The Dynamic Relationship Between the Commercial Real Estate and Real Estate Investment Trusts Markets

Majid Haghani Rizi*

Abstract

In this paper, we investigate the dynamic relationship between the commercial property market and the real estate investment trusts market at the aggregate and property levels by undertaking a cointegration analysis. The results suggest that there exists a common long-run cointegrating relationship between the commercial property and real estate investment trusts markets at the aggregate and property levels. Any disequilibrium in this long-run relationship between these markets is corrected by movement in the real estate investment trusts market. Further, to address the extent of movement in these variables as part of one cointegrated system into permanent and transitory components, we use the Kalman filter by conducting a state-space model. The results show that the cyclical component in the real estate trusts market is large at the aggregate and property levels, which are consistent with cointegrations results.

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1 Introduction

While the real estate market plays an important role for investors to manage their risks, this market was at the center of the financial crisis during 2007–2008 and thus, has attracted the attention of academics. During the 2000–2001 recession, when a collapse in the stock market was not followed by a collapse in the real estate and housing market, this led to considering the real estate market as an alternative for investments. The real estate and housing market through the housing net wealth effect can impact households and investment decisions. The recent financial crisis was unique because it started with a significant decline in the real estate market and was followed by a decline in the stock market. This led to a run on shadow banking and then the extraordinary events in the financial system, which, through the wealth effect, led to a decline in GDP and the recent recession.

There are two ways to invest in the real estate market; directly and indirectly. Investors and households can buy properties, hold and then manage them with direct ownership. Real estate investment trust companies are an alternative to investing in the commercial real estate market, which is more efficient and liquid. Further, with low transaction costs, one can buy their share prices as common stocks and indirectly invest in the commercial real estate market. While both of these markets are underlying with the commercial property market, they have different risk characteristics, cost of capital and volatility of returns.

The real estate market and the stock market, around the time of the financial crisis, were both extremely volatile. Defaults and foreclosures in the real estate market in 2007 and 2008 were followed by a fall in the stock market and real estate investment trusts. Figure 1 provides a comparison of the total return S&P 500, real estate trusts index, and commercial property price index. This figure shows that the collapse of the real estate market from 2007 to 2009 was followed by a collapse in the total return of the stock market, as well as the real estate investment trusts total returns. This behavior is common among all sectors of real estate. Figure 2 shows the relationship between the real estate investment trusts market and the commercial property

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1 Among others, see Case et al. (2005); Hurst and Stafford (2004); Campbell and Cocco (2007); Cooper (2009); Mian and Sufi (2011); Haghani Rizi and Kishor (2016)
2 Among others, see Gorton et al. (2010); Pozsar et al. (2010); Covitz et al. (2013); Haghani Rizi and Kishor (2017)
3 Among others, see Riddiough et al. (2005); Carlson et al. (2010); Pavlov and Wachter (2011); Yunus et al. (2012); Ling and Naranjo (2015)
market for apartments, office, retail, and industry, and at the aggregate level in the United States. It shows that the commercial property market and real estate investments trust market fell from a high around 2007 to a low around 2009 for all sectors. Further, the real estate investment trusts market is more volatile than the commercial property market. The simultaneous development in these markets poses an interesting question: did development in the commercial property market lead to an increase in demand for real estate investment trusts and hence, the explosion in the size of the real estate investment trusts market? Or, did investments by real estate investment trusts in the commercial property market lead to a significant increase in the commercial real estate market?

Understanding the dynamic relationships between direct and indirect commercial real estate markets is of an interest in academia and industries. In this paper, we examine the dynamic relationships between the commercial property (CP, hereafter) market and the real estate investment trust (REIT, hereafter) market in the United States. We address this relationship for four types of sectors: apartment, retail, office, and industrial, as well as at the aggregate level in the United States. To do so, in the first stage we examine whether these markets move together over the long run by examining the existence of a shared common trend or cointegration among these variables at the aggregate and sector levels from 2000 through 2017. In the second step, we examine which of these variables adjusted to correct the disequilibrium in the short-run by using vector error-correction methodology. Using the information from the long-run cointegration model, we also decompose the movements in the CP and REIT markets into a trend and a cycle. This allows us to measure the extent of movements in these variables, which are permanent and transitory.

