Feature Article: Asset-Backed Securities

Changes in Nikkei 225 Composite Stocks- Trading Simulation and Implication

Katsuhiko Okada
Managing Director
IZ Management Co. Ltd
(Chartered Member of the Security Analysts Association of Japan)

Table of Contents

Some 39 index composite changes in the period between 1991 and 2002 were analyzed in the traditional event study framework. Statistically significant abnormal returns on both added and deleted stocks were observed not only on the day of announcement but also other days around the announcement date. Trading simulation based on typically employed trading strategies by proprietary dealers was also conducted. The simulation results reveal that the same trading strategies paid off repeatedly over the 12-year sample period. Considering the fact that index composite change is a recurrent event, one may argue that there is a case where arbitrage activity may not necessarily rule out mispricing.

Katsuhiko Okada: B.A. in Law Kwansei Gakuin University, 1985 /MBA Washington University John M. Olin School of Business, 1990./ M.A, in Business Administration Kobe University, 2004./ Associate Options Trader (1990-1992) Morgan Stanley & Co. Ltd Tokyo, Functional Vice President in Derivatives (1993-1996)UBS Securities Tokyo. Chief Investment Officer (1997-2002) PHI KOM Management Pte Ltd Singapore (Hedge Fund Management), Managing Director (2003-Present) IZ Management Co. Ltd (Investment Advisory)

Tables and Figures are tentatively shown in another PDF file (Only titles of them are translated into English).

Introduction

In financial economic theory, there is a long-held assumption that stocks have perfect substitutes and perfect elasticity of demand. Therefore, any supply or demand shocks that have no informational content should have little impact on stock price. Since stock price should be identical to the discounted future stream of cash flow that a firm is expected to generate, demand or supply size is an irrelevant issue for pricing. Theoretically, if a firm's shares are traded at an equilibrium price, a large buy order from a brokerage house is supposed to have little influence on the price level. The price should only move when the fundamental value of the firm changes. This may seem counter-intuitive, however the argument is supported by the existence of arbitrageurs. If a stock is priced more than its underlying fundamental value, a rational arbitrageur comes in and sells the stock and buys a similar stock whose fundamental value is fairly priced. The condition for arbitrageurs to freely buy (sell) undervalued (overvalued) stocks in the market is that a perfect substitute is always available. Under this condition, the demand curve of the stock would be flat. Scholes (1972) investigated large block order trades on NYSE. He found that stock price movement in the face of large sell (buy) orders is limited. His findings indicate that stock price reaction to a sell order is neutral when the seller is a trust fund or estate.[1] He insists that stock price does not respond to non-information. There are quite a few empirical studies on whether price changes occur in the absence of new information. They focused on block trades, equity issues, and stock splits. If stock price is independent from the size of demand as financial theory suggests, the predicted share price movement in response to a change in the stocks comprising an index is neutral. Since index change is an event that has little to do with a firm's fundamental value, a rational arbitrageur will come in and correct it should the price move upon the news. However, in previous studies, empirical evidence is not in line with this prediction. In the majority of index changes in the US, additions go up in price upon announcement while deletions lose value. There are several hypotheses to explain these price moves depending on post event abnormal returns but little evidence that stock price is immune.

The main purpose of this paper is to clarify the price movement of both added stocks (additions) and deleted stocks (deletions) from the Nikkei 225 based on the equivalent methodology of US studies. There are two broadly-quoted equity market indexes in Japan. One is the capital-weighted average of all listed stocks on the Tokyo Stock Exchange 1st Section (TOPIX) and the other is the price-weighted index of 225 representative stocks (Nikkei 225). The focus of index changes here is the price-weighted Nikkei 225. The Nikkei 225 is unique in its calculation method. While most actively traded index futures in industrialized countries are derived from capital-weighted indexes such as the S&P 500, the Nikkei 225 is a simple average of 225 issues divided by the divisor published by the *Nikkei Shimbun*. Therefore, this is the first paper that analyzes price-weighted index changes. Secondly, this paper investigates whether arbitrage activity functions to eliminate mispricing in the Japanese market. For this objective, a typical

[1] *Trust funds and estates use block trades when they mechanically adjust their portfolios. Therefore their sell (buy) orders do not contain any information about firms' fundamental value.*

proprietary dealer's position on the announcement of index change is simulated. The result of this simulation shows that arbitrage activity does not necessarily eliminate mispricing as presupposed in the theory. The fact that the same trading strategy paid off over the decade cast doubt on arbitrageurs' price correction ability over a short horizon.

Watakori (2000) and Saito and Onishi (2001) analyzed the Nikkei 225 change in April 2000. Since this particular event had a substantial impact on the overall stock market, it attracted widespread attention. Hanaeda and Serita (2003) employed a similar methodology used in most US studies and found that the demand curve of Japanese stocks is downward sloping. As for minor indices, Serita (1996) used the Nikkei 300 and Liu (2000) conducted a similar study using the Nikkei 500. Both identified that the event had a significant impact both on stock price and trading volume.

This paper analyzes all index changes since 1991 using the traditional event study framework. Previous study by Hanaeda and Serita (2003) dealt with only one event even though the stocks that were switched numbered 40. Therefore, any conclusion drawn from the analysis is not free from sampling bias. In particular, the change in April 2000 is considered to be a rather special case, and one may argue that it may not be representative of normal market response to index change. Studying the 39 index changes over the 12-year period overcomes such a problem.

Simulation based on arbitrageurs' position taking revealed an interesting pattern in stock prices. The same trading strategy generated a lucrative return over the period. This demonstrates that arbitrageurs failed to eliminate mispricing in this particular setting. Despite the fact that index changes are widely known and repeated events, mispricing persisted in our sample period.

In Section 2, prior literature and hypotheses regarding index changes are introduced. Section 3 describes the research design and Section 4 empirical findings. Trading simulation is conducted in Section 5 and a conclusion given in Section 6.

1. Previous Studies and the Theory of Index Change

Previous studies in the US reveal that index changes affect the performance of stocks concerned to a considerable degree. When changes are announced, prices of newly added stocks go up by a substantial margin, while deleted stocks decrease in value. As for the rationale behind this there are mainly four hypotheses discussed in previous studies. However, researchers have shown competing evidence in a variety of event samples, thus no consensus has been reached as yet. The four hypotheses that are commonly quoted in the literature will be discussed.

