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Comovement and index fund trading effect: evidence from Japanese stock market

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Abstract

We examine comovement in two famous Japanese stock indexes (the Nikkei 225 and the MSCI Japan) by employing the Barberis et al. (2005) methodology. First, we compare the equal-weighted Nikkei 225 with the value-weighted Nikkei 225 and find that the index fund trading effect is strong in the medium term. Second, we confirm that there is stronger comovement in the Nikkei 225 than in the MSCI Japan, which indicates the importance of "indexing demand."

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1 Introduction

Recently, investing in futures through stock indexes has become a major hedging tool for institutional investors. In addition, individuals have been index investing through mutual funds. Many empirical studies have attempted to reveal this trading effect. This is a topic that continues to be discussed. A part of this discussion includes the current investigation of individual stock's *additions* and/or *deletions* in the stock index. This study contributes to the explanation of the medium-term effect of index fund trading by comparing Japanese stock indexes.

It is important to know that there are two distinct qualities in relation to *additions* and/or *deletions* in the stock index. First, index makers subjectively select the stocks that are included in an index. As is the practice, each index has its own criteria. Nevertheless, its stock listings strongly depend on the makers' choices as to which securities are deemed suited to the index. This implies that the index redefinition is almost an information-free event and that, theoretically, it has minor impact on its stock prices and trading volumes, except as per behavioral financial theory.[1] Second, everyone interested in the stock market clearly knows of and recognizes these events.

Harris and Gruel (1986) and Shleifer (1986) adopt one perspective on this topic. In their early quantitative research, they found that a stock that is added to a stock index outperforms in terms of price. Following these studies, up to the present, many other studies have discussed this effect.[2] Contrary to this, and especially when taking a close look at the Japanese data, in their study of the Nikkei 225 Index, Hanaeda and Serita (2003) observed a big change in this index in the year 2000. The Nikkei 225 is the most famous stock index in Japan. It usually changes once a year with the inclusion of new securities. But in 2000, the Nikkei 225 Index suddenly announced its new criteria and also the *addition* and *deletion* of 30 securities. In this study, we call this event the "big change" (BC). Hanaeda and Serita (2003) found that this BC event had serious effects on stock prices. In contrast, Okada *et al*. (2006) examined a much wider time frame for the Nikkei 225 Index. For the period 1991 to 2002, they examined price movements on announcement days and predicted that, in the short term, the stock price would increase. Since the MSCI Japan Index is similar to the Nikkei 225, it is necessary to engage in a comparative analysis of these two indexes. Chakrabarti *et al*. (2005) examined the MSCI Standard Index, which consists of stocks of 29 countries. As a result, they indicated the same kind of abnormal returns as Shleifer (1986) did. In Chakrabarti *et al*. (2005), on the day after the announcement, abnormal returns were seen at a 1% significance level in US, UK, and Japanese indexes. However, abnormal returns at a 10% significance level were seen in the indexes of developing countries. On observation, Chakrabarti *et al*. (2005) insisted that the degree of "indexing demand" affects the price.

From another perspective, Vijh (1994) researched the correlation (beta) between the index and its individual stocks. In his study, the beta between the addition of stock, i, and the S&P 500 is regressed by the equation below, where stock i's return (R_i) is defined as the log first difference of the time series and v is an independent and identically distributed (i.i.d) disturbance term.

$$\mathrm{R}_{i,t} = \alpha_i + \beta_i \mathrm{R}_{S\&P500,t} + v_{i,t}$$

Vijh (1994) examined the changes in β that happened "before" and "after" the events. Calculating the difference between "before" and "after", he noted the changes in β, which are sometimes

[1] Denis *et al*. (2003) analyzed analysts' future prospects and noted that this kind of index inclusion is not an information-free event.