Using monthly data from 2000 to 2017, our results show that the CP and REIT markets are cointegrated and do move together in the long run at the aggregate and sector levels. Because the REIT market co-moves with the CP market over the long run, any short-run disequilibrium needs to be corrected. Our results show that if there is a disequilibrium in the long-run relationship between the REIT and CP markets, it is only the REIT market that responds to any deviation, while the CP market does not participate in the error-correction process at the aggregate and sector levels. These results shed some light on the question about the simultaneous development of the CP and REIT markets, and whether the explosive growth in the CP market also led to the development of the REIT market.
Given the finding that the REIT markets move to correct the disequilibrium, we utilize this information to decompose the movements in these two markets into trends and cycles by the multivariate Beveridge–Nelson (BN) trend-cycle decomposition. Our results show that the REIT cycle and CP cycle share very similar dynamics. We find that the cyclical component of the REIT market is bigger at the aggregate and sector levels. These results are consistent with the short-run relationship findings when we find that the REIT market moves to correct for any disequilibrium. Our results from the estimated cycle show sizable oscillations in these markets around the financial crisis, while there is significant heterogeneity among sectors. In addition, we find that there is a substantial positive cycle in the REIT market before the financial crisis, which implies a significant negative movement in the future in the REIT market at the aggregate and sector levels.

This paper is most closely related to a number of recent studies on the relationship between direct and indirect commercial property markets. Pagliari et al. (2005) and Riddiough et al. (2005) document the correlation and long-run relationship between real estate returns and REIT returns. Mühlhofer (2013) find a link between direct property returns and REIT returns in the short run by using a linear factor model, while Yunus et al. (2012) find long-run and short-run relationships between these two markets. Carlson et al. (2010) propose a general equilibrium model to understand the co-movements of commercial property price and REIT prices. Moreover, they show a positive correlation between these two markets, as well as the markets being imperfect and volatile over time. Pavlov and Wachter (2011) find a positive relationship between REIT and commercial property returns only in the office sector, while there are very weak and insignificant relationships in other types of properties when they use Carlson et al. (2010) model. Basse et al. (2009) address the relationship between REITs and utility stocks in the United States and show investment in REITs becoming riskier relative to investments in the utility market during the recent financial crisis, which has roots in the property market. Hoesli and Oikarinen (2012) examine whether the REIT market is closer to the CP market or general stock market by using variance decompositions and impulse responses for the U.S., U.K., and Australia. They find the REIT and CP markets are more substitute than the stock market in the long run, while the short-run movement between the REIT and stock markets is stronger than that between the CP and REIT markets. In contrast, Glascock et al. (2000), Chan et al. (2005), and Ling and Naranjo (2015) show that the REIT market behaves more like stocks than the commercial property market. Sun et al. (2015) show that a significant part of the volatility in REIT prices is because of anticipated
costs associated with financial distress during the recent financial crisis. Clayton and MacKinnon (2001, 2003) show that the relationship between REIT returns and returns to stocks and real estate has changed over time. They find the REIT market was closer to the stock market during the 1970s to 1980s but became better related to the commercial property market in the 1990s.

Whether the REIT market is related to the commercial real estate market or it moves by stock market factors, investment in the REIT, like other stocks, is related to macroeconomic conditions. Goodman (2003) and Ewing and Payne (2005) examine the relationship among macroeconomic factors and REIT returns. They show the REIT is highly correlated to the housing price index as one of the macroeconomic conditions. However, there are findings that show REIT returns do not follow the movements of the housing market. This paper extends the literature on the short-run and long-run relationships between the REIT and the commercial property markets by determining this link for four types of commercial real estate sectors by applying Dynamic OLS, VECM methods, and state-space models to extend the cointegration relationship in permanent and transitory movement. Moreover, we use commercial property price indices data published by Real Capital Analytics (RCA), which are more accurate indices for the commercial property market than house price indices. These were used in previous studies. (See, He (2000); Nishigaki et al. (2007); Chang et al. (2011); Highfield et al. (2015))

The remainder of this paper is structured as follows: in Section 2, we provide a background on the data used in the empirical analysis. Section 3 provides methodological issues and the empirical evidence. Finally, the conclusions are presented in Section 4.

