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The nature of listed real estate companies: property or equity market?

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Abstract This paper addresses the question of whether shares of public real estate companies should be treated as real estate or as equity investments. Because theoretical considerations do not suffice for making such a classification, we empirically investigate correlation structures and cointegration relationships of private and public real estate and equity markets for the United States and the United Kingdom. Our results suggest that public real estate stocks show similarities to the general stock market with regard to short-term return co-movements. For long-term investment horizons, the interdependence between direct and securitized real estate is much stronger. However, in the latter case, real estate stocks substantially lead the private property markets.

Keywords Private real estate · Property companies · Real estate investment trusts (REITs) · Stock market · Investment horizon

JEL Classification C12 · G11 · L85

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1 Introduction

Real estate is by far the most relevant class of alternative investments in terms of total invested volumes.[1] Investments in real estate can be made either directly by acquiring the physical asset or indirectly by purchasing shares of a company holding real estate. In general, private real estate markets are characterized by high transaction costs and low information efficiency, and are often referred to as illiquid. These problems are less severe for securitized real estate, which may lead to an improved risk/return structure. In addition to closed- and open-end funds, listed real estate companies or so-called public real estate are emerging as important investment vehicles, particularly in the form of tax-transparent real estate investment trusts (REITs). Based on the prototype of US REITs, numerous countries including France, Hong Kong, Japan, Korea, and Singapore, have established such investment opportunities in the last decade and REITs have recently been introduced in Germany and Great Britain as well. Consequently, since the beginning of the nineties, listed real estate companies have grown from small capitalized and unremarkable stocks to a highly attractive asset class of their own.

Investors who intend to substitute private real estate investments for public ones must determine whether this asset category offers the same or at least similar characteristics, i.e., the same risk/return factors and the same diversification potential. This is not at all obvious if real estate is held by a public property company whose share value is determined by the market (stock exchange) and not by an appraiser; other drivers of returns and risk factors may then come into play. On the one hand, the fundamental value driver is still real estate. The company acts as an intermediary, transforming direct ownership of land and buildings into share ownership, and as a result, investors obtain a vehicle that is easier to manage, and the market is provided with aggregate, standardized, and easily analyzable information in the form of a time series of corresponding stock returns. On the other hand, the company's value is affected by factors other than its real estate holdings, including its strategic position, management quality, leverage, etc., so that its performance does not depend solely on the performance of the underlying properties. Hence, we need to determine to what extent the returns on investments in listed real estate companies resemble property market returns.

Early empirical studies, mainly concerning the US market, demonstrated a strong similarity between the return behavior of REITs and the general stock market (e.g., Goetzmann and Ibbotson 1990; Ross and Zisler 1991). In addition, there was only little interdependence with the direct real estate market, so that little could be gained from diversification with other stocks. In contrast, more recent analyses have concluded that REIT returns and direct real estate are increasingly driven by the same factors, and that real estate companies represent the property market quite well (e.g., Barkham and Geltner 1995; Eichholtz and Hartzell 1996; Seiler et al. 1999). These conflicting results make a closer investigation of the nature of securitized real estate worthwhile.

[1] For example, Ibbotson and Siegel (1983) assess the portion of real estate in the "world wealth portfolio" at over 50%; also in the "world investable wealth" real estate has the largest portion of all assets.

The rest of the article is organized as follows. The next section highlights the specific characteristics of securitized real estate investments and the problems associated with their analysis. We then present an overview of the current literature. The following four sections empirically analyze the relationships between US REITs and British property companies and the corresponding stock and real estate markets. We conduct an extensive correlation analysis paying special attention to the lag structures between return series. We also apply a multivariate cointegration analysis (Johansen test) to investigate the long-term relationships between the asset categories. The final section contains a summary of our findings and conclusions.

2 Characteristics of listed real estate companies and the pitfalls of their analysis

The question of whether listed real estate companies represent the stock or the real estate market cannot be answered on a purely theoretical basis—good arguments exist for either thesis. Holding real estate directly and realizing rental income are the main business activities of a listed real estate company. Consequently, both the company's assets and its sources of revenue are linked to and influenced by real estate markets. Thus, one could expect that the value of a listed real estate company will be a function of the market value of its property holdings. However, due to its character as a going concern, additional factors irrelevant to property valuation may influence the valuation of real estate companies, such as strategic position, management quality, and the use of financial leverage. Furthermore, listed real estate shares are traded on stock exchanges where prices are determined daily by current supply and demand. Thus, the overall capital market condition, general market sentiment, market liquidity, and even the irrational (herding) behavior of market participants can all result in prices that are above or below the fundamental share value.

All in all, it is rather unlikely that the shares of real estate companies will perfectly reproduce the performance of direct property investments. Their share prices are reflective not only of the underlying real estate market, but are also based to some extent on corporate organization. Thus, the main question is which value-driving factors dominate—those typical for real estate or those typical for stocks?

Because the discrepancies in the arguments regarding the nature of securitized real estate do not allow for an unambiguous conclusion, an empirical investigation is required. However, the results of such an investigation will depend strongly on the real estate and stock markets under consideration, the sample period of the study, the object of the investigation, and the methodology employed. Furthermore, differences between direct real estate and real estate companies may arise due to the partial debt financing of the latter. Leverage effects increase the average profitability of REITs, but they also lead to higher return variability and thus, higher investment risk. These effects, however, are due to the capital structure of real estate companies and do not necessarily indicate a disconnection from the evolution of direct real estate markets.

Similarly, phases of highly positive or negative correlations do not inherently indicate a substantial similarity or dissimilarity between investment types. For example, a shift in the cycles of two assets due to a causal relationship can lead to alternating phases of positive and negative correlations. Figure 1 illustrates a situation where

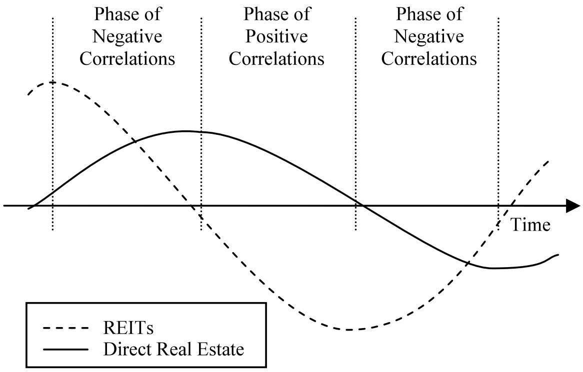

Fig. 1 Cyclic shift between returns of direct and securitized real estate (REITs)

the interrelationship between direct and indirect real estate is either strong, weak, or negative, depending on the phase considered. Thus, the link between direct and indirect real estate investments can depend on the time period studied. To avoid incorrect conclusions, any investigation should involve sufficiently long intervals.

A further potential bias could arise from ignoring the different techniques used for valuing real estate equity and direct real estate. Usually, market values of properties in investment portfolios are determined once a year. Due to this low appraisal frequency, the returns of appraisal-based indices show smoothing effects, especially if the various properties in the portfolio are appraised at different times throughout the year (Geltner 1993b). The smoothing effect is further strengthened by the fact that appraisers tend to rely on previous property valuations, which in turn weakens the price adjustment compared to any actual change in value (Quan and Quigley 1989).

In contrast, real estate share prices are the result of supply and demand and are determined each trading day. Hence, their returns exhibit stronger short-term fluctuations. In considering shorter periods, the realized return correlations appear to be lower than the "true" long-term interdependence. To avoid such effects, longer investment horizons should be examined or more appropriate methods of analysis should be employed.

