Impacts of Index Revisions on Weight Reduction Firms: Empirical Evidence in Japan

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Abstract

This paper analyzes the effects of being removed from a stock index on stock returns and firm value. As passive investment funds that track index grow, the mechanical selling associated with index changes has become more noticeable. This study focuses on the revisions of TOPIX, a major Japanese stock index, and examines the impacts on over 400 companies that are removed from it using an event study methodology. Previous research on global indices such as the S&P 500 has observed negative effects on the stocks removed, this study also finds significant negative impacts on the stocks removed from TOPIX. Although significant negative impacts are observed for stocks that are removed, the effects don't last long, unlike with large-cap stocks. (The event of micro-cap stock removal hasn't been seen in major stock indexes before, and need to be a subject of research.)

JEL classification: G12, G14

Keywords: Index premium, index revision, index funds, TOPIX

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1. Introduction

Stock indexes are expected to serve multiple roles. First, they represent the overall market movement. Second, they represent the theoretical market in investment theory, serving as benchmark indexes. For example, the Dow Jones Industrial Average (DOW 30), a globally recognized stock index calculated since 1896, was initially intended to measure the overall stock prices. Stock prices have been used as leading indicators of economic activity. In the 1970s, the role of representing investment theory was added. For instance, stock indexes representing the overall market have been used as "the market" in theories such as the Capital Asset Pricing Model (CAPM). This underscores the importance of stock indexes. Furthermore, it's recognized that because there are many financial products that track stock indexes, changes to these indexes can have significant impacts.

As mentioned, stock indexes play a significant role, and it is believed that their revision should not be frequent. Apart from regular updates like stock rebalancing or reconstitution, there have been very few major changes to stock indexes. Any changes that were made took into account the continuity of the index. Although steps have been taken to maintain the continuity of index, there have been significant changes recently to the TOPIX, a major benchmark index in Japan.

This paper focuses on stocks that are gradually excluded from the TOPIX, a leading stock index in Japan. TOPIX, which started in January 1968 with a base market capitalization of 100, indexes subsequent market values. Until market reforms at the Tokyo Stock Exchange in April 2022, it included all stocks listed on the former First Section of the market. Since April 2022, the First Section became the Prime Market and TOPIX has been separated from market structure.

Although there are 493 stocks being excluded from TOPIX, many of them are very small in terms of capitalization. Because they are small-cap stocks, they tend to be overlooked, and their exclusion is welcomed as it enhances the usefulness of the stock index. It has been announced by JPX (Japan Exchange) that their impact on TOPIX is less than 1%, but no information has been released about the impact on the excluded stocks themselves. As explained in detail in the manuscript, these excluded stocks have their weights in the index reduced each quarter. Depending on the context, we use the terms "gradually excluded" and

"weight-reduced" interchangeably.

TOPIX is a major stock index representing Japan's stock market, and its components' stocks have been purchased through index funds and ETFs that track TOPIX. Stocks that were passively bought by such funds and are now being weight-reduced from the index are expected to suffer negative effects. These adverse impacts are not based on fundamentals. This paper examines the effects of losing the index premium [3] on very small-cap stocks that were previously included in the index.

This paper is as follows. The next section surveys related papers. Papers on the revision of major global stock indexes and their impacts, as well as papers focusing on the TOPIX, are surveyed. Section three details recent changes to the TOPIX and discusses the background of the Tokyo Stock Exchange's market reorganization. Section four explains the data and methodology used, and section five discusses the results of the empirical analysis. The conclusion is in section six.

2. Related literature

Stocks added to or excluded from an index are known to impact their prices, and many related papers have been conducted on this topic (Shleifer, 1986; Petajistro, 2006; Appel et al., 2016; Chino and Sammon, 2022). In Japan, related literature examined the impacts of being removed from the TOPIX (Nakakuma and Ishii, 2001) but focused on the cases of removal from TOPIX due to delisting caused by bankruptcy or mergers. There are no studies analyzing stocks removed from the index by gradual weighting method due to index revision. Additionally, there is limited prior research on the impact of stock inclusion in TOPIX. [4]

In the following sections, we review related studies analyzing the effects of stock

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[3] We explain about "index premium" in details in subsection 2.1

[4] One reason for the limited analysis on stocks included in TOPIX is that TOPIX was an index comprising all stocks listed on the former First Section of the Tokyo Stock Exchange. Being included in TOPIX was synonymous with being listed on the First Section of the Tokyo Stock Exchange, including newly listed stocks and those upgraded from the Second Section. As a result, the events of entering the index and moving to a higher market overlapped, making it difficult to analyze the impact of index inclusion itself.

inclusion and exclusion events in indexes such as the S&P 500, as well as mid- and small-cap stock indexes like the Russell 1000 and Russell 2000.[5] We also briefly survey related research on Japanese stock indices. Since TOPIX is a free float-adjusted index, there are studies that analyze changes in the index due not only to the addition or removal of constituent stocks but also to changes in the free float weight. This paper will survey those related studies.