The imperfect substitute hypothesis[2] attributes the observed market response to the lack of similar assets

[2] The imperfect substitute hypothesis describes the situation where arbitrageurs cannot freely trade the misaligned stocks due to lack of close substitutes in the market.

available in the securities market. It argues that arbitrageurs' activity is limited because they cannot sell (buy) the overvalued additions (undervalued deletions) due to the lack of substitutes. The efficient market hypothesis (EMH) assumes that arbitrageurs would counter-sell (short) the overbought additions and buy the stocks of firms whose business content is similar to the ones they are short. After a while, the value of those two groups of stocks should converge, bringing about risk-free profit to arbitrageurs. EMH insists, therefore, regardless of the size of demand at the time of composite change, that stock prices remain the same as demand is information free. In the real world, however, similar stocks that can be substituted for arbitrageurs' short positions are not easily available. When additions face a large number of temporary bidders, the increase in demand will lead to higher stock prices. The stocks remain unduly expensive because the lack of substitutes makes it prohibitively difficult for arbitrageurs to short them. Thus, incompleteness of the securities market undermines the fair pricing of the stocks concerned. The imperfect substitute hypothesis is alternatively called the downward sloping demand curve hypothesis (DSDC) as information free demand moves stock prices. Shleifer (1986) found additions to the S&P500 rise approximately 3% on average. He supported DSDC by indicating that the rise was not temporary. Wurgler and Zhuravskaya (2002) investigated S&P 500 Index changes between 1976 and 1996 and found the adopted stocks rose 3.5% on average. They also supported the DSDC hypothesis for the same reason. They looked into the arbitrage risk of stocks in the market and found only 25% had close substitutes. The lack of close substitutes in the market makes it difficult for arbitrageurs to collectively participate should the stock price be derailed. Hanaeda and Serita (2003) investigated the relationship between the cumulative abnormal return of additions and arbitrage risk. They found a positive relationship between them implying that the lack of close substitutes makes stock price vulnerable to a demand shock.

The price pressure hypothesis, on the other hand, describes price action as a result of market maker behavior. When additions to an index are announced, it creates a temporary positive demand shock. There are a large number of bidders for the stocks and the market has to absorb them. Market makers take the opposite side of the trade. They will unwind the position gradually after the effective date. However, they have to carry the position for several days and are subject to price risk during that period. To compensate for that risk, market makers demand a premium and thus the prices of stocks concerned rise beyond fair value.

Harris & Gurel (1986) investigated S&P500 composite changes between 1978 and 1983. They found the additions rose both in price and volume but that the temporary impact faded in two weeks. They concluded the rise was a simple reaction to temporary price pressure.

Given that all the available information is reflected in the stock price, the price rise of additions is due to non-public information contained in the event itself. The announcement of index additions conveys some information about the fundamentals of the stocks. For instance, additions to an index may increase awareness of the stocks among securities analysts. Being included in analysts' coverage will eventually increase a firm's brand awareness among investors. Jain (1987) investigated the sub-indexes of the S&P 500 and found that stock prices rise when additions take place not only with respect to the major indexes that institutional investors follow but also minor sub-indexes. Beneish and Gardner (1995) found that additions to the Dow Jones Industrial Average exhibited little change in price and volume while deleted stocks declined in price and volume to a statistically significant extent. Both of these findings are consistent with the information hypothesis. Simply being one of the members of the index composite has some value, which is priced in the market.

2. Research Design

An event study framework is employed for analysis of composite changes between 1991 and 2002. The stock index futures market started in 1988 and the change in 1991 was the first major one since the futures market became liquid. There were a total of 39 index changes during this period. In every case, announcement was made after the market had closed and publicized in the morning edition of the *Nikkei Shimbun* the following day. There is a one- to 30-day interval until any new composite of the index becomes effective. Investors tracking the index adjust their portfolios during this period. This paper looks at two different event days, one when the change is publicly announced which is defined as the announcement day (AD), and the other when the actual change takes place and which is defined as the change day (CD).

Table 1 shows the 39 cases from 1991. The total number of stocks added/deleted was 178. These 39 index changes include periodic review by the *Nikkei Shimbun* as well as the bankruptcy and merger of constituent firms, which occasionally brings the number of stocks comprising the Nikkei 225 to fewer than 225 for a few days. Normally, there are two to 10 days between AD and CD, but bankruptcy necessitates immediate change. For example, when Nikkatsu went bankrupt on July 1st, 1993, newly added Iseki Machinery started trading as a constituent of the Nikkei 225 on July 2nd.

Table 1: Index Change Events between 1991 and 2002

No	AD	CD	Deletions	Additions	No	AD	CD	Deletions	Additions
1	1991 9 25	〜1991 10 1	Taito	Kumagai Constr.	14	2000 6.23.	〜 2000. 7.3.	Tonen Corp	Shiseido
			Katakura	Sumitomo H.I.					
			Teikoku Textile	Topy Industry	15	2000. 9.8.	〜 2000 9.22.	IBJ	Yokohama B.
			Matsuzakaya	Tomen Corp				DKB	Toyo Trust
			Shochiku	Nissho Iwai Corp				Fuji Bank	Shinko Sec.
			Toho	Sankyu					
2	1992 9 18	〜1992 9 24	Japan Stainless	Aoki Constr.	16	2000. 9.8.	〜 2000 9.26.	KDD	Alps Elec.
3	1992 9 25	〜1992 10 1	Godo Shusei	Hazama Const.					
			Daito Boseki	Ninebea	17	2000. 9.8.	〜 2000. 10.2.	Tekken Constr.	Mizuho
			Takashimaya	Seika Ind.				Japan Se. Fin.	Secom
4	1993 3.26.	〜1993. 4. 1.	Sanyo National Pulp	Iseki Mach.	18	2001 3. 9.	〜 2001.3.23.	Japan Paper	JAL
5	1993 7. 1.	〜1993. 7. 2.	Nikkatsu	Shionogi Pharm.					
6	1995 9 22	〜1995 10 2	Japan Wool	Marui	19	2001.3.9	〜 2001.3.27.	Sakura Bank	Takashimaya
7	1996 3 19	〜1996 3 25	Bank of Tokyo	Chubu Elec				Bank of T.M.	Credit Saison
8	1996 9 17	〜1996 9 24	Honshu Paper	Sanwa Bank				Sanwa Bank	Yamato Trans.
9	1997 9 17	〜1997 9 24	Mitsui Toatsu	Toyo Rubber				Tokai Bank	–
10	1998 9 17	〜1998 9 24	Japan Cement	Asahi Bank				Mitsu Trust	–
			Showa Marine Tran.	KDD				Toyo Trust	–
11	1999 3 16	〜1999 3 25	Mitsubishi Oil	NTT Data					
			Navix Line	Clarion	20	2001.3.9	〜 2001.3.30		Japan Unibac
12	2000 3 21	〜2000 3 28	Mitsui Trust	Daiwa Sec.					
					21	2001.3.9	〜 2001.4.3.		MTFG
13	2000 4.14.	〜2000 4.24.	Nichiro	JT					UFJ Holdings.
			Mitsui Mining	Kao					
			Sumitomo Coal	Daiichi Pharm	22	2001.9.11	〜 2001.9.25	Sumitomo Marine	JR West
			Japan Tensaito	Eisai					
			Honen	Termo	23	2001.9.11	〜 2001.10.1.	Iseki Mach.	Sekisui House
			Fuji Textile	TDK				Keihin Railway	Fujisawa Pharm
			Toyo Rayon	Mistumi Elec					
			Rasa Industry	Matsushita Comm	24	2001.11.27.	〜 2001.11.28	Niigata Iron W.	Sumitomo Real E.
			Japan Carbide	Adventest	25	2001.11.26.	〜 2001.12.5.	Daiwa B.	–
			Japan Chemical	Casio	26	2001.12.6.	〜 2001.12.7.	Aoki Const.	Daikin
			Japan Synthetics	Fanuc	27	2002.11.26.	〜 2001.12.12	--	DB Holdings
			Asahi Denka	Kyocera	28	2002.2.15.	〜 2002.2.25	Asahi B.	–
			Nihon Yushi	Taiyo Yuden	29	2002.2.22	〜 2002.2.27.	--	Chiba B.
			Toyo Rubber	Matsushita Denko	30	2002.3.3.	〜 2002.3.4.	Sato Kogyo	–
			Japan Carbon	MMC	31	2002.3.3.	〜 2002.3.6.	--	Japan Comsis
			Noritake	Fuji Heavy	32	2002.3.19.	〜 2002.3.26.	Tokyo Marine	–
			Shinagawa Ref.	Tokyo Electron	33	2002.3.19.	〜 2002.4.2.	--	Mikea Holdings
			Japan Metal	Seven-Eleven	34	2002.9.5.	〜 2002.9.6.	Fujita Const.	–
			Nihon Yakin	Ito-Yokado	35	2002.9.5.	〜 2002.9.11.	--	MT Holdings
			Nihon Denko	Jusco					
			Mitsubishi Steel	IBJ	36	2002.9.5.	〜 2002.9.19.	Japan Energy	Trend Micro
			Shimira	Daiwa B.				Kwasaki Steel	Olympus
			Showa Cable	Tokai B.				NKK	Isetan
			Tokyo Seiko	Shizuoka B.					
			Japan Piston Ring	Sumitomo Trust	37	2002.9.5.	〜 2002.9.25.	Matsushita Comm	–
			Seika Ind.	Yasuda Trust				JAL	–
			Iwatani Ind.	Sumitomo Marine					
			Maruzen	JR East	38	2002.9.5.	〜 2002.9.25.	--	Shin Nikko
			Sankyu	DDI				--	JFE
			Mistui Warehouse	NTT-Docomo					
					39	2002.9.5	〜 2002.10.2.	Kyokuto Boeki	CSK
								Tobishima Const.	Japan Air Sys.

