 0.04% for both retail investors and member firm traders.

Table 3 also shows average abnormal returns following one-day price decreases of $\leq -10\%$. The cell at the intersection of the full period, decreases column, and the row labeled Days 1–3 shows the average cumulative abnormal return over the three days after a large price decrease over 1981 to 1991. This large, significant price rebound, 2.17%, more than compensates for the transaction costs of member firm traders and, if a large purchase can be made, of retail investors as well. It seems to offer a profit—but at what risk? The abnormal returns in this table are estimated with an excess return version of the market model,

TABLE 3

Abnormal Returns of Nikkei Firms following One-Day Price Changes of −10% or Less and +10% or More

Event Period	1/81–12/91[a] Full Period		1/81–12/85 Subperiod One		1/86–12/89[a] Subperiod Two		1/90–12/91 Subperiod Three	
	Increases	Decreases	Increases	Decreases	Increases	Decreases	Increases	Decreases
Sample Size	2015	479	635	87	786	100	594	292
Day 1	0.20%	0.96%	−0.09%	2.61%	0.22%	1.56%	0.49%	0.28%
	(1.87)	(3.69)*	(−0.41)	(3.53)*	(1.30)	(3.16)*	(2.67)*	(0.86)
	[0.46]**	[0.61]**	[0.42]**	[0.67]**	[0.45]**	[0.70]**	[0.50]	[0.56]**
Day 2	−0.20%	0.66%	−0.16%	−0.06%	−0.31%	0.44%	−0.09%	0.94%
	(−2.32)*	(2.85)*	(−0.98)	(−0.13)	(−2.34)*	(1.05)	(−0.58)	(2.90)*
	[0.44]**	[0.55]**	[0.47]	[0.48]	[0.41]**	[0.55]	[0.44]**	[0.57]**
Day 3	0.03%	0.55%	−0.03%	−1.70%	0.24%	0.49%	−0.18%	1.22%
	(0.40)	(2.31)*	(−0.19)	(−5.03)*	(1.86)	(1.38)	(−1.29)	(3.53)*
	[0.46]**	[0.53]	[0.43]**	[0.32]**	[0.48]	[0.49]	[0.47]	[0.60]**
Days 1–3	0.04%	2.17%	−0.28%	0.85%	0.15%	2.50%	0.22%	2.44%
	(0.30)	(4.90)*	(−0.67)	(1.12)	(0.59)	(3.35)*	(0.71)	(3.71)*
	{−1.42}	{11.49}*	{−4.18}*	{2.07}*	{1.01}	{5.82}*	{0.51}	{10.14}*
	[0.47]**	[0.67]**	[0.45]**	[0.68]**	[0.45]**	[0.70]**	[0.49]	[0.66]**
Days 4–20	0.57%	3.44%	1.20%	0.64%	0.10%	0.76%	0.56%	5.06%
	(2.24)*	(5.45)*	(2.27)*	(0.77)	(0.27)	(0.89)	(1.33)	(5.46)*
	{1.51}	{7.77}*	{1.58}	{0.24}	{−0.06}	{0.70}	{1.24}	{9.29}*
	[0.52]	[0.73]**	[0.54]	[0.77]**	[0.49]	[0.58]**	[0.54]**	[0.76]**

Mean abnormal returns are presented, with cross-sectional *t*-values in parentheses, *z*-values based on the variance of cumulative abnormal returns in braces, and the proportion of positive abnormal returns in brackets. Day 0 is the date of the large price change.

[a]Major price changes occurring during October 16–23, 1987 are excluded.

*Indicates mean significantly different from zero at the 0.05 level; and **indicates proportion significantly different from 0.50 at the 0.05 level.

which adjusts for systematic risk. The beta risk of these Nikkei stocks increases after a major price decrease; yet, the apparent profit is substantially greater than is justified by the increase in systematic risk.[11] Further, as shown by the values in brackets, 67% of cumulative abnormal returns after large price decreases are positive. This suggests a profit opportunity for member firm broker/dealers as well as retail investors capable of making large transactions. On closer examination, however, evidence supporting risk-adjusted profits is far weaker than it appears. The discussion in the next section is, on balance, favorable to profits, yet when the many difficulties investors face when executing trades at the prices examined here are considered, we conclude that risk-adjusted profits are not likely.