2.1 Impact of Changes in Index Constituents

Early research on stock index rebalancing includes Shleifer's (1986), which analyzed the impact of new additions to the S&P 500 on the respective stock prices. Shleifer (1986) reported that the stock prices of newly added companies to the index increase, the positive returns last days, and there is a correlation between index fund buying and returns. Many other studies also suggest that buying by index funds during S&P 500 rebalancing leads to abnormal price returns (Jain, 1987; Lynch and Mendenhall, 1997; Petajistro, 2006; Kasch and Sarkar, 2012; Patel and Welch, 2017; Chino and Sammon, 2022)

Since 1989, the S&P 500 has started releasing information about stock changes before the effective date. Prior to this change, the announcement date and the effective date were the same, which led to extreme trading concentration on the announcement day as index funds grew. To address this, a five-business-day preparation period was introduced between the announcement and the effective date. After this change, a reversal phenomenon was observed. This phenomenon refers to the relative increase in the stock prices of newly included companies from the announcement date, followed by a relative decrease after the effective date. For excluded stocks, prices tend to fall from the announcement date and rise after the effective date. Petajistro (2006) suggests that this is due to speculators trading ahead between the announcement and the effective date. This situation is known as “the index

[5] The Russel 1000 and 2000 are float-adjusted market capitalization-weighted indexes, those include stocks listed on the New York Stock Exchange and NASDAQ with market capitalizations ranking from 1001st to 3000th. Most U.S. small-cap funds use these indexes as their benchmark. It has been calculated since the end of 1986. To maintain continuity as a small-cap index, the constituent stocks are updated once a year. There are also related indexes like the Russell 1000, which includes the top 1000 stocks by market capitalization.

premium". Since index funds mechanically track an index, the index premium represents costs. When stocks are added to an index, the index funds must buy the stocks on the day they are added at a price that includes the premium. When stocks are removed from an index, the index funds must sell the stocks on the day they are removed at a price that does not include the premium. Investors who are not constrained such as speculators can buy stocks ahead of time and profit by selling them when they are added to the index, resulting in a cost that index funds have to bear.

This phenomenon is observed not only in the S&P 500 but also in the U.S. mid- and small-cap indexes like the Russell 1000 and Russell 2000 (Petajistro, 2006; Appel et al., 2016; Chino and Sammon, 2022). Although the rules for stock changes in the Russell indexes are different from S&P 500 and are based on market capitalization, making them easier to predict, the index premium is still observed.

2.2 Impact of Changes in FFW and Related Research on the Japanese Market

Major stock indexes use a market capitalization-weighted system that takes into account free float weight (FFW). Each stock's FFW is determined and then multiplied by the number of shares outstanding to integrate it into the index. This means that if a stock's FFW increases, its weight in the index also increases, and if the FFW decreases, its weight in the index decreases. There are some studies examining the impact of changes in FFW (Norges Bank, 2014).

The study by Norges Bank (2014) is interesting. It compares the performance of two similar stock indexes: both are FTSE Global Equity Indexes, but one uses Full Market Weights (FMW) and the other uses Free Float Weights (FFW). By analyzing these indexes, which differ only in their weighting method, they observed that there is a correlation between free float weight and stock liquidity. The index adjusted for free float weight performs better in terms of liquidity because it reduces investments in less liquid stocks. However, they also observed that the FFW index has lower returns compared to the FMW index and shows a reversal phenomenon in stock returns.[6]

[6] Norges Bank (2014) explains that the FMW portfolio outperformed the FFW portfolio by

This paper analyzes stocks gradually removed from TOPIX between October 2022 and January 2025. We also review related research focused on the Japanese stock indexes. Nakakuma and Ishii (2001) studied stocks listed on the TSE First Section (and thus included in TOPIX) and examined their excess returns before and after being included in TOPIX. They found positive returns up to the day before inclusion, but negative excess returns after the inclusion date. Nakakuma and Ishii (2001) attribute this to index funds buying at the peak price the day before inclusion. Kurita and Irie (2023) examine the Tokyo Stock Exchange reform of April 2022 and TOPIX revision from multiple perspectives. They discuss issues related to the free float weight and propose improvements to TOPIX as a benchmark. Chattopadhyay et al. (2019) state that for the relatively new JPX-Nikkei 400 index, the returns of included stocks have improved and their ROE has increased (This sentence might be unnecessary and may be deleted later. There are still a few papers that have not been cited yet, which will be included later.)

