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Using REIT Data to Assess the Economic Worth of Mega-Events: The Case of the 2020 Tokyo Olympics

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Abstract

This paper proposes an alternative approach by which to evaluate the effects of hosting mega-events (e.g., the Olympics, the Football World Cup, or the World Expo). Based on the capitalization hypothesis, studies within the literature have examined whether the announcement of mega-events affects the prices of firms' stock or real estate properties. While the use of firm-level stock prices allows us to see the effects on corporate profits, using real estate property prices more comprehensively captures the effects on domestic areas inside and outside the host city. However, since the latter approach (unlike the former approach) does not involve the use of high-frequency data, it is difficult to distinguish clearly the effects that stem from related mega-events announcements. In contrast, I use data from real estate investment trusts (REITs), whose prices have the dual features of stock and property prices. Use of the standard event study methodology while using high-frequency data allows one to estimate abnormal returns accruing from the mega-event of interest; it also clarifies the relationship between return level and the characteristics of a REIT property. I present an empirical example—the 2020 Tokyo Olympics—and the results are as follows: 1) investors assessed that the comprehensive effects would be positive, 2) the effect becomes smaller as the distance from the host city (Tokyo-to) increases; and 3) even in areas far from Tokyo-to, real estate used for hotels and commercial facilities are relatively susceptible to the effects of hosting the Olympics.

Keywords: mega-events; Olympic games; real estate investment trust; event study, Japan

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1. Introduction

How much value is inherent in hosting a global mega-event such as the Olympics, the Football World Cup, or the World Expo? Such prestigious projects tend to be seen as an honor by the host citizens, but they do require considerable public funds. Usually, a large amount of national tax money is allocated to the project—that is, residents in nonhost cities and regions must also bear the event cost. Thus, the economic net benefits that a nation enjoys from hosting a mega-event are a matter of public concern.

The impact of mega-events on various economic aspects has been investigated in the literature.¹ Rose and Spiegel (2011) find that hosting mega-events significantly increases national exports, and Brückner and Pappa (2015) show that the Olympics in particular has a positive impact on gross domestic product (GDP), consumption, and investment.² In addition, other studies investigate the effects on host cities' income and employment levels (Jasmand and Maennig 2008; Hagn and Maennig 2008, 2009; Feddersen et al. 2009; Feddersen and Maennig 2012; Miyoshi and Sasaki 2016) and on tourism (Mitchell and Stewart 2015).

According to the capitalization hypothesis, future benefits and cost flows that accrue from a mega-event should be incorporated into the present value of assets, such as firm stocks and real estate properties. Many researchers have examined whether successful Olympics bids announcements significantly affect firms' stock prices (Berman et al. 2000; Veraros et al. 2004; Samitas et al. 2008; Leeds et al. 2009; Mirman and Sharma 2010; Sullivan and Leeds 2016). These analyses of stock price fluctuations deal only with the effects on corporate profits. On the other hand, investigating changes in property prices as a result of information on mega-events can uncover more comprehensive effects on domestic areas. Kavetsos (2012) highlights the positive impacts of the 2012 London Olympics announcement (i.e., a successful bid in 2005) on property transaction prices in the host areas (boroughs) within London and the vicinity of the main stadium.³

An approach that uses property price data, however, suffers from the removal of simultaneous shocks unrelated to the effects of mega-events; an approach that uses stock price data would easily address this problem. This is because of differences in asset liquidity. A stock is frequently traded in the exchange markets, and so its price is available in high-frequency data (e.g., day, hour, or real-time unit data). This feature reduces the risk that multiple significant shocks will occur concurrent with the announcement period. In contrast, the liquidity of real estate properties is poor, because transactions do not occur frequently; thus, following the news release on a mega-event, a reasonable time period is needed to accumulate a certain number of transaction observations. Moreover, the available time series data on property prices (e.g.,

¹ See Baade and Matheson (2016) and Maennig (2017) for surveys on the effects of major sports events, including the Olympics.

² For these studies, Maennig and Richter (2012) and Langer et al. (2017) highlight the estimation bias that stems from not considering structural economic differences between hosting countries and others (or bidding countries and others).

³ Some associated retrospective studies investigate the effects of constructing and opening sports stadiums, and use a hedonic price model with property price data (e.g., Tu 2005; Ahlfeldt and Maennig 2010).

transaction prices or appraisal values⁴) are usually of a low frequency (in general, one-year units). This suggests the high risk of multiple shocks being mixed.⁵

The current study proposes an alternative approach by which to assess the value of hosting mega-events, and it makes use of real estate investment trust (REIT) data. REITs are financial instruments that generally raise funds through companies that invest in income-producing real estate—that is, a REIT price has the dual features of security and a property price.⁶ Since REIT prices are obtained in the form of high-frequency data (like stock prices), it is possible to employ an event study methodology to measure abnormal returns due to the announcement of the mega-event of interest.⁷ An abnormal return would imply the comprehensive effects of holding the mega-event, because a REIT price, like a property price, represents the discounted present value of future rents from the properties in which the REIT invests and which it owns.

Additionally, the determinants of the abnormal returns level can be clarified by using the characteristics of the REIT properties. REITs create real estate portfolios in terms of property attributes, for risk diversification purposes; this implies that the portfolio of each REIT has a unique set of characteristics. It is possible to investigate the relationship between estimated abnormal returns and the characteristics of a REIT portfolio (in this case, location and intended use of properties) by estimating a cross-sectional model.

I examine the effectiveness of this method by taking up the case of the 2020 Tokyo Olympics. On September 8, 2013, Tokyo won its bid to host those Olympics, and it is thought that the International Olympic Committee (IOC) announcement changed investors' prospects on future income from the properties that Japanese REITs (J-REITs) own. The results of using event study methodology show that the prices of the J-REITs responded significantly to the IOC announcement. In addition, I find that the abnormal returns level depends on the geographical configuration of the J-REIT properties. In particular, investors expected that the Olympics would mainly affect the host city (i.e., Tokyo-to), and that the extent of the impact would gradually decrease as the greater distances from the host city. However, even in domestic areas far from the host city, the property values of hotels and commercial facilities are found to be relatively sensitive to the Olympics, compared to those of other intended use.

This study is the first to investigate the impacts of major sports events on REIT returns. Some studies address events strongly associated with a REIT itself. (See Howe and Jain 2004, for regulatory change, and Tang et al. 2016, for debt announcements for each REIT.) Others identify the effects of social and economic mega-events. (See Bredin et al. 2007, for monetary policy; and Glascock and Lu-Andrews 2015, for

⁴ The values of non-traded properties are greatly appraised referring to the actual transaction prices of neighboring properties. Due to the expense, the frequency of such updates is usually once a year.

⁵ Even with difference-in-differences method, this problem owing to low liquidity (or low-frequent data) cannot be completely addressed. Because this method does not cope with anything against other shocks unrelated to the shock of interest for analysis, common to all sample units belong to the treatment group (or control group).

⁶ There are some studies investigating whether the fundamental value of the J-REIT is determined by the real estate price and/or the stock price. For J-REITs, see, for example, Miyakoshi et al. (2016).