B. Period of Observation

Research by Cox and Peterson (1994) on NYSE stocks finds that the pattern of prices following large price decreases differs importantly from one subperiod to another and that abnormal returns decrease in later, more liquid periods. They attribute this to changes in the level of general liquidity in security markets. Of

[11]Pre-event betas average 0.88 while post-event betas average 0.93; the increase is statistically significant. Assuming a risk premium on the market of 8%/year, the risk premium per trading day (assuming 250 trading days per year) is 0.0320%/day or 0.0308%/day as the arithmetic or compounded daily rate is calculated. An increase of 0.05 in beta raises the expected daily return by 0.0016 or 0.0015%/day.

course, the existence of time-varying differences in these patterns is not really the most important point; the issue is whether the patterns persist and have economic significance. Table 3 shows average abnormal returns for Nikkei stocks following one-day price increases of 10% or more over the periods 1981–1985, 1986–1989, and 1990–1991, as well as 1981–1991. The second subperiod corresponds roughly to a rapid rise in TSE stock prices. The third subperiod covers a prolonged and significant fall in TSE stock prices. Average abnormal returns after price increases on days 1, 2, 3, and days 1–3 vary considerably in each period but, in general, these values are not significantly different from zero.

Table 3 also shows average abnormal returns in subperiods following large price decreases. The average abnormal return on day 1 was 2.61% over 1981–1985 and 1.56% during 1986–1989; these values are both significantly larger than zero. Yet the corresponding return during 1990–1991 was an insignificant 0.28%. TSE trading volume declined substantially during 1990–1991, hence, the fall in the day 1 average abnormal return was probably not the result of an increase in general liquidity, as Cox and Peterson (1994) suggest might explain a similar fall in day 1 abnormal returns for NYSE stocks.[12] Day 2 returns following large price decreases were small and insignificant during 1981–1985 and 1986–1989, but significant during the latest period. The Days 1–3 block measures average cumulative abnormal returns over the days after the large price fall. It shows small, insignificant average abnormal returns during 1981–1985, and large, significant returns in 1986–1989 and 1990–1991. These magnitudes are similar to what Cox and Peterson found for NYSE stocks (though not to the pattern of abnormal returns over time).[13] Table 3 also shows cumulative abnormal returns over days 4 to 20 after the large price fall. The value for the last period is large and significant; it is strikingly different from Cox and Peterson, who found significant, negative abnormal cumulative returns for NYSE stocks.

C. Price Movement Limits and Other Rules

The TSE administers a range of limits for daily stock price movements, as was discussed previously. The intent is to prevent any short-term wild price fluctuations due to order imbalance. The practical application of these rules means that some major price changes may be drawn out over several trading sessions. The maximum change per day rules clearly limit day-to-day price variation. Both the maximum trade-to-trade price variation and minimum tick size rules determine the range of trade-to-trade variation; when good or bad news is gradually absorbed

[12]The Tokyo Stock Exchange Fact Book (1992) reports that the trading volume of the TSE decreased from 964.5 million shares during 1988–1989 to 440.0 million shares per trading day during 1990–1991.

[13]Cox and Peterson ((1994), p. 261) report the following cumulative abnormal returns for NYSE stocks after one-day price declines of at least 10% or greater (*t*-statistics are shown in parentheses).

Years	1963–1967	1968–1972	1973–1977	1978–1982	1983–1987:8	1987:11–1991:6
Days 1–3	1.87%	1.17%	1.14%	1.22%	0.77%	0.06%
	(4.77)	(4.03)	(3.13)	(3.98)	(2.55)	(0.13)
Days 4–20	0.26%	−2.35%	0.47%	−0.96%	−2.12%	−2.64%
	(0.40)	(−5.38)	(0.85)	(−2.16)	(−4.35)	(3.31)

by stock price, trade-to-trade prices are constrained to be in this range. When surprising news causes major order imbalance, the TSE's special quotes procedures are applied and this slows price movements. Together these procedures substantially reduce the probability that our sample includes extremely large one-day price changes. For example, a one-day ±30% price change event that would be included in comparable research on American stocks could not occur in most cases in the data used in this research.