3. TOPIX revisions

3.1 Global Trends in Stock Indices

Major stock indexes use a weighted average based on market capitalization. There are two main methods for calculating stock indexes: one based on market capitalization and the other on price averages. The indexes representing the major countries' stock markets, however, are typically weighted by market capitalization. Since the 2000s, stock indexes that use weighting by market capitalization have been changed to a calculation method based on tradable share market capitalization (see **Table 1**)[7]. TOPIX shifted to this method in three stages from October 2005 to June 2006.

Table 1 about here

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41 basis points per year over the period 2004-2012.

[7] Tradable market capitalization is the market capitalization of publicly traded shares and this is officially named as "the free-float adjusted market capitalization-weighted" by The Tokyo Stock Exchange. The calculation method based on it is called "the free-float adjusted market capitalization-weighted method".

Similar to major stock indexes in other countries, the TOPIX has also become a free-float adjusted index. This change reflects the diversifying needs required for stock indexes. Not only has there been an expansion in financial products for passive management, but there are also index derivatives such as stock index futures, and the variety of stock indexes has increased, including those differentiated by size, industry, and ESG compliance.

3.2 Summary of TOPIX Revisions

From April 2020 to March 2022, the rules related to TOPIX revisions were steadily decided and announced. This paper uses event study methodology, main announcements are summarized in **Table2**. There were two major revisions related to this paper. One was the redefinition of the free-float ratio. Stocks that were previously recognized as free-float under the old rules were no longer accepted under the new rules, resulting in a decrease in weight for many TOPIX constituent stocks. Since TOPIX uses a free-float adjusted market capitalization for its index weighting, adjustments were made to ensure that these changes did not impact the stock index, maintaining the continuity of the TOPIX. This revision was implemented in three phases: April, May, and June of 2022. [8]

Table 2 about here

TOPIX was an index composed of all stocks listed on the former First Section of the Tokyo Stock Exchange, with over 2,000 constituent companies. Previously, TOPIX served as an index showing the overall market movement. In April 2022, when the market was reorganized, the index was separated from the market categories. However, the separation did not happen immediately; stocks that were part of TOPIX on the last day of the old market categories,[9] April 1, 2022, remained in the TOPIX for some time.

Stocks being removed from TOPIX are small-cap stocks with a free-float market

[8] The free-float ratio, 5% increments, is reviewed annually based on each company's securities report.

[9] The new market categories started on April 4, 2022, and are now divided into three markets: Prime, Standard, and Growth.

capitalization of less than 10 billion yen. Starting from the end of October 2022, their weight in the index will be gradually reduced over 10 quarterly phases until the end of January 2025. Those stocks, which uses a free-float adjusted market capitalization weighted average for its weighting, will reduce the weight by 10% each phase.

It was announced on October 7, 2022, that 493 stocks were to be removed from TOPIX, but a year later, on October 6, 2023, the number was updated to 439 stocks. The decrease from 493 to 439 over the year was due to stocks that were delisted after being designated for removal (11 stocks) and stocks that remained in TOPIX after reevaluation (43 stocks). The 43 stocks that were reevaluated and not removed will have their weights restored by 0.1 each quarter. The listing maintenance standards for the Prime Market and the criteria for remaining in TOPIX are summarized in **Table 3**.

