Time Horizons and Diversification Benefits of Japanese REITs

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Abstract

We assess the diversification potential of REITs for investors in stock market and in direct real estate assets using a novel methodology based on the cointegration and vector error-correction framework capturing simultaneously long-run relationship and short-run dynamics. Our approach allows to adapt long-run equilibrium analysis to the standard mean-variance framework of modern portfolio theory. The correlation between J-REITs and direct real estate assets is positive and increases over time, while the correlation between J-REITs and the stock market is non-monotonic and turns negative for some sectors and holding periods. While J-REITs offer diversification benefits to stock market investors, especially over longer horizons, their diversification potential is limited due to their high volatility and critically depends on the sectors.

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1. Introduction

The enactment of the Investment Trust Law in Japan in November 2000 launched the Real Estate Investment Trust (J-REIT) as a vehicle for property investment in the Japanese stock market. Since its inception, this new asset class has enjoyed a high level of popularity among investors. The number of J-REITs listed on the Japan Stock Exchange grew from 2 in 2001 to 62 as of 2019, and their total market capitalization in 2019 exceeded ¥15 trillion ($140 billion). J-REITs are established as investment corporations which are closed-end funds publicly traded on a stock exchange. As of the beginning of 2019, these corporations had more than 4 thousand real estate properties under management in a variety of property sectors including office, residential, retail, hotel, and logistics.[5] Currently, J-REITs are the largest REITs class in Asia and the fifth largest in the world (Cho, 2017).

Given their short history of existence, and their rapid growth in recent years, J-REITs remain largely under-researched as an asset class. Individual and institutional investors, as well as portfolio managers, have been attracted by the higher liquidity, the better transparency, and the simplicity in term of management that J-REITs offer compared to direct real estate investments (Yunus, Hansz, & Kennedy, 2012). But do these advantages come at a cost?

Extant research has shown that the listing and delisting of companies carry major implications for their equity values (Foerster & Karolyi, 1999; King & Segal, 2009; G. C. Sanger & McConnell, 1986; G. Sanger & Peterson, 1990). Related to these phenomena, a general concern with REITs is that, once included in the universe of traded equities, the asset class might be influenced by the dynamics of the returns on common stocks traded on the exchange. As Yunus et al. (2012) point out, REITs and equities are traded by the same group of investors and are, therefore, subject to the same capital flows. That is, the returns on REITs might react to macroeconomic conditions, investor sentiment, or even investor irrationality and herding behavior in ways that are similar to the reaction of stocks. Furthermore, as REITs are corporate organizations whose objective is to generate income to their shareholders, their values are likely to reflect aspect related to management quality and capital structure in addition to the value of the underlying physical properties they manage (Morawski, Rehkugler, & Fuss, 2008). Hence their holding period returns – particularly over short and medium term horizons – might be more in line with common stocks rather than private investments in real estate. It is thus an empirical question of whether J-REITs provide the

[5] See, e.g. www.j-reit.jp/en/market/

same diversification benefits to stock market investors as direct investments in real estate. Given these characteristics of the asset, a related question of practical importance concerns the extent to which investors should hold J-REITs in their portfolio depending on their investment horizon.

In this paper, we develop a novel approach for studying the portfolio implications of including J-REITs in the portfolios of investors in the stock market and investors in direct (physical) real estate assets. Our main methodological contribution consists in deriving the correlations between J-REITs, direct real estate assets and stocks as well as their volatilities using a model that accounts both for the long-run relationship between these assets and their short-term dynamics. That is, we first estimate a vector error correction model (VECM) involving the three assets, and then, using Monte Carlo simulation techniques, we derive correlations and volatilities over different horizons (from one month to up to 240 months) from the estimated VECM parameters. This approach allows us to bridge the gap between the co-integration analysis often undertaken in studies related to asset substitutability with modern portfolio theory. We buttress our findings by performing scenario analyses by changing the VECM parameters which relate to the weak exogeneity and the exclusion tests based on the VECM. Performing our analysis for four J-REIT property categories – office, residential, retail, and hotel – we explore how correlations and volatility differ over various time horizons.

The rest of the paper is organized as follows. The next two sections highlight the past and recent research on REITs, direct real estate and stocks, and provide the background information of J-REITs. These are followed by the a section on the data, where we summarizes the data sources and provide descriptive statistics. Next, in the section on the methodology, we discuss how the correlations between the assets are derived from an estimated Vector Error Correction Model. Finally, we tabulate and discuss the empirical findings in the section on the results, and offer conclusion in the closing section.

2. Related Literature

The emergence of REITs as a liquid alternative to direct real estate investments in North America and Europe, and, more recently, in the Asia-Pacific have garnered much attention from investors, commentators, and the academic community. As a result, in the past three decades, vibrant literature has developed which explores the return characteristics of this new asset class. A comprehensive overview of this literature is beyond the scope of the current paper. In this section, we will focus on the contributions that are most closely related to the current study, in terms of the research question and methodological approach.

The question about whether REITs can generate the same level of expected returns and diversification benefits as their direct real estate counterparts or investments in the stock market, has received considerable attention in academic literature. Seck (1996) developed a notion of asset substitutability based on whether their asset values are driven by the same elements of relevant information. He finds that securitized real estate assets and direct (appraisal-based) commercial real estate assets are not substitutable. In particular, securitized real estate asset prices follow a random walk while appraisal-based assets do not. Ling & Naranjo (1999) introduced the concept of integrated assets based on the attribution of the risk premia of the assets to the systematic risk factors. They found that REITs are integrated with the stock market, whereby the level of integration has been increasing during the 1990s.

Some more recent literature on REITs applied co-integration framework. Morawski et al. (2008) studied co-integration relationship between REITs and equity markets in the United States and the United Kingdom and found that real estate stocks exhibit co-movement with the general stock market over short- and medium-term horizons, but for long-term horizons they are more strongly linked to direct real estate. Furthermore, they argued that price discovery occurs in the securitized real estate market as they lead the private property market. Hoesli & Oikarinen (2012) analyze sector-level REITs and find that they are more closely related to direct real estate assets than stocks, particularly in the long run. Yunus et al. (2012) reach similar conclusions in a study of several developed countries. Examining the effect of fundamentals, Kroencke, Schindler, & Steininger (2018) find that REITs are a substitute for direct investments in real estate. Glascock, Prombutr, Zhang, & Zhou (2017) compare listed property companies, i.e. securitized real assets which are not structured as REITs, and find that they are not direct substitutes to each other. Pagliari, Scherer, & Monopoli (2005), however, testing for differences in the return and volatilities of private and public real estate equities, reject the hypothesis that returns and volatilities are significantly different from each other. More recently, Pagliari (2017) examines private and public real estate investments in a mixed-asset portfolio over long horizons and discusses portfolio allocations over private and public real estate assets for investors with different risk preferences. Hansz, Zhang, & Zhou (2017) examine whether equity and mortgage REITs are substitutable. While rejecting this hypothesis, they find that the equity REITs market is the leading market and the two REIT classes have largely dissimilar risk and return profiles.

There are several studies focused on examining the performance of REITs in Japan. Su, Huang, & Pai (2010) present a comparative study between Japan and the United States and report that the behavior of REITs critically depends on the state of the stock market. In particular REITs behave similarly to stocks only in periods of low stock market volatility. Several recent papers have documented that the decision of J-REIT decision to acquire new real estate properties has a positive effect on returns (Ooi, Ong, & Neo, 2011; Tang, Mori, Ong, & Ooi, 2016). Newell & Peng (2012) examine the role of J-REITs in mixed-asset performance and find that, since their inception, J-REITs have delivered superior risk-adjusted returns, particularly in the period after the financial crisis. Most closely related to the present study is the analysis of Cho (2017) who performs a sector-level portfolio analysis based on rolling window correlations. He finds relatively low correlations between REITs and stocks and bonds and reports that J-REIT returns significantly vary by sector, with hotel and industrial J-REITs being the best performers in terms of risk-adjusted returns. In this paper, while we focus on the same sectors, we derive correlations in a setting which takes into account the short-run dynamics and long-run relationships between three types of assets, namely, REITs, direct real estate, and common stocks.