Table 4 shows a subset of the TSE's daily price limits, the size of special quote prices, and the size of the minimum tick.[14] Note that the price limits are not percentages but rather absolute yen limits; the maximum size of the price change depends on the previous day's closing price. The size of the permitted price change is discontinuous. For example, a stock trading at 1,990 yen the day before the large price change would be permitted to change (up or down) as much as 1.5% ($\approx 30/1990 \times 100$) from one transaction (or special quote) to the next and by as much as 15% ($\approx 300/1990 \times 100$) on the price change day. Yet a similar stock that traded at 1,500 yen the day before the large price change event could change (up or down) by as much as 2% ($= 30/1500 \times 100$) from one transaction (or special quote) to the next and by as much as 20% ($= 300/1500 \times 100$) per day. Columns (B), (C), and (D) in Table 4 show limits on potential price or quote changes and minimum tick size within a stock price level category. In spite of the daily price limits, a great deal of daily price variation is possible for Nikkei 300 stocks, which were mostly traded in the 1,000 to 10,000 yen range during the period of this study.[15] It is likely that most of the large one-day price changes examined here occurred without hitting the TSE's price limits.[16]

The TSE's minimum tick size rules could potentially introduce measurement errors. The minimum tick is important in the reversal process since it can be viewed as a conservative minimum estimate of additional transaction costs. As shown in Table 4, the TSE's minimum tick size is i) one yen for stocks selling below 1,000 yen; ii) 10 yen for stocks with prices between 1,000 and 10,000 yen; and iii) 100 yen for stocks selling at or above 10,000 yen. Thus, there is no systematic relationship between the minimum tick size and share price level (or firm size) on the TSE. In the case of large stock price decreases, it is reasonable to conjecture that day 0 closing (transaction) prices are likely to be on the bid-side of a tick while day 1 closing prices might be on the ask-side of a tick. This means that even without fundamental changes in share value, returns are likely to be positive on day 1, reflecting a tick-size bounce. Since our sample consists of the most liquid TSE stocks, it is reasonable to assume that the potential effect will be one tick. Minimum tick size on the TSE ranges between 0.1% and 1%,

[14]Table 4 is constructed from Tokyo Stock Exchange (1989), (1992). These limits apply over the entire sample period of this study.

[15]For share prices from 1,000 to 10,000 yen, the existence of daily price limits does not prevent any stock from being included in our sample as long as actual transactions occur at the daily limit.

[16]Note that for some price categories, the highest price stocks are only marginally eligible to have a(n) (absolute) 10% or greater price change event that would be included in this research. In general, the TSE's price-dependent daily price limits do not affect our sample. However, the chance that the events included in the sample actually hit the price limits differs across the price limit categories. High price stocks in the highest price categories ($10{,}000 \leq P \leq 29{,}900$ yen) are effectively prevented from experiencing price changes of (absolute) 10% or greater. Few Nikkei 300 stocks are in this category.

TABLE 4

TSE Daily Price Limits, Trade-to-Trade Variation, and Special Quote Prices (A Subset)

(A) Price Range: P = Previous Day's Closing Price/Quote	(B) Yen Price Change Limit from (A) and Permitted Range of Potential Price Change	(C) Trade-to-Trade Price Change Limit and Permitted Change in Special Quote Prices (Maximum Price Variation)	(D) Yen Price Change Limit and Minimum Tick Size (Minimum Price Variation)
$1 \leq P \leq 99$	30, 30% ~ ∞	5, 5% ~ ∞	1, 1% ~ ∞
$100 \leq P \leq 199$	50, 25% ~ 50%	5, 2.5% ~ 5%	1, 0.5% ~ 1%
$200 \leq P \leq 499$	80, 16% ~ 40%	5, 1% ~ 2.5%	1, 0.2% ~0.5%
$500 \leq P \leq 999$	100, 10% ~ 20%	10, 1% ~ 2%	1, 0.1% ~ 0.2%
$1000 \leq P \leq 1490$	200, 13.33% ~ 20%	20, 1.33% ~ 2%	10, 0.67% ~ 1%
$1500 \leq P \leq 1990$	300, 15% ~ 20%	30, 1.5% ~ 2%	10, 0.5% ~ 0.67%
$2000 \leq P \leq 2990$	400, 13.33% ~ 20%	40, 1.33% ~ 2%	10, 0.33% ~ 0.5%
$3000 \leq P \leq 4990$	500, 10% ~ 16.67%	50, 1% ~ 1.67%	10, 0.2% ~ 0.33%
$5000 \leq P \leq 9990$	1000, 10% ~ 20%	100, 1% ~ 2%	10, 0.1% ~ 0.2%
$10000 \leq P \leq 29900$	2000, 6.67% ~ 20%	200, 0.67% ~ 2%	100, 1% ~ 0.3%

Source: Tokyo Stock Exchange (1989), (1992).