(Note) AD refers to the date when the annoucement of index change is published in the media. Actual composite chage does not occur until the effective date denoted as "CD".There are total of 39 index change events since 1991.

The Nikkei 225 is a price-weighted average of its constituent stocks.[3] It simply adds the prices of the 225 stocks and divides by a divisor calculated by the *Nikkei Shinbun*. When an index change is announced, the index is calculated in this manner until the new composite of stocks becomes effective on the CD. After the CD, the new member firms' shares are added and divided by the new divisor. The index has to maintain its price sequence over time. Therefore, the new divisor is calculated to guarantee the sequence before and after the CD. The following equation has to be satisfied. The sum of the pre-change 225 stocks / the pre-change divisor = the sum of the post-change 225 stocks / the new divisor.

Index tracking investors who wish to minimize risk due to composite change would like to sell stocks to be deleted and buy stocks to be added one day prior to the CD. To be specific, if they could swap the deletions and additions at the closing price, they would bear no risk.

This event study uses the market model[4]. The estimation of beta is based on the 221 days of a time series return of the market and the stocks. Thus, between 250 days and 30 days prior to the AD is the estimation period. TOPIX is used as a proxy for market return. Table 2 shows the beta of both additions and deletions. For example, the beta value of the deleted portfolio in event 1 is 1.0899. This is estimated from the time series data of the simple average of the three deleted firms' return and the market return. The R-square value is 0.3587 and the t-value rejects the null hypothesis that the beta is zero at the 1% significance level. Events 13 and 14, however, fail to reject the null hypothesis.[5] This describes one aspect of the peculiarity of the composite change in April 2000. Witness the contrast between deletions and additions. The composite change in April 2000 was peculiar in its size, content, and timing. The deletions generally belong to the so-called "old economy" and additions to the "new economy". While Watakori (2001) criticizes the way the change was conducted, it should be noted that the April 2000 event was distinctly different from the others in various aspects. Table 2 is a simple manifestation that the choice of the deletions and additions was unusually biased.

Using the beta in Table 2, abnormal return is calculated as follows:

$$AR_{it} = R_{it} - \hat{b}_i R_{mt} \qquad (1)$$

, where

AR_{it} is the abnormal return of portfolio i at day t

$\hat{b}_i$ is the estimated ß of portfolio i

[3] *Japan Railway, Japan Tobacco, and NTT DoCoMo are calculated by converting them to 50 yen face value.*

[4] *The market model assumes the time series model as* $R_{it} = b_i R_{mt} + e_{it}$*. This study estimated beta using (-250, -30) estimation period. The intercept and the risk rate used in CAPM are disregarded.*

[5] *The market model was used to estimate abnormal return for these two events.*

R_{mt} is TOPIX return at day t

R_{it} is portfolio i's return at day t

Table 2: Beta Estimates For the Index Changes

	Exiting Portfolio			Entering Poirfolio		
Event Number	ß	Adjusted R-square	t-value	ß	Adjusted R-sq	t-value
1	1.0899	0.3587	11.5873	1.4754	0.7843	29.5383
2	1.0480	0.3258	10.7686	1.7381	0.6113	19.4283
3	1.5786	0.4071	12.8376	1.3644	0.7030	23.8362
4	1.3456	0.4355	13.6354	1.4992	0.4910	15.2484
5	0.9472	0.2245	8.3707	1.0034	0.2829	9.7703
6	1.5267	0.4625	14.4601	1.0060	0.3036	10.2930
7	1.3208	0.5535	17.3933	0.3208	0.1735	7.1564
8	1.0383	0.2242	8.3982	1.3955	0.4313	13.6037
9	1.2840	0.3498	11.3858	0.8543	0.1975	7.7011
10	1.7772	0.3865	12.3483	1.5559	0.5038	15.6745
11	1.3463	0.3930	12.5678	0.9708	0.1421	6.3582
12	0.9518	0.0629	4.0233	1.3457	0.3075	10.3458
13	0.0687	0.0013	0.5714	0.9632	0.7440	26.5191
14	0.1936	0.0085	1.4441	0.1373	0.0173	2.0702
15	0.7450	0.1156	5.6469	0.8571	0.2245	8.4043
16	1.4777	0.1934	7.6493	0.6525	0.0551	3.7736
17	0.2390	0.0173	2.0713	1.3989	0.1633	6.9014
18	0.4675	0.0519	3.6544	0.5212	0.0486	3.5316
19	0.7068	0.2333	8.6175	0.6026	0.1913	7.5983
22	0.2918	0.0753	4.4585	0.4356	0.0626	4.0353
23	0.6442	0.2237	8.3845	0.3554	0.0759	4.4755
24	1.1370	0.2258	8.4522	0.7472	0.1965	7.7412
25	1.2599	0.2687	9.4690		Deletion only	
26	1.3934	0.1476	6.5138	0.9338	0.1924	7.6401
28	1.3974	0.2307	8.5361		Deletion only	
29		Addition only		0.6493	0.1625	6.8669
31		Addition only		0.5692	0.0759	4.4589
32	0.8154	0.3063	10.3580		Deletion only	
36	1.0302	0.3640	11.8182	0.8809	0.4873	15.2276
37	1.2232	0.5120	15.9998		Deletion only	
39	0.8000	0.3251	10.8404	1.2572	0.3487	11.4308