⁷ The event study methodology supposes that the effects of an event will reflect immediately in security prices, assuming rationality in the marketplace (MacKinlay 1997).

extreme market-related events such as the Lehman Brothers bankruptcy.) This study contributes to the latter research stream; however, it is also the first study to examine the relationship between the extent of a shock and the characteristics (e.g., location and intended use) of REIT properties.⁸

The remainder of this paper is organized as follows. Section 2 shows the J-REITs' returns before and after the Tokyo 2020 Olympics announcement, and then goes on to describe the use of the normal event study method. Section 3 investigates the relationship between the change in returns and the J-REITs' characteristics, and Section 4 concludes.

2. Effect of announcement of the 2020 Tokyo Olympics on J-REIT returns

This section first describes some features of the market and of J-REIT investment properties. Second, it preliminarily states how J-REIT returns changed when Tokyo-to won the bid to host the 2020 Olympics and Paralympics. Finally, I calculate the abnormal returns for individual J-REIT prices on the first trading day immediately following the bid announcement, and test the null hypothesis that the extent of abnormal returns is not really "abnormal": the average of the abnormal returns is zero.

2.1 The Features of the J-REIT market and J-REIT investment properties

The J-REIT market developed rapidly between 2001 and 2016. J-REITs were established in September 2001, comprising two companies; their market capitalization at the end of 2001 was JPY 222 billion. At the end of 2016, however, J-REITs comprised 57 companies, and their market capitalization at the end of that year was JPY 12,123 billion.⁹ J-REITs comprise the largest REIT market in the world after the United States and Australia: as of November 2014, the number of REITs in the United States was 231; in Australia, 52; and in Japan, 46. Market capitalization (in USD millions) in the United States was 82,549; in Australia, 86,169; and in Japan, 84,100.¹⁰

How frequently are J-REIT securities traded on the stock market? Table 1 shows the distribution of the daily average (trading-day base in 2013) of trading volume, shares outstanding, and turnover ratio for the 41 J-REITs, and the securities belonging to the Nikkei 225 (the so-called Nikkei Stock Average) that had listed at the end of August 2013.¹¹ The turnover ratio on any given day is defined as the trading volume divided by the shares outstanding on that day; I use the turnover ratio as an indicator of security liquidity.¹² The mean value of the daily average turnover ratios for the 41 J-REITs is 0.0050, and the standard deviation is 0.0031. These values are about one-half those of securities belonging to the Nikkei 225, which are listed

⁸ The purpose of the study of Glascock and Lu-Andrews (2015) is to clarify how REIT liquidity and size determine the extent of abnormal returns as a result of extreme market-related events.

⁹ This information on J-REITs is obtained from the Association for Real Estate Securitization (ARES) J-REIT Databook (<http://j-reit.jp/statistics/>).

¹⁰ See Table 1 in Miyakoshi et al. (2016), wherein the data source is the EPRA Global REIT Survey (2014) of the European Public Real Estate Association.

¹¹ These 41 J-REITs are also used later, to investigate the effect of the 2020 Tokyo Olympics. Their names and security codes are summarized in Table 3.

¹² Glascock and Lu-Andrews (2015) also use the turnover ratio as an indicator of REIT liquidity.

stocks with active trading and high liquidity selected from the listed stocks of the first section of the Tokyo Stock Exchange.

The number of real estate properties that J-REIT companies have acquired and own has also increased; Figure 1 shows the number and total acquisition cost of properties each year. In general, information on the individual properties within J-REITs is found in the settlement of accounts of each J-REIT investment company. In the case of Japan, the Association for Real Estate Securitization (ARES) constructs and discloses the J-REIT Property Database, which includes various types of attributes of the real estate properties, including location, market value, intended use (i.e., purpose of use), and age.¹³ Figure 2 shows the number and asset value of J-REIT properties by intended use—namely, residences, hotels, offices, commercial facilities, and logistics facilities. The proportions of properties used as residences, commercial facilities, and offices are considerably larger than those used as logistics facilities or hotels, in terms of number and asset value. The number of properties used as residences is the largest, followed by commercial facilities and offices. In contrast, the asset value of properties used as offices is the largest, followed by commercial facilities and residences. Figure 3 shows the geographical distribution of population, GDP, and J-REIT properties, by prefecture.¹⁴ J-REIT properties are found in most areas of Japan, but are heavily concentrated in certain prefectures—especially Tokyo-to, Kanagawa-ken, Chiba-ken, Saitama-ken, Osaka-fu, and Aichi-ken, whose population and GDP figures are relatively high among those in Japan.

For the sake of risk diversification, REITs are likely to construct real estate portfolios while bearing in the mind property attributes; the portfolio of each REIT will therefore bear a unique set of characteristics. Table 2 reports the features of each J-REIT's portfolio properties. The mean proportion of value by intended use (i.e., asset value base) are as follows: 37.7% for offices, 27.1% for residences, 16.9% for commercial facilities, 11.6% for logistics facilities, and 6.7% for hotels. Additionally, the standard deviation, minimum, and maximum values indicate that each proportion value varies widely across the J-REITs. As for proportion of value by prefecture (asset value base), the mean values in the key areas are as follows: 55.2% for Tokyo-to, 9.7% for Osaka-fu, 7.0% for Kanagawa-ken, 6.0% for Chiba-ken, 3.6% for Saitama-ken, and 3.6% for Aichi-ken. It is clear that most of the J-REIT companies tend to invest in and own real estate located in Tokyo-to. Additionally, the magnitude of the proportion of properties in Tokyo-to varies greatly across the J-REITs, as the standard deviation of Tokyo-to's proportion is much larger than that of the other prefectures listed in Table 2.

2.2 Tokyo's 2020 Olympics bid win and J-REIT returns

On September 8, 2013, it was announced that Tokyo-to would host the 2020 summer Olympics and Paralympics. In spite of failing to secure the 2016 summer Olympics, Tokyo-to continued to engage in

¹³ The ARES J-REIT Property Database is available from the ARES website (<https://jreit-pdb.ares.or.jp/pdb/>).

¹⁴ The prefecture is the first level of administrative division in Japan. There are 47 prefectures, and the name of each has “ken,” “fu,” “to,” or “do” appended to it.

invitation activities, and appealed to the idea of a geographically compact games: most of the competitions would take place within 8 km of the athletes' village. It is thought that the IOC announcement changed investors' prospects regarding future income from properties inside and outside Tokyo-to, and guided them towards those that the J-REITs owned. Incidentally, OddsChecker.com, a website for UK bookmakers, announced on September 3, 2013 that Tokyo-to had a 44% chance of winning the Olympics bid.¹⁵ Thus, it is likely that investors predicted that the chances of Tokyo's victory or defeat were even. Consequently, the Olympic games site decision probably forced investors to change their investment portfolio including J-REITs.¹⁶ Here, I check the movement of J-REIT prices around the day when Tokyo-to won that bid.

The award day was a Sunday (i.e., a nontrading day in Japan); thus, I assume that J-REIT returns responses to the announcement would occur on the first trading day thereafter. For this analysis, I set September 9, 2013 as the event day; on that day, all 41 J-REITs were trading on the Tokyo Stock Exchange. Figure 4(a) shows the daily change in the average value over the 41 J-REITs' returns around the event day (i.e., 39 pre-event trading days, the aforementioned event trading day, and five post-event trading days).¹⁷ I find that the average value on the event day is 2.9%—an apparently large change compared to the previous day. In addition, no large negative value emerged in the five post-event days. Figure 4(b) shows the cumulative values of the daily average returns described in the Figure 4(a). I find that the cumulative values are negative in the pre-event days, but that the negative width sharply shrinks on the event day, and becomes (and remains) positive in the post-event days. These observations suggest that the announcement of Tokyo's win likely significantly changed investors' prospects regarding J-REIT properties.