Table 3 about here

3.3 Theory framework and Hypothesis building

Previous research used the information theory and index premium assumption to explain the impact of inclusion or exclusion of a stock into/from an index. Index inclusion certified the quality of the company and entailed a price increase (Shleifer, 1986). On the other hand, being removed from the index may damage the image of a firm and entailed a price decrease. Moreover, in stock markets with different market segmentation, certain kinds of investors are only interested in stocks that are part of index, and that exclusion of a stock from the index will push these investors sell off the shares in addition to institutional investors like index funds or ETFs. In our data set, most weight-reduced stocks have small market capitalizations and do not meet the listing maintenance standards of the Prime Market or the criteria to remain in TOPIX. Exclusion of a stock from TOPIX should not be a great news and being-weighted stocks may have a price decrease after each weighting phase announcement. These arguments lead to our first hypothesis below:

Hypothesis 1. Gradually weighted stocks have a negative stock return during each weighting phase

In addition, our sample has more than 400 firms subject to index exclusion and we take the advantage of this rich data to extend our analysis using additional information, namely the firms' weight in TOPIX. Among the sample, we focus on the firms having smallest weight in TOPIX. We assume that they will suffer from the largest stock price decline because of their tiny role in the index. According to the theory of investment behavior (Dale, 1967), the investment decision and level of investment are determined by past changes and past values of the stock under consideration. After the announcements of JPX, there will be a closer scrutiny of weighted firms by analysts and investors. Therefore, there is an increase in public information about these targeted firms. Excluded firms having large weight will catch attentions from investors more than small-weighted firms. As a result, the liquidity will be different from large-weighted and small-weighted stocks, in which small-weighted ones will suffer from lower liquidity. According to the liquidity theory, if the stock liquidity is low, the bid-ask spread will be larger. Less liquid assets, such as smallest weighted stocks will have larger spread and more negative returns during the weighting phases. Therefore, based on these arguments, we build the second hypothesis as follows:

Hypothesis 2. Smallest weighted stocks have a larger negative stock return than the sample average.

4. Empirical analysis:

4.1 Preliminary analysis

We visualize the stock performance of several firms in our sample and find the preliminary results supporting our two hypotheses.

Figure 1 shows the average stock price of the ten stocks with the smallest weight in TOPIX (minimum weight is 0.0001%), plotted along with trading volume, starting from December 1, 2020, set at 100. It is observed that the stock prices of the smallest weight stocks have been declining over the long term. However, no trend of significant price drops during high trading volumes is observed for stocks that have smallest weight stocks are definitely among those weight-reduced.

Figure 1 about here

Figure 2 illustrates the price movements of TOPIX, TOPIX Small, and the ten stocks with the smallest weights. The figure shows that while TOPIX and TOPIX Small were rising, the weight-reduced stocks were not rising but declining.

Figure 2 about here

4.2 Event studies

4.2.1 Event study methodology

In this subsection, we use an event study methodology to measure the effects of exclusion from TOPIX on stock returns. More specifically, we search for abnormal stock returns surrounding the announcement of a firm being weight-reduced from TOPIX.

Most of the studies on the impact of index revision have adopted event study to carry out the analysis. Event studies can be implemented in several ways. Gerald (2001) summarized two approaches for carrying out event studies based on the classification of underlying theory of asset prices. The first approach assumes that there is no underlying theory of asset prices. This approach utilizes two models: Average Return Model (using constant-average return) and Market Model[10]. The second approach assumes that there is an underlying theory of asset prices and consists of Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Theory (APT). The CAPM uses a constant risk-free rate and imposes constraint on the constant term relative to market model while APT model appeals very theoretically and empirically but difficult to apply in practice.

In this research, we use the market model. The market model operates by comparing performance during event periods to periods of no event. The model application is adopted through the following processes:

1. Identification of the event and the definition of the event window

[10] The market model was first developed by William Sharpe and this is a regression model relating the yield of an asset to the yield of the market.

2. Definition of the estimation window

3. Estimation of Alpha and Beta during the estimation window

4. Estimation of abnormal return for each security during the event window

5. Calculation of the average abnormal return for all securities in period t in each group

6. Estimation of the cumulative average abnormal return (CAR)

7. Testing whether each group's CAR is statistically significant

Identification of the event

In event study, an event could be a stock split, earning announcements, merger or takeover announcement or a regulatory change. In general, this event sends important information about the firms to the market and is assumed to make a substantial change of investor's expectation of the firm's future. Our data range is from 2021 to 2023 and each weighting phase of the revision serves as the event. The event date is the announcement of each weighing. We identify the exact date for this using the announcement release on JPX. The first event date is 28th October 2022; the second event date is 30th January 2023; the third event date is 27th April 2023; the fourth event date is 28th July 2023; and the fifth event date is 30th October 2023.

As mentioned above, the weight of stocks being excluded from the index will be gradually reduced 10% over ten quarterly phases until the end of January 2025. In this study, we currently examine the impact of the first five weighting phases ending at October 2023; at the same time, we are collecting stock price data when available and aim to make a full analysis of the whole ten phases by early 2025.