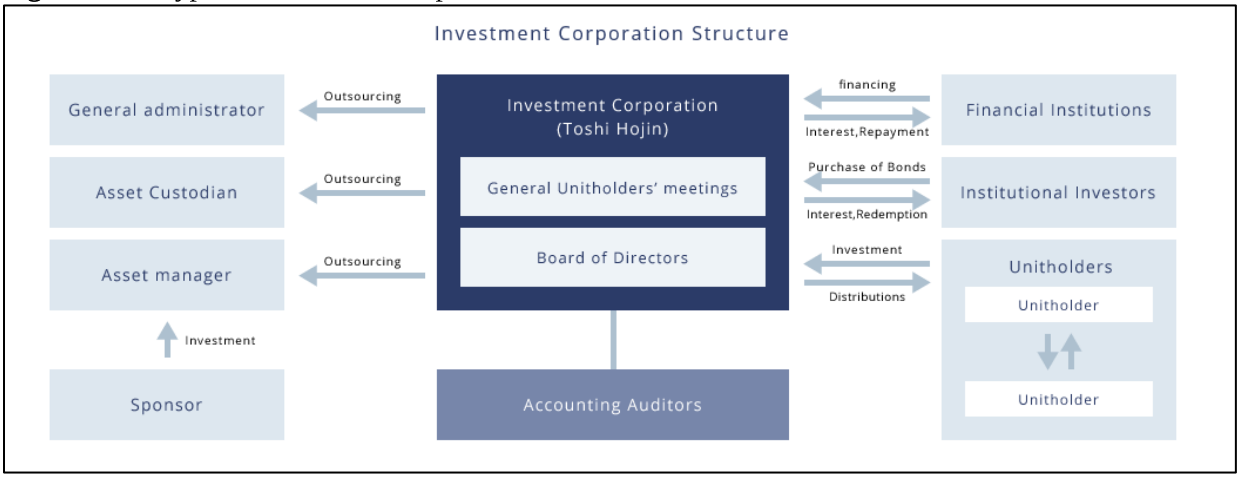
3. Institutional Background on J-REITs

According to the Investment Trust Law (ITL) in Japan, J-REITs are formed as investment corporations (EPRA, 2016). The legal structure of J-REITs presented Figure 1 indicates that that J-REITs outsource their business activities to external managers. This is a major difference to the structure of U.S REITs which are internally managed.[6] The external management of J-REITs is facilitated by sponsors (Onishi & Sugihiro, 2015). Typical sponsors of J-REITs are real estate asset managers involved in the management of listed property companies. These real estate managers hold a fiduciary duty to J-REIT shareholders (Chen, Gao, Kaul, Leung, & Tsang, 2014). They are involved in the process of property acquisitions or disposals (Iwakura & Ueno, 2016). In the year 2013, the ITL regulation was amended to require that any decision made by managers be subject to prior consent from the investment corporation i.e. J-REIT shareholders (Iwakura & Ueno, 2016). Similar to the legislation in the U.S. and other countries, J-REITs are required to distribute 90% of their annual income to shareholders. Under the provision of the Japanese Special Taxation Law, J-REITs are subjected to a 35% corporate tax rate on the net income not distributed to shareholders (EPRA, 2016). As J-REITs provide a liquid vehicle for exposure to real estate

[6] See, e.g. https://www.ey.com/en_gl/real-estate-hospitality-construction/how-to-choose-the-right-management-structure-for-your-reit

assets, they are attractive to various group of investors: institutional investors such as mutual funds, foreign investors and domestic individual investors.[7] While in the majority of countries there exists both equity and mortgage REITs,[8] the currently existing REITs in Japan are equity REITs only.

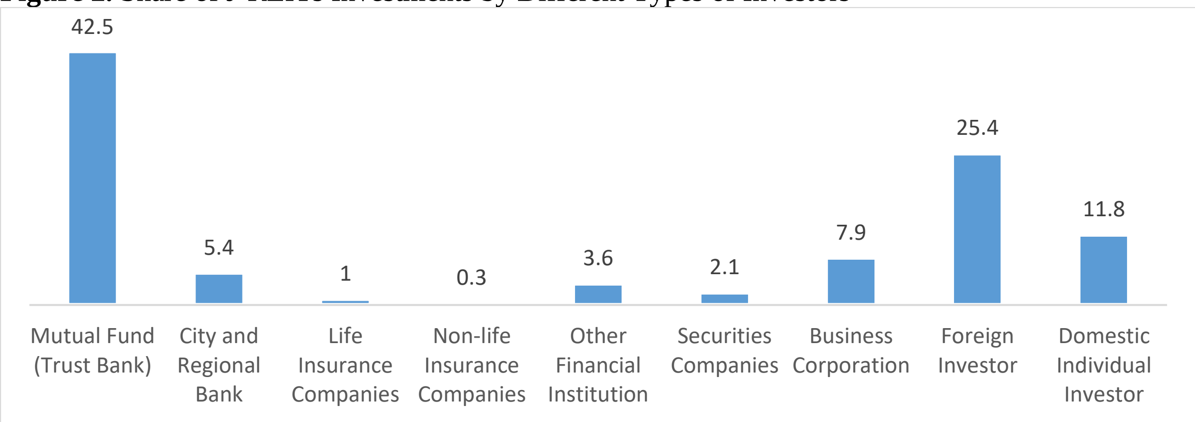
Figure 1. A Typical Investment Corporation Structure of a J-REIT[9]



Source: The Association of Real Estate Securitization, Japan

Figure 2 presents a snapshot of the distribution of investments by investor type as of August 2018. It shows that the largest group of investors are mutual funds followed by foreign investors.

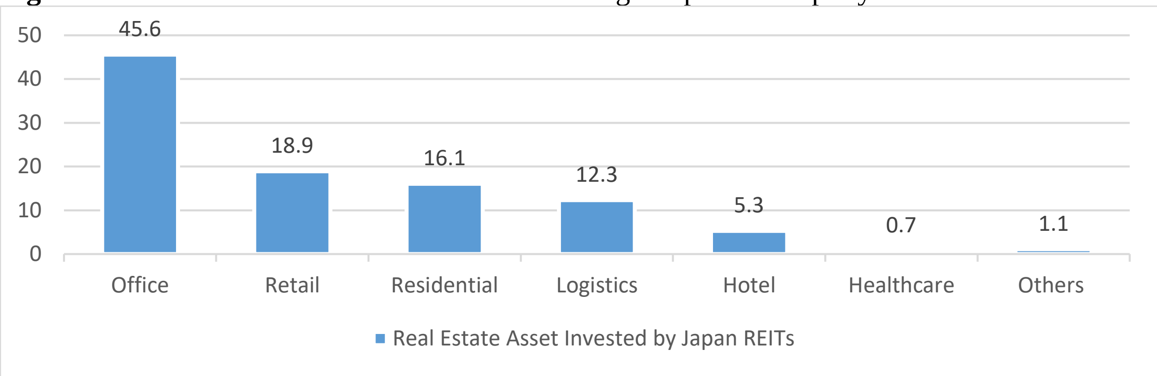
Figure 2. Share of J-REITs Investments by Different Types of Investors



[7] The Figures are taken from the REIT Investor Survey published in August 2018. See (Tokyo Stock Exchange, 2018).
[8] Equity REITs directly invest in physical real estate properties. Mortgage REITs hold either residential or commercial mortgages or mortgage-backed securities (Hansz et al., 2017). To the best of our knowledge, J-REITs only consist of the former type (equity REITs) and not mortgage REITs.
[9] See https://j-reit.jp/en/about/

J-REITs invest in various property sectors. Figure 3 provides a breakdown by sector showing the largest investments to be in the Office sector (45.6%), followed by Retail (18.9%) Residential (16.1%), Logistics (12.3%) and Hotel (5.3%).