Furthermore, I also make comparisons with firm-level stock market movements. Figures 5(a) and (b) show plots of the returns for the Nikkei 225 stock index and the cumulative values, respectively. It appears that the Nikkei 225 stock index reacted to the IOC's announcement; however, unlike with the J-REITs, the positive returns on the event day appear to be “less abnormal” than the return movements during the pre-event days. Additionally, Figure 6 is a scatterplot of the Nikkei 225 stock index's return and the average returns of the 41 aforementioned J-REITs, for the same period. I find that the relationship on the event day (presented as a circle) seems to be an outlier compared to the stable relationships on the pre-event days. These observations imply that the impact on the J-REITs is stronger than that on the Japanese firms via the stock market.¹⁸

¹⁵ See the article in “Around The Rings” (http://aroundtherings.com/site/A_44382/Title_Istanbul-Plans-Viewing-Party-Odds-Favor-Tokyo/292/Articles).

¹⁶ On the other hand, since investors predicted that Tokyo would win with a chance of 44%, there is a possibility that prior investment was made according to the degree of the expectation for victory. Therefore, the estimation of the effects I estimate may be interpreted as the lower bound.

¹⁷ Hoshino Resort (No. 3287), one of the 41 J-REITs, was first listed on the stock market on July 12, 2013, 40 trading days prior to the event day. This is because I set July 16, 2013 (the next trading day) as the beginning of the pre-event days period.

¹⁸ Actually, Sullivan and Leeds (2016) clarify statistically that the Nikkei 225 stock index did not respond to the IOC's announcement; they do so by estimating an autoregressive regression.

2.3 Calculating abnormal returns and testing hypotheses

I examine whether the announcement of the Tokyo win affected J-REIT returns—and if so, by how much—by following the standard event study methodology (e.g., MacKinlay 1997). This involves the estimation of abnormal returns and the testing of hypotheses. Abnormal returns are a measure used to evaluate the impact stemming from an event of interest, and they are calculated as the actual returns minus the normal returns in an event period. Normal returns are defined as the expected returns without being conditional on the event of interest for analysis—for example, the 2020 Olympics site decision, as seen in the case study in this study. There are two common choices for modeling normal returns: the *constant mean return model* and the *market model*. The former model assumes that the mean returns of a given security are constant through time, where the normal returns in the event period are usually calculated by averaging actual returns over the pre-event period. On the other hand, the latter model assumes a stable linear relationship between market returns and each security's actual returns, where the normal returns in the event period are predicted thorough the linear relationship estimated in the pre-event period.

This case study focuses on results that derive from using the constant mean return model. The market model is thought to be superior to the constant mean return model with respect to removing effects due to common shocks to securities, rather than those due to the shock of interest in an event period.¹⁹ It is, however, advantageous in this case study to apply the constant mean return model, considering the possibility that mega-events can also significantly affect market returns (i.e., J-REIT market returns or firm stock market returns). If the IOC's announcement also had a significant impact on the firm via the stock market, it would be difficult to correctly identify the extent of that impact on the J-REIT returns by using the market model. We cannot rule out the possibility, according to the preliminary observation mentioned above (see Figures 5 and 6 in subsection 2.2).

I set two length patterns for the pre-event period, to estimate the normal returns. One is July 16, 2013 to September 6, 2013 (i.e., 39 pre-event trading days); the other is June 22, 2012 to September 6, 2013 (i.e., 300 pre-event trading days); hereafter, I refer to the former period as “pattern A” and the latter period as “pattern B.”²⁰ Pattern A is the same as that in Figures 4 and 6 (subsection 2.2), and it is the longest span to include all the J-REITs listed on the event day (i.e., the 41 aforementioned J-REITs). On the other hand, pattern B is longer than pattern A, although the number of J-REITs therein (i.e., 35 J-REITs) is smaller. The difference in the number of J-REITs comes from the fact that six of the 41 J-REITs had not been listed for all 300 of the pre-event days.²¹

Table 4 summarizes each J-REIT's normal and abnormal returns on the event day (September 9, 2013) according to the two aforementioned patterns (i.e., pattern A: 39 pre-event trading days, and pattern B: 300 pre-event trading days) in the constant mean return model. The weighted and simple average of abnormal

¹⁹ The noncommon (or individual) shocks to securities in an event period can be addressed by averaging abnormal returns over securities, even when we apply the constant mean return model.

²⁰ September 6, 2013 was the trading day immediately preceding the event day.

²¹ MacKinlay (1997) suggests the use of more than 120 pre-event trading days.

returns of pattern A exceeds 3%; the maximum value is 7.80%, the minimum value is 0.53%, and the standard deviation is 1.43%. These results are almost identical to those of pattern B.

Using these estimated abnormal returns values, I conduct a t-test for the null hypothesis (i.e., that hosting the 2020 Olympics has no impact on the J-REIT returns); the simple average abnormal returns over the J-REIT securities at event day is 0. Actually, a normal t-test may lead to over-rejection when event days for each security are clustering (e.g., the extreme example is that the event day is the same for all securities, as in this study). This is because the covariances between the abnormal returns for securities will not be 0 (MacKinlay 1997). Thus, I use the adjusted test statistics proposed by Kolari and Pynnönen (2010):

$$t_{KP} = t_{BMP} \sqrt{\frac{1-\bar{r}}{1+(n-1)\bar{r}}}, \quad (1)$$

where n is the number of securities, and \bar{r} is the average of the sample cross-correlations over the pre-event days' residuals.²² t_{BMP} is the test statistics proposed by Boehmer et al. (1991):

$$t_{BMP} = \frac{\overline{SAR}\sqrt{n}}{s}, \quad (2)$$

where \overline{SAR} is the average of the event-day scaled abnormal returns ($SARs$), and s is the (cross-sectional) standard deviation of the $SARs$, defined as the square root of the sample variance. SAR is defined as the abnormal returns divided by the standard deviation of pre-event days residuals corrected by prediction error, as described by the right-hand side of equation (5) in Kolari and Pynnönen (2010).²³

Table 5 presents the results of testing the hypothesis. Under the null hypothesis, the adjusted t-statistic t_{KP} in the constant mean return model is 2.31 for pattern A and 1.74 for pattern B, thus rejecting the null hypothesis at the 5% and 10% significance levels, respectively. These results indicate that hosting the 2020 Olympics had an impact on the J-REITs' returns.

3. Estimating determinants of the extent of the abnormal returns

To get a sense of the magnitude of the impacts of the Tokyo 2020 Olympics on J-REITs, this section examines the relationship between the level of abnormal returns and the characteristics of J-REIT property portfolios. Specifically, I clarify whether the attributes of intended use and location influence the level of abnormal returns—and if so, how.