Note: 1. Portfolio returns are calculated by simple arithmatic average of composite stocks.
2. Portfolio betas are estimated based on the 200 day estimation period, which is AR-230 to AR-3
3. Exiting portfolio of event No. 13 & 14 were unable to reject their null hypothesis that beta is zer
4. I used market model to estimate the beta
results

The event window is defined as 10 days prior to the AD and 25 days after the CD. The abnormal return is calculated during this period. Statistical significance is measured using the t-test. t-values are computed as follows:

$$t_{AR_{it}} = \frac{AR_{it}}{\hat{s}_i} \qquad (2)$$

, where

$t_{AR_{it}}$ is the t value of portfolio i

$\hat{s}_i$ is portfolio i's standard deviation of its time series data for 221 days. When the composite change greatly affects stock price on a single day, it is detected by $t_{AR_{it}}$. If the change affects stock price for a few days, it is reflected in the cumulative abnormal return (CAR). The statistical significance of CAR is measured by $t_{CAR_{it}}$. t-value of event i is denoted as,

$$t_{CAR_{it}} = \frac{CAR_{it}}{\sqrt{d}\hat{s}_i} \qquad (3)$$

, where

CAR_{it} is the cumulative abnormal return of portfolio i at day t.

d is the number of days abnormal returns are accumulated.

$\hat{s}_i$ is portfolio i's standard deviation of its time series data for 221 days.

When stocks are deleted from the index, they are excluded from our sample since they decrease in value due to bankruptcy rather than being deleted. Other stocks outside the sample include Millea Holdings, Mitsui Banking and Trust Holdings, Shin Nikko Holdings, JEF Holdings and Japan Air System Holdings. There is not sufficient pre-event price history available for any of these to estimate beta.

Mean abnormal return (MAR) and mean cumulative abnormal return (MCAR) were also calculated. MAR is the average abnormal return of i portfolio across all events. Likewise, MCAR is the average cumulative abnormal return of i portfolio across all events.

$$MAR_t = \frac{1}{m}\sum_{i=1}^{39} AR_{it} \qquad (4)$$

, where

MAR_t is the average abnormal return of i portfolio across 39 events. m denotes the number of events available for analysis.[6] Table 3 shows the MCAR from 10 days prior to the AD. These figures are computed from

$$MCAR_t = \sum_{t=-10}^{t} MAR_t \qquad (5)$$

, where $MCAR_t$ is the ten-day cumulative figure of MAR_t

[6] *Some events consist of only deletions while others only additions. Some have only one day between AD and CD and others have 16. Therefore, one has to count the number of events available in a given day for MAR calculation.*

3. Empirical Findings

Section A demonstrates abnormal return distribution surrounding the announcement day, and section B explores a possible explanation of the price pattern in relation to hypotheses found in previous literature on the subject.

A. Stock price behavior around the announcement date

Table 3 shows MAR and MCAR around the AD and CD. The event window period is defined as （-10, 10）, -10 being 10 days prior to the announcement date and 10 being 10 days after it. The third column indicates the number of events. Note that the number of events in the event window drops dramatically for deletions after the CD. This is due to the fact that the majority of deletions are stocks that disappeared from the market. Many of them were merged or went bankrupt. They remained tradable after announcement but not over the effective date. Eventually, only seven events remained over the CD. The fourth column shows the standard deviation of the 221-day time series data of the addition (deletion) portfolio and the last column is the cumulative MAR from 10 days prior to the event day.

As described in the introduction, additions to (deletions from) the index itself do not convey any fundamental information. In other words, such non-informational events should not affect stock price. However, the statistically significant reaction of both the additions and deletions portfolio on AD+1 should be noted. The temporary demand increase (supply increase) in the stocks in the additions (deletions) portfolio affects the value of the stocks to a statistically significant extent.

Suppose the composite change event has some informational value, its content should be reflected on the day of the announcement. However, one can also observe statistically significant MARs on other days as well. For instance, on AD+1, AD+2, and AD+3, MARs are significantly negative for deletions and positive for additions. It is interesting that stock prices fail to fully discount the information upon receipt.[7]

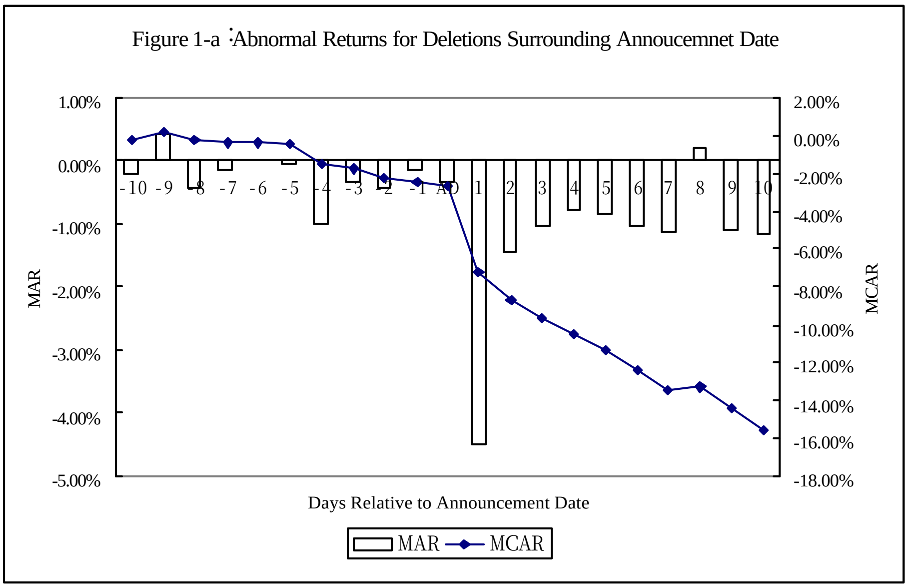
[7] *Serita （1996） explains this phenomenon using non-uniformity of information.*