Figure 3. J-REITs Real Estate Investment According to Specific Property Sectors



As of 2018, there were a total of 3568 real estate properties with a market capitalization of about ¥15 Trillion owned by listed J-REITs. Most of the properties are located in the Tokyo metropolitan area, although recently some J-REITs have acquired properties in the Greater Tokyo area. Locations outside Tokyo include Nagoya, Osaka, and Fukuoka (Nomura Research Institute, 2018). Table 1 reports the estimated market values for the underlying real estate properties between the year 2013 and the year 2018. We observe a substantial increase in the number and the estimated market values of the properties over the five sectors. Furthermore, the occupancy rate by tenants has historically been quite high, never dropping below 95% during this period. The rent on all properties averages ¥9,900 per tsubo.[10] The average rent of office REITs properties is ¥18,400 for residential, ¥11,100 for retail, ¥5,800 for office, and ¥9,700 for hotel. These rents allowed J-REITs to declare a stable dividend yield over the 2013-2018 time period, averaging 4% per annum (Nomura Research Institute, 2018). The performance of REITs and their underlying real estate assets necessitates an in-depth analysis of their diversification benefits over different time horizons.

[10] A 'tsubo' is equivalent to 3.3 square meters.

Table 1 Estimated Market Value for Underlying Properties Held by J-REITs

Sector	Number of Properties (Year 2013)	Estimated Market Value (in Million Yen) (Year 2013)	Number of Properties (Year 2018)	Estimated Market Value (in Million Yen) (Year 2018)
Office	620	4,845,259,000	876	7,857,314,000
Residential	1224	1,829,408,300	1586	2,911,634,105
Retail	228	1,861,975,000	385	3,094,713,000,
Hotel	54	287,577,000	238	1,423,896,000
Logistics	110	779,377,000	293	2,655,169,000

Note. The information is based on the authors' calculations based on the ARES Database.[11]

4. Data

In this study, we employ the total return indices provided by Datastream to study the performance of J-REITs. The classification of J-REITs in Datastream is based on the constituents in their portfolios which fall in the following four categories: Office, Retail, Hotel, and Residential sectors. For each sector, the constituent is weighted by market capitalization.[12]

As a measure of returns of direct real estate, we use the data produced by the Association for Real Estate Securitisation (ARES) in Japan. These indices are known as ARES Japan Property Indices (AJPI) and represent total return appraisal-based indices.[13] We employ both the aggregate and the sector-level indices representing the four aforementioned sectors. The construction of these indices mimicks that of the US National Council of Real Estate Investment Fiduciaries' (NCREIF) Property Index. The AJPI indices comprise income-producing properties owned by institutional real estate investors. They are derived from a weighted average income (net operating income) and capital (changes in appraisal values) owned by institutional real estate investors.[14,15] In the data, the direct real estate total return indices are reported in monthly frequency on an unlevered basis. To account for leverage, we adopt the Barclays Japan Asia-Pacific BAA Corporate Bond redemption yield which is a

[11] See https://index.ares.or.jp/en/ajpi/
[12] Source (Thomson Reuters Datastream, 2012).
[13]See https://index.ares.or.jp/en/ajpi/
[14] See https://index.ares.or.jp/en/about/
[15] See https://index.ares.or.jp/en/ajpi/download.php

proxy for the cost of debt, denoted by k_{dt}. Following Hoesli & Oikarinen (2012), the levered direct real estate indices are obtained by using the formula:

$$DRE_t = (DRE_t^U - k_{dt} \times LTV)/(1 - LTV) \quad (1)$$

where DRE_t is the levered direct real estate index at time t, DRE_t^U as the unlevered direct real estate index, k_{dt} is the cost of debt in time t, LTV is the loan-to-value ratio of J-REITs (both aggregate and sectors) which we set at 55% for the study period (Sumitomo Mitsui Trust Research Institute, 2016).[16]

We use the Tokyo Stock Exchange (TOPIX) total return index as the proxy for common stocks.[17] We express all indices in real terms by deflating the nominal index values by the monthly consumer price index (CPI). For the analysis, we take natural logarithms of the REITs, direct real estate and stock market indices so as to obtain continuously compounding returns by differencing the time series. We analyze the time period from April 2004 (2004m4) to November 2018 (2018m11) for all sectors with the exception of the hotel sector, for which observations begin in June 2006 (2006m6). A summary of the variables used for each property sector is provided in Table 2.

[16] The survey conducted by Sumitomo Mitsui Trust Research Institute in year 2016, indicates the J-REITs real estate managers report LTV ratios of more than 50% and less than 60%. Hence, we set the LTV for this study at the 55% level.

[17] Total return indices at levels exhibit the theoretical growth in value of share price over specified period and dividends which are assumed to be re-invested to purchase additional units of shares, at the closing price applicable on the ex-dividend date. This is in contrast to Price Index which only account for the theoretical growth in value of share price over a specified period of time. Source (Datastream).

Table 2 Data Sources and Variables

Variable	Abbreviation	Source	Period
Direct Real Estate			
Overall	DRE	AJPI Aggregate	2002:m6-2018:m11
Residential	Residential_DRE	and Sectorial	2004:m4-2018:m11
Retail	Retail_DRE	Direct Real Estate	2003:m6-2018:m11
Office	Office_DRE	Indices	2001:m12-2018:m11
Hotel	Hotel_DRE		2006:m6-2018:m11
REITs			
Overall	REIT	Datastream Japan REITs	2002:m6-2018:m11
Residential	Residential_REIT	Datastream Japan Residential REITs	2004:m4-2018:m11
Retail	Retail_REIT	Datastream Japan Retail REITs	2003:m6-2018:m11
Office	Office_REIT	Datastream Japan Office REITs	2001:m12-2018:m11
Hotel	Hotel_REIT	Datastream Japan Hotel REITs	2006:m6-2018:m11
Common Stocks			
	Stock	Tokyo Price Index (TOPIX)	2001:m12-2018:m11

Notes: Data is collected from Datastream except for the Direct Real Estate indices whose source is the AJPI.

Descriptive statistics are reported in Table 3, whereby continuously compounded returns are obtained by taking the difference in logs. In general, REITs (except Residential REITs) have higher mean compared to direct real estate indices; however, the direct real estate indices are less volatile than the REITs indices. The standard deviation of the direct real estate indices ranges in between 0.0042 to 0.0063, while the standard deviation of the J-REITs indices ranges in between 0.0600 to 0.1040. The stock market index has lower volatility compared to REITs. All return series are negatively skewed, except for the Hotel sector. The kurtosis of all time series, especially those for REITs, exceeds 3 which indicates a leptokurtic distributions of returns.

Table 3 Descriptive Statistics

Variables	Mean	Standard Deviation	Min	Max	Skewness	Kurtosis
ΔStock	0.0035	0.0536	-0.1397	0.1379	-0.3879	3.2541
Δ REIT	.0057097	.0668202	-.5283532	.1532699	-2.863372	24.9587
ΔResidential_REIT	.0022471	.0598906	-.3764892	.1624589	-1.348811	11.46753
ΔRetail_REIT	.0055941	.0685894	-.4607646	.1871585	-1.791835	14.57263
ΔOffice_REIT	.0056586	.0689593	-.4957215	.1963831	-2.178942	18.19491
ΔHotel_REIT	.009394	.1038385	-.6529332	.4638646	-1.000597	15.49757
ΔDRE	.0044682	.0050568	-.0144541	.0159929	-.5489311	3.902252
ΔResidential_DRE	.0039735	.0042231	-.0132058	.012315	-1.011965	4.631804
ΔRetail_DRE	.004386	.0048329	-.0145855	.0147467	-1.027583	4.91657
ΔOffice_DRE	.004241	.005775	-.0156069	.0181355	-.285903	3.588227
ΔHotel_DRE	.0059194	.0063417	-.0107696	.0235949	.4827343	3.365076

Notes: This table reports the descriptive statistic for all indices. The indices are inflation adjusted using the monthly CPI. The direct real estate index is a levered index by construction. Reported statistics for all series (REITs, direct real estate and stocks) represent differences in logs.