Another reason for including longer return periods is based on the inefficiency of real estate markets.[2] In efficient markets, where all information is immediately reflected in the prices, subsequent returns are independent and originate from the same probability distribution. As a result, expected values, variances, and covariances change proportionally over time, and return correlations between two efficient investments do not depend on the investment horizon. This is obviously not the case for direct real estate investments, which often display strong cyclical behavior (Gottlieb 1976; Phyrr et al. 1999). Statistical return characteristics and return correlations with other investments depend on the time horizon in this case. Consequently, the results obtained from analyzing short-term returns do not need to hold for the returns from long-term investments.

[2]For empirical studies of real estate market efficiency, see Guntermann and Smith (1987), Gau (1987), Case and Shiller (1989), Clayton (1998) and Wang (2000).

Due to high search and transaction costs, which reduce short-term investment returns, institutional investors consider private real estate as a long-term investment. Properties are seldom held in institutional portfolios for less than 5 to 7 years (Fisher and Young 2000; Collett et al. 2003). Thus, if real estate stocks reflected the evolution of direct real estate, we would expect this to manifest mainly over long-term horizons. It seems rather unlikely that short-term (daily) fluctuations of real estate stock prices could be traced back to changes in the real estate markets.

3 Research overview

Extensive studies of the nature of REIT investments started in the late 1980s and revealed remarkable differences between listed real estate companies and direct, non-securitized real estate investments. Goetzmann and Ibbotson (1990) were among the first to note that the return time series of REITs and commingled real estate funds (CREFs), which they used to represent real estate investments, had significantly different characteristics. The mean return and the volatility of the REIT index were far above those of the CREF index, and the series were only weakly correlated. REITs also exhibited many similarities to the S&P 500 Index. These results were reinforced by Ross and Zisler (1991), who found that the average return and volatility of the REIT index exceeded the average return and volatility of the S&P 500 Index, and actually resembled small-cap stocks. Since then, low correlations between time series of US REITs and direct real estate investments have been repeatedly confirmed (see Gyourko and Keim 1992; Geltner and Kluger 1998; Corgel and deRoos 1999; Clayton and MacKinnon 2001). Differences between public and private real estate have also been reported for other countries, as demonstrated by Hoesli et al. (2004) and Hübner et al. (2004).

Similar conclusions can be drawn from studies on return-driving factors. Seck (1996) detected low substitutability of direct property investments by securitized real estate (REITs) using a variance ratio test and variance decomposition. Ling and Naranjo (1999) in their examination of equity and direct real estate portfolios, found support for the hypothesis that REITs are integrated with stock markets, whereas direct real estate is segmented. These results confirmed other studies, such as those of Li and Wang (1995), Peterson and Hsieh (1997), Oppenheimer and Grissom (1998), and Glascock et al. (2000).

A closer look at the correlations between REITs and the general stock market, however, somewhat weakens the above findings. It turns out that the correlations have declined considerably during the last decade. According to Ghosh et al. (1996), the correlation coefficients between NAREIT and S&P 500 returns averaged 0.77 for the period from 1985 to 1989, but were only about 0.40 for the period from 1994 to 1996. Analogous decreasing correlations between REITs and stocks for the US market were noted by Ziering et al. (1997) and by McIntosh and Liang (1998). In addition, Van der Spek and van Doorn-Gröniger (2001) confirm the same tendency for UK property companies; Hoesli and Camilo (2007) found the same effect in 13 of the 16 countries they analyzed.

This phenomenon is usually attributed to the rapid growth of the traded real estate company sector. In earlier years, REITs were too small in terms of market capitalization to be the object of special investment strategies; they tended to "float" with the general stock market. As soon as their capitalization and relevance increased, however, they became more independent of other stocks, and came to be viewed as an asset class of their own (Ghosh et al. 1996). This evolution was confirmed empirically by Clayton and MacKinnon (2001), who found increasing correlations between REIT and direct real estate returns in the 1990s. The narrowing of the difference between public and private real estate returns in the United States was also noted by Pagliari et al. (2005).

Many of the studies mentioned above assume that any possible relationships between real estate, stocks, and REITs should be measured on the basis of synchronous data. However, several authors have focused on possible time lags in the real estate return series. For example, Giliberto (1990) shows that the relationship between REIT and direct real estate returns is distinctly stronger when a lead in the REIT time series is considered.

Gyourko and Keim (1992) argue that the weak correlations often detected between direct and indirect real estate returns are misleading because most real estate indices are based on valuations conducted every 6 to 12 months. Any changes in property valuations are reflected in the index very slowly, while stock market reactions occur much more quickly. As a result, appraisal-based indices must lag REIT prices. Indeed, the authors find a statistically significant relationship between the adjusted returns of the NCREIF and the 1-year lagged returns of the NAREIT index. Confirming this result, Seiler et al. (1999) estimate that the optimal lead time of US REITs for individual real estate sectors is between 3 and 5 quarters. Eichholtz and Hartzell (1996) estimate the lag of appraisal-based returns in the United Kingdom to be about 6 months. They found that lags in the United States and Canada were longer, but were unable to make more precise estimations. Further evidence of the relationship between private and public real estate is provided by the Granger causality tests conducted by Myer and Webb (1993) and by Barkham and Geltner (1995), both of which studies found that REITs lead most of the real estate indices.[3]

The results of the cited research seem unambiguous: the majority of the studies raise doubts about a close, simultaneous relationship between real estate stocks and direct real estate investments. However, the interdependence of these two asset classes increases strongly when a lead in REITs is assumed. In this context, it is somewhat surprising that the highly relevant issue of investment horizon has not been thoroughly addressed in the literature to date.[4] Most studies use the shortest available return frequencies—usually months, quarters, or years. In fact, such short investment periods make sense only for analyzing stock markets, i.e., comparing real estate

[3] Myer and Webb (1994), however, found no causal relationship between US retail REITs and commercial real estate.

[4] An exception is Geltner et al. (1995), who note the relevance of the investment horizon with respect to the construction of portfolios including securitized and nonsecuritized real estate assets. Lee and Stevenson (2005) investigate the effects of the selected time horizon in the context of portfolio optimization with REITs, but not with direct real estate.

stocks with other stocks, because investors make predominantly short-term investments there. For direct investments, longer investment horizons should be assumed. As discussed earlier, the use of short-term return periods could lead to underestimating the actual interdependence between direct real estate and real estate stocks.

4 Choosing an analysis method

In the following three sections, we employ correlation and cointegration analyses to examine the interrelationships between REITs, or listed property companies, the general stock market, and direct real estate in the United States and the United Kingdom. Our goal here is twofold. First, we want to illustrate the nature of real estate stocks with respect to the two other assets. We expect to confirm the conclusions of other researchers, particularly with respect to potential lag structures. Second, we want to extend the literature by explicitly studying the influence of the length of investment horizon and/or holding period on the relationships.

The first part of our analysis is based on Bravais–Pearson correlations between the time series representing direct and indirect real estate and stock markets. This method is frequently used to detect relationships between economic variables. For this study, the advantage of such a simple measure of dependence lies in its insensitivity to multiplicative time series shifts. For the purpose of comparing REITs to direct real estate markets, this implies that constant leverage effects will not affect the correlation structure between both time series. Thus, we avoid the problems resulting from the debt financing of real estate companies that were discussed at the beginning of the paper. Of course, in reality, a perfectly stable capital structure, as we assume here, is not feasible, but we do not expect that its slight variations, especially when evened out on an index level, will significantly bias the results. For this reason, we perform all estimations without making corresponding adjustments to the REIT time series.[5]

Nevertheless, using the correlation coefficient may still be problematic. Aside from the fact that it captures only linear dependence, its validity could be distorted by the cyclical nature of real estate markets, which can lead to high autocorrelations, nonstationarity, and possibly, nonnormal distributions of returns. This problem is even more severe for long-term returns, which due to data availability, are computed as rolling returns. In effect, the subsequent values contain a significant common component.