3.1 Cross-section regression model and construction of independent variables

I look to assess 1) the relationship between the degree of impact and the distance from the host city, 2) the relationship between the degree of impact and the intended purpose of a property, and 3) which intended use is relatively susceptible to the shock of a mega-event, even when the property is far from the host city.

²² In the case of the constant mean return model, the residual at a pre-event day for a security is calculated as the actual returns at the pre-event day minus the estimated normal returns.

²³ The dominator of this right-hand side corresponds to the square root of equation (8) in MacKinlay (1997).

To do so, I estimate the following cross-sectional regression model (3).

$$\widehat{AR}_{i\tau} = a + b \cdot \log(WAD_i) + \sum_{k=2}^K c_k \cdot USAGE_{ki} + \sum_{k=2}^K d_k \cdot \log(WAD_i) \cdot USAGE_{ki} + \varepsilon_i, \quad (3)$$

where $\widehat{AR}_{i\tau}$ is the abnormal return for J-REIT i at time τ , as obtained in the previous section; WAD_i is the weighted average of distances between the host city and the location of the properties that J-REIT i owns—that is, how far the J-REIT asset is from the host city; $USAGE_{ki}$ is the usage-share variable that corresponds to the share of the amount, based on market value, of real estate used for intended use k for J-REIT i ; and ε_i is the disturbance term.

To build WAD_i , I use the straight-line distances between the offices of two prefectural governments (i.e., Tokyo-to and the prefecture in which the property is located). The weights are the shares of asset value based on market value.

For $USAGE_{ki}$, I classify the J-REITs' real estate properties into five categories, as previously mentioned: residences, hotels, offices, commercial facilities, and logistics facilities. For example, if a mega-event were to increase the number of tourists, the share price of a J-REIT that invests in hotels is likely to respond to the announcement of hosting the Olympics. Furthermore, if a mega-event were to significantly improve its incomes or amenities, the share price of a J-REIT that invests in residences should also respond to it. $USAGE_{1i}$ is used as a base variable, where one of the categories must be excluded from the regression equation. (Here, I select “residence.”)

Equation (3) also includes the interaction terms $(\log(WAD_i) \cdot USAGE_{ki})$, whose coefficients (d_k) are clues important to clarifying the third aforementioned assessment.

Table 6 presents the descriptive statistics of the independent variables. $USAGE_{ki}$ is the same as in Table 2. The mean value for WAD_i is 140 km, and the standard deviation is 160 km. The minimum is 0; thus, I consider $\log(WAD) \equiv \log(WAD + 1)$ for the regression.

3.2 Results

Table 7 shows the results of regression (3). Models 1 and 2 have only one type of independent variable— $\log(WAD_i)$ or $USAGE_{ki}$, respectively—while Model 3 has both types. Additionally, Model 4 adds the interaction terms $(\log(WAD_i) \cdot USAGE_{ki})$ to the independent variables of Model 3.

The estimated coefficients on $\log(WAD_i)$ in Models 1, 3, and 4 are significantly negative; this means that the farther from Tokyo a property location is, the less of an impact the Olympics will make on it.

The results of the estimated coefficients on $USAGE_{ki}$ in Model 2 differ from those of Model 3. Since the adjusted R-squared of Model 3 is much better than that of Model 2, we should rely on the results of Model 3.

The coefficient on hotels in Model 3 is positive and significant at the 10% significance level: a 1% increase in the share of hotels, to replace a 1% decrease in the share of residences, increases the extent of

the abnormal returns (0.026%). The coefficients on offices and commercial facilities are positive and negative, respectively, but both are insignificant, even at the 10% significance level. This means that in terms of effect, they do not differ from residences. The coefficient on logistics facilities is negative and significant at the 10% significance level; a 1% increase in the share of logistics facilities, to replace a 1% decrease in the share of residences, lowers the extent of the abnormal returns (−0.009%).

The adjusted R-squared of Model 4 is better than that of Model 3; this implies the importance of considering the interaction between location and intended use. The significant value of the coefficient on $\log(WAD_i)$ in Model 4 (−1.498) supposedly measures the negative effect when real estate is fully allocated to residences; however, the results of the coefficients on $\log(WAD_i) \cdot USAGE_{ki}$ show that the magnitude of this negative relationship depends on the intended use. The coefficients on these interaction terms regarding hotels and commercial facilities are positive; they are significant at the 5% and 10% significance levels, respectively. These results suggest that the magnitude of the negative relationship for hotels and for commercial facilities is weaker rather than that for residences.²⁴ These results indicate that, even in locations far from the host city, hotels and commercial facilities are more likely to be affected by the Olympics.

4. Conclusion

Using Japanese real estate investment trust (J-REIT) data, this study proposes an alternative method for evaluating the effects of hosting mega-events. The approach using property price data targets the effects on domestic areas—more comprehensively than the approach using firm-level stock price data. However, the former approach suffers from the removal of simultaneous shocks unrelated to the mega-event. As property transactions do not occur frequently, property price data are available only at a low frequency (e.g., annual data); this feature implies the high risk of multiple shocks being mixed. In contrast, using a J-REIT price allows one to capture the features of both property and stock prices. Starting from this, I examine the impact of the 2020 Tokyo Olympics and Paralympics, using standard event study methodology. The results show that investors expect Olympics to have an impact mainly on the host city (i.e., Tokyo-to), and the extent of said impact gradually decreases as the distance from the host city increases. However, even in domestic areas far from the host city, the property values of hotels and commercial facilities are more sensitive to the Olympics than those of properties with other intended uses. As a future work, we need to compare this result of event study using J-REIT data with the associated retrospective studies.

As the REIT market grows, the number of REITs will increase and the related real estate portfolios will become richer in variety. In this context, the method described herein will become increasingly helpful for researchers to clarify the comprehensive effects of holding mega-events, and for policymakers to hold

²⁴ Additionally, the value for offices is negative and significant at the 10% significance level.

mega-event as an explosive for urban and regional developments.

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Figures and Tables

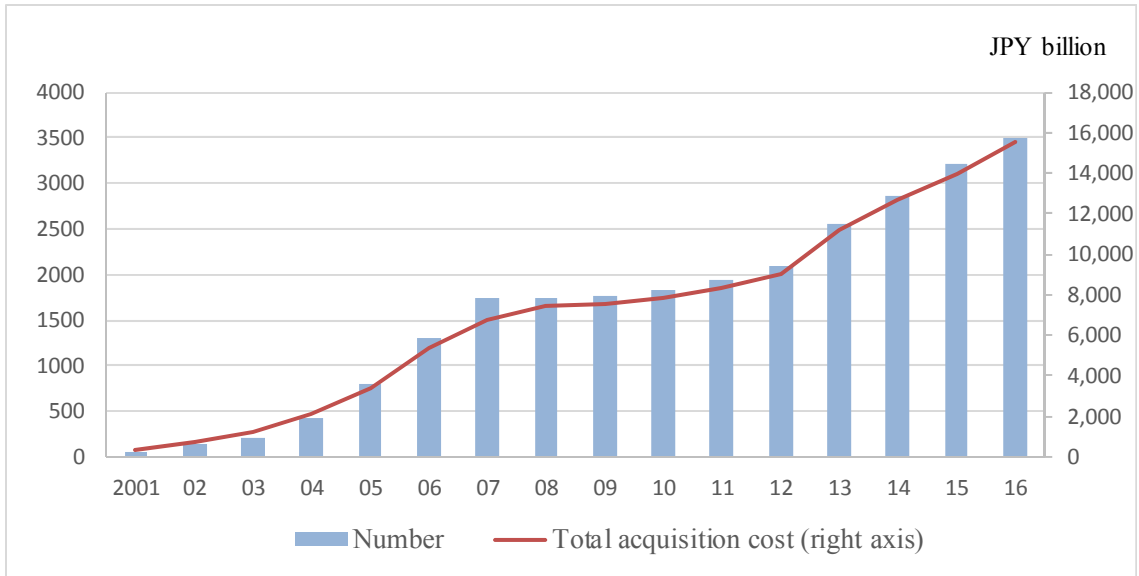


Figure 1 Plots of number and total acquisition cost of J-REIT properties

Source: ARES J-REIT Databook (<http://j-reit.jp/statistics/>).