5. Methodology

The main methodological contribution of this paper is the development of a portfolio choice framework which explicitly accounts for the short-run dynamics and long-run relationship among the assets. In particular, we derive the covariance matrix of returns between the three asset categories based on the estimation of a vector error-correction model (VECM). This approach allows us to unify co-integration theory, which is concerned with long-run relationships, with modern portfolio theory which relies on volatilities and correlations between the assets as inputs in the portfolio selection problem. We derive theoretically the volatilities and correlations over different time horizons and explore their portfolio choice implications.

There are several attempts in the literature to establish a link between co-integration and portfolio diversification analysis. Glascock et al. (2017) build on Bekaert & Harvey (1995) time-varying integrative asset pricing model to explore the link between next-period expected returns and co-integration. In each period of this model, returns are with given probability co-integrated, and in the polar case where this probability is one, the assets have the same expected returns in the following period. Unlike this model, we do not assume an equilibrium asset pricing relationship, but rather build a framework based on co-integration analysis. In this framework, future returns are governed by an autoregressive process and respond to deviation from long-run equilibrium. Pagliari (2017) presents a portfolio application allowing for assets to be serially correlated (i.e. they follow an AR(1) process, or, in other words, exhibit momentum). Within this framework, the author discusses correlations between returns over different horizons. While similar in aim and spirit, our approach also accounts for the long-run relationships between the assets.

5.1 Vector Error-Correction Model

Let y_t denote the vector of the J-REITs, direct real estate, and the stock indices (in logs) in month t, $y_t = (\mathrm{DRE_t}, \mathrm{REIT_t}, \mathrm{Stock_t})'$. The VECM system of equations is represented in matrix form as follows

$$\Delta y_t = \mu + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \Pi y_{t-1} + \varphi_t \tag{2}$$

Here $\Delta y_t = y_t - y_{t-1}$ is the vector of returns in month t, μ is a (3x1) vector of constants, and φ_t is the vector of error terms. The matrices Γ_i for $i = 1,2, \dots, (p-1)$ are (3x3) matrices of autoregressive terms for the returns of lag i which captures the short-term dynamics of the assets, and $(p-1)$ is the number of lags included in the empirical model. The matrix Π caputres the long-run relationship among the components of y_t, and it can be represented as a product of two matrices ($\Pi = \alpha\beta'$) where α is a (3 x r) matrix of speed-of-adjustment coefficients and β' is an (r x 3) matrix of long-run cointegrating coefficients. Hereby r is the rank of matrix Π which equal to the number of distinct co-integrating relationships between the assets (see, e.g. Lutkepohl, 2005). The number of co-integrating vectors is determined either using the trace statistics or the maximum eigenvalue test statistic. In the trace test, the null hypothesis states that the number of co-integrating vectors does not exceed *r*, and it is tested against the alternative that the number of vectors exceeds *r*. The null hypothesis of the maximum eigenvalue test is that there are a maximum number of r cointegrating relations which is tested against the alternative of r+1 cointegrating relations. The maximum number of autoregressive lags to include in the underlying VAR process is usually determined by some information criterion; in this paper we use the Hannan-Quinn information criterion. Applying this test to our data, we establish one co-integrating relationship (r=1) and one autoregressive lag in the VECM, $(p-1) = 1$. For this case, the VECM can be represented as

$$\begin{bmatrix}\Delta DRE_t\\ \Delta REIT_t\\ \Delta Stock_t\end{bmatrix}=\begin{bmatrix}\mu_D\\ \mu_R\\ \mu_S\end{bmatrix}+\begin{bmatrix}a_{DD} & a_{DR} & a_{DS}\\ a_{RD} & a_{RR} & a_{RS}\\ a_{SD} & a_{SR} & a_{SS}\end{bmatrix}\begin{bmatrix}\Delta DRE_{t-1}\\ \Delta REIT_{t-1}\\ \Delta Stock_{t-1}\end{bmatrix}$$
$$+\begin{bmatrix}\alpha_D\\ \alpha_R\\ \alpha_S\end{bmatrix}\begin{bmatrix}1 & \beta_R & \beta_S\end{bmatrix}\begin{bmatrix}DRE_{t-1}\\ REIT_{t-1}\\ Stock_{t-1}\end{bmatrix}+\begin{bmatrix}u_t\\ v_t\\ w_t\end{bmatrix} \qquad (3)$$

In this representation, the second terms account for the short-run dynamics of the assets, the third term captures the long-run equilibrium relationship, and the last term represents the vector of random errors.

5.2 Derivation of cumulative return correlations and volatilities from the VECM estimates

We present equation (3) in the form

$$\begin{bmatrix}\Delta DRE_t\\ \Delta REIT_t\\ \Delta Stock_t\end{bmatrix}=\begin{bmatrix}a_{DD} & a_{DR} & a_{DS}\\ a_{RD} & a_{RR} & a_{RS}\\ a_{SD} & a_{SR} & a_{SS}\end{bmatrix}\begin{bmatrix}\Delta DRE_{t-1}\\ \Delta REIT_{t-1}\\ \Delta Stock_{t-1}\end{bmatrix}+\begin{bmatrix}\alpha_D\\ \alpha_R\\ \alpha_S\end{bmatrix}e_{t-1}+\begin{bmatrix}u_t\\ v_t\\ w_t\end{bmatrix}$$

where $e_t = DRE_t - b_R REIT_t - b_S Stock_t$ and $e_{t-1} = DRE_{t-1} - b_R REIT_{t-1} - b_S Stock_{t-1}$.

Combining the two above two equations, we obtain

$$e_t - \Delta DRE_t + b_R \Delta REIT_t + b_S \Delta Stock_t = e_{t-1} \qquad (4)$$

Adding equation (4) to the other three equations presented in (3), we obtain the following system of equations

$$\begin{bmatrix}1 & 0 & 0 & 0\\ 0 & 1 & 0 & 0\\ 0 & 0 & 1 & 0\\ -1 & b_R & b_S & 1\end{bmatrix}\begin{bmatrix}\Delta DRE_t\\ \Delta REIT_t\\ \Delta Stock_t\\ e_t\end{bmatrix}=\begin{bmatrix}a_{DD} & a_{DR} & a_{DS} & \alpha_D\\ a_{RD} & a_{RR} & a_{RS} & \alpha_R\\ a_{SD} & a_{SR} & a_{SS} & \alpha_S\\ 0 & 0 & 0 & 1\end{bmatrix}\begin{bmatrix}\Delta DRE_{t-1}\\ \Delta REIT_{t-1}\\ \Delta Stock_{t-1}\\ e_{t-1}\end{bmatrix}+\begin{bmatrix}u_t\\ v_t\\ w_t\\ 0\end{bmatrix}$$

A shorthand representation of the above system is given by

$$\mathrm{BX_t = DX_{t-1} + \varphi_t} \qquad (5)$$

where $\mathrm{X_t = (\Delta DRE_t, \Delta REIT_t, \Delta Stock_t, e_t)'}$. Pre-multiplying equation (5) with $\mathrm{B^{-1}}$ we obtain

$$\mathrm{X_t = B^{-1}(DX_{t-1} + \varphi_t)} \qquad (6)$$

The variance-covariance matrix of error terms, given by

$$\Omega \coloneqq Cov\left(\begin{bmatrix}u_t\\ v_t\\ w_t\end{bmatrix}\right)=\begin{bmatrix}\sigma_{uu}^2 & \sigma_{uv}^2 & \sigma_{uw}^2\\ \sigma_{uv}^2 & \sigma_{vv}^2 & \sigma_{wv}^2\\ \sigma_{uw}^2 & \sigma_{wv}^2 & \sigma_{ww}^2\end{bmatrix}$$

is estimated by fitting the VECM.