The definition of the event window

This is the period over which an event occurs, in this study, that is the period around the announcement of each weighing. Here, the event windows are (-1, +1), (-5, +5), (-10, +10), meaning 1 day, 5 days and 10 days before and after the announcement. Day 0 is the date of each weighing announcement.

Definition of the estimation window

This is the period over which the parameters (Alpha and Beta) are estimated. This period is usually longer than the event window. According to Campbell, Lo & MacKinlay (1997), estimation windows are often between 120 and 250 trading days. In this study, we use the estimation windows are 150 trading days before the event window.

Estimation of Alpha and Beta during the estimation window

We collected stocks' prices of the firms being weight-reduced using Nikkei NEEDs. Originally, we get the name of weight-reduced firms from the list announced on October 7, 2022 by Japan Stock Exchange that 493 stocks were to be removed from TOPIX, but a year later, on October 6, 2023, the number was updated to 439 stocks. The decrease from 493 to 439 over the year was due to stocks that were delisted after being designated for removal (11 stocks) and stocks that remained in TOPIX after reevaluation (43 stocks). As we need data on stock prices for each firm, at least 170 trading days before the first exclusion phase and 20 days after the announcement, six firms have been excluded due to the lack of stock data. Our final sample for event studies consists of 433 firms.

Daily stock prices were considered in this study. It is the adjusted closing stock price type. The adjusted closing price on a given day of trading is the one that has been amended to include any distributions and corporate actions that occurred at any time prior to the next day's open. Previous research often used the adjusted closing when examining historical returns because it gives analysts an accurate representation of the firm's equity value beyond the simple market price. The return on the Tokyo Stock Exchange TOPIX index serves as the market return.

All stock prices of 433 firms collected during the estimation window were used to estimate Alpha and Beta factors. We use Stata software application to calculate Alpha and Beta factor. Return calculated in estimation window is term normal return because this period is classified as a period of normal market condition.

Estimation of abnormal return for each security during the event window

After having obtained Alpha and Beta factors for each stock, we started calculating the abnormal return. Abnormal return is the excess return of a security or portfolio of securities

over the market portfolio. Event studies use abnormal return to evaluate market reaction in periods before, during and after the announcement of an event. Abnormal return occurring before an event window reveal whether the market has anticipated the information contained in the event or there has been trading on inside information. Ordinary Least Square (OLS) market model was used to calculate the abnormal return. Following is the formula for the OLS market model used to compute the abnormal returns:

$$ARjt = Rjt - (\alpha + \beta Rmt)$$

Where:

ARjt: abnormal return of stock j on day t

Rjt: actual return on the jth stock on day t

Rmt: return on the market index (TOPIX)

α, β: the market model parameter estimates for stock j during the estimation period (-170, -20). The coefficients were obtained by regressing each security return on the market return. The estimated parameters were then used to compute the daily abnormal returns for the three event windows (-1, +1), (-5, +5), and (-10, +10).

Calculation of the average abnormal return for all securities in period t in each group and the cumulative average abnormal return

Having done the calculation of abnormal returns for all securities in the sample groups, the average of abnormal returns was calculated for each event window, namely (-1, +1), (-5, +5), and (-10; +10). This helps eliminate idiosyncrasies in measurement due to particular stocks. Then, the next step is to calculate Cumulative Average Abnormal Returns. This is the sum of AR over the number of days in the event window. CAR is a useful statistical analysis in addition to AR because it helps get a sense of the aggregate effect of the abnormal returns. The final step is the test procedure on the abnormal returns. CAR will be tested for their statistical significance using the t-test and rank-sum test.

4.2.2 Event study for the whole sample

We first apply event study to our final sample of 433 firms. We obtained the adjusted closing

stock prices for each firm around the announcement event, including 170 trading days before and 20 trading days after the first exclusion phase. The estimation window is defined as 170 to 20 days before the first exclusion announcement, or a (–170, –20) day window. There is same five event dates for each company.

Table 4 summarizes the results of the market reactions to the announcement of the five exclusion weighting phases. The table presents the mean and median CARs for all 433 firms over five events. The mean CAR over the (–1, +1) window is minus 1.64% and statistically significant. The median CAR over the (–1, +1) windows is also negative and statistically significant. It is notable that among 2,165 abnormal return values, the number of negative returns is 1,720, roughly four times higher than the number of positive values. In other words, the prices of weight-reduced stocks mostly decline after each weighting reduction phase, which proves our Hypothesis 1. The impact of mechanical rebalancing by passively managed products cannot be ignored.