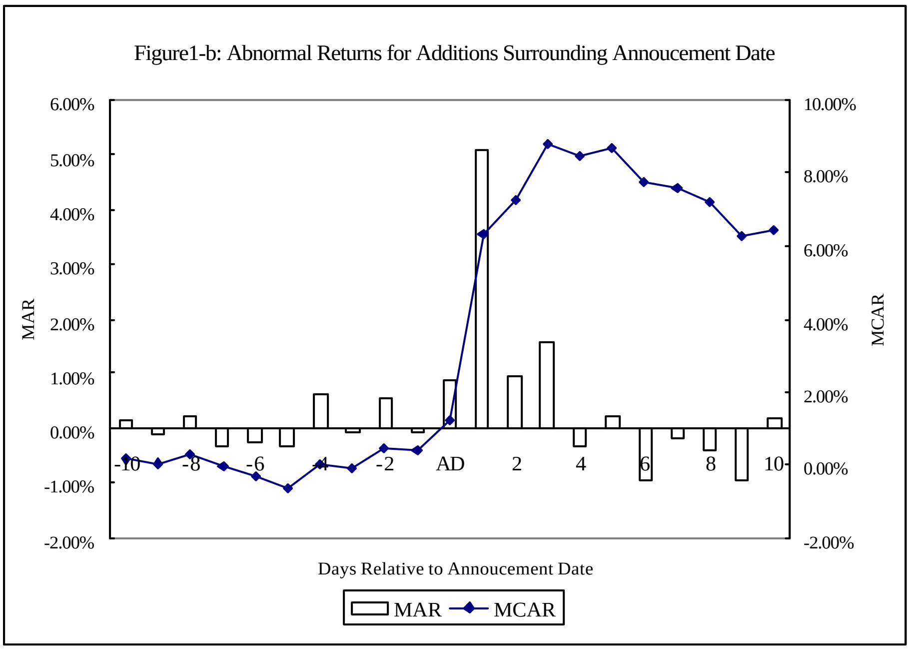
Table 3: Abnormal Returns for Additions and Deletions Surrounding AD and CD.

Annoucement Day Basis						Change Day Basis					
Days relative		Deletions				Days relative		Deletions			
to event	MAR	# of event	t-value		MCAR	to event	MAR	# of event	t-value		MCAR
-10	-0.21%	27	-0.426		-0.21%	-10	0.29%	27	0.579		0.29%
-9	0.40%	27	0.807		0.19%	-9	-0.37%	27	-0.738		-0.08%
-8	-0.43%	27	-0.867		-0.24%	-8	-0.44%	27	-0.886		-0.52%
-7	-0.16%	27	-0.322		-0.41%	-7	-0.06%	27	-0.127		-0.59%
-6	0.01%	27	0.017		-0.40%	-6	-0.51%	27	-1.011		-1.09%
-5	-0.07%	27	-0.142		-0.47%	-5	-1.26%	27	-2.518	***	-2.36%
-4	-1.00%	27	-1.992	**	-1.47%	-4	-1.75%	27	-3.499	***	-4.11%
-3	-0.33%	27	-0.655		-1.79%	-3	-2.52%	27	-5.033	***	-6.64%
-2	-0.44%	27	-0.884		-2.24%	-2	-2.32%	27	-4.617	***	-8.95%
-1	-0.15%	27	-0.304		-2.39%	-1	-3.61%	27	-7.209	***	-12.56%
AD	-0.33%	27	-0.660		-2.72%	CD	4.81%	7	6.033	***	-7.75%
1	-4.50%	26	-8.805	***	-7.22%	1	1.26%	7	1.579		-6.49%
2	-1.43%	26	-2.800	***	-8.65%	2	-0.28%	7	-0.357		-6.78%
3	-1.03%	24	-1.905	**	-9.68%	3	-1.44%	7	-1.805	**	-8.22%
4	-0.78%	19	-1.263		-10.46%	4	2.03%	7	2.542	***	-6.19%
5	-0.85%	18	-1.432		-11.31%	5	-0.44%	7	-0.555		-6.63%
6	-1.02%	15	-1.670	*	-12.33%	6	0.55%	7	0.693		-6.08%
7	-1.13%	14	-1.890	*	-13.46%	7	-0.35%	7	-0.434		-6.42%
8	0.21%	14	0.349		-13.25%	8	-0.34%	7	-0.425		-6.76%
9	-1.10%	10	-1.386		-14.35%	9	0.08%	7	0.106		-6.68%
10	-1.16%	10	-1.465		-15.51%	10	-0.29%	7	-0.362		-6.97%
Days relative		Additions				Days relative		Additions			
to event	MAR	# of event	t-value		MCAR	to event	MAR	# of event	t-value		MCAR
-10	0.15%	27	0.376		0.15%	-10	0.52%	27	1.271		0.52%
-9	-0.12%	27	-0.294		0.03%	-9	-0.71%	27	-1.723	*	-0.19%
-8	0.24%	27	0.580		0.27%	-8	0.07%	27	0.180		-0.11%
-7	-0.32%	27	-0.775		-0.05%	-7	0.20%	27	0.490		0.09%
-6	-0.27%	27	-0.659		-0.32%	-6	0.65%	27	1.587		0.74%
-5	-0.33%	27	-0.793		-0.64%	-5	0.60%	27	1.448		1.34%
-4	0.62%	27	1.509		-0.02%	-4	1.05%	27	2.560	***	2.39%
-3	-0.07%	27	-0.174		-0.10%	-3	2.11%	27	5.115	***	4.50%
-2	0.52%	27	1.268		0.43%	-2	1.96%	27	4.755	***	6.46%
-1	-0.08%	27	-0.183		0.35%	-1	3.16%	27	7.681	***	9.62%
AD	0.86%	27	2.080	**	1.21%	CD	-2.36%	27	-5.735	***	7.26%
1	5.09%	27	12.371	***	6.30%	1	-1.16%	27	-2.824	***	6.10%
2	0.95%	27	2.303	**	7.25%	2	-0.04%	27	-0.105		6.05%
3	1.55%	27	3.774	***	8.80%	3	-0.34%	27	-0.834		5.71%
4	-0.33%	27	-0.802		8.47%	4	-0.63%	27	-1.531		5.08%
5	0.23%	27	0.556		8.70%	5	-0.58%	27	-1.405		4.50%
6	-0.94%	27	-2.282	**	7.76%	6	0.06%	27	0.138		4.56%
7	-0.16%	27	-0.397		7.60%	7	-0.14%	27	-0.345		4.41%
8	-0.40%	27	-0.966		7.20%	8	-0.57%	27	-1.391		3.84%
9	-0.96%	27	-2.323	***	6.24%	9	0.21%	27	0.498		4.05%
10	0.17%	27	0.412		6.41%	10	0.11%	27	0.267		4.16%

(Note) 1. ***,**,* indicates that the null hypothesis of abnormal return is zero is rejected at 1%,5%, 10% level respectively. T-values are omitted. 2. MCAR is the cummulative MAR from AD-10 onwards.

Figure 1 describes MAR and MCAR around the AD and Figure 2 displays them around the CD. Figure 1-a indicates the deletion portfolio's behavior around the AD. There seems to be a steady decline before the AD but the degree is not statistically significant. There is a possibility that some investors are trading on speculation or information leakage with respect to their deletions, but they are affecting stock price only to a limited degree. On days after AD, the deletion portfolio's return dives. The decline continues over the sample period, and MCAR at AD+10 is -15.51%. Figure 1-b indicates the addition portfolio's behavior. Like the case with deletions, stocks tend to edge up before the AD but not significantly. Return on the additions portfolio shoots up on days after AD and MCAR at AD+10 is +6.41%.