[2] For a survey, refer Eliott *et al*. (2006).

emphasized as evidence of the *comovement*.[3] Expanding on Vijh (1994), Barberis *et al*. (2005; henceforth BSW) introduced a bivariate regression test to which they added stocks from the S&P 500 as well as those not listed on the S&P 500. BSW used their bivariate regression to distinguish the fundamentals view from other views. The problem with simple fundamentals view is that it does not explain the changing beta. Therefore, if we observe that there are changes in β, then this predicts that the other views, which are often based on behavioral financial theories, are correct. Adding to the S&P 500, the comovement in other countries' indexes is now popularly observed.[4]

In this study, we apply BSW's bivariate regression to the Nikkei 225 and the MSCI Japan index, which provides new evidence in support of the existence of comovement. However, it is important to note that BSW's bivariate regression was not tested in Greenwood and Sosner (2007) and Claessens and Yafeh (2012). In particular, this study discusses two main findings that prove the situational analysis premised on the behavioral financial theory arguments mentioned above. First, comparing the equal-weighted (EW) Nikkei 225 Index with the value-weighted (VW) Nikkei 225 Index, we focus on the medium-term price movement. The original Nikkei 225 Index is a price-weighted arithmetic average index listed on the first section of the Tokyo Securities Exchange (TSE). In addition, index investors always trade Nikkei 225 itself through futures, mutual funds, etc. So in comparison to the EW with the VW indexes, we examine the effect of index fund behavior more explicitly than we examine the S&P 500. Second, comparing the Nikkei 225 Index with the MSCI Japan, we examine the effect of "indexing demand," which is in alignment with the perspectives of Chakrabarti *et al*. (2005).

The rest of this study is organized as follows: First, we describe our model and the data that show how to calculate β to detect comovement in the Japanese stock market. Second, we present our empirical results, which mainly show two findings: that there is stronger comovement in the EW than in the VW, and that there is weaker comovement in the MSCI Japan than in the Nikkei 225. Finally, we conclude that each result will provide new evidence of comovement in the Japanese stock market.

2 Equation and Data

For measurements of comovement, we first show the model and then how to set up the data. In particular, in the Japanese stock market data, the capitalization index in the Nikkei 225 is not disclosed. Thus, we have to collect data on the total market capitalization of the Nikkei 225.

2.1 Model

Suppose the investor recognizes two categories(X, Y); we set the Nikkei 225 Index and the MSCI Japan as X, then the rest of the market as Y. Paying attention to the relationship between X and Y, we assume X plus Y is equal to the market, m. The stock, i, is included in Y before the *additional* event happens. Once the *additional* event happens, the stock, i, moves to X. In this situation, we want to check whether stock i's β on X and Y changes. We checked this by employing both Vijh's

[3]We assume comovement as defined by Shleifer (2000).

[4]Refer, London FTSE (Mase (2008)), MSCI-Canada (Coakley *et al*. (2008)), Nikkei 225 (Greenwood and Sosner (2007)), and around the world (Claessens and Yafeh (2012)).

univariate and BSW's bivariate regressions below.

$$\mathrm{R}_{i,t} = \alpha_i + \beta_i \mathrm{R}_{X,t} + v_{i,t} \tag{1}$$
$$\mathrm{R}_{i,t} = \alpha_i + \beta_{i,X} \mathrm{R}_{X,t} + \beta_{i,Y} \mathrm{R}_{Y,t} + v_{i,t} \tag{2}$$

Vijh indicated that the β_i increased. In addition, by their model, BSW indicated that the $\beta_{i,X}$ increased, and the $\beta_{i,Y}$ decreased after the *additional* event happened (vice versa in the case of *deletions*). In addition to β, BSW also indicated that the coefficient of determination, R^2, increased in the univariate regression after the *additional* event happened (vice versa in the case of *deletions*). By controlling for R_Y, BSW indicated that a stock that is added to X (deleted from X) will experience a larger increase (decrease) in β on X's return. This would be the merit of using the bivariate regression. After the estimation of both regressions in the "before" and "after" scenarios, we calculated the differences as follows:

$$\Delta\beta_i = \beta_{i,after} - \beta_{i,before}$$

$$\Delta R_i^2 = R^2_{i,after} - R^2_{i,before}$$

The differences of βs in the bivariate regression were also calculated in the same manner ($\Delta\beta_X$, $\Delta\beta_Y$). After the calculation of each stock i's $\Delta\beta$, ΔR^2, $\Delta\beta_X$, and $\Delta\beta_Y$, we averaged them and defined them as $\overline{\Delta\beta}$, $\overline{\Delta R^2}$, $\overline{\Delta\beta_X}$, and $\overline{\Delta\beta_Y}$, respectively. When testing for the change in the comovement, we want to test whether each of them is zero. Thus, the null hypothesis for each $\overline{\Delta\beta}$, $\overline{\Delta R^2}$, $\overline{\Delta\beta_X}$, and $\overline{\Delta\beta_Y}$ would be zero. BSW used simulation methods to calculate the standard errors (s.e.) as did we.

Below, we present X and Y in detail. In addition, from the individual data, we demonstrate how to mimic the EW Nikkei 225, the VW Nikkei 225, and the MSCI Japan, respectively.

In the case of the EW Nikkei 225 as X, it is easy to make portfolio X's returns. By collecting all 225 securities, n, and averaging their returns for a cross section, we mimicked the EW Nikkei 225's securities' returns from the equation below: [5]

$$\mathrm{R}_{EW\ Nikkei\ 225,t} = \frac{1}{225}\left(\sum_{n=1}^{225} \mathrm{R}_{n,t}\right)$$

As for Y, we first calculated the average returns on all TSE securities, j, then we subtracted weighted X's returns. Thus, we set up the (EW TSE securities except for the weighted EW Nikkei 225) returns as $\mathrm{R}_{EW\ Y}$ from the equation below:[6]

$$\mathrm{R}_{EW\ Y,t} = \frac{1}{J-225}\left(\sum_{j=1}^{J} \mathrm{R}_{j,t} - 225 \times \mathrm{R}_{EW\ Nikkei\ 225,t}\right)$$

In the case of the VW Nikkei 225 as X, we set the total market capitalization of 225 securities equal to 100 at the starting date in the regression, then we calculate the returns as portfolio X's returns ($\mathrm{R}_{VW\ X}$). For the market, m, which in this case is the TSE, the capitalization (CAP) and the returns on a capitalization-weighted index of the non-Nikkei 225, as Y, are inferred from the identity (which is the same procedure as with BSW):

$$\mathrm{R}_{m,t} = \left(\frac{\mathrm{CAP}_{Y,t-1} - \mathrm{CAP}_{X,t-1} - \mathrm{CAP}_{i,t-1}}{\mathrm{CAP}_{m,t-1}}\right)\mathrm{R}_{VW\ Y,t} + \left(\frac{\mathrm{CAP}_{X,t-1}}{\mathrm{CAP}_{m,t-1}}\right)\mathrm{R}_{VW\ X,t} + \left(\frac{\mathrm{CAP}_{i,t-1}}{\mathrm{CAP}_{m,t-1}}\right)\mathrm{R}_{i,t}$$

[5] We dropped event security, i, and missing data, so the number of collected securities is not 225 at actual calculation.

[6] As same as X, event security, i, and missing data were also dropped.

The same procedure used with the VW Nikkei 225 was applied for the MSCI Japan. The original MSCI Japan chose 315 securities from the TSE, the Osaka Securities Exchange, the JASDAQ, and the Nagoya Securities Exchange. From 315 securities, we dropped the *additional* stocks, i, and missing data; this left us with 276 securities. We formed a capitalization-weighted index of these 276 securities as X (mimicking the MSCI Japan).[7] The returns on the capitalization-weighted index of the non-MSCI Japan securities are shown as Y and are inferred by the same procedure as for the VW Nikkei 225.