We extent the event window to a longer period using two event windows (-5, +5) and (-10, +10). Similar to the event window (-1, +1), the mean CAR over the (–5, +5) window is minus 1.32% and statistically significant. The median CAR over the (–5, +5) windows is also negative and statistically significant. The mean CAR over the (–10, +10) window is minus 0.22% but insignificant. On the other hand, the median CAR over the (–10, +10) windows is negative and statistically significant.

Overall, the prices of weight-reduced stocks mostly decline after each weighting reduction phase, and firms suffered from negative returns, which proves our Hypothesis 1. The impact of mechanical rebalancing by passively managed products therefore cannot be ignored.

Table 4 about here

4.2.3 Event study for the sub sample based on the index weight

We further examine the impact of TOPIX index revision on the stocks being weight-reduced by using sub-sample. The first sample breakup is based on the weight of stocks in the index. As mentioned above, TOPIX is a free-float adjusted market capitalization-weighted index. We

downloaded the TOPIX component stocks weight from Japan Exchange Group website[11]. As of 28th June 2024. there are 2,137 stocks included in the TOPIX index and the weight of component stocks is very diverse, ranging from very small as 0.000001 to 0.044279.

Our focus is the stock group having the smallest weight in TOPIX as most of stocks being excluded belongs to this group. In details, we find information on stock weight in TOPIX for 427 firms in our sample with data on weight up to June, 2024. The mean of weight is 0.00000269, showing at most firms subject to index exclusion hold small weight in the index.

In this session, we aim to examine the stock performance of the firms having smallest weight in TOPIX among the firm sample subjected to exclusion. We assume that they will suffer from the largest stock price decline because of their tiny role in the index. Having tabulate the data, we find eight firms having the weight of zero. These firms are to be delisted or under supervision by TSE to determine whether these firms have fallen under the delisting criteria or not. So, we do not consider these firms for our analysis. As the result, the number of firms having smallest weight in our sample is 112 firm, with the weight of 0.000001, making up roughly 26% of the total firm sample.

We carry out similar event studies for this firm group similar to what we have done in the sub-section 4.1.1. **Table 5** summarizes the results of the market reactions to the announcement of the firms having the smallest weight in TOPIX in the sample of firms being weight-reduced. The table presents the mean and median CARs for112 firms over five events. The mean CAR over the (–1, +1) window is minus 2.62% and statistically significant. The median CAR over the (–1, +1) windows is minus 2.38% and statistically significant. It is notable that among 560 abnormal return values, the number of negative returns is 490, seven times higher than the number of positive values. This shows that the stock of smallest weight firms declined more compared to the whole sample average over the five weighting phases, inferring that the index exclusion is more detrimental for the small firms.

Table 5 about here

[11] https://www.jpx.co.jp/english/markets/indices/topix/

Similarly, we extent the event window to a longer period using two event windows (-5, +5) and (-10, +10). The mean CAR over the (–5, +5) window is minus 1.51% and statistically significant. The median CAR over the (–5, +5) windows is also negative and statistically significant. However, the mean CAR over the (–10, +10) window is plus 0.51% but insignificant. On the other hand, the median CAR over the (–10, +10) windows are negative 0.63 and statistically significant.

The empirical evidence from the sample breakup shows that the weight of stocks in the index plays an important role. Among the firms subject to TOPIX exclusion, the smallest weighted firms suffered most. The abnormal returns are deeply negative and most of stocks declined in the day right after each weighting announcements. The impact of mechanical rebalancing by passively managed products therefore cannot be ignored and is more detrimental to firms of small size.

5. Conclusion

This research analyzes the effects of being removed from a stock index on stock returns. As passive investment funds that tracks index grow, the mechanical selling associated with index changes has become more noticeable. This study focuses on the revisions of TOPIX, a major Japanese stock index, and examines the impacts on over 400 companies that are removed from it using an event study methodology. TOPIX has been an index with little change until now, mostly increasing with the addition of stocks listed on the former TSE First Section and those that joined after the merger with the Osaka Stock Exchange. Exclusions were mostly limited to de-listings. There has never been a major global stock index that gradually removes a large number of small-cap stocks. This situation can be seen as a consequence of TOPIX's approach of continuously including small-cap stocks without limit.