The consequences for the correlation analysis are twofold: (1) the lack of stationarity may lead to unstable correlations over time, so a relatively slight change in the time interval could lead to very different results; in this case, empirical measurement would provide imprecise information about the level of the interdependence; and (2) the correlation coefficient is only fully meaningful if the multivariate distribution is elliptical, as noted by Embrechts et al. (1999, 2002). Since most real estate return

[5] Adjustments of the leverage effect have been conducted by Barkham and Geltner (1995), Geltner and Rodriguez (1997), and Pagliari et al. (2005).

series have a positive or negative skewness and/or an excess kurtosis (Miles and McCue 1984; Young and Graff 1995), the joint distribution is far from being elliptical, and thus, the coefficient does not exhaust the full interval $[-1, +1]$. As a result, the correlations are underestimated and a low dependence will be falsely concluded even though the variables are highly correlated. The significance test is also not applicable in this case.

Our rationale for conducting the correlation analysis despite these problems lies mainly in its ease of interpretation. The results we obtained were surprisingly clear about what kind of investment is achieved by using real estate stocks, but doubts about their validity still remain. Fortunately, during the analysis, it turned out that the methodical problems were not as severe as we feared. Nevertheless, in order to validate the previous results on long-term return correlations, we conducted a multivariate cointegration analysis using the Johansen test. It allows revealing a long-term relationship between time series, but does not require stationarity since differencing removes a priori any long-term data trends (Alexander 2001). Moreover, this test works directly on the raw price data, so no information is lost during return calculation.

Applied on our data, the test showed that the time series were cointegrated, which means that the spread between private and public real estate was stable over time. This also implies the stability of the correlation structures as stated in the first part of the analysis. Hence, the two parts of our empirical study can be viewed as complementary.

5 Data

Our analysis of the interrelationships between REITs, stocks, and real estate in the United States is based on the NAREIT, NCREIF, and S&P 500 indices. The index of the National Association of Real Estate Investment Trusts (NAREIT) consists of 183 REITs publicly traded in the United States with a total market capitalization of nearly US $440 billion (as of December 2006). It is divided into two subindices referring to equity REITs (companies holding real estate) and mortgage REITs (companies investing in mortgage loans); only the equity NAREIT index is considered here.

The Property Index of the National Council of Real Estate Investment Fiduciaries (NCREIF) is based on valuations by NCREIF members. It is adjusted for leverage effects (unleveraged), and includes all types of real estate. The index has been calculated quarterly since 1978, and currently comprises approximately 5,500 properties in the United States with a total market value of nearly US $270 billion (as of the first quarter of 2007). In addition to the original NCREIF index, we also employ the transaction-value index (TVI) developed by Fisher and Geltner (2000).[6] This transaction-based real estate index is calculated on the basis of properties sold from

[6]The improved transaction-based index is also available at http://web.mit.edu/cre/research/credl/tbi.html, but with a shorter history.

the NCREIF index database; the data are available, however, only until 2001. We use the S&P 500 Composite Index to cover the US stock market.[7]

The data for Great Britain are derived from the GPR General PSI UK Index, the IPD UK Monthly Index, and the FTSE 100 Index. The GPR General PSI UK Index is a subindex of Global Property Research's GPR General PSI Index. It has been calculated monthly since 1984 and represents companies that generate at least 75% of their revenues from real estate investments and development. The index encompasses British real estate corporations with a market capitalization of nearly £100 billion (as of March 2007).

The IPD UK Monthly Index of the British Institute's Investment Property Databank is a value-weighted index, calculated monthly on the basis of the last available open market valuations of properties held by property funds. It covers approximately 4,300 properties with a total market value of over £55 billion (as of March 2007). The FTSE 100 Stock Index of the FTSE Group consists of the 100 largest-capitalization companies, representing approximately 80% of the British stock market.

The time periods and frequencies of the indices have been adjusted to maintain data consistency. Thus, we used predominantly quarterly data for the 1978–2006 period for the United States (1978–2001 for the TVI index) and monthly returns from 1983 to 2006 for Great Britain. End-of-period values (quarterly or monthly) were used for all stock indices.

6 Correlation analysis

In this section, we employ a correlation analysis to compare the properties of public real estate companies with private (direct) real estate markets, and with other public companies. We analyze US and UK data in separate subsections. By varying the assumed holding periods and checking for lead-lag structures, we demonstrate the nontrivial nature of this investment vehicle.

6.1 US analysis

As noted previously, investment horizon can play an important role in the analysis of relationships between REITs and other assets (Geltner et al. 1995). To control for this influence, we examined returns for various holding periods, ranging from one quarter to 5 years. The annual, 3-year, and 5-year returns were computed as rolling returns over a moving time window so as to obtain sufficiently long time series.

Table 1 exhibits the correlations between the returns of the indices over our entire sample period. For quarterly and annual returns, the relationship between REITs and stocks is much stronger than that between REITs and real estate. For longer return periods, however, the opposite is true—the NAREIT and NCREIF returns are more highly correlated than those of the NAREIT and the S&P 500. Hence, as holding periods increase, the relationship between REIT returns and stock returns declines, while

[7] Because the S&P 500 Composite is available as a total return index only since 1988, we use its backfilled version from Thomson Financial Datastream.

Table 1 Return correlations among the NAREIT, NCREIF, and S&P 500 indices

Correlation between	Quarterly returns	Annual returns	3-year returns	5-year returns
NAREIT and NCREIF	0.04	0.06	0.17	0.31
NAREIT and S&P 500	0.25	0.27	−0.04	−0.07

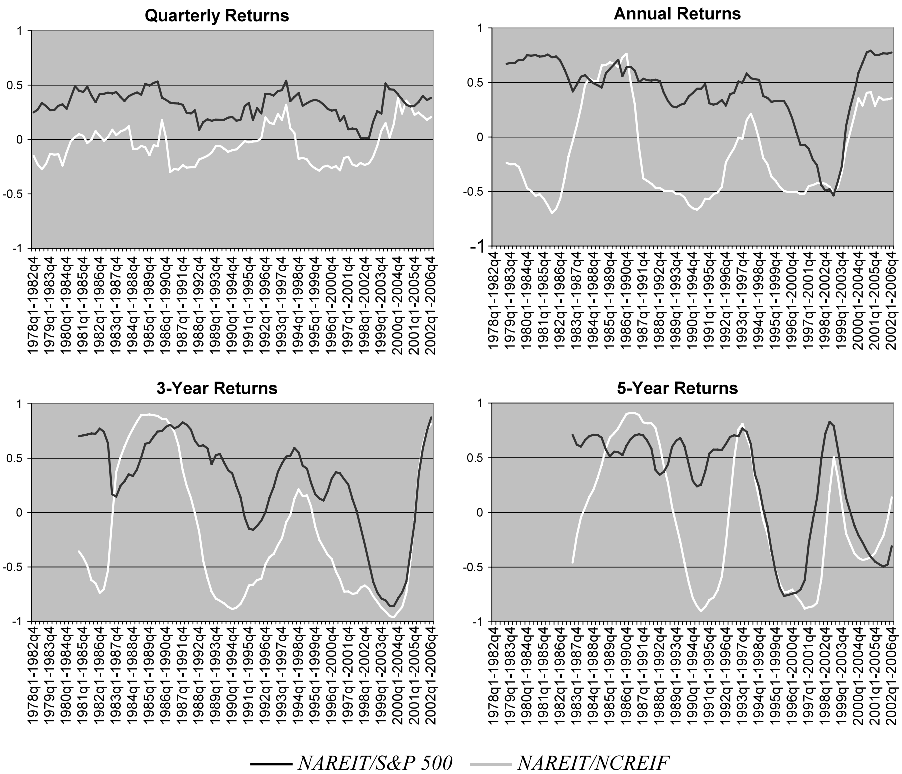

Fig. 2 Rolling 5-year return correlations among the NAREIT, NCREIF, and S&P 500 indices

the relationship between REIT returns and direct real estate returns increases. Note, however, that due to the nonnormality of returns distributions, it was not possible to conduct significance tests.