Maximum potential daily price changes are calculated as the Previous Day's Closing Price divided by the Limit of Price Fluctuation from the Previous Day's Closing Price. For example, stocks with closing prices in the $100 \leq P \leq 199$ yen category can rise or fall by 50 yen, giving potential maximum price changes of $\pm 25\% (\approx \pm 50/199 \times 100)$ to $\pm 50\% (= \pm 50/100 \times 100)$. A similar procedure applies to both maximum trade-to-trade price variation (or special quote prices) and minimum tick size as shown in columns (C) and (D).

depending on the closing price on day 0. Hence, the potential measurement error due to tick-size bounce for highly liquid Nikkei 300 stocks is, on average, 55 basis points $\{= [(0.1\% + 1\%) \times 100]/2\}$, which is close to the cost of a round trip, large transaction on the TSE.

As discussed in the data section, our data set excludes stocks that experience large price changes on a quotation basis without actual transactions because of the TSE's price movement and quote limits. Although these price changes are not realized on a daily transactions basis, it would be interesting to perform separate tests that include these data or at least treat them separately in ex post analysis. Unfortunately, we simply do not have these data.[17]

Table 5 shows abnormal returns after large price changes of +5% or more and −5% or less over the period 1981–1991. The event samples here include more large price changes that do not hit daily price limits than those in Table 3. If

[17] Since the momentum of price changes is probably halted by daily price limits, there might be an impact on the ex post mean abnormal return following large price changes. This is particularly true when price limits are applied to quoted prices at which no transactions occur. However, because of the method by which our data set is constructed, the chance that these types of large price changes (special quotes with zero volume) are included in our sample is null. Still, transactions could occur at the limit price after the price limits have been hit on a special quote basis. These types of transactions are included in our sample, except for a few of the highest priced Nikkei 300 stocks. We expect that cases where the daily price limits are hit and have subsequent genuine transactions will be rare and will have only a small or limited impact on ex post abnormal returns. In this case, no significant order imbalance exists at the closing price and the full set of transaction and price information is available to investors who might trade the following day.

clear and similar ex post patterns exist for smaller price changes such as these, the general result should be robust in the presence of daily price limits. Table 5 shows that average abnormal returns following 5% or greater one-day price increases are economically small, though significantly less than zero. There is considerable variation from one subperiod to another, but the general conclusion is similar to results for days after 10% or greater one-day increases (Table 3). There is little evidence of an economically significant price pattern. There is modest evidence of a longer-term positive price pattern over days 4–20.

TABLE 5

Abnormal Returns of Nikkei Firms following One-Day Price Changes of −5% or Less and +5% or More

Event Period	1/81–12/91[a] Full Period		1/81–12/85 Subperiod One		1/86–12/89[a] Subperiod Two		1/90–12/91 Subperiod Three	
	Increases	Decreases	Increases	Decreases	Increases	Decreases	Increases	Decreases
Sample Size	19300	8370	6462	1921	8428	2906	4410	3543
Day 1	−0.20%	0.89%	−0.39%	1.19%	−0.06%	1.07%	−0.18%	0.59%
	(−8.26)*	(23.60)*	(−8.95)*	(14.62)*	(−1.71)	(17.97)*	(−3.87)*	(9.75)*
	[0.41]**	[0.63]**	[0.37]**	[0.67]**	[0.43]**	[0.65]**	[0.42]**	[0.60]**
Day 2	−0.09%	0.40%	−0.09%	0.47%	−0.10%	0.29%	−0.07%	0.45%
	(−4.17)*	(10.90)*	(−2.35)*	(6.48)*	(−3.09)*	(5.07)*	(−1.61)	(7.37)*
	[0.43]**	[0.54]**	[0.43]**	[0.53]**	[0.43]**	[0.53]**	[0.44]**	[0.55]**
Day 3	−0.05%	0.20%	−0.04%	−0.14%	−0.08%	0.18%	−0.02%	0.41%
	(−2.52)*	(5.67)*	(−1.00)	(−1.93)*	(−2.51)*	(3.39)*	(−0.59)	(6.67)*
	[0.45]**	[0.50]	[0.44]**	[0.46]**	[0.44]**	[0.49]	[0.47]**	[0.54]**
Days 1–3	−0.33%	1.49%	−0.52%	1.52%	−0.24%	1.54%	−0.28%	1.45%
	(−9.06)*	(25.64)*	(−7.42)*	(13.65)*	(−4.30)*	(17.27)*	(−3.91)*	(14.36)*
	{−15.42}*	{38.32}*	{−14.36}*	{18.72}*	{−6.06}*	{21.32}*	{−6.54}*	{25.82}*
	[0.42]**	[0.65]**	[0.40]**	[0.67]**	[0.43]**	[0.64]**	[0.43]**	[0.65]**
Days 4–20	0.70%	1.46%	0.45%	0.71%	0.60%	0.68%	1.22%	2.50%
	(10.26)*	(14.28)*	(3.66)*	(3.27)*	(5.82)*	(4.08)*	(9.32)*	(15.65)*
	{8.82}*	{14.52}*	{2.11}*	{2.74}*	{5.06}*	{3.79}*	{8.81}*	{16.81}*
	[0.53]**	[0.60]**	[0.55]**	[0.60]**	[0.50]	[0.54]**	[0.57]**	[0.65]**