Using equation (6), we perform the following Monte Carlo simulation. We first generate 10,000 draws from the multivariate normal distribution φ_t, and applying equation (6) iteratively, we calculate $X_1, X_2, \ldots X_T$ for $T = 240$ months (i.e. 20- year horizon). Hereby the matrices B and D represent the VECM estimates. Let x_t and y_t represent any two of the three elements of the vector X_t (i.e. denote any two of the investable assets). The variance of the cumulative returns for time horizon T for each asset is calculated as

$$V_{x,T} = var\left(\sum_{t=1}^{T} x_t\right)$$

The covariance of the cumulative returns between x_t and y_t for the time horizon T are expressed as

$$\Gamma_T = Cov\left(\sum_{t=1}^{T} x_t, \sum_{i=1}^{T} y_t\right)$$

From this representation, we obtain the correlation between each pair of variables as

$$Corr\left(\sum_{t=1}^{T} x_t, \sum_{t=1}^{T} y_t\right) = \frac{\Gamma_T}{\sqrt{V_{x,T} V_{y,T}}}$$

5.3 Empirical estimation

We estimate equation (2) using the maximum likelihood estimation procedure of Johansen (1988) and Johansen & Juselius (1990). Johansen proposes two maximum likelihood test statistic. The trace test statistic is given by

$$\lambda_{trace(r)} = -T \sum_{i=r+1}^{n} \ln(1 - \lambda_i) \tag{7}$$

where T is the number of observations and λ_i are the estimated eigenvalues of Π. The null hypothesis is that there exist no more than r cointegrating relations, and the alternative is that there is more than r. Large values of the statistics lead to a rejection of the null hypothesis. The maximum eigenvalue test is given by

$$\lambda_{\max(r,r+1)} = -T \ln(1 - \lambda_{r+1}) \tag{8}$$

where T is again the number of observations and λ_{r+1} is the estimated (r+1)-th eigenvalues of Π. The null hypothesis of the maximum eigenvalues test is that there are a maximum number of r cointegrating relations which is tested against the alternative of r+1 cointegrating relations. Consequently, these two statistics are derived by a continuous iterative process until the null hypothesis of r number of cointegrating relations cannot be rejected. There are 3 distinct cases: first, the rank of Π is equal to zero, signifying that there is no stationary linear combination of y_t, i.e. the components of y_t are not cointegrated. Second, Π can have full rank, (in our case, r=3), which implies that the components of y_t are stationary. Finally, if Π has non-zero but less than full rank, (in our case, r is either 1 or 2), there are r cointegrating relationships. In the latter situation, the Π matrix in equation (2) can be further decomposed to estimate the vectors of α and β' by maximum likelihood.

5.4 Post-estimation tests: weak exogeneity and long-run exclusion

The weak homogeneity test and the long run exclusion tests are related to the estimated vectors α and β'. In the weak homogeneity test we are interested in whether the coefficient of α for an individual variable is significantly different from zero (Hunter, 1992). We test the null hypothesis H_0: $\alpha = 0$ against the alternative H_a: $\alpha \neq 0$. If we fail to reject the null hypothesis, then the variable does not adjust to the long-run equilibrium relationship after a random deviation. The exclusion test examines whether an individual variable 'participates' in the long-run cointegrating relationship, that is whether it enters with a coefficient different from zero in the co-integrating equation (Hunter, 1992; Juselius, 1995). In particular, we test the null H_0: $\beta = 0$ against H_a: $\beta \neq 0$. In both tests, under the null hypothesis the sampling distribution of the test statistics is Chi-squared.

6. Results

We first report the results of the co-integration analysis and then derive the correlation between the assets.

6.1 Unit Root Tests

We first examine whether the individual time series have a unit root. In Table 4 we report both the Philips & Perron (1988) and the Dickey-Fuller Generalised Least Squares (DF-GLS) unit root tests. Table 4 shows that the logarithms of the indices for REITs, direct real estate and the stock market are I (1) processes for all market segments. That is, the log-differences of indices are stationary (at the 5% significance level). We conclude that the VECM formulated in equation (2) is an appropriate specification for our analysis by using a number of lags as shown in the table.

Table 4 Unit Root Tests

	Philips & Perron		DF-GLS	
Variable	Level	First difference	Level (Lags)	First difference (Lags)
Stock	-1.169	-13.146^{1}	-0.490 (1)	-8.188 ^{1} (1)
REIT	-1.345	-14.109^{1}	0.376 (1)	-8.452^{1}(1)
Residential_REIT	-1.007	-10.957^{1}	-1.006 (1)	-2.205^{1} (1)
Retail_REIT	-1.586	-13.800^{1}	-0.060(1)	- 8.092^{1} (1)
Office_REIT	-1.462	-14.630^{1}	0.419 (1)	-2.088^{1} (6)
Hotel_REIT	-0.432	-11.775^{1}	-0.056(1)	-8.856^{1}(1)
DRE^{l}	-0.652	-5.748 ^{1}	-2.088 (4)	-4.213^{1} (1)
Residential_DRE^{l}	1.278	-6.741^{1}	-2.041 (7)	-4.202^{1} (2)
Retail_DRE^{l}	-0.958	-5.772^{1}	-2.500(5)	- 3.480^{5} (2)
Office_DRE^{l}	-1.155	-4.776 ^{1}	-3.180 (1)	-3.823^{1} (1)
Hotel_DRE^{l}	1.364	-3.760^{1}	-1.176 (1)	-3.162^{1} (1)

Notes: This table shows the Phillips & Perron and Dickey-Fuller GLS (DF-GLS) unit root test for all series; REITs, stock market and direct real estate indices. 'l' denotes an additional linear time trend component for both unit root tests. The critical values for Phillips & Perron test at 1% and 5% significance level are -4.010 and -3.440 when a trend component is included and -3.480 and -2.880 when the trend component is excluded in the test. The critical values for DF-GLS at 1% and 5% significance level are -3.490 and -2.950 when a trend component is included and -2.590 and -1.950 when trend component is excluded in the test. 5 and 1 indicate significance levels of 5% and 1%, respectively.

6.2 Cointegration tests

We estimate the VECM given by the system of equations (2) separately for each of the property sectors: Retail, Office, Hotel, and Residential. The optimal lag length in equation (2) is two (j=2) determined by the Hannan-Quinn Information Criteria (HQIC). The results from the Johansen test for determining the number of cointegrating relationships are presented in Table 5. We implement the trace test and the maximum eigenvalue test using a 5% significance level. Both tests indicate one long-run cointegrating relationship between REITs, direct real estate and stock market for all property sectors except for the Residential sector for which no cointegrating relationship exists. For this sector, the relationship is best described by a VAR model.[18]

[18] By applying the Pantula principle, we choose to apply Case 2 for the Johansen test of cointegration and subsequent estimation of the VECM.

Table 5 Johansen Cointegration Test

Null	Trace TEST	Critical Values CV 5%	Maximum Eigenvalue	Critical Values 5 % CV
All				
r ≤ 0	60.4068	34.910	46.4534	22.000
r ≤1	13.9534[5]	19.960	10.9267[5]	15.670
Retail				
r ≤ 0	57.0647	34.910	42.6614	22.000
r ≤1	14.4033[5]	19.960	9.1238[5]	15.670
Office				
r ≤ 0	59.9276	34.910	44.2239	22.000
r ≤1	15.5956[5]	19.960	12.4831[5]	15.670
Hotel				
r ≤ 0	37.297	34.910	25.637	22.000
r ≤1	11.660[5]	19.960	9.656[5]	15.670
Residential				
r ≤ 0	26.5611[5]	34.910	18.1630[5]	34.910
r ≤1	8.3981	19.960	8.0361	19.960

Notes: This table shows the Johansen test for cointegration between REITs, direct real estate and stocks both in Aggregate and individual property sector. We apply two tests for cointegration that are Trace Test and Maximum Eigenvalue statistic. The null hypothesis is there is no more than r number of cointegrating relation. 5 indicates significance at the 5% level.