In the next step, we analyze changes in the return correlations between the assets. For this purpose, we calculate correlation coefficients for rolling (overlapping) time intervals of 5 years. The returns are again recalculated for various return periods, ranging from one quarter to 5 years. The results are shown in Fig. 2.

At the beginning of our sample period, the correlations between short-term returns of the NAREIT and S&P 500 indices are moderate and demonstrate a slightly decreasing tendency. In contrast, the correlations between REITs and direct real estate fluctuate around zero. For longer holding periods, however, the correlation structure is remarkably different. The coefficients for the 3- and 5-year returns of the NAREIT

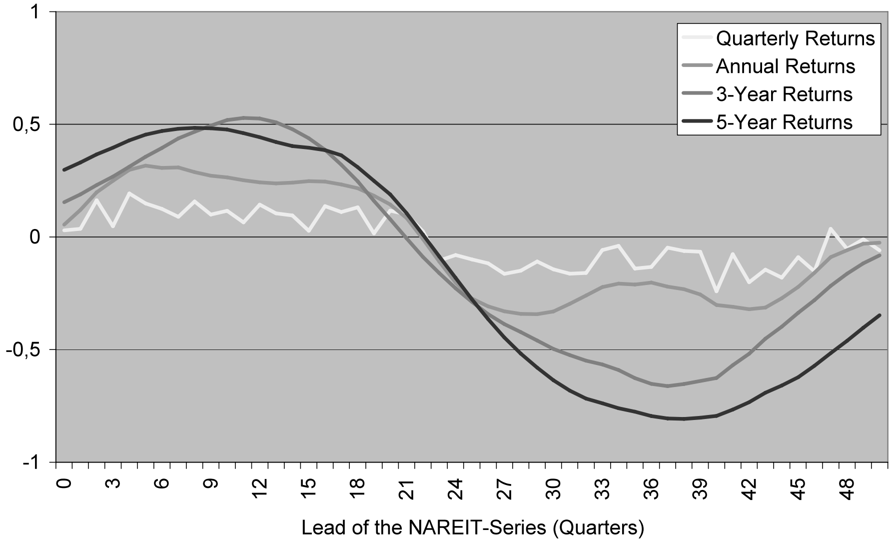

Fig. 3 Return correlations between NCREIF and NAREIT depending on the lead in the NAREIT data

and the S&P 500 fluctuate irregularly, alternating between high and low values. However, the instability of the correlation structure between the NAREIT and NCREIF returns has a distinctly regular pattern, which becomes increasingly apparent for long investment horizons: the coefficient values change nearly sinusoidally within the positive and negative range.

There are several possible reasons for this apparently mysterious regularity of variations in the correlation coefficients between private and public real estate. On the one hand, they may, in fact, imply a varying returns relationship. On the other hand, they may result from a random overlapping in the time series. However, in this case, both explanations seem unlikely.

A third possibility could be the effect described in Sect. 2, which occurs in shifted time series (see Fig. 1). Indeed, if we observe the raw return series of the NAREIT and NCREIF indices, particularly the 3- and 5-year returns, its similar development becomes apparent, although it is shifted by several quarters. We can observe positive correlations in phases when both time series process synchronously, and negative correlations when they diverge. No such relationship can be stated for the NAREIT and S&P 500 returns.

The latter conclusion is confirmed by calculations conducted on the basis of the shifted time series. Figure 3 shows the correlation coefficients between the NAREIT and NCREIF returns when considering a lead of the NAREIT series. The results are roughly similar for all holding periods: the correlation coefficient increases with the lead of the REIT series until reaching a maximum, at which point it starts to decrease. The length of the optimal lead, however, depends on the time horizon. For annual, 3-year, and 5-year returns, the maximum correlation is reached at leads of 5, 11, and 8 quarters, respectively. This means that the development of long-term direct real estate returns, as measured by the NCREIF index, corresponds approximately

Table 2 Return correlations among GPR, IPD, and FTSE 100 indices

Correlation between	Monthly returns	Quarterly returns	Annual returns	3-year returns
GPR and IPD	0.07	0.14	0.39	0.66
GPR and FTSE 100	0.52	0.59	0.40	0.15

with the development of REIT returns 2 or 3 years earlier. This result is significantly longer than the lead of 2 to 4 quarters previously reported in the literature. As we believe, this is due to the fact that most of the previous research used short-term investment horizons, which lead to a much less clear correlation structure for various leads than the one obtained for long-term investment horizons. If we observe only the quarterly NAREIT and NCREIF returns, we see that the highest coefficient of 0.19 is measured for a lead of 4 quarters. However, from Fig. 3, we see that this is merely a local maximum, which may have occurred randomly. The coefficient values for leads of between 3 and 20 quarters are not much weaker. Hence, this study suggests significantly longer leads of REIT returns than previously suspected.

In a complementary analysis, we examined the possibility of a lead-lag structure between REIT and stock returns, but obtained no reasonably interpretable results.

6.2 UK analysis

To ensure that the US phenomenon is not unique to the US markets, we conducted analogous calculations for the British direct real estate, general stock, and property company indices. In addition to monthly returns, we considered rolling quarterly, annual, and 3-year returns as investment horizons. Because of the shorter time series, we did not calculate 5-year returns.

The return correlations of the indices, set out in Table 2, are similar to those for the US market. For short investment periods, the relationship between property companies and the stock market is stronger than it is for property stocks and direct real estate. It is weaker for longer investment periods. Furthermore, as the investment horizon increases, the correlations between GPR UK and the FTSE 100 decrease, whereas those between GPR UK and IPD UK tend to increase.

Our analysis of the rolling return correlations between the GPR UK, IPD UK, and the FTSE 100 indices found less robust results than in the US case. We used 5-year (60-month) time intervals to calculate the coefficients. The correlations between property stocks and general stocks remained as expected at a medium level and exhibited a slightly decreasing tendency. The structure of the correlations between property stocks and direct real estate, however, lacked extreme regular fluctuations. Nevertheless, we checked for the presence of a lead of the property stocks in the United Kingdom.

Figure 4 shows the correlations between the IPD returns and the GPR returns with a lead. Note that there are significantly stronger relationships between the two indices when we consider a lead of the GPR series. The correlation coefficients are also distinctly higher for longer return periods. However, in comparison to our US

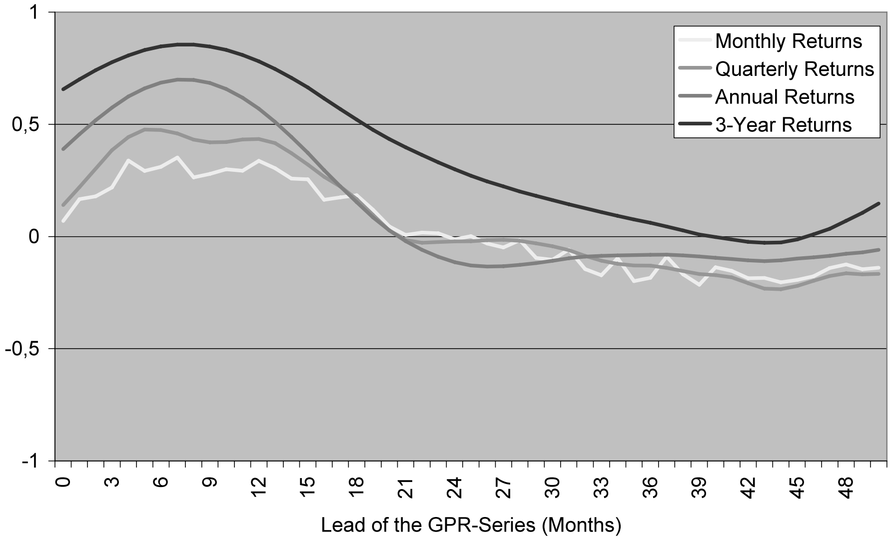

Fig. 4 Return correlations between IPD UK and GPR UK depending on the lead in the GPR data

results, the optimal leads are much shorter.[8] The strongest relationship between real estate stocks and direct real estate occurs at a lead of approximately 7 months.[9]

In contrast, our analysis of the correlations between British real estate stocks and stocks in general showed no sign of interdependence between the shifted time series. Thus, we assume that the lead effect is only valid for the relationship between property companies and direct real estate.