2.2 Data and Estimation Window

To provide a deeper understanding of the above, it is imperative to include an explanation of the data. From *Nikkei Quick*, we collected the 225 securities that were included in the Nikkei 225 and all the TSE securities data for each year of the study. For example, if the *additional* event happened on May 25, 1990, the benchmark year was 1990. Further, we collected all the TSE securities data listed on January 1, 1990. We also picked up all the Nikkei 225 *additions* and *deletions* from 2000 to 2012. These added up to 209 events. From these, we excluded M&As, bankruptcies, and missing data. This exclusion leaves us with 119 events (*additions* 73, *deletions* 46). Hanaeda and Serita (2003) noted that a BC in the Nikkei 225 Index in 2000 had serious effects on stock prices. We indicated the estimation results on all the events and the BC, respectively. Due to the serious effects on prices in the BC, the larger changes of β and R^2 will be assumed.

In the case of the MSCI Japan, we selected events from their website.[8] From 2007 to 2011, the events added up to 87 events (*additions* 30, *deletions* 57). With the same exclusion of the Nikkei 225, we were left with 73 events (*additions* 24, *deletions* 49).

Next, we take a closer look at the data frequency and the estimation window. For frequency, we used daily data. We define the effective day of the *addition* and *deletion* as time zero. To avoid short-term fluctuations, we do not include the announcement day and the day the event became effective. We set the estimation windows [-300, -30] as "before" and [+30, +300] as "after".

3 Estimation Results

In this section, we show the results of the previous section. First, we present comovement in the EW Nikkei 225, which was partly shown in Greenwood and Sosner (2007). If changes in β and R^2 were noted in the EW Nikkei 225, we can confirm the existence of comovement as per BSW. Second, we show the results of the VW Nikkei 225 and compare the VW with the EW. If larger coefficients are shown in the EW than in the VW, this implies that the index fund trading effect is strong in the medium term. Last, we show the results for the MSCI Japan and compare the MSCI Japan with the Nikkei 225. From a comparison of the estimation results, we anticipated that we could investigate the degree of comovement beforehand. While no futures were traded on the MSCI Japan because of the regulations, we expected that there would be no comovement and smaller coefficients in the MSCI Japan than in the Nikkei 225. If there are smaller coefficients in the MSCI Japan, it indicates the importance of the "indexing demand," which is in alignment with the perspectives of Chakrabarti *et al*. (2005).

[7] The correlation between mimicking the MSCI Japan and the original MSCI Japan is 0.999213.

[8] http://www.msci.com (accessed on December 15, 2012).

In Table 1, Greenwood and Sosner (2007) show a comovement in relation to the BC in the Nikkei 225 Index, in the year 2000. In their study, they estimated a univariate equation (1) and indicated the changes of β. The rest of Table 1 is our contribution which shows comovement in the Nikkei 225 Index.

<Table 1 is here>

We can ensure four points from Table 1: First, in the univariate regression, each $\overline{\Delta\beta}$ and $\overline{\Delta R^2}$ is statistically different from zero in the full sample of *additions* and *deletions*; such as 0.31 in the "*additions*, 2000-2012 all" and -0.46 in the "*deletions*, 2000-2012 all". These are also consistent with Vijh (1994) and BSW, which implies the existence of comovement. Second, in both the univariate and the bivariate regressions, the "BC in 2000" scores larger changes than in the "2000-2012 ex BC." This implies the uniqueness of the BC in 2000 and that such a big change might prompt a stronger comovement. Third, when comparing $\overline{\Delta\beta}$ in the univariate with $\overline{\Delta\beta_X}$ in the bivariate, the bivariate regression results are stronger than the univariate ones across "2000-2012 all," "BC in 2000," and "2000-2012 ex BC." Keep in mind that it is important whether $\overline{\Delta\beta_X}$ is larger in absolute value than $\overline{\Delta\beta}$. In the case of "*additions*, 2000-2012 all," $\overline{\Delta\beta_X}$ (0.71) is larger than $\overline{\Delta\beta}$ (0.31) in the univariate regression. By controlling β_X in the bivariate regression, BSW tried to distinguish the classical theory (fundamental view) from behavioral theory (category view). In sum, as with BSW, the third point supports the behavioral financial theory. Fourth, in the bivariate regression, Table 1 shows that *deletions* events have statistically stronger changes than *additions* events do. For example, comparing $\overline{\Delta\beta_X}$, "*deletions*, BC in 2000" (-1.74) is much stronger in absolute value than "*additions*, BC in 2000" (0.85). BSW insisted such larger coefficients in *deletions* might also support the behavioral view. Here again, it is not important that $\overline{\Delta\beta_X}$ offsets $\overline{\Delta\beta_Y}$ in the bivariate regression in this context.