2 Data

To consider the dynamic relationship between the CP and REIT markets, we use monthly data for apartment, office, retail, and industrial sectors and at the aggregate level for the period from 2000 to 2017 in the United States. The summary of data is presented in Table 1 and suggests that the REIT market for all sectors and the All REIT are more volatile than the CP market, as measured by the standard deviation. Figure 1 plots the price index of the CP and REIT markets

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4 Among others, see, Lizieri and Satchell (1997); Riddiough et al. (2005); Pagliari et al. (2005); Chang et al. (2011); Ling and Naranjo (2015)

5 Highfield et al. (2015) use S&P Case Shiller House Price Index, He (2000); Nishigaki et al. (2007) use the median sale price index of new houses, Chang et al. (2011) use the housing price index from the Office of Federal Housing Enterprise Oversight.
for different sectors and the All REIT over time. It is clear that the volatility of the REIT price index is much larger than that of the CP price index, both at the aggregate and sector levels. In addition, this figure shows that the CP and REIT markets move very closely together at the sector and aggregate levels in the United States. This provides very preliminary evidence of the potentially strong interconnections that exist between these two markets.

**Commercial Property**  In this paper, we collect the Commercial Property Price Index (CPPI, hereafter) as indicators of the CP market that Real Capital Analytics published by property types in the United States. Real Capital Analytics use a structural time series to estimate the property price changes over time for commercial properties. In this study, we use the seasonally adjusted Commercial Paper Index for different sectors; apartment, retail, office, and industries, as well as the aggregate level.\(^6\) Figure 2 shows the monthly CPPI. Thus, it is clear that the CP market collapsed during the financial crisis of 2007–2009 and then started to increase thereafter.

**Real Estate Investment Trust**  Real estate investment trusts own, operate, or invest in commercial property. The National Association of Real Estate Investment Trusts (NAREIT) collects and publishes REITs data. Data series are focused on the commercial real estate market, which is linked to rental income. In this paper, we use the REIT price index series for apartments, offices, retail, and industries, and All REIT at the aggregate level. Figure 2 shows the monthly data in sector levels and all REIT. This figure shows that the REIT price index declined during the financial crisis and has started to back the same trend, while there is a significant heterogeneity among sectors regarding to this behavior.

### 3 Empirical Results

We first undertake a preliminary exercise in examining the relationships between the REIT and CP markets for all sectors and the aggregate level. For this purpose, we decompose the movements in the REIT and the CPPI for all sectors into a trend and a cycle using the Hodrick–Prescott filter. Our results clearly show that there is a positive correlation between the CPPI cycle and the cycle of the REIT. Next, we examine long-run and short-run relationships by using dynamic ordinary least squares (DOLS) and the vector error-correction model (VECM) methods. Then, we use the cointegration information and extend dynamic relationships into permanent and transitory

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\(^6\)See [www.rcanalytics.com](http://www.rcanalytics.com) for more information
movements.

3.1 The Long-Run Relationship

To study the long-run cointegrating relationship, it is important first to test whether each variable is nonstationary. An alternate method to examine the relationship between these markets would have been a VAR model. However, that would have required differencing the series, which would have thrown off the information in the levels of the series. We exploit the information present in the levels of these series by adopting the cointegration approach. Table 2 summarizes the results of the unit root test. We find that the levels of the REIT price index and CPPI at the aggregate and sector levels contain a unit root, whereas the null hypothesis of the existence of the unit root is rejected for the first difference form of these variables.