Mean abnormal returns are presented, with cross-sectional *t*-values in parentheses, *z*-values based on the variance of cumulative abnormal returns in braces, and the proportion of positive abnormal returns in brackets. Day 0 is the date of the large price change.

[a]Major price changes occurring during October 16–23, 1987 are excluded.
*Indicates mean significantly different from zero at the 0.05 level; and **indicates proportion significantly different from 0.50 at the 0.05 level.

Table 5 also shows evidence of an economically modest but statistically significant price pattern following one-day price declines of $\leq -5\%$. The pattern is significant in all subperiods and for most of the individual days after the $\leq -5\%$ price change. The general pattern is similar to the pattern following $\leq -10\%$ changes, as shown in Table 3.

D. Sample Selection Bias

The sample selection approach used here is similar to that of Bremer and Sweeney (1991); a stock is included in the sample if the value of its one-day rate of return exceeds (is less than) a specific trigger value, 10(−10)%. This sample selection approach makes no adjustment for market movements or the systematic risk of stocks. This approach, while having the considerable virtue of simplicity, may incorrectly include observations for stocks that are not adjusting to unexpected good (bad) information; an important part of the returns of these stocks may simply reflect market movements.

A simple solution is to restrict the sample to include only stock returns whose day 0 *abnormal* return is larger (smaller) than the trigger value. Table 6 does this for one-day price changes of (absolute) 10% or greater. These abnormal returns differ from those presented in Tables 3 and 5; they are estimated as the security's excess return less its normal value based on a statistical model estimated over a benchmark period *before* the large price change event. As expected, the new sample selection approach reduces the sample size. Statistical significance is smaller for many days too. Nevertheless, the sizes of the days 1–3 average abnormal returns remain similar to the results shown in Table 3. The main difference is that the days 4–20 average cumulative abnormal return after price decreases is lower, 2.01% vs. 3.44% in Table 3 for the 1981–1991 period. However, this change comes mainly from calculating normal returns using the pre-event benchmark period. This decrease in the size of the average abnormal cumulative return is similar to what Cox and Peterson (1994) found for NYSE data.

TABLE 6

Abnormal Returns of Nikkei Firms following One-Day Price Changes of −10% or Less and +10% or More for a Market-Adjusted Return Series