Next, in Table 2, we compare the VW Nikkei 225 with the EW Nikkei 225, which indicates the importance of index fund trading.

<Table 2 is here>

As in Table 1, Table 2 in itself shows us three characteristics (comovement in almost all parts of the table, the uniqueness of the BC, and the effectiveness of the bivariate regression). However, Table 2 cannot ensure the fourth point (a stronger comovement in *deletions* than in *additions*). From here, by comparing Table 2 with Table 1, some results reveal crucial points.

The differences between Tables 1 and 2 are as follows: the changes in the coefficients in Table 2 are smaller in absolute value than in Table 1, except for the "*additions*, 2000-2012 ex BC." For example, when looking at Table 2, the coefficient for the univariate regression in the "*additions*, BC in 2000" shows weaker comovement than in Table 1 (0.35 in Table 2 versus 0.45 in Table 1). Additionally, in Table 2, at the "*additions*, BC in 2000," $\overline{\Delta\beta_X}$ in the bivariate regression is 0.30 and decreases from the 0.35 given in the univariate regression. This decrease violates BSW's prediction. Overall, these differences between Tables 1 and 2 provide evidence that in the medium term, comovement in the EW would be stronger than in the VW. This is because index investors always trade Nikkei 225 itself and the Nikkei 225 is a price-weighted arithmetic average index. This compliments the analysis of Okada et al. (2006), where they focused on index arbitrage trading in the short term.

Last, the comovement in the MSCI Japan is shown in Table 3.

<Table 3 is here>

When comparing Table 3 (the MSCI Japan) with the Nikkei 225, we point out that we cannot confirm the changes of β in the univariate equation in the MSCI Japan. In the case of *additions* in the univariate regression, $\overline{\Delta\beta}$ shows 0.00. Investors usually recognize a news release about *addition* and/or *deletion* events of the Nikkei 225 and the MSCI Japan. This indicates that *additions* and *deletions* to both indexes factually mean almost the same thing for investors. In contrast, anecdotal evidence indicates that institutional investors trade more on the Nikkei 225 than on the MSCI Japan.[9] Thus, this result might offer further empirical support that the index fund trading effect is relatively strong, which is consistent with Chakrabarti *et al*. (2005). However, in the univariate regression, $\overline{\Delta R^2}$ in both *additions* and *deletions* is statistically different from zero, which implies the existence of comovement. In addition, in the bivariate regression, there are changes in β in the MSCI Japan; $\overline{\Delta\beta_X}$ in *additions* (0.65) and in *deletions* (-0.49). An interpretation on these results would be that comovement in the MSCI Japan is relatively smaller than in the Nikkei 225, but there *is* comovement in the MSCI Japan.

4 Concluding Remarks

In this study, we check comovement in two indexes: the Nikkei 225 and the MSCI Japan; both are famous in the Japanese stock market. Comparing the EW Nikkei 225 with the VW Nikkei 225 indicates there is stronger comovement in the EW Nikkei 225. This implies the importance of the index fund trade in the medium term. When comparing the MSCI Japan with the Nikkei 225, this study provides evidence that weaker comovement in the MSCI Japan is consistent with the perspectives of Chakrabarti *et al*. (2005) which emphasized the importance of "indexing demand."