Table 6 presents the VECM results for the overall market and for the four property sectors. The cointegrating vector [1 β_R β_S] are normalized with respect to the direct real estate indices. Column (9) reports the β_R, while column (14) present the cointegrating coefficient for stocks, β_S. Although there is one cointegrating relation between REITs, direct real estate and stocks, we can see that, the beta coefficients of stocks, β_S are insignificant. The beta coefficient of REITs, β_R varies across property sectors. The Retail REITs have the highest beta while the beta of Hotel REITs is the lowest. For example the β_R shows that a unit increase in the Retail direct real estate index is associated with an increase in the retail REITs index by 0.7237 unit (see, e.g. Bhattacharya & Banerjee, 2003).

Columns (1), (5) and (10) present the speed of adjustment for the direct real estate, REITs and stocks respectively. We observe that the α_D for all sectors is negative and significant. For the REITs, the speed of adjustment coefficient is positive and significant for the overall market and for the Hotel sector, whereas α_R is insignificant for the other property sectors. The speed of adjustment coefficients α_S are insignificant for all sectors.

Columns (1) (5) and (10) present the speed of adjustment for the direct real estate, REITs and stocks respectively. We observe that the α_D for all sectors are negative and significant. For the REITs, the speed of adjustment coefficient is positive and significant for the overall market and for the Hotel sector, whereas α_R is insignificant for the other property sectors. The speed of adjustment coefficient α_S is insignificant for all sectors. The autoregressive coefficients are not significant in most of the case, except for the a_{DD}, a_{RD}, and a_{SR}. The bottom of Table 6 presents estimates of the covariance matrix for the error term.

Table 6 Vector Error Correction

	ΔDRE				ΔREIT					ΔStock				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Sector	α_D	a_{DD}	a_{DR}	a_{DS}	α_R	a_{RD}	a_{RR}	a_{RS}	β_R	α_S	a_{SD}	a_{SR}	a_{SS}	β_S
All	-0.0129[1]	0.4602[1]	-0.0030	-0.0038	0.0621[10]	3.0110[5]	0.0017	0.0251	-0.6502[1]	-0.0164	0.0749	0.1425[5]	0.0173	-0.0243
	(0.0018)	(0.0670)	(0.0040)	(0.0050)	(0.0375)	(1.3494)	(0.0820)	(0.1019)	(0.1037)	(0.0301)	(1.0716)	(0.0652)	(0.0809)	(0.1308)
Retail	-.01138[1]	0.4885[1]	-0.0015	-0.0055	0.0468	2.7149[5]	0.0325	-0.0246	-0.7237[1]	-0.0451	-0.4103	0.1408[5]	-0.0152	-0.1664
	(0.0017)	(0.0648)	(0.0039)	(0.0049)	(0.0355)	(1.3049)	(0.8003)	(0.1004)	(0.0839)	(0.0276)	(1.0111)	(0.0620)	(0.0778)	(0.1118)
Office	-0.0142*	0.4783[1]	-0.0032	-0.0040	0.0435	2.2186[10]	-0.0135	-0.0014	-0.5482[1]	-0.0227	-0.2144	0.1039[10]	0.0185	-0.1436
	(0.0019)	(0.0603)	(0.0038)	(0.0047)	(0.0386)	(1.2021)	(0.0768)	(0.0935)	(0.0813)	(0.0316)	(0.9859)	(0.0630)	(0.0767)	(0.1166)
Hotel	-0.0082[1]	0.6357[1]	-0.0033	-0.0060	0.1043[5]	5.2316[1]	0.0195	0.1279	-0.5297[1]	-0.0382	-1.2212	0.1550[1]	0.0149	-0.0926
	(0.0017)	(0.0645)	(0.0030)	(0.0058)	(0.0467)	(1.7575)	(0.0836)	(0.1588)	(0.0701)	(0.0239)	(0.8981)	(0.0427)	(0.0812)	(0.173)
Reside-ntial	-	0.3762[1]	0.0035	0.0103[10]	-	2.2850[5]	0.1278	-0.0154	-	-	1.6740[10]	0.0195	0.0049	-
		(0.0698)	(0.0058)	(0.0063)		(1.0477)	(0.0865)	(0.0949)			(0.9729)	(0.0803)	0.0882	

Table 6 (continued) Variance Covariance Matrix for the Disturbance Terms

Sector	σ^2_{uu}	σ^2_{uv}	σ^2_{uw}	σ^2_{uv}	σ^2_{vv}	σ^2_{vw}	σ^2_{uw}	σ^2_{wv}	σ^2_{vw}
All	0.00003979	0.00016823	0.00004474	0.00016823	0.00869297	0.00332574	0.00004474	0.00332574	0.00551481
Retail	0.0000422	0.00016394	0.00001327	0.00016394	0.00871273	0.00284499	0.00001327	0.00284499	0.00522688
Office	0.00004307	0.00012949	0.00004338	0.00012949	0.00896573	0.00348042	0.00004338	0.00348042	0.00567386
Hotel	0.00007432	0.00041034	-0.00002389	0.00041034	0.0213581	0.00332139	-0.00002389	0.00332139	0.00550746

Notes: This table reports the estimates of Vector Error Correction Model as in Equation (3), (4) and (5). Figures in parentheses are standard error and 1, 5 and 10 report the significance at 1%, 5% and 10% levels.

In Table 7, we report the p-values associated with the weak exogeneity and the exclusion tests for Stocks, REITs, and direct real estate. At the 5% significance level, we fail to reject the null that the β_S is not significantly different from zero. Hence, stocks can be excluded from the long-run relationship. Hence, the long run dynamics ia driven by the relation between REITs and direct real estate. Testing for weak exogeneity, for the case for direct real estate, we reject the null that α_D is not significantly different from zero. The direct real estate, thus is an asset that adjusts to the long-run equilibrium relationship. Hence, we undertake the normalization with respect to direct real estate because this asset is neither weakly exogenous nor excluded, unlike the case of REITs and stocks (Hunter & Ali, 2014). For the case of REITs, we fail to reject the null $\alpha_R = 0$ except for the entire market and Hotel sector. While Hotel REITs respond to deviations from the long-run equilibrium relationship, the Hotel sector is less responsive than the Office and Retail sectors. Regarding Stocks, we fail to reject the null $\alpha_S = 0$. Hence, stocks not only do not participate in the long-run relationship between the assets but also does not respond to deviations from the long-run equilibrium.

Table 7 Exclusion and Weak Exogeneity Tests

	H_0			
Sectors	$\alpha_D = 0$	$\alpha_R = 0$	$\alpha_s = 0$	$\beta_S = 0$
All	0.0000	0.0990	0.1019	0.8750
Retail	0.0000	0.1883	0.3085	0.1920
Office	0.0000	0.2596	0.4733	0.3110
Hotel	0.0000	0.0257	0.1097	0.6470

Notes: Table show the p-values for the weak exogeneity and exclusion tests based on a chi-squared test. The tests are not conducted for the Residential sector as there is no cointegration between the assets in this sector.

In summary, J-REITs are bound by a long-run relationship with their respective direct real estate market counterparts but not with the stock market. These results conform to empirical evidence from other countries, e.g. the US market (Hoesli & Oikarinen, 2012, 2016). Since J-REITs are not behave as common stocks, they can be a close substitute to the direct real estate asset. We turn next to the discussion of the correlations between the cumulative returns of REITs, direct real estate, and stocks which we derive from the VECM estimates.