7 Cointegration analysis

In this section, we validate the results achieved in the correlation analysis by employing the Johansen multivariate cointegration test. As noted earlier, the simple correlation analysis, although illustrative and easily interpreted, may fail when the analyzed time series are not stationary. Therefore, we need to include the theory of cointegration processes in order to determine whether the raw prices of REITs or listed property companies exhibit a long-run equilibrium relationship with either direct real estate markets or stock markets. We expect the analysis to support the conclusions reached thus far.

7.1 Phillips–Perron test of stationarity

Before applying the Johansen cointegration methodology, we need to test whether the time series are integrated of the same order, or whether each series requires the same

[8] See Barkham and Geltner (1995) and Eichholtz and Hartzell (1996) for similar results.

[9] The maximum values of the correlation coefficients between the GPR and the IPD returns were reached with leads of 7 months for monthly, annual, and 3-year returns, and a lead of 6 months for quarterly returns.

degree of differencing to achieve stationarity. As discussed in Engle and Granger (1987), a series is said to be integrated of order d, $I(d)$ if the d times differenced series has a stationary invertible ARMA representation. The Phillips–Perron (PP) test is used to determine the order of integration of a time series (Phillips 1987; Phillips and Perron 1988). Since the PP test is based on weaker assumptions about the model residuals than is the augmented Dickey–Fuller (ADF) test, it may be more appropriate for investigating autocorrelated series. This is especially true for direct real estate indices.[10]

One advantage of using the PP tests is that rather than including the lagged values of ΔY_t as independent variables, it corrects the standard errors of the t-values using the Newey and West (1994) nonparametric correction in conjunction with the Bartlett window.[11] Thus, the PP test does not require the assumption of homoscedasticity in the error terms (Perron 1989). Moreover, since lagged terms for the variable under consideration are set to zero, there is no loss of effective observations from the series (Phillips and Perron 1988). Consequently, the PP test provides unit root test results that are robust to both autocorrelation and time-dependent heteroscedasticity in the residuals.[12]

According to the unit root test, all time series were nonstationary in levels.[13] However, when first differences are used, the null hypothesis is rejected at the 1% level for all series. The constant term or drift parameter, present in nearly every return series, reflects the fluctuations around the mean. Thus, we conclude that all financial series are nonstationary in levels and stationary in returns. This means that all indices are integrated of the same order, i.e., $I(1)$, which is a necessary condition of testing for cointegration.

7.2 The Johansen test

The concept of cointegration was first introduced by Granger (1983) and Engle and Granger (1987). The property of cointegration is possessed by some nonstationary time series. If two nonstationary time series are cointegrated, a linear combination of these series exists that is stationary. The Johansen methodology, a maximum likelihood estimation of a fully specified error correction model, allows us to test for the

[10] The original Dickey–Fuller (DF) test ignores possible autocorrelation in the error process. It is included in the ADF test, along with explanatory variables to approximate autocorrelation. In comparison to the ADF test, the PP test does not require the crucial *iid* error assumption. Thus, the test is robust to a wide range of heterogeneously and weakly dependent innovations. See Chaudhry et al. (1999, p. 348, n. 4).

[11] To correct for serial correlation and autoregressive heteroscedasticity of the error terms, the ADF test requires the introduction of lagged first difference terms. This raises the question of the lag order required to whiten the residuals. In contrast, the PP method estimates the nonaugmented DF test, and modifies the t-ratio of the γ coefficient so that serial correlation does not affect the asymptotic distribution of the test statistic.

[12] Nevertheless, the ADF test confirms the results from PP test that for whole periods and for subperiods the considered variables are $I(1)$. To conserve space, we do not report the results of the ADF and PP test here. They are available from the authors on request.

[13] The UK sample starts with January 1989 instead of the beginning of 1987 because the data series for the latter starting point and particularly for the first subperiod are not integrated of the same order (according to the Phillips–Perron test).

presence of more than one cointegration vector.[14] Hence, it is based on a vector autoregressive specification, VAR(k) for the $n \times 1$ vector of $I(1)$ stochastic variables, X_t, with an $n \times 1$ iid Gaussian error vector (Maddala and Kim 1998):

$$X_t = A_1 X_{t-1} + \cdots + A_k X_{t-k} + \varepsilon_t \tag{1}$$

where X_{t-k} are assumed to be predetermined, A_i are $n \times n$ matrices of parameters, ε_t is a vector of normal distributed error terms, with a mean of zero and constant variance, and k is the maximum number of lag lengths for processing the white noise.

To obtain the vector error correction model in transitory form, we can rewrite the system in (1) in differences (see Johansen and Juselius 1990):

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \cdots + \Gamma_{k-1} \Delta X_{t-k+1} + \Pi X_{t-1} + \varepsilon_t \tag{2}$$

where ΔX_t is the vector of price changes in period t, Γ represents the short-run dynamics, and Π is the long-run impact matrix, which will have a reduced rank if there is cointegration. The number of stationary linear combinations of X_t, i.e., the cointegrating vectors is determined by the rank of this matrix. If Π is of an intermediate rank and $0 < r(\Pi) = r < n$, so that r linear combinations of nonstationary variables are stationary, then r cointegrating vectors (or equivalently $n - r$ stochastic trends) exist. Because the matrix does not have a full rank, two $n \times r$ matrices α and β can be factored so that $\Pi = \alpha\beta'$, where $'$ denotes transposition. Consequently, we can rewrite (2) as:

$$\Delta X_t = \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-i} + \alpha\beta' X_{t-1} + \varepsilon_t. \tag{3}$$

In this factorization, the r columns of β can be defined as cointegrating vectors, i.e., the linearly independent combinations of X_t that are stationary. α is the matrix of the error correction terms, which shows the impact of r cointegrated vectors on ΔX_t. The ith row of α represents the direction and strength of the adjustment process.

To determine the rank r of the estimated matrix $\hat{\Pi}$, the eigenvalues $\tilde{\lambda}_i$ must first be calculated. The number of significantly nonzero eigenvalues shows the rank of the matrix $\hat{\Pi}$, and can be evaluated by the trace and maximum eigenvalue tests. The *trace statistic* is the result of testing the restriction $r \le q$ $(q < n)$ against the completely unrestricted model $r \le n$:

$$\lambda_{\text{trace}} = -T \sum_{i=q+1}^{n} \ln(1 - \tilde{\lambda}_i) \tag{4}$$

where T is the sample size and $\tilde{\lambda}_{r+1}, \ldots, \tilde{\lambda}_n$ are the $n - r$ smallest squared canonical correlations. The second restricted maximum likelihood ratio test is referred to as

[14] However, Dickey et al. (1991) argue that the Engle–Granger cointegration approach is sensitive to the choice of dependent variables, i.e., the results of the test may not be consistent. In contrast, the Johansen multivariate cointegration test is more robust. For more on this argument and on the use of the Johansen test in the context of tactical and strategic asset allocation, see Füss and Kaiser (2007).

the maximum eigenvalue test statistic. The λ_{max} is found by again testing the null hypothesis of at most q cointegrating vectors against the alternative of one additional cointegrating vector (i.e., $r \leq q+1$):

$$\lambda_{max} = -T \ln(1 - \tilde{\lambda}_{q+1}) \quad (5)$$

where $\tilde{\lambda}_1, \ldots, \tilde{\lambda}_q$ the largest squared canonical correlations.