We conclude that comovement would change subsequent to the events of *additions* and/or *deletions* in the Japanese stock market. However, as in the previous research, we exclude from the estimation window both the announcement day and the day upon which the event becomes effective; we do this to avoid the effects of short-term fluctuations. In particular, in the BCs that occurred in the Nikkei 225 in 2000, only five days were given between the announcement and the effective date of the event (refer, Hanaeda and Serita (2003)). Whether each day would affect the transition of comovement and how this comovement would change over the short term are the issues that deserve further research.

[9](All of this footnote is obtained from the website of the Osaka Securities Exchange and iShares, and accessed on May 15, 2013)
In the Osaka Securities Exchange, MSCI JAPAN Index Futures started trading in 2002. MSCI JAPAN Index Futures traded only 75 million yen (about 599 thousand US dollars). However, in 2002, the Nikkei 225 Futures traded 109 trillion yen (about 872 billion US dollars). In 2003, the Osaka Securities Exchange suspended trading in MSCI JAPAN Index Futures because this index did not meet the requirements of the relevant laws and regulations on futures contracts in Japan (Under Japanese law and regulation, a futures contract cannot be based on an index that contains Real Estate Investment Trusts (REITs)). On the other hand, iShares launched ETFs on the MSCI Japan, in 1996. In 2012, the trading value are as follows: iShares' ETF on the MSCI Japan in the NYSE was about 38 billion US dollars (daily trading volume multiplied by the close price and sum up) and the Nikkei 225 futures in the Osaka Securities Exchange was about 2,236 billion US dollars.

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Table 1: Comovement in equal-weighted (EW) Nikkei 225

	Sample	N	Univariate		Bivariate	
			$\overline{\Delta\beta}$	$\overline{\Delta R^2}$	$\overline{\Delta\beta_X}$	$\overline{\Delta\beta_Y}$
			(s.e.)	(s.e.)	(s.e.)	(s.e.)
additions	2000-2012 all	73	0.31***	0.1653***	0.71***	-0.63***
			(0.09)	(0.0018)	(0.02)	(0.02)
	BC in 2000	28	0.45***	0.1415***	0.85***	-0.66***
			(0.10)	(0.0015)	(0.06)	(0.06)
	2000-2012 ex BC	45	0.22***	0.1801***	0.63***	-0.62***
			(0.09)	(0.0020)	(0.02)	(0.02)
deletions	2000-2012 all	46	-0.46***	-0.1326***	-1.39***	1.39***
			(0.10)	(0.0012)	(0.05)	(0.05)
	BC in 2000	29	-0.68***	-0.1702***	-1.74***	1.66***
			(0.10)	(0.0016)	(0.04)	(0.04)
	2000-2012 ex BC	17	-0.10	-0.0683***	-0.80***	0.94***
			(0.12)	(0.0019)	(0.08)	(0.08)

We select all Nikkei 225 *additions* and *deletions* from 2000 to 2012. These add up to 209 events. From these, we exclude M&As, bankruptcies, and missing data. This exclusion leaves us with 119 events (*additions* 73, *deletions* 46). We show all events, a BC in 2000, and all events excluding the BC, respectively. N in the table means the sample size. For each event stock, i, returns on the EW Nikkei 225, R_X, returns on the rest of the EW TSE, R_Y, and v as an independent and identically distributed (i.i.d) disturbance term, the regressions are below:

$$\mathrm{R}_{i,t} = \alpha_j + \beta_i \mathrm{R}_{X,t} + v_{i,t}$$

$$\mathrm{R}_{i,t} = \alpha_j + \beta_{i,X} \mathrm{R}_{X,t} + \beta_{i,Y} \mathrm{R}_{Y,t} + v_{i,t}$$