Table 1 Liquidity of J-REITs and firm stocks that belonging to Nikkei 225

| | Mean | S.D. | Min. | Max. |
|--|----------|----------|---------|-----------|
| <i>J-REIT (Daily average in 2013)</i> | | | | |
| Trading volume | 2688.4 | 3567.5 | 383.8 | 13769.7 |
| Shares outstanding | 604778.4 | 682784.0 | 20078.0 | 2473485.1 |
| Turnover ratio | 0.0050 | 0.0031 | 0.0015 | 0.0200 |
| <i>Nikkei225 (Daily average in 2013)</i> | | | | |
| Turnover ratio | 0.0082 | 0.0066 | 0.0019 | 0.0472 |

Notes: I use the sample of 41 J-REITs and 222 firm stocks that belonged to the Nikkei 225 (Nikkei Average Stock) as of the end of August 2013.

Source: NEEDS Financial Quest, NIKKEI Media Marketing Inc.

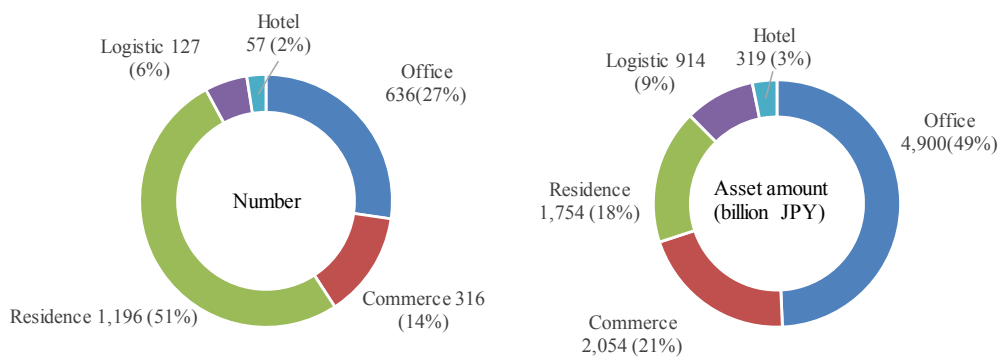


Figure 2 The numbers and asset values of J-REIT properties, by intended use

Notes: Using the latest financial reports of each J-REIT at the end of August 2013 (from the ARES J-REIT Property Database [<https://jreit-pdb.ares.or.jp/pdb/>]), I classify the J-REIT real estate properties into five categories: Residence, Hotel, Office, Commercial facilities, and Logistics facilities. If a piece of real estate has more than two intended uses, I select that which is listed first, assuming that this is likely the primary one. The asset value is based on market value—specifically, appraisal values at that time.

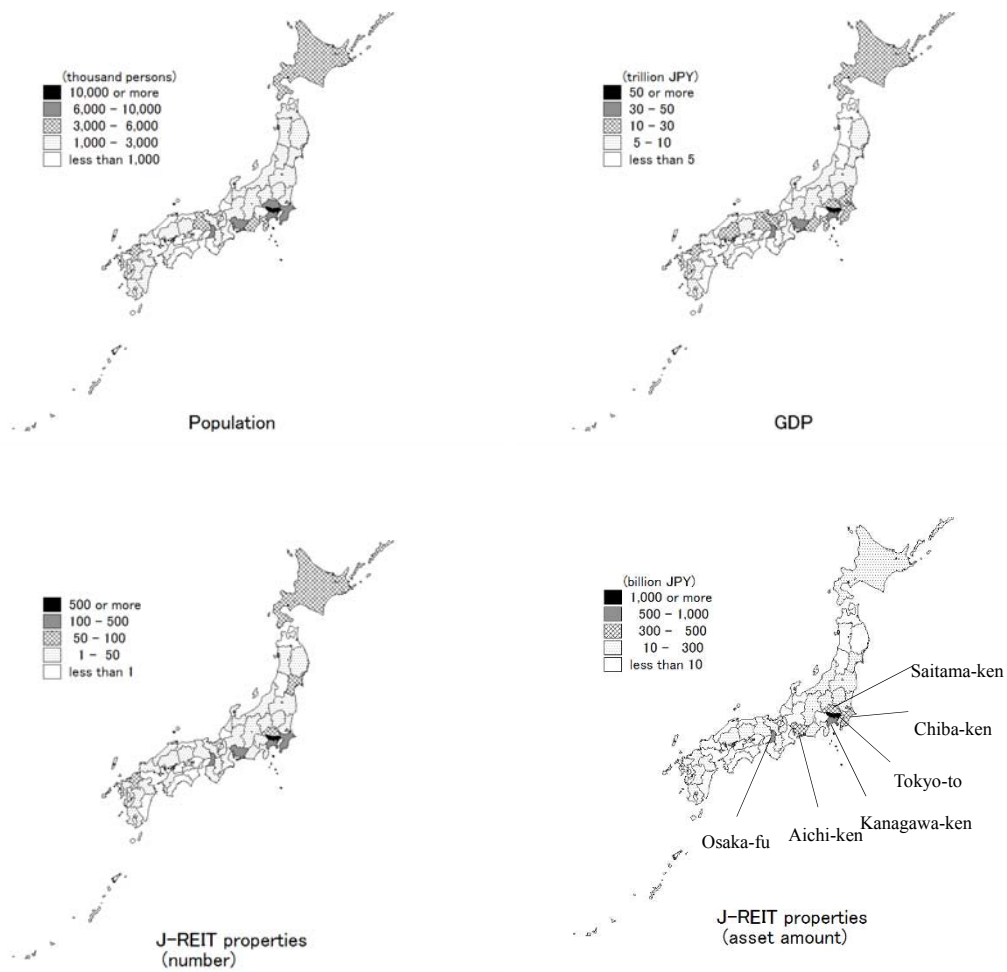


Figure 3 Geographical distribution of population, GDP, and J-REIT properties, by prefecture

Notes: Population data (as of 2013) are from the Ministry of Internal Affairs and Communications. GDP data (as of 2013) are from the Cabinet Office of the government of Japan (Economic and Social Research Institute). J-REIT data are from the ARES J-REIT Property Database (as of the end of August 2013).