Similar to previous research on global indices such as the S&P 500, we observed negative effects on the stocks removed using Japanese data. Results from event studies show that average abnormal returns are significantly negative in the short event windows. However, the impact faded in the long run. It’s clear that gradually removed stocks tend to be sold, but not all stocks are uniformly sold; some removed stocks still experience positive abnormal returns.

Moreover, we contribute to related literature with the new finding related to impact of index weight. Among the firms subject to TOPIX exclusion, the smallest weighted firms suffered most and the impact of mechanical rebalancing by passively managed products therefore is more detrimental to firms of small size. Future studies will include analyses distinguishing between returning and continuously weight-reduced stocks, considering differences in industries, and categorizing stocks based on their weight in TOPIX for further analysis.

Table 1

Stock Index	Country	Calculation method	free-float conversion	Conversion date
TOPIX	Japan	weighted average based on market capitalization	○	October 2005 - June 2006
S&P500	The US	weighted average based on market capitalization	○	March 2005 - September 2005
FTSE100	England	weighted average based on market capitalization	○	June 2001
DAX	Germany	weighted average based on market capitalization	○	June 2006
CAC40	France	weighted average based on market capitalization	○	December 2003
Nikkei225	Japan	price average		
DOW30	The US	price average		

Source: Author's creation.

Table2 Major Events in Index Revisions

Date	TOPIX related events
25-Dec-20	Announcement to review TOPIX
1-Jul-21	First Evaluation of components of TOPIX. The minumum criterion is set to 10 billion yen
31-Mar-22	Second Evaluation of components of TOPIX
Apr-22～June-22	Reassessment of TOPIX free-float ratio
7-Oct-22	**Announcement of 493 gradual weight reduction stocks (after market closure)**
End of Oct-22	**Commencement of the first weight reduction date. October 28 (Friday) is the adjustment trading day for index funds, and October 31 (Monday) is the month-end trading day**
End of Jan-23	**Second weight reduction date. January 30 (Monday) is the adjustment trading day for index funds. January 31 (Tuesday) is the month-end trading day**
31-Mar-23	Determination of values (tradable share market capitalization) for TOPIX reevaluation
End of Apr-23	**Third weight reduction. April 27 (Thursday) is the adjustment trading day for index funds, and April 28 (Friday) is the end-of-month trading day**
End of Jul-23	**Fourth weight reduction. July 28 (Friday). July 31 (Monday) is the end-of-month trading day**
22-Oct-23	Determination of values (annual turnover ratio of trading value) for reevaluation. Final evaluation
End of Oct-23	5th Weight Reduction
End of Jan-24	6th Weight Reduction
End of Apr-24	7th Weight Reduction
End of Jul-24	8th Weight Reduction
End of Oct-24	9th Weight Reduction
End of Jan-25	Tenth weight reduction. Gradually weight reduction stocks will be completely excluded from TOPIX.

Source: Author's creation based on various materials from the Tokyo Stock Exchange.

Table 3

	Listing maintenance standards for the Prime Market	Adopted as a criterion for excluded stocks
Number of Shareholders	more than 800	
Number of tradable share	more than 20,000units	
Number of tradable share market capitalization	more than 10 billion yen	○
Free Float Ratio	more than 35%	
Trading volume	An average of more than 0.02 billion yen per day	
Net assets	Net assets must be positive	
Annual turnover ratio of trading volume		○

Source: Created by the author from various materials of the Tokyo Stock Exchange.

Table 4

Cumulative average abnormal returns for the five weighting phases:

Window	Mean CAR (%)	*t*-statistic for mean CAR	Median CAR (%)	Number of positive: negative	Sign test for median CAR (p-value)
[-1, +1]	-1.64***	27.8	-1.69***	445:1720	0.000
[-5, +5]	-1.32***	12.03	-1.35***	710:1455	0.000
[-10, +10]	-0.22	1.26	-0.88***	960:1205	0.000

Notes: This table provides the CARs for 433 firms subject to TOPIX revision for the five weighting stages. Market model CARs were computed using days –170 to –20 as the estimation period for the market model parameters. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Table 5

Cumulative average abnormal returns for the five weighting phases of the smallest weight in TOPIX