Event Period	1/81–12/91[a] Full Period		1/81–12/85 Subperiod One		1/86–12/89[a] Subperiod Two		1/90–12/91 Subperiod Three	
	Increases	Decreases	Increases	Decreases	Increases	Decreases	Increases	Decreases
Sample Size	1286	218	575	78	552	55	159	85
Day 1	0.27% (1.82) [0.46]**	1.17% (2.50)* [0.61]**	−0.10% (−0.43) [0.42]**	3.12% (4.22)* [0.71]**	0.46% (2.14)* [0.47]	0.88% (1.11) [0.64]**	0.91% (2.07)* [0.54]	−0.39% (−0.47) [0.49]
Day 2	−0.22% (−1.83) [0.44]**	0.68% (1.74) [0.56]	−0.06% (−0.34) [0.48]	−0.26% (−0.63) [0.53]	−0.41% (−2.43)* [0.41]**	−0.14% (−0.28) [0.45]	−0.09% (−0.24) [0.41]**	2.09% (2.45)* [0.65]**
Day 3	0.07% (0.58) [0.44]**	0.25% (0.62) [0.47]	−0.06% (0.33) [0.42]**	−1.57% (−4.46)* [0.33]**	0.34% (2.00)* [0.47]	0.63% (1.19) [0.49]	−0.43% (−1.13) [0.42]	1.65% (1.85) [0.58]
Days 1–3	0.12% (0.53) {3.65}* [0.46]**	2.10% (2.56)* {7.56}* [0.67]**	−0.22% (−0.54) {1.42} [0.45]**	1.29% (1.90) {4.12}* [0.75]**	0.38% (1.15) {3.56}* [0.46]	1.37% (1.20) {1.43} [0.60]**	0.39% (0.45) {1.01} [0.51]	3.35% (1.66) {7.07}* [0.64]**
Days 4–20	0.91% (2.55)* {6.59} [0.52]	2.01% (1.79) {1.93} [0.66]**	1.65% (2.92)* {8.56}* [0.54]**	1.17% (1.22) {0.68} [0.84]**	0.73% (1.48) {1.94}* [0.49]	0.99% (0.73) {0.30} [0.50]	−1.13% (−1.06) {−1.05} [0.51]	3.34% (1.34) {2.19}* [0.63]**

Daily Mean abnormal returns are presented, with cross-sectional *t*-values in parentheses, *z*-values based on the variance of cumulative abnormal returns in braces, and the proportion of positive abnormal returns in brackets. Day 0 is the date of the large price change. This table conditions the price decrease on the abnormal return, rather than the actual return.

[a]Major price changes occurring during October 16–23, 1987 are excluded.

*Indicates mean significantly different from zero at the 0.05 level; and **indicates proportion significantly different from 0.50 at the 0.05 level.

VI. Conclusion

This research shows that Nikkei 300 stock returns tend to be significantly positive after large price decreases. This is similar to the pattern observed for American stocks in other research. The price pattern remains statistically significant when adjustments are made for potential problems. The statistically significant results exist independently of the October 1987 market break. Further, the size and duration of the pattern hints that traders/investors might profit from large price decrease events; however, transaction costs, possible tick-size bounce and other factors reduce the likelihood that retail investors can profit from reversals after large stock price decreases. The market impact of large scale transactions probably prevents institutional investors from exploiting these reversals. Nevertheless, the price pattern remains economically significant for TSE member brokers who are not charged commissions.

The pattern following large price decreases on the TSE has become more significant recently. This result is different from research on North American stocks. Unlike some research on American stocks, our research finds little evidence of significant patterns following large stock price increases for the TSE. We find modest evidence of longer-term significant returns beginning four days after a large price decrease. This too is similar to some research on American stocks.

The structure of the TSE's trading mechanism is very different from American exchanges. It is essentially a single price, two-way, transaction-based continuous auction market with special procedures designed to suppress fast and large price changes. Specifically, there are no designated market makers, but there are *saitori* who simply match orders between the buyers and sellers to process single price transactions. Thus, there are no competitive bid and ask prices; order-matched (transaction) prices are the only observed prices under ordinary demand and supply conditions (there are, of course, bid and ask limit orders that are maintained by the *saitori*). Instead of active market-making, *saitori* indicate special quotes in order to slow the speed of price change or to prevent large price changes.

Knowledgeable investors report that Japanese brokers often provide limited market-making services. Japan's high, fixed commissions encourage competitive brokers to provide specialist services such as predictable immediacy and price resilience to their better retail customers. On the basis of our discussions with broker/dealers, we believe that these institutions feel an obligation to provide liquidity on day 0 (especially when share price is decreasing). They implicitly guarantee that shares can be traded before the daily price limits are hit on a special quote basis. We conjecture that large broker/dealers and TSE member firms respond to large price decrease events not by trading for their own profit, but rather by supplying (at their own expense) liquidity to their preferred retail customers. They protect large institutional customers from greater loss by reducing price-decrease momentum on day 0 and by not exploiting profit opportunities on day 1 and later. This view is consistent with the continued economic significance of the pattern in recent years.

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