Table 2 Characteristics of J-REIT portfolio properties (at the end of August 2013)

| | Mean | S.D. | Min. | Max. |
|---|-------|-------|------|--------|
| Number of properties | 56.9 | 46.2 | 6.0 | 204.0 |
| Asset value of properties (billion JPY) | 242.5 | 199.7 | 17.6 | 1048.2 |
| Intended use (%; asset value base) | | | | |
| Residence | 27.1 | 40.8 | 0.0 | 100.0 |
| Commercial facilities | 16.9 | 25.5 | 0.0 | 100.0 |
| Office | 37.7 | 38.6 | 0.0 | 100.0 |
| Logistics facilities | 11.6 | 28.9 | 0.0 | 100.0 |
| Hotel | 6.7 | 22.2 | 0.0 | 100.0 |
| Location (%; asset value base) | | | | |
| Tokyo-to | 55.2 | 30.3 | 0.0 | 100.0 |
| Kanagawa-ken | 7.0 | 6.4 | 0.0 | 26.9 |
| Chiba-ken | 6.0 | 10.3 | 0.0 | 47.4 |
| Saitama-ken | 3.6 | 6.1 | 0.0 | 30.6 |
| Osaka-fu | 9.7 | 15.1 | 0.0 | 80.5 |
| Aichi-ken | 3.6 | 3.7 | 0.0 | 12.7 |

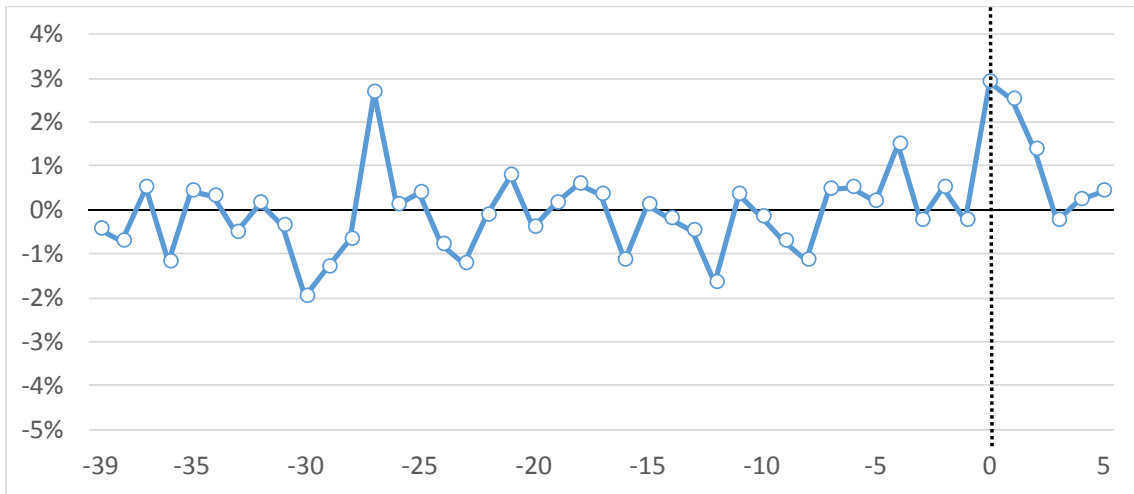
Notes: I use the sample of 41 J-REITs listed at the end of August 2013. The asset value is based on market value—specifically, appraisal values at that time. J-REIT data are from the ARES J-REIT Property Database (as of the end of August 2013).

Table 3 Actual returns of 41 individual J-REITs on the event day (September 9, 2013)

| Securities code | Name | Listing date | Close price at 6-Sep-2013 (JPY) | Actual return (%) |
|-----------------|--------------------------------|--------------|---------------------------------|-------------------|
| 8951 | Nippon Building | 10-Sep-2001 | 545,500 | 4.31 |
| 8952 | Japan Real Estate | 10-Sep-2001 | 531,500 | 4.14 |
| 8953 | Japan Retail | 12-Mar-2002 | 186,600 | 2.09 |
| 8954 | ORIX JREIT | 12-May-2002 | 106,300 | 4.14 |
| 8955 | Japan Prime Realty | 14-Jun-2002 | 287,800 | 3.34 |
| 8956 | Premier | 10-Sep-2002 | 378,000 | 5.69 |
| 8957 | TOKYU REIT | 10-Sep-2003 | 101,000 | 2.97 |
| 8958 | Global One | 25-Sep-2003 | 274,500 | 3.64 |
| 8959 | Nomura Real Estate Office | 4-Dec-2003 | 424,000 | 0.83 |
| 8960 | United Urban | 22-Dec-2003 | 129,500 | 2.78 |
| 8961 | MORI TRUST | 13-Feb-2004 | 167,200 | 3.71 |
| 8964 | Frontier | 9-Aug-2004 | 430,000 | 2.67 |
| 8966 | HEIWA | 8-Mar-2005 | 64,900 | 3.70 |
| 8967 | Japan Logistics | 9-May-2005 | 175,800 | 2.50 |
| 8968 | Fukuoka REIT | 21-Jun-2005 | 145,600 | 1.24 |
| 8972 | Kenedix Office | 21-Jul-2005 | 384,500 | 2.73 |
| 8973 | Sekisui House SI | 28-Jul-2005 | 92,800 | 2.48 |
| 8975 | Ichigo Office REIT | 12-Oct-2005 | 57,800 | 2.25 |
| 8976 | Daiwa Office | 19-Oct-2005 | 366,500 | 4.09 |
| 8977 | Hankyu REIT | 26-Oct-2005 | 98,000 | 1.63 |
| 8982 | Top REIT | 1-Mar-2006 | 423,500 | 7.67 |
| 8984 | Daiwa House Residential | 22-Mar-2006 | 181,750 | 2.75 |
| 8985 | Japan Hotel | 14-Jun-2006 | 39,450 | 5.45 |
| 8986 | Japan Rental Housing | 22-Jun-2006 | 67,100 | 1.49 |
| 8987 | Japan Excellent | 27-Jun-2006 | 105,400 | 3.61 |
| 8963 | Invincible | 1-Aug-2006 | 13,010 | 2.23 |
| 3226 | Nippon Accommodations | 4-Aug-2006 | 321,500 | 3.11 |
| 3227 | MCUBS MidCity | 29-Aug-2006 | 219,300 | 1.92 |
| 3234 | MORI HILLS REIT | 30-Nov-2006 | 113,600 | 4.58 |
| 3240 | Nomura Real Estate Residential | 14-Feb-2007 | 471,000 | 4.46 |
| 3249 | Industrial & Infrastructure | 18-Oct-2007 | 432,500 | 2.08 |
| 3269 | Advance Residence | 2-Mar-2010 | 199,000 | 1.56 |
| 8979 | Starts Proceed | 27-Jul-2010 | 169,900 | 1.47 |
| 3278 | Kenedix Residential | 26-Apr-2012 | 194,000 | 2.53 |
| 3279 | Activia Properties | 13-Jun-2012 | 702,000 | 2.14 |
| 3263 | Daiwa House REIT | 28-Nov-2012 | 331,000 | 1.96 |
| 3281 | GLP J-REIT | 21-Dec-2012 | 94,000 | 1.60 |
| 3282 | Comforia Residential | 5-Feb-2013 | 152,000 | 3.29 |
| 3283 | Nippon Prologis | 14-Feb-2013 | 169,400 | 1.30 |
| 3285 | Nomura Real Estate Master | 12-Jun-2013 | 95,600 | 0.42 |
| 3287 | Hoshino Resorts | 12-Jul-2013 | 582,000 | 3.26 |
| | Number of J-REITs | | | 41 |
| | Weighted average | | | 3.15 |
| | Simple average | | | 2.92 |
| | Standard deviation | | | 1.43 |
| | Min. | | | 0.42 |
| | Max. | | | 7.67 |

Notes: The 41 J-REITs were listed on the Tokyo stock market on the event day; in this table, they are listed in order of initial listing date. The weighted averages of actual returns are calculated using the weights of the shares of close price on September 6, 2013, the trading day immediately preceding the event day.