Because all time series are integrated of the same order, we can now apply the specifications of the unrestricted VAR model. For the US and UK samples, the order of the VAR models is determined by the Akaike and the final prediction error (see Lütkepohl 1991). Both information criteria concerning the whole sample period indicate a VAR model of order 6 for the US data, and of order 5 for the UK data.[15] Hence, the vector error correction model (VECM) involves $k-1=5$ terms in differences for the U.S. sample, and $k-1=4$ terms in differences for the U.K. data. Note that these values are roughly identical to the leads of the indirect real estate returns stated in the correlation analysis for short holding periods. However, they are shorter than those for long holding periods.

The standard tests for cointegration, i.e., the trace and maximum eigenvalue tests, are biased toward nonrejection of the no-cointegration hypothesis. Hence, when structural breaks were suspected, the tests were carried out for all subsamples. In our case, a structural break results from a change in investor perception of REITs or property companies at the beginning of the 1990s. Thus, for the US market, the subsamples are defined for the periods 1978q1–1991q3 and 1992q1–2006q4; for the monthly UK data, they are defined for 1989/01–1993/06 and 1995/01–2006/12.[16] These subsamples are referred to as the "previous" and the "current" period, respectively. The model chosen for the trace and maximum eigenvalue tests is without deterministic trend, but with a restricted constant in the cointegration vectors, which agrees with the results of the unit root tests.

The cointegration results for the US data are reported in Table 3. For the whole sample, as well as for the first subsample, the trace and maximum eigenvalue tests do not reject the hypothesis of a single cointegration vector at the 5% level at least. According to Cheung and Lai (1993), the λ_{trace} statistic is more robust than the λ_{max} statistic. Thus, we use the former to determine the cointegrating vectors.[17] When the cointegrating vector is normalized on the first component NAREIT index for all periods, the coefficient of the S&P 500 index compared to the NCREIF index is

[15] For the US subsamples of 1978q1–1991q3 and 1992q1–2006q4, the VAR lag orders are 2 and 4 (for AIC and FPE), respectively. Comparatively, for the UK subsamples of 1989/01–1993/06 and 1995/01–2006/12, the lag orders are 4 and 5 (for AIC and FPE), respectively.

[16] The structural breaks are tested via the CUSUM test and Quandt–Andrews breakpoint test for one or more unknown structural breakpoints. The structural break in the IPD series results from a sharp increase in returns, ranging from 1.2% to 3.5% per month from June 1993 to April 1994 (for a 1.95% average per month). The Quandt–Andrews test detects a significant breakpoint in May 1993, the starting point of the extraordinarily high monthly IPD returns. In contrast, for the US data, the Quandt–Andrews test shows no structural break, while the CUSUM test reveals a structural break in the fourth quarter of 1991.

[17] The residual analysis based on LM test statistics suggests there is no remaining autocorrelation in the residuals. Thus, the residuals support the adequacy of the models for cointegration analysis.

Table 3 Johansen's multivariate cointegration results for the US market

Panel A: Entire sample from 1978q1 to 2006q4

H_0	Trace test λ_{trace}			Maximum eigenvalue test λ_{max}		
	Estimated statistics	5% critical value	1% critical value	Estimated statistics	5% critical value	1% critical value
$r = 0$	36.38*	34.91	41.07	23.21*	22.00	26.81
$r \leq 1$	13.16	19.96	24.60	10.40	15.67	20.20
$r \leq 2$	2.76	9.24	12.97	2.76	9.24	12.97

Cointegrating vector normalized on NAREIT (s.e. in parentheses)				Adjustment coefficients (s.e. in parentheses)		
NAREIT US	NCREIF US	S&P 500	C	NAREIT US	NCREIF US	S&P 500
1.0000	−1.0116	−0.2887	1.0091	−0.0042	0.0143	0.1996
	(0.1511)	(0.0805)	(0.4416)	(0.0561)	(0.0069)	(0.0518)

Panel B: Subsample from 1978q1 to 1991q3

H_0	Trace test λ_{trace}			Maximum eigenvalue test λ_{max}		
	Estimated statistics	5% critical value	1% critical value	Estimated statistics	5% critical value	1% critical value
$r = 0$	59.25**	34.91	41.07	44.81**	22.00	26.81
$r \leq 1$	14.43	19.96	24.60	10.17	15.67	20.20
$r \leq 2$	4.26	9.24	12.97	4.26	9.24	12.97

Cointegrating vector normalized on NAREIT (s.e. in parentheses)				Adjustment coefficients (s.e. in parentheses)		
NAREIT US	NCREIF US	S&P 500	C	NAREIT US	NCREIF US	S&P 500
1.0000	−1.1407	−0.5447	3.7148	0.0949	0.0408	0.0922
	(0.2597)	(0.1977)	(0.5660)	(0.0462)	(0.0061)	(0.0424)

Panel C: Subsample from 1992q1 to 2006q4

H_0	Trace test λ_{trace}			Maximum eigenvalue test λ_{max}		
	Estimated statistics	5% critical value	1% critical value	Estimated statistics	5% critical value	1% critical value
$r = 0$	44.68**	34.91	41.07	20.65	22.00	26.81
$r \leq 1$	24.03*	19.96	24.60	13.61	15.67	20.20
$r \leq 2$	10.42*	9.24	12.97	10.42*	9.24	12.97

Cointegrating vector normalized on NAREIT (s.e. in parentheses)				Adjustment coefficients (s.e. in parentheses)		
NAREIT US	NCREIF US	S&P 500	C	NAREIT US	NCREIF US	S&P 500
1.0000	−1.0018	0.2510	−2.8178	0.0481	0.0373	−0.0242
	(0.1338)	(0.1089)	(0.5850)	(0.0893)	(0.0085)	(0.0869)

Note: ** and * indicate that the null hypothesis of no cointegration can be rejected at the 1% and 5% significance levels, respectively. The λ_{trace} and λ_{max} statistics are computed under the assumption of no deterministic trend, but with a constant in the cointegrating vector. Critical values for the Johansen test are from Osterwald-Lenum (1992). r refers to the number of cointegrated vectors in the model; eigenvalues are for $k = 6$ (Panel A: 0.189, 0.089, 0.246), $k = 2$ (Panel B: 0.564, 0.172, 0.076), and $k = 4$ (Panel C: 0.291, 0.203, 0.160)

Table 4 Testing the entering in and the adjustment to the relevant cointegrating vector