A detailed description of the returns (R_X, R_Y) can be found in Section 2.1. In the univariate regression, we also calculated the coefficient of determination (R^2). The pre- and post-event estimation periods are [-300, -30] as "before" and [+30, +300] as "after" on a daily basis (time zero is the effective day of the event). After estimating both regressions on "before" and "after", we calculate the differences as follows:

$$\Delta\beta_i = \beta_{i,after} - \beta_{i,before}$$

$$\Delta R_i^2 = R_{i,after}^2 - R_{i,before}^2$$

The differences for βs in the bivariate regression were also calculated in the same manner ($\Delta\beta_X$, $\Delta\beta_Y$). After calculating each stock i's $\Delta\beta$, ΔR^2, $\Delta\beta_X$, and $\Delta\beta_Y$, we averaged them and defined them as $\overline{\Delta\beta}$, $\overline{\Delta R^2}$, $\overline{\Delta\beta_X}$, and $\overline{\Delta\beta_Y}$, respectively. The null hypothesis for comovement is that each $\overline{\Delta\beta}$, $\overline{\Delta R^2}$, $\overline{\Delta\beta_X}$, and $\overline{\Delta\beta_Y}$ would be zero. BSW used simulation methods to calculate the s.e. (s.e. in the table), as did we. The s.e. are adjusted by using simulations to account for cross-correlation and are reported in parentheses. ***, **, and * denote the significant differences from zero at the 1%, 5%, and 10% levels in the one-sided tests, respectively.

Table 2: Comovement in value-weighted (VW) Nikkei 225

	Sample	N	Univariate		Bivariate	
			$\overline{\Delta\beta}$ (s.e.)	$\overline{\Delta R^2}$ (s.e.)	$\overline{\Delta\beta_X}$ (s.e.)	$\overline{\Delta\beta_Y}$ (s.e.)
additions	2000-2012 all	73	0.29***	0.1499***	0.33***	-0.10***
			(0.09)	(0.0013)	(0.03)	(0.03)
	BC in 2000	28	0.35***	0.1221***	0.30***	0.05
			(0.13)	(0.0014)	(0.10)	(0.10)
	2000-2012 ex BC	45	0.26***	0.1672***	0.34***	-0.20***
			(0.09)	(0.0015)	(0.03)	(0.03)
deletions	2000-2012 all	46	-0.15***	-0.0197***	-0.36***	0.45***
			(0.11)	(0.0011)	(0.06)	(0.06)
	BC in 2000	29	-0.23***	-0.0186***	-0.33***	0.42***
			(0.12)	(0.0014)	(0.09)	(0.09)
	2000-2012 ex BC	17	0.00	-0.0216***	-0.42***	0.51***
			(0.13)	(0.0018)	(0.10)	(0.10)

We select all Nikkei 225 *additions* and *deletions* from 2000 to 2012. These add up to 209 events. From these, we exclude M&As, bankruptcies, and missing data. This exclusion leaves us with 119 events (*additions* 73, *deletions* 46). We show all events, a BC in 2000, and all events excluding the BC, respectively. N in the table means the sample size. For each event stock, i, returns on VW Nikkei 225, R_X, returns on the rest of the VW TSE, R_Y, and v as an independent and identically distributed (i.i.d) disturbance term, the regressions are below:

$$\mathrm{R}_{i,t} = \alpha_j + \beta_i \mathrm{R}_{X,t} + v_{i,t}$$

$$\mathrm{R}_{i,t} = \alpha_j + \beta_{i,X} \mathrm{R}_{X,t} + \beta_{i,Y} \mathrm{R}_{Y,t} + v_{i,t}$$

A detailed description of the returns (R_X, R_Y) can be found in Section 2.1. In the univariate regression, we also calculated the coefficient of determination (R^2). The pre- and post-event estimation periods are [-300, -30] as "before" and [+30, +300] as "after" on a daily basis (time zero is the effective day of the event). After estimating both regressions on "before" and "after", we calculate the differences as follows;

$$\Delta\beta_i = \beta_{i,after} - \beta_{i,before}$$
$$\Delta R_i^2 = R_{i,after}^2 - R_{i,before}^2$$