Let $reit_{it}$ and $cp_{it}$ represent the natural logs of the real REIT and real CPPI for the apartments, offices, retail, and industrial areas, and the aggregate level. Given that these variables are nonstationary in levels, the following Equation 1 presents the long-run relationship between the three variables:

$$resit_{i,t} = \beta_0 + \beta_1 cp_{i,t} + \epsilon_{i,t}$$

where $\beta_0$ is the intercept and $\beta_1$ is the slope coefficients for the CPPI. If there exists a common long-run movement between these variables, then the estimated cointegrating residual $\hat{\epsilon}_{it} = reit_{it} - \hat{\beta}_0 - \hat{\beta}_1 cp_{it}$ should be stationary. To check for the stationarity of estimated residuals, the standard unit root test is applied. Here, the coefficients ($\beta_0$ and $\beta_1$) of Equation 1 constitute the cointegrating vector of the system, which reflects how these variables move together in the long run. One would expect that an increase in $cp_{it}$ would have a positive impact on $reit_{i,t}$. Consequently, $\beta_1$ is expected to have a positive sign at the aggregate level and property types. Further, the relative size of $\beta_1$ would provide information about the relative influence of the CPPI on the REIT in the long run, as these slope coefficients capture the elasticity of the REIT with respect to the CPPI. To estimate the cointegrating relationship between the REIT and the CPPI, we adopt the dynamic ordinary least squares (DOLS) methodology. Given the possibility of serial correlation in the error term, we use Newey–West heteroscedastic autocorrelation consistent standard errors.\(^7\) More
specifically, the following DOLS is estimated with lags selected based on the Akaike information criterion (AIC):

\[ reit_{i,t} = \beta_0 + \beta_1 cp_{i,t} + \sum_{i=0}^{n} \gamma_i \Delta cp_{i,t-i} + e_{i,t} \]  

Panel A in Table 3 shows that the null hypothesis of the existence of the unit root in the estimated cointegrating residual (\( \hat{e}_{i,t} = reit_{i,t} - \hat{\beta}_0 - \hat{\beta}_1 cp_{i,t} \)) is rejected. Panels B and C in Table 3 summarize the results of the cointegration from ? and ?. These results are shown for the robustness check of our baseline DOLS model. Based on the Johansen test, there is at least one cointegrating vector between the REIT and the CPPI at the aggregate and sector levels. In addition, the results of the Engle–Granger test show that the null hypothesis of the unit root in the residual from the regression of the reit on the cp is rejected, suggesting the existence of a cointegrating relationship between the REIT and CPPI. Table 4 presents the DOLS estimates along with the p-values. The results clearly show that all coefficients (\( \beta_0 \) and \( \beta_1 \)) that capture the cointegrating relationship are highly significant and the cointegrating residual is stationary. This implies that the REIT and the CPPI share a statistically significant and common long-term trend between them.

Further, evidence suggests that a one percent increase in the CPPI leads to an increase in the REIT price index by 0.89 percent at the aggregate level, 1.03 percent for the retail and industries sectors, and 0.84 percent for the office sector in the long run. Figure 3 shows the estimated residuals obtained from the DOLS method and represents how the estimated cointegration residual behaved over time. We find that before the recent financial crisis, the REIT price index was higher than their long-run relationship. However, from 2008 to 2010, the movement of REITs was significantly below the long-run value. We also find that after the recent financial crisis, the REIT expanded above the long-run relationship, which implies that either the REIT is expected to decrease or the CPPI is expected to increase in the future for all types of properties and aggregate levels, while there is a significant heterogeneity among sectors.

### 3.2 The Short-Run Relationship

If there exists a long-run relationship among integrated variables, then at least one of the variables moves to correct any short-run disequilibrium. Based on this idea, the Engle–Granger least squares.
representation theorem provides the vector error-correction model (VECM) representation of the cointegrated system. The VECM, as posited by Engle and Granger (1987), has the following representation:

\[ \Delta Y_t = \nu + \Gamma(L)\Delta Y_{t-1} + \alpha \beta' Y_{t-1} + \epsilon_t \]

where, \( \Delta Y_t = (\Delta reit_{i,t}, \Delta cp_{i,t})' \) represents the vector of the first differences of the three variables and \( \Gamma(L) \) represents a finite-order distributed lag operator. The vector of adjustment parameters is given by \( \alpha = (\alpha^{reit}, \alpha^{cp})' \). In this model, the number of lags is chosen based on the AIC and then the following system of equations is estimated:

\[ \Delta reit_{i,t} = \gamma_{10} + \gamma_{11} \Delta reit_{i,t-1} + \gamma_{12} \Delta cp_{i,t-1} + \ldots + \gamma_{14} \Delta reit_{i,t-1} + \alpha^{reit} \beta' Y_{t-1} + \epsilon_{reit_{i,t}} \tag{3} \]

\[ \Delta cp_{i,t} = \gamma_{20} + \gamma_{21} \Delta reit_{i,t-1} + \gamma_{22} \Delta cp_{i,t-1} + \ldots + \gamma_{24} \Delta reit_{i,t-1} + \alpha^{cp} \beta' Y_{t-1} + \epsilon_{cp_{i,t}} \tag{4} \]

The last period disequilibrium is represented by \( \beta' Y_{t-1} = reit_{i,t-1} - \beta_0 - \beta_1 cp_{i,t-1} \). The statistical significance of coefficients \( (\alpha^{reit}, \alpha^{cp}) \) indicates that the corresponding variable corrects in the current period in response to the previous period’s shock, which disturbed the long-term equilibrium. If at least one of the \( \alpha \)’s is significantly different from zero, then we can conclude that \( Y_t \) is cointegrated.

Table 5 represents the VECM results, which show that \( \alpha^{reit} \) is statistically significant, while, \( \alpha^{cp} \) is not at the sector and aggregate levels. This implies that the REIT markets will correct any deviation of the CP markets from the shared long-run trend, while the CP markets do not participate in the error-correction process. Our results show that the speed of adjustment at the aggregate level and office sector are \(-0.13\), which implies that about half of the equilibrium gap is restored within 2 to 3 years. However, the apartment, retail, and industrial sectors have a slower adjustment process, with a half-life ranging between 4 and 6 years. Thus, while there is a shared long-run relationship between the REIT and CP markets, the error correction is only done by the REIT market. In addition, based on the magnitude of the coefficient \( \alpha^{REIT_{si}} \), REIT markets converge to the long-run equilibrium value relatively faster for the office sector and the aggregate level than for the apartment, retail, and industrial sectors.
3.3 Beveridge–Nelson Decomposition

Given that there exists a cointegrating relationship between the REIT and CP markets, we can use this information to perform a trend-cycle decomposition. This exercise will further help us understand the trend and cyclical component of the REIT and CP markets that are a part of one cointegrated system. In particular, it allows us to measure the extent of the movement in these variables that are permanent and transitory in nature. Moreover, it can also reinforce the results found in the above sections.

The cointegration results at the aggregate level, as well as the sector levels, suggest that between the REIT and CP market, it is the REIT that error corrects, whereas the CP does not. If that is the case, then the cyclical component of the REIT should be able to identify these dynamics for all sectors and the aggregate level. We use a state-space approach to estimate the permanent and transitory components of an integrated time series. Based on the VECM model presented above, the transition equation of the state-space system is represented as:

\[
\begin{bmatrix}
\Delta \text{reit}_{i,t}^* \\
\Delta \text{cp}_{i,t} \\
\Delta \text{reit}_{i,t-1} \\
\Delta \text{cp}_{i,t-1} \\
\Delta \text{reit}_{i,t-2} \\
\Delta \text{cp}_{i,t-2} \\
\Delta \text{reit}_{i,t-3} \\
\Delta \text{cp}_{i,t-3} \\
\beta'Y_t
\end{bmatrix} =
\begin{bmatrix}
\gamma_{11} & \gamma_{12} & \gamma_{13} & \gamma_{14} & \gamma_{15} & \gamma_{16} & \gamma_{17} & \gamma_{18} \\
\gamma_{21} & \gamma_{22} & \gamma_{23} & \gamma_{24} & \gamma_{25} & \gamma_{26} & \gamma_{27} & \gamma_{28} \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
\beta' & \gamma_{91} & \gamma_{92} & \gamma_{93} & \gamma_{94} & \gamma_{95} & \gamma_{96} & \gamma_{97} & \gamma_{98} & \alpha
\end{bmatrix}
\begin{bmatrix}
\Delta \text{reit}_{i,t-1}^* \\
\Delta \text{cp}_{i,t-1} \\
\Delta \text{reit}_{i,t-2}^* \\
\Delta \text{cp}_{i,t-2}^* \\
\Delta \text{reit}_{i,t-3}^* \\
\Delta \text{cp}_{i,t-3}^* \\
\beta'Y_{t-1} \\
e_{Y,t}
\end{bmatrix}
\]