Panel A: Entire sample from 1978q1 to 2006q4			
$\beta_{\text{NAREIT}} = 0$	$\chi^2(1) = 12.6443^{***}$	$\alpha_{\text{NAREIT}} = 0$	$\chi^2(1) = 0.0044$
$\beta_{\text{NCREIF}} = 0$	$\chi^2(1) = 10.3442^{***}$	$\alpha_{\text{NCREIF}} = 0$	$\chi^2(1) = 3.7150^{*}$
$\beta_{\text{S\&P500}} = 0$	$\chi^2(1) = 6.8686^{***}$	$\alpha_{\text{S\&P500}} = 0$	$\chi^2(1) = 9.0732^{***}$
Panel B: Subsample from 1978q1 to 1991q3			
$\beta_{\text{NAREIT}} = 0$	$\chi^2(1) = 9.5330^{***}$	$\alpha_{\text{NAREIT}} = 0$	$\chi^2(1) = 3.7876^{*}$
$\beta_{\text{NCREIF}} = 0$	$\chi^2(1) = 6.2939^{**}$	$\alpha_{\text{NCREIF}} = 0$	$\chi^2(1) = 27.3729^{***}$
$\beta_{\text{S\&P500}} = 0$	$\chi^2(1) = 5.9336^{**}$	$\alpha_{\text{S\&P500}} = 0$	$\chi^2(1) = 4.2794^{**}$
Panel C: Subsample from 1992q1 to 2006q4			
$\beta_{\text{NAREIT}} = 0$	$\chi^2(1) = 4.6072^{**}$	$\alpha_{\text{NAREIT}} = 0$	$\chi^2(1) = 5.1755^{**}$
$\beta_{\text{NCREIF}} = 0$	$\chi^2(1) = 3.2563^{*}$	$\alpha_{\text{NCREIF}} = 0$	$\chi^2(1) = 7.0397^{***}$
$\beta_{\text{S\&P500}} = 0$	$\chi^2(1) = 2.2659$	$\alpha_{\text{S\&P500}} = 0$	$\chi^2(1) = 0.0426$

Notes: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively

smaller in absolute values:

$$\begin{aligned}
&\text{Panel A:} \quad \text{NAREIT} = -1.0091 + 1.0116\,\text{NCREIF} + 0.2887\,\text{SP500},\\
&\text{Panel B:} \quad \text{NAREIT} = -3.7148 + 1.1407\,\text{NCREIF} + 0.5447\,\text{SP500},\\
&\text{Panel C:} \quad \text{NAREIT} = 2.8178 + 1.0018\,\text{NCREIF} - 0.2510\,\text{SP500}.
\end{aligned}$$

For the 1992q1–2006q4 period especially, the coefficient for the S&P 500 changes sign and is close to zero. This may be a signal that the stock market does not enter the common stochastic trend for this period. This result confirms our conclusions from the correlation analysis: the link between real estate stocks and the stock market has weakened significantly in recent years.

A formal likelihood ratio test allows us to analyze the nature of the cointegrating vectors and the adjustment coefficients. Table 4 sets out the results from the tests of restrictions on the composition of the cointegrating vector present in each sample, and the tests of restrictions on the reaction of asset returns to the common trend. The results from Panel A (for the entire period) reveal that direct real estate and the stock market share a common trend with REITs; however, only the NCREIF and stock returns react significantly to the common trend, as the α coefficient suggests.

These results change for the 1992q1–2006q4 period in Panel C, where the stock market does not enter the common stochastic trend. The respective cointegration vector normalized on the first component NAREIT reads as $(1, -1.002, 0.251)$. When we test the hypothesis $H_0 : \beta_1 = -\beta_2$ (and $\beta_3 = 0$) by imposing the corresponding restrictions, the likelihood ratio test equals 3.6561 and is not significant. This means that the cointegrating coefficients of indirect and direct real estate indices are the same amount but of different signs $(1, -1, 0)$. Thus, the prices of direct real estate and REITs evolve in the same way over the long run.

The discovery of cointegration, and hence, the presence of a common stochastic trend between REITs and direct real estate, confirms long-term price comovements between these two assets.

Table 5 summarizes the results for the trace and maximum eigenvalue tests for the UK market. For all periods, except the second subsample, we obtain one cointegrating vector at the 5% significance level. This suggests that one common stochastic trend is driving the markets. However, the normalized cointegrating vectors of the various panels do not show results as clear-cut as those found for the US data.

For the UK data, we also analyzed the nature of the cointegrating vectors and the adjustment coefficients with the formal likelihood ratio; the results are summarized in Table 6. For the whole sample, both the GPR and the IPD indices enter the cointegrating vector, and the returns of these series react to the common stochastic trend at the 10% level. The strongest adjustment to equilibrium comes from the GPR index.

The results for the subsamples are not so clear. All three indices enter the cointegrating vector in the first subperiod, but only FTSE 100 enters in the second subperiod. The results of the adjustment process are also difficult to interpret: they appear to be driven by direct real estate returns in the first subperiod, and by stock returns in the second.

Taken together, the findings of our cointegration tests show a long-term relationship between private and public real estate markets in the cointegrated system. Such cointegrated series are bounded in their variance and tend not to deviate very much over the long run. As a result, the covariance matrix also remains somewhat stable over time. This fact is particularly important for the validity of the correlation analysis we conducted earlier. The correlation relationship between cointegrated series should be stable and largely independent of the sample choice, i.e., slight alterations in the sample period should not lead to significantly different correlation coefficient values. Cointegration also implies that there is an underlying common factor tying the direct and securitized real estate markets together. This holds for both the United States and for the United Kingdom, although the empirical evidence for the latter is not as strong.

8 Discussion of the results

Our analysis of the relationship between return series of real estate stocks and those of direct real estate and the general stock market provides two important empirical findings concerning their nature that are in accord with previous studies (see especially Geltner et al. 1995; Eichholtz and Hartzell 1996). First, for short-term holding periods and synchronous return measurements, a moderate relationship exists between property stocks and the stock market, but it has declined in the recent years. Second, for long-term holding periods, real estate stocks show more resemblance to direct real estate investments, but their returns tend to lead the returns observed on the direct markets.

The first finding, backed by both correlation and cointegration analyses, can be explained by short-term fluctuations in investor sentiment and reactions to changes in fundamental economic data, which obviously affect the entire financial market. However, decreasing correlations for short-term holding periods suggest that investors are

Table 5 Johansen's multivariate cointegration results for the UK market

Panel A: Entire sample from 1989/01 to 2006/12

H_0	Trace test λ_{trace}			Maximum eigenvalue test λ_{max}		
	Estimated statistics	5% critical value	1% critical value	Estimated statistics	5% critical value	value value
$r = 0$	35.64*	34.91	41.07	20.22	22.00	26.81
$r \leq 1$	15.43	19.96	24.60	9.12	15.67	20.20
$r \leq 2$	6.30	9.24	12.97	6.30	9.24	12.97
Cointegrating vector normalized on NAREIT (s.e. in parentheses)				Adjustment coefficients (s.e. in parentheses)		
GPR UK	IPD UK	FTSE 100	C	GPR UK	IPD UK	S&P 500
1.0000	−1.1574	−0.3002	2.8066	−0.0281	−0.0019	0.0144
	(0.2253)	(0.2137)	(0.8777)	(0.0138)	(0.0009)	(0.0117)

Panel B: Subsample from 1989/01 to 1993/12

H_0	Trace test λ_{trace}			Maximum eigenvalue test λ_{max}		
	Estimated statistics	5% critical value	1% critical value	Estimated statistics	5% critical value	1% critical value
$r = 0$	40.06*	34.91	41.07	23.74*	22.00	26.81
$r \leq 1$	16.32	19.96	24.60	12.98	15.67	20.20
$r \leq 2$	3.34	9.24	12.97	3.34	9.24	12.97
Cointegrating vector normalized on NAREIT (s.e. in parentheses)				Adjustment coefficients (s.e. in parentheses)		
GPR UK	IPD UK	FTSE 100	1	GPR UK	IPD UK	FTSE 100
1.0000	−6.5853	1.1239	20.9690	0.0231	0.0085	0.0109
	(1.2891)	(0.2679)	(7.0175)	(0.0448)	(0.0019)	(0.0379)