The differences for βs in the bivariate regression were also calculated in the same manner ($\Delta\beta_X$, $\Delta\beta_Y$). After calculating each stock i's $\Delta\beta$, ΔR^2, $\Delta\beta_X$, and $\Delta\beta_Y$, we averaged them and defined them as $\overline{\Delta\beta}$, $\overline{\Delta R^2}$, $\overline{\Delta\beta_X}$, and $\overline{\Delta\beta_Y}$, respectively. The null hypothesis for comovement is that each $\overline{\Delta\beta}$, $\overline{\Delta R^2}$, $\overline{\Delta\beta_X}$, and $\overline{\Delta\beta_Y}$ would be zero. BSW used simulation methods to calculate the s.e. (s.e. in the table), as did we. The s.e. are adjusted by using simulations to account for cross-correlation and are reported in the parentheses. ***, **, and * denote the significant differences from zero at the 1%, 5%, and 10% levels in the one-sided tests, respectively.

Table 3: Comovement in MSCI Japan (value-weighted)

Sample		N	Univariate		Bivariate	
			$\overline{\Delta\beta}$	$\overline{\Delta R^2}$	$\overline{\Delta\beta_X}$	$\overline{\Delta\beta_Y}$
			(s.e.)	(s.e.)	(s.e.)	(s.e.)
additions	2007-2011	24	0.00	0.05658***	0.65***	-0.65***
			(0.09)	(0.0035)	(0.02)	(0.02)
deletions	2007-2011	49	0.06	-0.06861***	-0.49***	0.56***
			(0.09)	(0.0063)	(0.01)	(0.01)

We select all the MSCI Japan's *additions* and *deletions* from 2007 to 2011. These add up to 87 events. From these, we exclude M&As, bankruptcies, and missing data. This exclusion leaves us with 73 events (*additions* 24, *deletions* 49). N in the table means the sample size. For each event stock, i, returns on mimic the MSCI Japan, R_X, and returns on the rest of the market, R_Y, and v as an independent and identically distributed (i.i.d) disturbance term, the regressions are below:

$$\mathrm{R}_{i,t} = \alpha_j + \beta_i \mathrm{R}_{X,t} + v_{i,t}$$

$$\mathrm{R}_{i,t} = \alpha_j + \beta_{i,X} \mathrm{R}_{X,t} + \beta_{i,Y} \mathrm{R}_{Y,t} + v_{i,t}$$

A detailed description of the returns (R_X, R_Y) can be found in Section 2.1. In the univariate regression, we also calculated the coefficient of determination (R^2). The pre- and post-event estimation periods are [-300, -30] as "before" and [+30, +300] as "after" on a daily basis (time zero is the effective day of the event). After estimating both regressions on "before" and "after", we calculate the differences as follows:

$$\Delta\beta_i = \beta_{i,after} - \beta_{i,before}$$
$$\Delta R_i^2 = R_{i,after}^2 - R_{i,before}^2$$

The differences in the βs in the bivariate regression were also calculated in the same manner ($\Delta\beta_X$, $\Delta\beta_Y$). After calculating each stock i's $\Delta\beta$, ΔR^2, $\Delta\beta_X$, and $\Delta\beta_Y$, we averaged them and defined them as $\overline{\Delta\beta}$, $\overline{\Delta R^2}$, $\overline{\Delta\beta_X}$, and $\overline{\Delta\beta_Y}$, respectively. The null hypothesis for comovement is that each $\overline{\Delta\beta}$, $\overline{\Delta R^2}$, $\overline{\Delta\beta_X}$, and $\overline{\Delta\beta_Y}$ would be zero. BSW used simulation methods to calculate the s.e. (s.e. in the table), as did we. The s.e. are adjusted by using simulations to account for cross-correlation and are reported in parentheses. ***, **, and * denote the significant differences from zero at the 1%, 5%, and 10% levels in the one-sided tests, respectively.