(5)

In this model, \( \Delta \text{reit}_{i,t}^* = \Delta \text{reit}_{i,t} - \mu \) and \( \Delta \text{cp}_{i,t}^* = \Delta \text{cp}_{i,t} - \mu \) are demeaned \( \text{reit}_i \) and \( \text{cp}_i \) and

\[
\begin{align*}
\gamma_{11} &= \text{gamma}_{11} - \beta_{\gamma_{21}}, \\
\gamma_{12} &= \text{gamma}_{12} - \beta_{\gamma_{22}}, \\
\gamma_{13} &= \text{gamma}_{13} - \beta_{\gamma_{23}}, \\
\gamma_{14} &= \text{gamma}_{14} - \beta_{\gamma_{24}}, \\
\gamma_{15} &= \text{gamma}_{15} - \beta_{\gamma_{25}}, \\
\gamma_{16} &= \text{gamma}_{16} - \beta_{\gamma_{26}}, \\
\gamma_{17} &= \text{gamma}_{17} - \beta_{\gamma_{27}}, \\
\gamma_{18} &= \text{gamma}_{18} - \beta_{\gamma_{28}}, \\
\end{align*}
\]

and \( e_{Y,t} = e_{\text{mmf},t} - e_{\text{cp},t} - e_{\text{repo},t} \).

The stated model can be compactly written as:

\[
\Delta X_t = F\Delta X_{t-1} + \nu_t
\]

(6)
The BN cycles for the three markets are the first three elements of \(-F(I - F)\Delta X_t\) matrix. Figures 4, 5, and 6 show the results from the BN decomposition for the reits_i and cp_i. Figure 4 shows the cyclical component for each variable, whereas 5 and 6 show the trend and the actual values for these variables at the aggregate and sector levels.

Figures 5 and 6 show that for the REIT markets, trends and actual values significantly overlap with each other, as compared with the trends and actual values of the CP at the aggregate and sector levels. The difference between the trend and the actual level (Figure 4) shows that the cyclical components in case of the REIT are fairly small compared with the CP cycles. These results further support the evidence found in the previous section, that the REIT adjusts for any short-term deviations in long-run relationships. Among these sectors, the actual behavior of the office sector is the closest to its trend line in REIT (Fig. 4). Further, REIT cycles show some evidence of sustained deviations from the zero-mean line for all sectors and the aggregate level. The overall results are consistent with the evidence found from the cointegration and VECM exercise in the previous section.

4 Conclusion

This paper examines the dynamic relationship between the commercial property real estate investment trusts markets at the aggregate and sector levels, as well as the apartment, office, retail, and industrial industries. Our results show that the CP market is cointegrated with the REIT market and they move together in the long run for all sectors and the aggregate level. We find that any deviation of the REIT and CP markets from their long-run equilibrium forces the REIT market to error correct to restore the equilibrium’s path. Because the REIT markets move to correct for the disequilibrium, most of the variations in it are transitory compared with the movements in the CP markets, which are permanent. This implies that the short-run movements in the REIT markets are independent of the movements in the CP markets at the aggregate level, as well as the sector levels. Further, we use the information from the cointegration relationship to estimate permanent and transitory components. Our results from the multivariate Beveridge–Nelson cycle corroborate the findings from the VECM and capture the recent boom and bust of these markets.
References


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Hurst, E. and F. P. Stafford (2004). Home is where the equity is: Mortgage refinancing and household consumption. *Journal of money, Credit, and Banking* 36(6), 985–1014.