(Note) 1. MAR is the mean abnormal return for a given day computed from the cross sectional average of the samples. 2. MCAR is the mean cummulative abnormal returns. MCAR is the cummulated MAR from AD-10 onwards. 3. Actual annoucements becomes public knowledge after the market close on AD. Therefore the MAR is the largest on AD+1.

Comparison of the absolute magnitude of the event makes it apparent that deletions are the most affected. Figures 2-a and 2-b also uncover another difference between deletions and additions. Cumulative abnormal returns are maintained in the case of the former while the latter gives them back after the CD. Beneish & Gardner (1995) found that additions to the Dow Jones Industrial Average made little difference between pre and post event while deletions had a significant negative effect. My findings with respect to the Nikkei 225 are similar in a sense that deletions are the most affected.

Figure 2-a: Abnormal Returs for Deletions Surrounding Effective Date

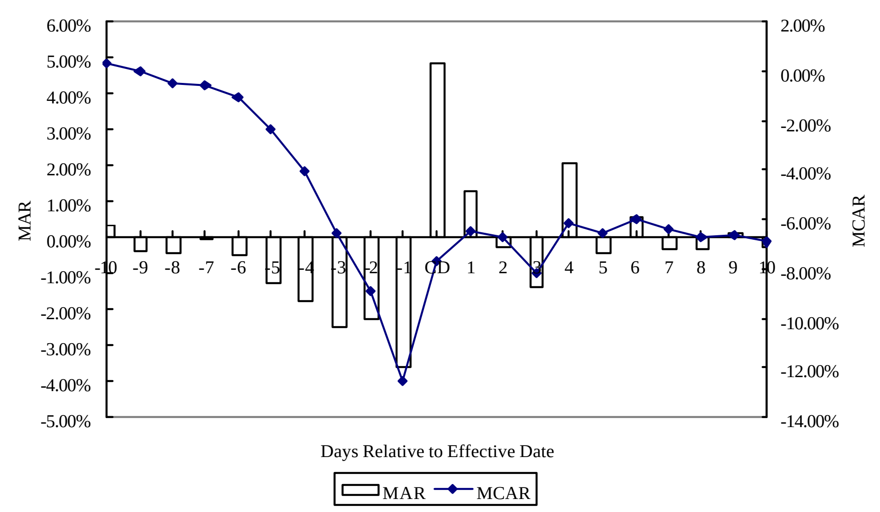
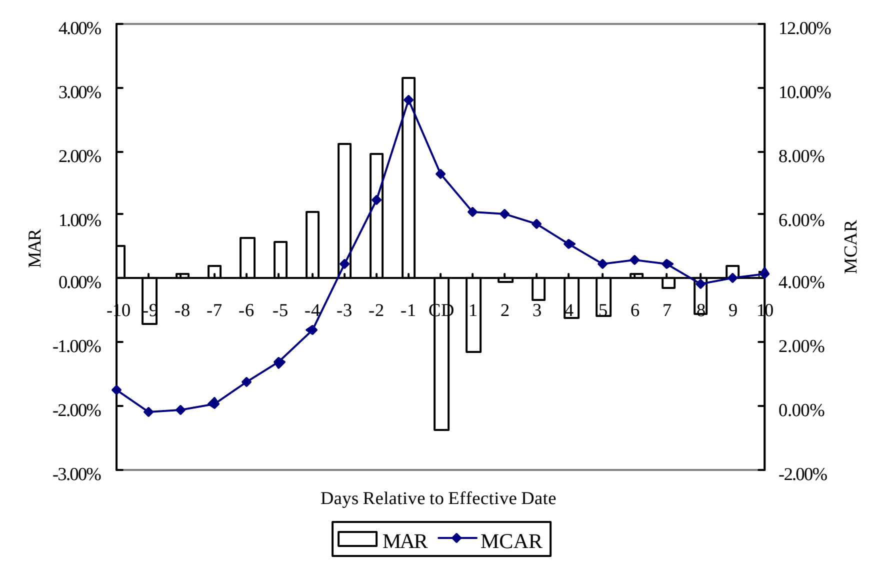


Figure 2-b: Abnormal Returns For Additions Surrounding Effective Date



(Note) 1. MAR is the mean abnormal return for a given day computed from the cross sectional average of the samples. 2. MCAR is the mean cummulative abnormal returns. MCAR is the cummulated MAR from AD-10 onwards.

B. Existing hypotheses and interpretation

The findings are not consistent with the price pressure hypothesis which considers the increased value of the additions is due to temporary price pressure from noise traders. As noise traders buy the additions upon announcement, the market maker facilitates the trade by selling them at a premium. The premium is compensation for the market maker to unwind the position as the demand shock fades. By the same token, a discount is necessary for the market maker to absorb the negative demand shock upon deletion announcement. If price pressure is the cause of price action, post-event abnormal return should be negative. The findings indicate that both deletions and additions in the post-event period fail to return to where they stood before announcement. The results also indicate that the event drives equilibrium to a new level.

The imperfect substitute hypothesis implies that the price of a stock is vulnerable to an external shock when no perfect substitute is available. When price moves above fair value, rational investors would sell the stock concerned and substitute it in their portfolio with another stock of similar fundamentals. If availability of an appropriate substitute is limited, rational investors would leave overvalued stocks as they are. An addition with a positive demand shock would see price rise above fair value and stay there since there is little room for arbitrage. Correspondingly, triggered by a negative demand shock, deletions would permanently decrease in value. However, there is asymmetrical return between the addition and deletion samples. The deletion samples decline in value more than the addition samples rise. This is not perfectly explainable by the imperfect substitute hypothesis. If the demand shock is the only cause of price movement, one should be able to observe a similar price pattern for both additions and deletions. Therefore, asymmetric price movement may indicate some other cause behind price movement. One may argue that the market is vulnerable to negative news. Securities analysts tend to generate positive reports. Thus, market participants are used to positive news. In such circumstances, negative news attracts investor attention more so than positive news.

4. Trading Simulation

One of the major arguments of the efficient market hypothesis is that arbitrageurs in the market behave in a way to achieve such efficiency. When stock price moves away from fundamental value, arbitrageurs come in and take the opposite position, which eventually drives value to its equivalent. Trading strategy typically employed by arbitrageurs is simulated below.

A. Two types of trading strategy

Upon announcement of composite change, arbitrageurs go long on the stocks newly adopted and short sell deletions. For short sales, they go to the securities lending market and borrow the stocks. Since borrowing demand in the securities lending market shoots up upon announcements, they have to act quickly. This long position in additions and short position in deletions will be held until one day prior to the change date. Arbitrageurs intend to unwind the position as close as possible to the closing of the change date. Arbitrageurs would face price risk if they were unable to unwind the position by the closing bell. There is a possibility that the stocks they have do not close due to the imbalance of trades.[8] Some arbitrageurs start unwinding positions 10 to 15 minutes prior to the close.