6.3 Correlation analysis

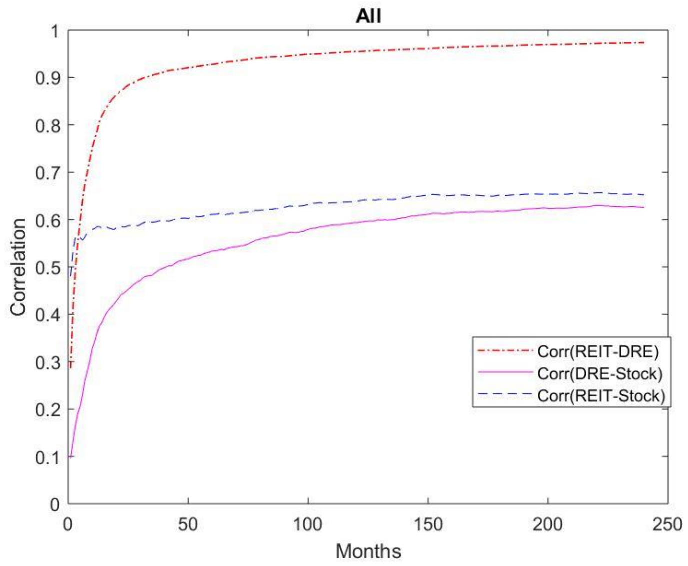
In this section, we analyze the correlations between the REITs, direct real estate and stocks derived from the parameter estimates in the vector error correction model. Correlation estimates are constructed from the B, D and Ω matrices. To account for the weak exogeneity of stocks and REITs for the Office and Retail sectors, we set α_S and α_R to zero. Similarly, to account for the long-run exclusion of stocks we set β_S to zero. For each time horizon, T according to our simulation procedure, we randomly draw observations from the vector of error terms φ_t using the estimated covariance matrix Ω. The cumulative returns for horizon T are the sum of returns for each component of the vector X_t for all three assets. Using 10,000 draws from this distribution, we calculate the three pairwise correlations between cumulative returns for each time horizon, T.

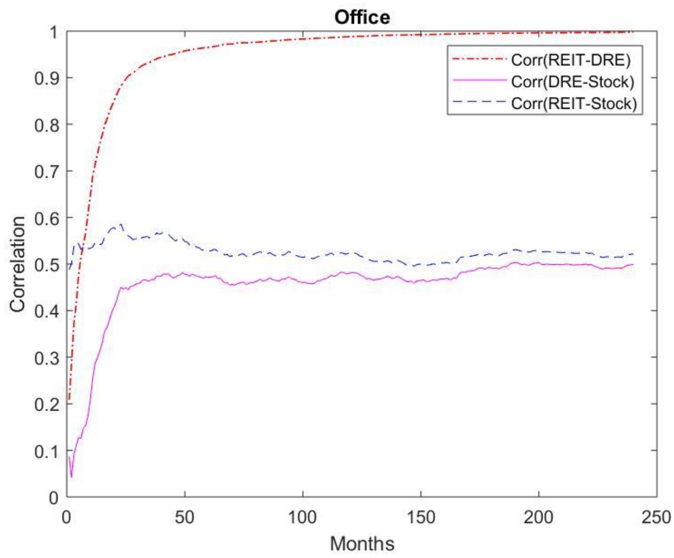
Figure 4 represents the three correlation pairs for the entire market and for the different property sectors. We illustrate the correlations for time periods from $T=1$ to $T=240$ months. For the correlation between REITs and direct real estate, we observe an increasing trend. The correlations are relatively high and exceed 0.9 for periods of four years or more. The correlation between REITs and direct real estate return is getting close to one when T exceeds 100 months for Retail REITs and when T exceeds 200 months for Office REITs.

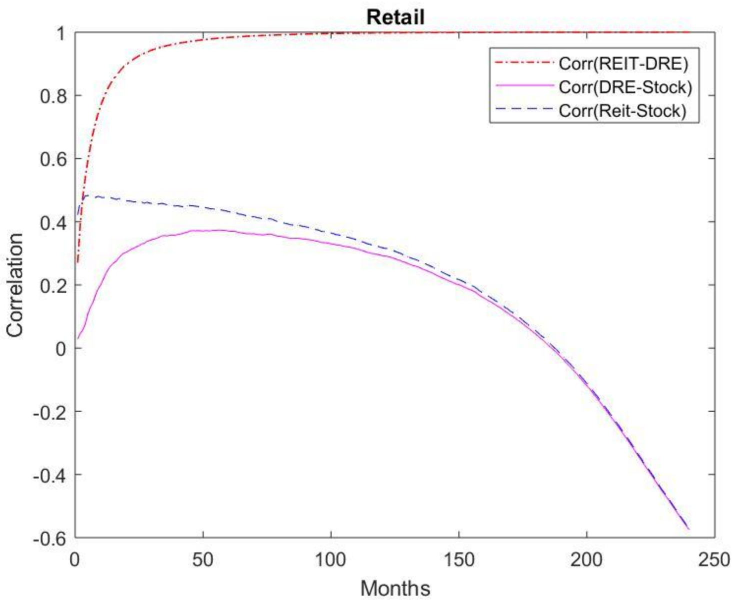
The correlation between REITs and stocks are fluctuating around 0.5 to 0.6 for the Office sector. The correlations between REITs and stocks are always lower than the correlations between REITs and direct real estate, both over the short and over the long horizon. Interestingly, the correlation of the Hotel and Retail REITs with stocks are showing a decreasing pattern and turns negative for longer time horizons. This suggests that REITs can be used to hedge long positions in the stock market.

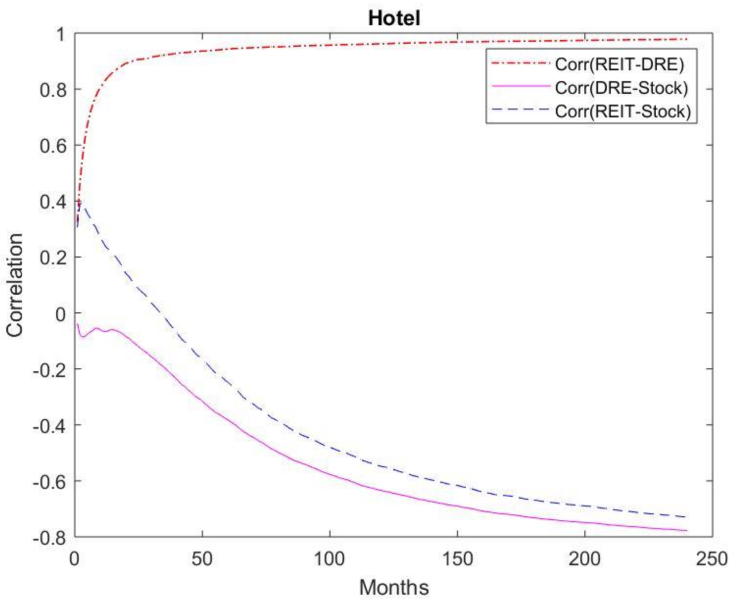
The correlation between Office direct real estate and stock return are showing an increasing trend and fluctuating around 0.4 to 0.5. For the entire market, the correlation between direct real estate and stocks increases with the holding period, yet at a decreasing rate, and remains between 0.5 and 0.6 for longer time horizons. As the time horizon increases, the correlation between REITs and stocks as well as direct real estate and stocks tend to converge, most notably for the Retail sector. This pattern is observed for the other property sectors (Overall, Office, and Hotel), yet the convergence is slower as the correlations exhibit almost a parallel pattern.