Table 1: Descriptive Statistics

<table>
<thead>
<tr>
<th>Statistic</th>
<th>N</th>
<th>Mean</th>
<th>St. Dev.</th>
<th>Min</th>
<th>Max</th>
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<tbody>
<tr>
<td>CPPI-All</td>
<td>203</td>
<td>87.563</td>
<td>13.383</td>
<td>67.555</td>
<td>112.348</td>
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<td>CPPI-Apartment</td>
<td>203</td>
<td>93.069</td>
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<tr>
<td>CPPI-Industrial</td>
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<td>12.167</td>
<td>69.259</td>
<td>110.028</td>
</tr>
<tr>
<td>CPPI-Office</td>
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<td>84.668</td>
<td>13.240</td>
<td>64.370</td>
<td>110.704</td>
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<tr>
<td>REITS-All</td>
<td>203</td>
<td>146.733</td>
<td>31.146</td>
<td>62.841</td>
<td>223.841</td>
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<tr>
<td>REITS-Apartment</td>
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<td>236.787</td>
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<td>78.421</td>
<td>379.689</td>
</tr>
<tr>
<td>REITS-Industrial</td>
<td>203</td>
<td>221.910</td>
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<td>455.547</td>
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<td>REITS-Office</td>
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<td>270.399</td>
<td>55.023</td>
<td>112.060</td>
<td>450.318</td>
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</table>

Note: The table reports the summary statistics for the Commercial Property Price Index (CPPI) and the Real Estate Investment Trust price index (REIT) at the aggregate (All) and sector levels; Apartment, Retail, Industrial, Office.

Table 2: Unit Root Test

<table>
<thead>
<tr>
<th>Variable</th>
<th>Level ADF</th>
<th>Level P-Value</th>
<th>First Difference ADF</th>
<th>First Difference P-Value</th>
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<tr>
<td>CPPI-All</td>
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<td>0.00</td>
<td></td>
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<td>0.435</td>
<td>0.00</td>
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<tr>
<td>CPPI-Retail</td>
<td>0.834</td>
<td>0.00</td>
<td></td>
<td></td>
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<tr>
<td>CPPI-Industrial</td>
<td>0.576</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPPI-Office</td>
<td>0.701</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>REITS-All</td>
<td>0.649</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>REITS-Apartment</td>
<td>0.418</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>REITS-Retail</td>
<td>0.70</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>REITS-Industrial</td>
<td>0.966</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>REITS-Office</td>
<td>0.872</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: ADF denotes the augmented Dickey–Fuller tests test. The null hypothesis is unit root.
Table 3: Cointegration Test

Panel A: Cointegration results from the DOLS approach

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Apartment</th>
<th>Retail</th>
<th>Industrial</th>
<th>Office</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residual</td>
<td>ADF P-Value</td>
<td>0.03</td>
<td>0.02</td>
<td>0.03</td>
<td>0.08</td>
</tr>
</tbody>
</table>

Panel B: Cointegration results from Engle and Granger (1987)

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Apartment</th>
<th>Retail</th>
<th>Industrial</th>
<th>Office</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residual</td>
<td>ADF P-Value</td>
<td>0.00</td>
<td>0.01</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Panel C: Cointegration results from Johansen (1991)

<table>
<thead>
<tr>
<th>Cointegration Vectors</th>
<th>All Trace statistic</th>
<th>Apartment Trace statistic</th>
<th>Retail Trace statistic</th>
<th>Industrial Trace statistic</th>
<th>Office Trace statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>44.38</td>
<td>51.77</td>
<td>39.65</td>
<td>36.81</td>
<td>40.87</td>
</tr>
<tr>
<td>At most 1</td>
<td>2.79</td>
<td>3.65</td>
<td>2.53</td>
<td>2.09</td>
<td>36.81</td>
</tr>
</tbody>
</table>

Note: This table represents the cointegration results. Panel A reports the estimates of the unit root for the residual of DOLS and panel B shows the estimates from Engle and Granger (1987). ADF denotes the augmented Dickey–Fuller test. Panel C shows the estimated from Johansen (1991) for 0.05 critical value.