Arbitrageurs generate excess return using the following two trading strategies (Table 4). The first is typically employed by arbitrageurs who anticipate a continuous price rise in the post-announcement period. The rise may be caused by irrational traders who simply follow the "bullish" trend. In practice, such an arbitrageur shorts deletions (long on additions) upon announcement. He keeps the position until one day prior to the change date and squares it as close as possible to the market close of that day. He may want to wait until just before the closing bell knowing that index-tracking investors will come in and buy the additions (sell the deletions) near the close. The second strategy is based on the conviction that irrational noise traders who do not have any good reason to buy additions except for rising momentum (sell the deletions except for falling momentum) will reverse their positions once such momentum dissipates. Therefore, the strategy is to short the additions (go long on the deletions) at the closing price on one day prior to the change date. Subscripts a, b, and c differ depending on how many days the positions are held. Strategy-a dictates unwinding at the close of the change date while strategy-b on CD+1 and strategy-c on CD+2.

Table 4: Arbitrageurs' Trading Simulation

		Announcement (AD)	+1	+2	+3	. . . .	-1	Change Date (CD)	+1	+2	+3
Strategy 1	Deletions		S	S	S		Sq				
	Additions		L	L	L		Sq				
Strategy 2-a	Deletions						L	Sq			
	Additions						S	Sq			
Strategy 2-b	Deletions						L	L	Sq		
	Additions						S	S	Sq		
Strategy 2-c	Deletions						L	L	L	Sq	
	Additions						S	S	S	Sq	

(Note) "S" indicates the short position while "L" the long position. "Sq" shows the traders to liqudate whatever position he carried upto that day.

B. Simulation results

Table 5 describes average return of the strategies regarding 77 deletions and 69 additions. The same analysis was

[8] *When there is an order imbalance at the close, the Tokyo Stock Exchange uses a tentative closing price when the imbalance of trades is likely to create a gap in the closing price. The tentative price is calculated as the last traded price plus the predetermined price range.*

also conducted based on the portfolio approach. Since the composite change event which occurred in April 2000 is dominant in size, controlling it using the portfolio approach is useful.

Table 5 Results of the Trading Simulations

	Strategies employed for Deletions			
	Strategy 1	Strategy 2-a	Strategy 2-b	Strategy 2-c
Deletion Samples (n)	77	46	46	46
Average	10.61%	6.20%	7.41%	6.19%
Max	36.17%	26.11%	26.09%	26.96%
Min	-9.87%	-5.07%	-10.87%	-14.29%
% of winning trades	87.01%	86.96%	86.96%	84.78%
Deletion Events (n)	26	7	7	7
Average	7.97%	5.15%	7.13%	6.52%
Max	20.69%	10.16%	19.90%	19.05%
Min	-7.93%	1.69%	1.21%	-3.62%
% of winning trades	88.46%	100.00%	100.00%	85.71%
	Strategies employed for Additions			
Addition Samples (n)	69	69	69	69
Average	12.29%	3.34%	4.22%	4.52%
Max	46.97%	12.69%	15.99%	18.78%
Min	-10.87%	-6.09%	-3.70%	-11.19%
% of winning trades	91.30%	86.96%	82.61%	84.06%
Deletion Events (n)	24	24	24	24
Average	6.17%	2.59%	3.50%	3.56%
Max	29.04%	8.05%	10.90%	12.38%
Min	-10.87%	-3.45%	-0.80%	-11.19%
% of winning trades	87.50%	82.61%	86.96%	91.30%
	Total			
Total Samples (n)	146	115	115	115
Average	11.27%	3.73%	4.53%	4.09%
Max	83.14%	30.13%	33.10%	33.26%
Min	-8.99%	-5.96%	-8.17%	-14.29%
% of winning trades	95.21%	96.52%	94.78%	93.04%
Total Events (n)	28	28	28	28
Average	12.69%	3.51%	4.78%	4.68%
Max	36.62%	12.79%	23.79%	22.21%
Min	-5.06%	-1.66%	-0.80%	-11.19%
% of winning trades	85.71%	92.86%	89.29%	89.29%

(Note) 1.Transaction costs such as brokerage comissions and securities lending fees are assumed to be zero. 2. Trading strategies on events are based on the equal weighted portfolio approach. Regardless of the size or number of the sample firms in a given event, traders are assumed to have invested equally.

For deletions and additions, strategy-1 generates 12.69% return per event over the 12-year period. Among the three sub-tactics of strategy-2, on the other hand, strategy 2-b seems to have generated the best performance both in the individual stock approach and the portfolio approach. Selling additions at the close of CD-1 performed worse than buying deletions at the close of CD-1 (strategy 2-b with 7.41% vs 4.22% in the individual stock approach, and 7.13% vs 3.50% in the portfolio approach). This could mean that deletions may deviate more from fundamental values than additions. If so, why do deletions perform worse? One may possibly hypothesize that that there is a barrier for arbitrageurs to participate in deletions. Since arbitrageurs have to borrow deleted stocks from the securities lending market during the event period, that may thwart non-institutional arbitrageurs from doing so. Thus, irrational momentum traders may cause stocks to deviate more from equilibrium.

Finally, the winning percentage of strategies is computed. All of the pre-determined systematic strategies generated profits 80% to 100% of the time. Considering the maximum and the minimum profit in the sample period, the strategies are evaluated as extremely profitable. Figures 3-a and 3-b respectively depict performance of deletions and additions over the 12-year period. Figure 3-c combines the two. Witness the continuously lucrative results from event No. 1 through No. 39. The composite change event is a recurrent one. Therefore, one can easily predict that the same trading pattern will repeat itself. If rational traders in the market act in a way that the theory suggests, there should remain no arbitrage opportunities over such a long period of time. The fact that the recurrent events generate a similar pattern of price predictability casts some doubt on the arbitrage argument in achieving the efficient market hypothesis.