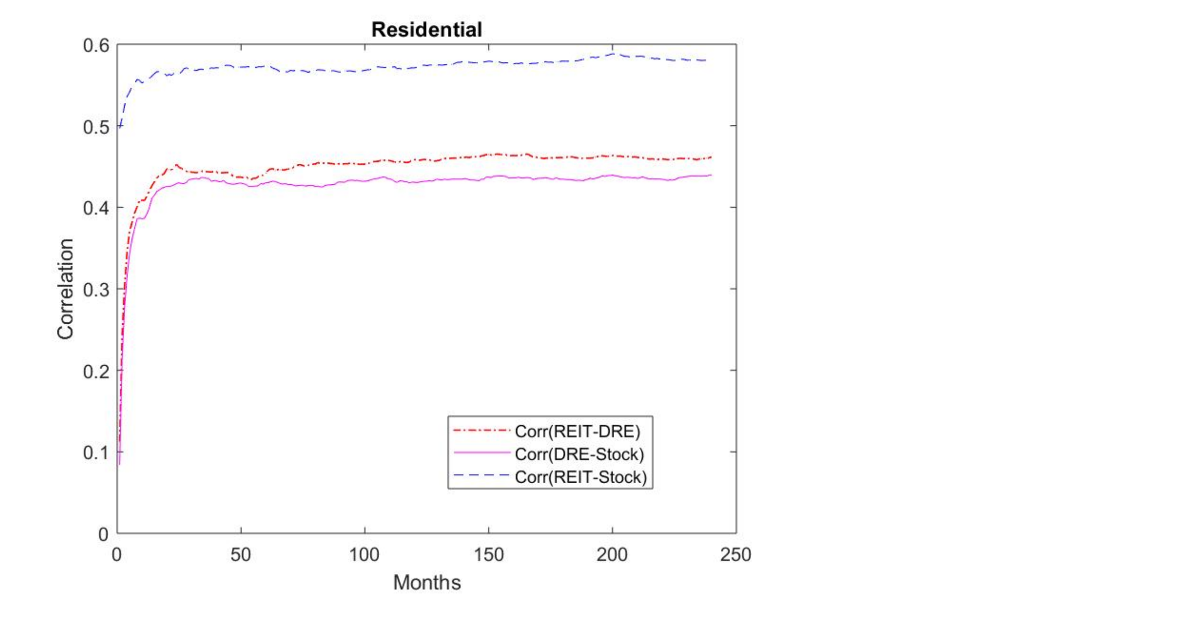
Figure 4 Correlations between REIT and Direct Real Estate, REITs and Stocks and Direct Real Estate and Stocks Return for All and for Individual Property Sectors.






Retail
Corr(REIT-DRE)
Corr(DRE-Stock)
Corr(Reit-Stock)
Correlation
Months
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
0
50
100
150
200
250

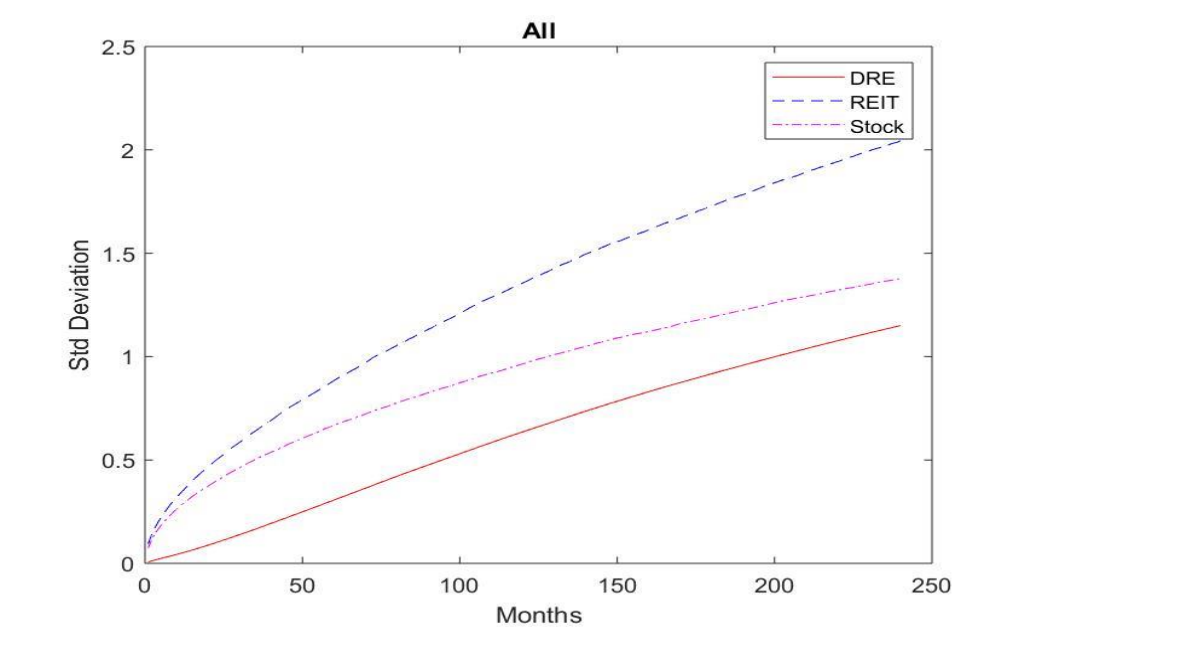

Hotel
Corr(REIT-DRE)
Corr(DRE-Stock)
Corr(REIT-Stock)
Correlation
Months
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
50
100
150
200
250



The Residential sector exhibits different correlation patterns because there is no co-integration relationship between the assets in this sector, that is the return dynamics follows a vector autoregressive (VAR) process. The correlation between Residential REITs and stocks fluctuates around 0.5 and 0.6 levels whereas the correlation between REITs and direct real estate as well as stocks and direct real estate fluctuates around 0.4 to 0.5 for holding periods of two years or more. The correlation between Residential direct real estate and stocks are even lower where it stays around 0.3 and slightly above 0.4. Our correlation between residential REITs and direct real estate are comparable with, albeit slightly lower than, the estimates of around 0.6 reported by Mackinnon & Al Zaman (2009) and Pagliari (2017) for the U.S. market. Our findings for Japan on the ranking of the pairwise correlations exhibit some differences with earlier studies of the US market which find that the correlation between REITs and stocks are higher than the correlation between the REITs and direct real estate in the short-run, when T is less than 12 months (Boudry, Coulson, Kallberg, & Liu, 2012; Morawski et al., 2008). In Japan, by contrast, the correlation between REITs and stocks return are always higher than the correlation between the direct real estate and stocks.

To examine the aspect of risk, in Figure 5 we represent the standard deviation for the cumulative sum of return as a function of the time horizon, T for the three assets. We observe that REITs are more volatile than stocks which in turn are more volatile than investments in direct real estate for all time horizons. These findings point to the limited diversification benefits of REITs when included in a portfolio of stocks instead of direct real estate.

Figure 5 Standard deviations of cumulative returns over different time horizons



7. Conclusion

Since the turn of the century, REITs in Japan has experienced steady growth and are increasingly viewed as an asset class able to deliver a variety of benefits to investors. Against the backdrop of high-level popularity, the fundamental characteristics of J-REITs as an asset remain under-researched. In this paper, we propose a novel method for deriving the correlations of REITs with direct real estate and the stock market in Japan in a model which takes into account the long-run interdependence and short-run dynamics of these assets. In line with results for countries in which REITs have been in existence over a longer time period, we find that REITs are a hybrid asset sharing some characteristics of the underlying physical real estate assets they derive income from and some characteristics of equity to which they bear similarity both with regard to business organization and trading marketplace. We find that, in general, REITs are more correlated with stocks and with direct real estate than direct real estate and stocks are, and that REITs are more volatile. Hence, there is a trade-off between diversification potential and other benefits that REITs offer to investor (e.g. liquidity, transparency, convenience, and simplicity in terms of management). Our analysis also reveals marked differences across market segments. While the correlations between REITs and the other assets in the Office and Residential sectors are increasing in the holding period, in the Hotel and Retail sectors they are decreasing and turn negative for longer horizons. Thus, the diversification benefits of REITs critically depend on the sectors in which they invest.

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