Table 4: The Dynamic OLS estimate of the Cointegrating Vector

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Apartment</th>
<th>Retail</th>
<th>Industrial</th>
<th>Office</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient</td>
<td>Value P-Value</td>
<td>Value P-Value</td>
<td>Value P-Value</td>
<td>Value P-Value</td>
<td>Value P-Value</td>
</tr>
<tr>
<td>$\beta_0$</td>
<td>0.97 0.16</td>
<td>0.73 0.48</td>
<td>0.85 0.54</td>
<td>-3.41 0.00</td>
<td>1.86 0.01</td>
</tr>
<tr>
<td>$\beta_1$</td>
<td>0.89 0.00</td>
<td>1.03 0.00</td>
<td>1.03 0.00</td>
<td>1.95 0.06</td>
<td>0.84 0.00</td>
</tr>
</tbody>
</table>

Note: The table reports Dynamic OLS estimates $\beta_0$ and $\beta_1$, represent the coefficients from the cointegration regression: $reit_{i,t} = \beta_0 + \beta_1 cp_{i,t} + \sum_{i=0}^{n} \gamma_i \Delta cp_{i,t-i} + \epsilon_{i,t}$.
Table 5: Summary of Coefficients of Lagged Residuals from VECMs

<table>
<thead>
<tr>
<th></th>
<th>$\Delta reits$</th>
<th>$\Delta cp$</th>
</tr>
</thead>
<tbody>
<tr>
<td>All REITs</td>
<td>-0.1312</td>
<td>0.0021</td>
</tr>
<tr>
<td></td>
<td>(0.0000)</td>
<td>(0.1464)</td>
</tr>
<tr>
<td>Apartment</td>
<td>-0.0502</td>
<td>0.0009</td>
</tr>
<tr>
<td></td>
<td>(0.0443)</td>
<td>(0.3278)</td>
</tr>
<tr>
<td>Retail</td>
<td>-0.0723</td>
<td>0.0001</td>
</tr>
<tr>
<td></td>
<td>(0.0000)</td>
<td>(0.8758)</td>
</tr>
<tr>
<td>Industrial</td>
<td>-0.0882</td>
<td>0.0001</td>
</tr>
<tr>
<td></td>
<td>(0.0011)</td>
<td>(0.8756)</td>
</tr>
<tr>
<td>Office</td>
<td>-0.1363</td>
<td>0.0008</td>
</tr>
<tr>
<td></td>
<td>(0.0000)</td>
<td>(0.5942)</td>
</tr>
</tbody>
</table>

Note: The table reports the estimates coefficients of lagged residuals from the VECM ($\Delta Y_t = \nu + \Gamma(L)\Delta Y_{t-1} + \alpha\hat{\beta}'Y_{t-1} + \epsilon_t$) for aggregate level as well as sector levels.

Figure 1: Total Return Comparison

Notes: This graph presents total return index of REITs, CPPI, and S&P 500 from 2000 to 2017.
Figure 2: Commercial Property Price Index and Real Estate Investment Trusts

Notes: The graph shows the monthly price index of CP and REIT markets at aggregate (All) and sector levels; Apartment, Office, Retail, Industrial from 2000 to 2017.

Figure 3: Residual from the DOLS

Notes: This figure shows the estimated cointegrating residual from the long-run relationship between the CP and REIT markets as represented by \( resit_{it} = \beta_0 + \beta_1 cP_{it} + \epsilon_t \).
Figure 4: Estimated Cycle from the Beveridge-Nelson decomposition

Notes: The graphs present the Beveridge-Nelson cycles of the CP and REIT markets at the aggregate (All) and sectors levels.

Figure 5: Estimated Trend from the Beveridge-Nelson decomposition (REIT markets)

Notes: The graphs present the trend and actuals of the REIT market at the aggregate (All) and sector levels.
Figure 6: Estimated Trend from the Beveridge-Nelson decomposition (CP markets)

Notes: The graphs present the trend and actuals of the CP market at the aggregate and sector levels.