Figure 3-a: Trading Profits from Deletions

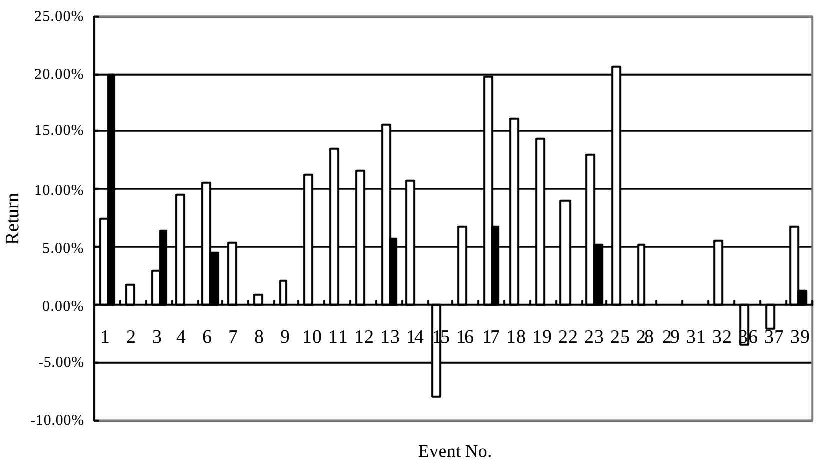


Figure 3-b: Trading Profits from Additions

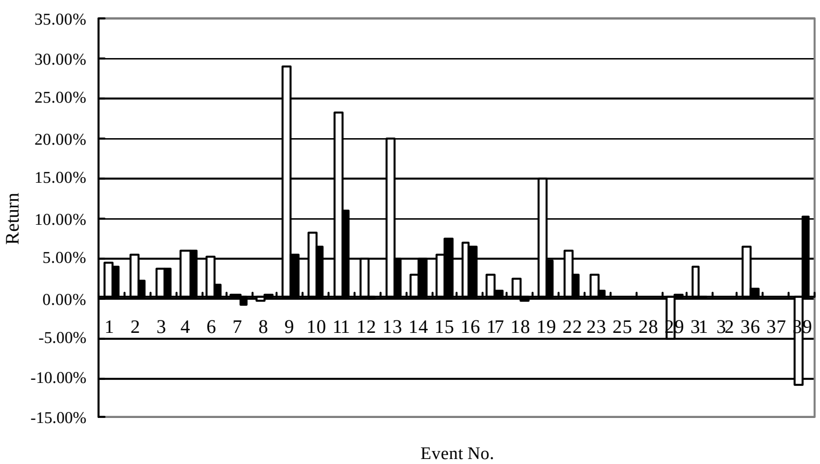
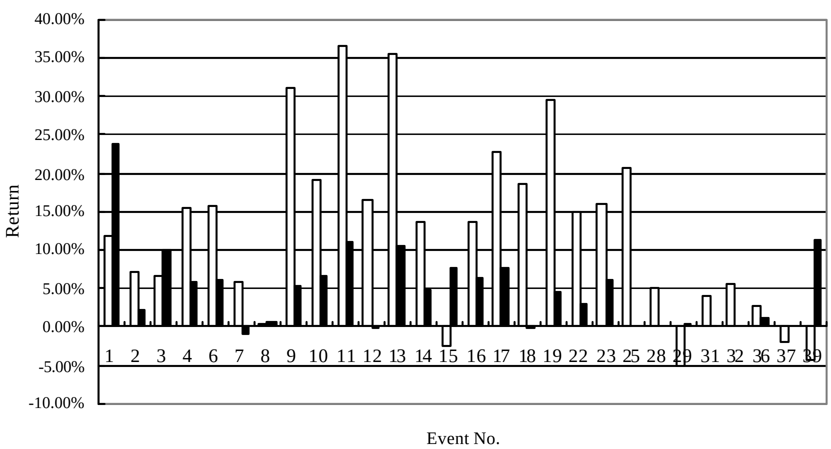


Figure 3-c: Trading Profits from Total Index Change



(Note) 1. The white bar chart shows the results of the strategy 1 while the black bar indicates the returns from strategy 2-b. 2. Graph shows only the strategy 2-b for the simplicity reason. 3. Returns are not adjusted by the market model. Raw returns from the strategy are shown in all the three cases.

C. Alternative hypotheses

Most prior studies try to explain abnormal returns assuming that arbitrage activity would drive a stock price to its fundamental value. The very reason abnormal return is present is due to the cost of arbitrage. This logic is consistent with the efficient market hypothesis where the market can eventually be efficient if it becomes frictionless. The behavioral economists' point of view, however, is different. Human beings sometimes behave in an irrational manner and so does the market. Investors' expected utility function is not monotonous as economists assume. They are risk averse when obtaining profit but become risk takers once their wealth falls into the red. This kink in the investors' utility function was originally pointed out by Tversky and Kahneman (1979) in their well-known prospect theory.

Since the advent of behavioral finance, there are a number of theories that describe the situation where investors behave in an irrational manner. In the case of index change, the positive feedback traders in the market may have played an important role by taking a position in the same direction as the event suggests. For additions, they go long on the stocks concerned and go short on deletions. Then some rational traders accelerate the momentum by also buying the additions and selling deletions. As De Long et al. (1990) suggest in their theory, rational investors do not necessarily counter trade with noise traders when they anticipate positive feedback traders will further push up the price. This theory is compatible with the price behavior in the index change. The initial upward drift may be caused by some index tracking investors who have no choice but to buy a certain number of shares by the change date. The upward drift catches the positive feedback traders' attention and they buy the additions as long as they go up. Rational traders will also buy the stock (although it deviates from its fundamental value) since they know positive feedback traders will pay an even higher price as long as upward momentum is intact. Such excess demand will only be met at a higher price. The reverse is true for deletions. Upon announcement, index tracking investors dump the stocks, causing the initial negative drift, which will subsequently trigger positive feedback traders' sales. Since no rational investor would counter such trading until the event is over, negative abnormal return for deletions is detected in the event period.

Does the index change have some features that facilitate such trading patterns? One has to be aware of the two psychological traits that make this event special. Firstly, investors tend to react to news that has short-term consequences rather than long-term ones as pointed out by Froot et al. (1992). Index change indeed has an impact on short-term consequences. Therefore, there is good chance that many investors participate in the event. Secondly, as Schafstein and Stein (1990) argue, institutional investors (index-fund managers) are penalized should they make a bad decision alone. However, if their colleagues make the same bad decision, they will not be penalized. This asymmetric compensation system induces them to take a similar action for an uncertain event such as index change. In this case, they choose to take no action until right before the change date to minimize tracking error. Despite the fact that selling deletions and buying additions is likely to generate higher expected return for a given risk, institutional investors concentrate trading in the vicinity of the close on CD-1. This is part of the reason why index tracking investors are willing to pay an overvalued price for additions and sell deletions at an undervalued price.

Conclusion

This empirical study of Nikkei 225 constituent changes sheds light on the market price of stocks from the following three perspectives. Despite the fact that there is no obvious reason to believe, ex-ante, that index change contains no new information, additions to the Nikkei 225 demonstrate statistically significant positive abnormal returns and deletions negative abnormal returns. This is inconsistent with Scholes (1970)'s argument where stocks do not react to non-information. Secondly, abnormal returns both on the additions and deletions are observed not only on the announcement date but also on other days in the post-announcement period. This may suggest that positive feedback traders exist behind such price action. Lastly, and most interestingly, despite the recurrent nature of index change, price predictability is evidenced. Additions rise until CD-1 and some of the gain is reversed in the post-CD period, but not all. Deletions decline until CD-1 and regain some of the loss in the post-CD period, but not all. This pattern by and large remains the same for the 12-year period.

The conclusion here is that mispricing in the market may not disappear even if a frictionless environment is achieved. The evidence presented here is contradictory to the efficient market hypothesis.

Here, I would like to express my gratitude to Prof. Shigeki Sakakibara, Prof. Nobuyuki Isagawa, and Prof. Yoshitaka Kai (Graduate School of Business Administration, KOBE UNIVERSITY) for their useful advice, as well as the referees for their valuable comments.

(This paper was submitted, selected and published as it was.)

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