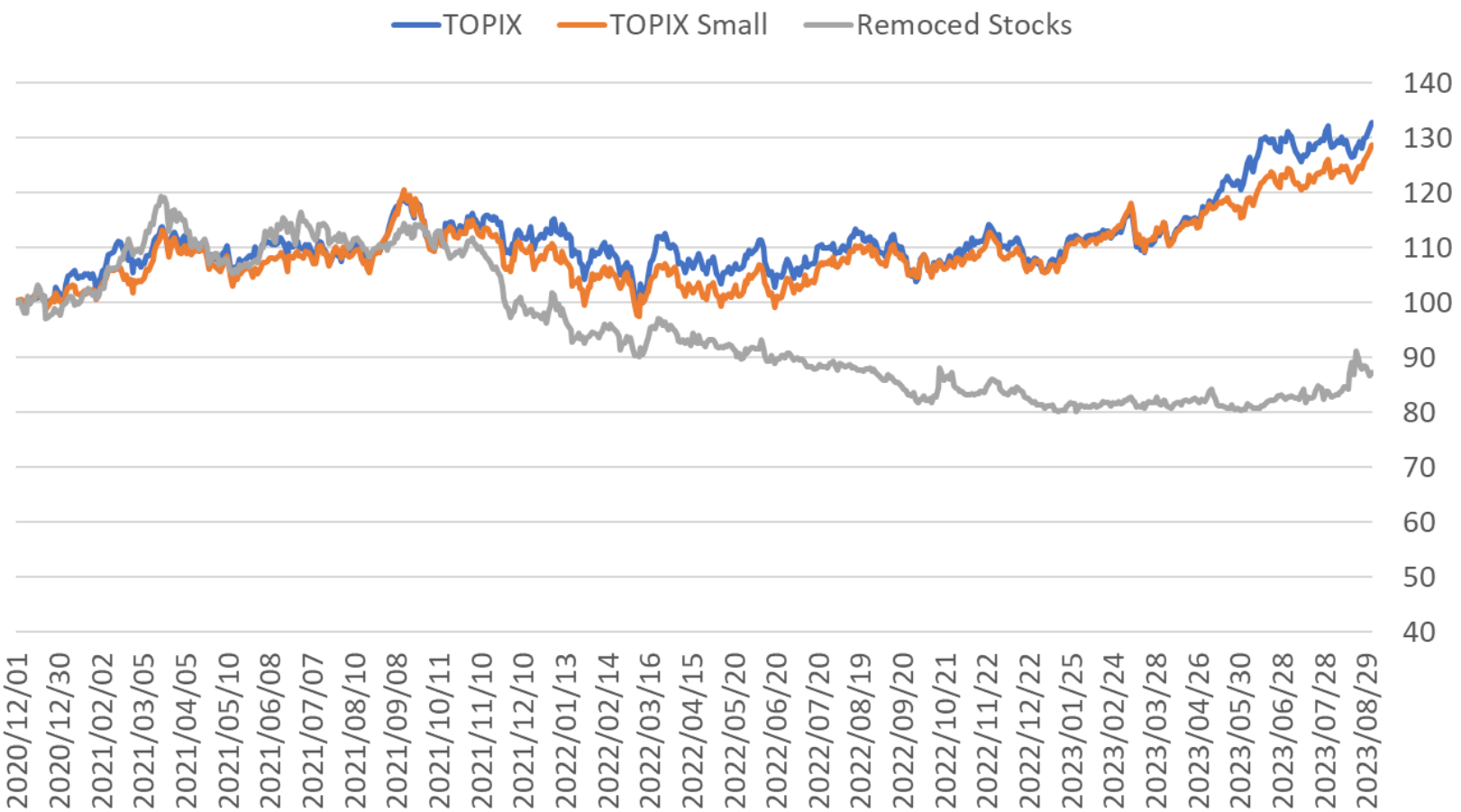
Window	Mean CAR (%)	*t*-statistic for mean CAR	Median CAR (%)	Number of positive: negative	Sign test for median CAR (p-value)
[-1, +1]	-2.62***	21.61	-2.38***	70:490	0.000
[-5, +5]	-1.51***	6.07	-1.59***	155:405	0.000
[-10, +10]	0.51	1.46	-0.63***	265:295	0.22

Notes: This table provides the CARs for 112 firms subject to TOPIX revision and having the smallest weight in TOPIX. Market model CARs were computed using days –170 to –20 as the estimation period for the market model parameters. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Figure 1

Average price of the minimum weight stocks (100=December 1st 2020)

Figure2 Changes in Stock Indexes and Exlusion Stocks (Dec.1st, 2020=100)



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