(a) Average returns for J-REITs



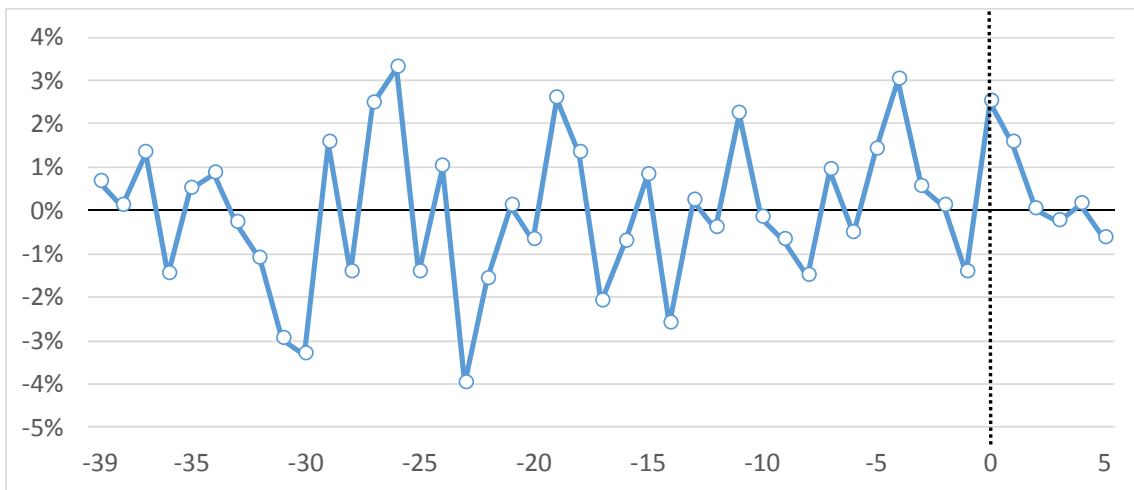
(b) Cumulative values of the average returns for J-REITs



Figure 4 Plot of J-REIT average returns around the event day

Notes: The observation period consists of 39 pre-event days, the event day, and five post-event days; the event day (September 9, 2013) is expressed as 0. The returns of the 41 J-REITs, each of which was traded on the Tokyo Stock Exchange on the event day, are calculated on a closing-price basis. J-REIT daily prices are obtained from the database of *NEEDS Financial Quest*, NIKKEI Media Marketing Inc.

(a) Average returns for Nikkei 225



(b) Cumulative values of the average returns for Nikkei 225

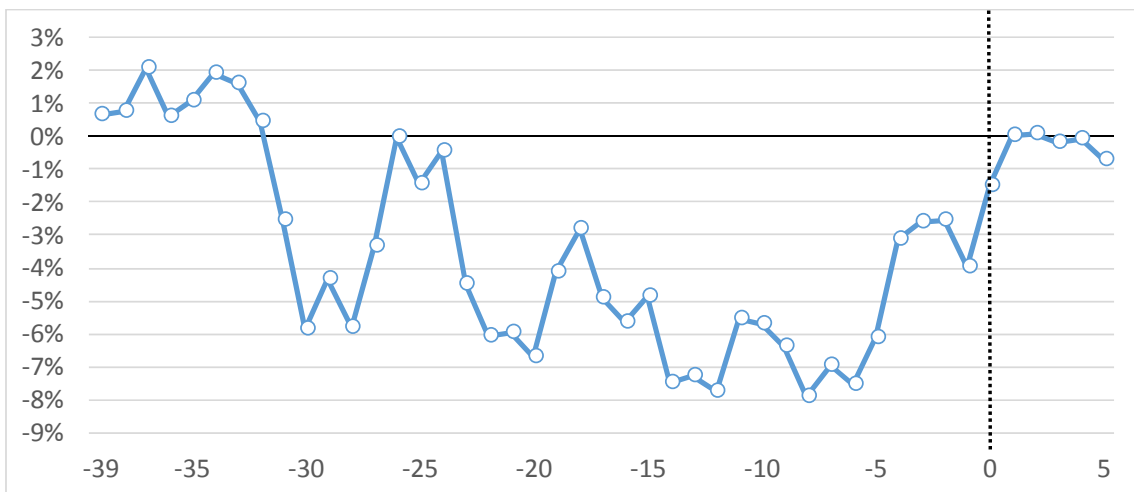


Figure 5 Nikkei 225 (Nikkei Stock Average) returns around the event day

Notes: The observation period is identical to that of Figure 2. The daily Nikkei 225 prices are obtained from the database of *NEEDS Financial Quest*, NIKKEI Media Marketing Inc.

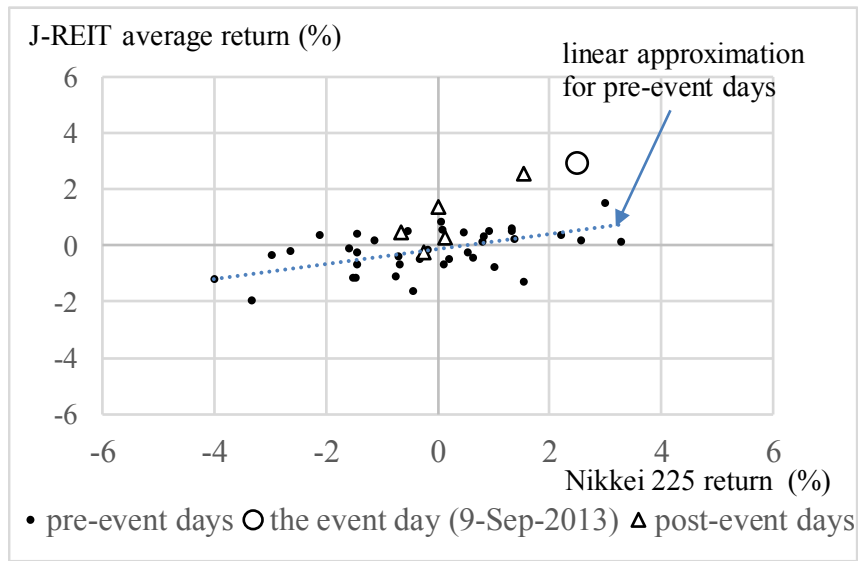


Figure 6 Scatterplot of Nikkei 225 returns and the J-REIT average returns around the event day.

Notes: The daily Nikkei 225 prices are obtained from the database of *NEEDS Financial Quest*, NIKKEI Media Marketing Inc. The figure uses the sample of the 41 J-REITs that were listed during all 39 pre-event days.

Table 4 Normal and abnormal returns on the event day

| J-REIT Securities code | Constant mean return model | | | |
|---------------------------|----------------------------|------------------------|----------------------|------------------------|
| | Pattern A | | Pattern B | |
| | Normal return (%) | Abnormal return (%) | Normal return (%) | Abnormal return (%) |
| 8951 | -0.20 | 4.51 | 0.14 | 4.17 |
| 8952 | -0.13 | 4.27 | 0.15 | 3.99 |
| 8953 | -0.26 | 2.35 | 0.16 | 1.93 |
| 8954 | -0.23 | 4.37 | 0.16 | 3.98 |
| 8955 | -0.04 | 3.37 | 0.09 | 3.25 |
| 8956 | -0.16 | 5.84 | 0.12 | 5.57 |
| 8957 | -0.36 | 3.33 | 0.10 | 2.87 |
| 8958 | -0.11 | 3.75 | 0.04 | 3.60 |
| 8959 | -0.13 | 0.96 | 0.01 | 0.82 |
| 8960 | -0.00 | 2.78 | 0.16 | 2.62 |
| 8961 | -0.15 | 3.85 | 0.09 | 3.62 |
| 8964 | -0.19 | 2.87 | 0.10 | 2.57 |
| 8966 | -0.20 | 3.89 | 0.14 | 3.56 |
| 8967 | -0.11 | 2.61 | 0.09 | 2.41 |
| 8968 | -0.22 | 1.45 | 0.11 | 1.13 |
| 8972 | -0.11 | 2.85 | 0.15 | 2.58 |
| 8973 | -0.13 | 2.61 | 0.11 | 2.36 |
| 8975 | -0.17 | 2.42 | 0.17 | 2.08 |
| 8976 | -0.07 | 4.17 | 0.22 | 3.87 |
| 8977 | -0.05 | 1.69 | 0.11 | 1.52 |
| 8982 | -0.13 | 7.80 | -0.01 | 7.68 |
| 8984 | -0.26 | 3.01 | 0.11 | 2.64 |
| 8985 | 0.10 | 5.35 | 0.22 | 5.23 |
| 8986 | -0.14 | 1.63 | 0.21 | 1.28 |
| 8987 | -0.18 | 3.79 | 0.10 | 3.50 |
| 8963 | -0.06 | 2.29 | 0.25 | 1.98 |
| 3226 | -0.18 | 3.29 | 0.09 | 3.02 |
| 3227 | -0.08 | 1.99 | 0.02 | 1.89 |
| 3234 | -0.27 | 4.84 | 0.21 | 4.37 |
| 3240 | -0.17 | 4.63 | 0.06 | 4.40 |
| 3249 | -0.31 | 2.40 | 0.20 | 1.88 |
| 3269 | -0.25 | 1.81 | 0.10 | 1.45 |
| 8979 | -0.01 | 1.48 | 0.15 | 1.32 |
| 3278 | -0.27 | 2.80 | 0.04 | 2.49 |
| 3279 | -0.19 | 2.33 | 0.16 | 1.97 |
| 3263 | -0.15 | 2.12 | | |
| 3281 | -0.02 | 1.61 | | |
| 3282 | -0.39 | 3.68 | | |
| 3283 | -0.06 | 1.36 | | |
| 3285 | -0.11 | 0.53 | | |
| 3287 | -0.01 | 3.27 | | |
| Number of J-REITs | 41 | 41 | 35 | 35 |
| Weighted average | -0.15 | 3.31 | 0.10 | 3.16 |
| Simple average | -0.15 | 3.07 | 0.12 | 2.96 |
| Standard deviation | 0.10 | 1.43 | 0.06 | 1.43 |
| Min. | -0.39 | 0.53 | -0.01 | 0.82 |
| Max. | 0.10 | 7.80 | 0.25 | 7.68 |

Notes: Abnormal returns for a J-REIT on the event day are calculated as actual returns on the event day minus normal returns on the event day. The normal return on the event day is calculated following the constant mean return model of the standard event study method (e.g., MacKinlay 1997). Weighted averages are calculated using the weights of the shares of closing price on the trading day preceding the event day.

Table 5 Results of hypothesis tests

| | Pattern A | Pattern B |
|-----------------------------|-------------------|------------------|
| Average of abnormal returns | 3.07 ** (2.31) | 2.96 * (1.74) |

Notes: Abnormal returns for a J-REIT on the event day are calculated as actual returns on the event day minus normal returns on the event day. The normal return on the event day is calculated following the constant mean return model of the standard event study methodology (e.g., MacKinlay 1997). I set two patterns for the pre-event period to estimate the normal returns: pattern A is July 16, 2013 to September 6, 2013, and Pattern B is June 22, 2012 to September 6, 2013. The values above the parentheses are averages over the 41 J-REITs that correspond to all the J-REITs listed on the event day, or over the 35 J-REITs that continued to list over the period of pattern B. The values in parentheses are adjusted t-statistics proposed by Kolari and Pynnönen (2010), to control for cross-correlation between abnormal returns. Significantly different from zero at *90% confidence, **95% confidence, ***99% confidence.

Table 6 Descriptive statistics for independent variables

| | | Mean | S.D. | Min. | Max. |
|------------------------------|-----------------------|------|------|------|-------|
| <i>WAD</i> (100km) | | 1.4 | 1.6 | 0 | 8.7 |
| <i>USAGE_k</i> (%) | Residence | 27.1 | 40.8 | 0 | 100.0 |
| | Hotel | 6.7 | 22.2 | 0 | 100.0 |
| | Office | 37.7 | 38.6 | 0 | 100.0 |
| | Commercial facilities | 16.9 | 25.5 | 0 | 100.0 |
| | Logistics facilities | 11.6 | 28.9 | 0 | 100.0 |

Table 7 Cross-sectional model

| | model 1 | model 2 | model 3 | model 4 |
|---------------------|----------------------|----------------------|-----------------------|----------------------|
| $\log(WAD)$ | -1.349 ** [0.578] | | -1.594 *** [0.520] | -1.498 ** [0.622] |
| $USAGE_k$ | | | | |
| Hotel | | 0.011 [0.009] | 0.026 * [0.015] | -0.014 [0.013] |
| Office | | 0.011 * [0.006] | 0.007 [0.005] | 0.021 ** [0.009] |
| Commercial | | -0.011 * [0.006] | -0.001 [0.008] | -0.022 [0.014] |
| Logistics | | -0.013 ** [0.005] | -0.009 * [0.005] | -0.018 [0.020] |
| $\log(WAD)*USAGE_k$ | | | | |
| Hotel | | | | 0.027 ** [0.011] |
| Office | | | | -0.026 * [0.015] |
| Commercial | | | | 0.021 * [0.013] |
| Logistics | | | | 0.011 [0.019] |
| Constant | 4.059 *** [0.464] | 2.910 *** [0.335] | 3.908 *** [0.464] | 3.848 *** [0.432] |
| Adj-R-squared | 0.185 | 0.193 | 0.367 | 0.482 |
| Sample size | 41 | 41 | 41 | 41 |

Notes: The estimation method for regression (3) is least squares. Robust standard errors used to correct for heteroskedasticity are in squared brackets.

Significantly different from zero at *90% confidence, **95% confidence, ***99% confidence.