Panel C: Subsample from 1995/01 to 2006/12

H_0	Trace test λ_{trace}			Maximum eigenvalue test λ_{max}		
	Estimated statistics	5% critical value	1% critical value	Estimated statistics	5% critical value	1% critical value
$r = 0$	34.89	34.91	41.07	21.03	22.00	26.81
$r \leq 1$	13.86	19.96	24.60	8.10	15.67	20.20
$r \leq 2$	5.76	9.24	12.97	5.76	9.24	12.97
Cointegrating vector normalized on NAREIT (s.e. in parentheses)				Adjustment coefficients (s.e. in parentheses)		
GPR UK	IPD UK	FTSE 100	C	GPR UK	IPD UK	FTSE 100
1.0000	−2.2276	−1.3426	15.8818	−0.0113	−0.0009	0.0104
	(0.5132)	(0.7116)	(4.6986)	(0.0063)	(0.0004)	(0.0055)

Note: ** and * indicate that the null hypothesis of no cointegration can be rejected at the 1% and 5% significance levels, respectively. The λ_{trace} and λ_{max} statistics are computed under the assumption of no deterministic trend, but with a constant in the cointegrating vector. Critical values for the Johansen test are from Osterwald-Lenum (1992). r refers to the number of cointegrated vectors in the model; eigenvalues are for $k = 5$ (Panel A: 0.089, 0.041, 0.029), $k = 4$ (Panel B: 0.356, 0.214, 0.060), and $k = 5$ (Panel C: 0.136, 0.055, 0.039)

Table 6 Testing the entering in and the adjustment to the relevant cointegrating vector

Panel A: Entire sample from 1989/01 to 2004/12			
$\beta_{GPR} = 0$	$\chi^2(1) = 2.8604$*	$\alpha_{GPR} = 0$	$\chi^2(1) = 3.0333$*
$\beta_{IPD} = 0$	$\chi^2(1) = 2.9625$*	$\alpha_{IPD} = 0$	$\chi^2(1) = 2.8411$*
$\beta_{FTSE\ 100} = 0$	$\chi^2(1) = 1.5569$	$\alpha_{FTSE\ 100} = 0$	$\chi^2(1) = 1.1051$
Panel B: Subsample from 1989/01 to 1993/06			
$\beta_{GPR} = 0$	$\chi^2(1) = 4.4653$**	$\alpha_{GPR} = 0$	$\chi^2(1) = 0.1983$
$\beta_{IPD} = 0$	$\chi^2(1) = 9.9394$***	$\alpha_{IPD} = 0$	$\chi^2(1) = 9.3360$***
$\beta_{FTSE\ 100} = 0$	$\chi^2(1) = 4.8503$**	$\alpha_{FTSE\ 100} = 0$	$\chi^2(1) = 0.8211$
Panel C: Subsample from 1995/01 to 2006/12			
$\beta_{GPR} = 0$	$\chi^2(1) = 0.7210$	$\alpha_{GPR} = 0$	$\chi^2(1) = 0.9306$
$\beta_{IPD} = 0$	$\chi^2(1) = 1.9846$	$\alpha_{IPD} = 0$	$\chi^2(1) = 0.7464$
$\beta_{FTSE\ 100} = 0$	$\chi^2(1) = 2.8818$*	$\alpha_{FTSE\ 100} = 0$	$\chi^2(1) = 4.0596$**

Notes: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively

increasingly regarding real estate stocks as a separate asset class and do not evaluate them together with other stocks. This disconnection has been observed in both the United States and in the United Kingdom.

The fact that correlations between simultaneous returns of real estate stocks and direct real estate are clearly higher for longer holding periods corresponds with our previous expectations. Since direct real estate qualifies as a long-term investment, it should influence the performance of real estate stocks in a similar manner. This was demonstrated by the correlation coefficients between long-term returns on the one hand, and the cointegrating vectors of the respective time series on the other, for both the United States and the United Kingdom.

Less obvious is the distinct lead that real estate stock returns have over those of direct real estate investments. Several explanations of this effect are possible. The time shift may result from the well-known drawbacks of appraisal-based real estate indices. As discussed earlier, the low frequency of appraisals, their aggregation in the index values, and the fact that appraisers tend to use the latest available values as starting points for new valuations may all result in smoothing the index series. The same effect may also cause appraisal-based indices to reflect the actual market trend with a lag. While computation of a real estate index requires time, developments in public markets are reflected almost immediately in the stock prices. As a result, we expect that real estate stock indices will react significantly more quickly to fundamental market developments than do indices of nonsecuritized investments where prices are derived only indirectly. In this case, the lag would be the result of index imperfections, and may not occur in the unobserved "true" market values.

Our empirical results suggest, however, that this cannot be the only explanation. In studies with desmoothed real estate indices, from which the "valuation lag" was

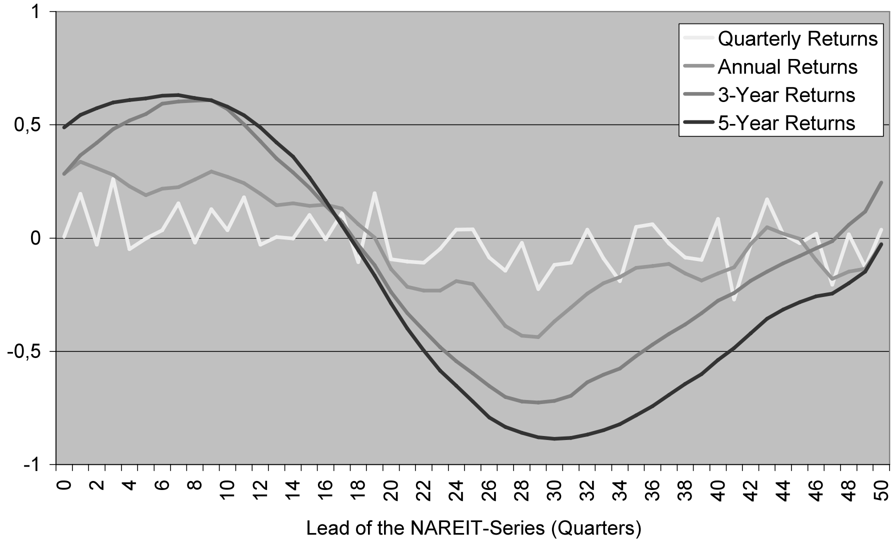

Fig. 5 Return correlations between the TVI and NAREIT indices depending on the lead in the NAREIT data

removed,[18] shifts between real estate stocks and direct real estate were reduced, compared to the smoothed series, but did not completely disappear (Barkham and Geltner 1995; Eichholtz and Hartzell 1996). To account for this anomaly, we conducted a correlation analysis for the United States using the desmoothed TVI index to represent the US property market. The resulting structure of correlations between the TVI index and the NAREIT index is shown in Fig. 5. The lead of the REIT series is slightly shorter compared to our original result, but still substantial. Maximum correlations for longer investment horizons are found for a lead in the REIT returns of about 7 to 9 quarters. Because of the lack of an appropriate desmoothed real estate index, we were not able to conduct an analogous analysis for the United Kingdom, but we suspect that a similar effect would be found there. Hence, we assume the lead is not spurious, but can be justified economically.

It is very likely that lags in the return process of direct real estate can be explained by the inefficiency of these markets. For example, long construction times inevitably lead to a lagged reaction of supply to changes in demand. Unlike most other goods, the supply of real estate cannot be adjusted quickly. Long-term lease contracts have similar effects. The heterogeneity associated with poor comparability, low market transparency, long investment horizons, and high transaction costs hinder efficient investor reactions. The consequences are lagged adjustments of rents and prices to relevant economic news.

In effect, real estate markets are partially predictable (see Wheaton et al. 1999; Polleys et al. 1999), and tend to lag the general economic trend (Grebler and Burns

[18]See Geltner (1993a), Corgel and deRoos (1999), and Fisher and Geltner (2000) for the methods of desmoothing appraisal-based real estate indices.

1982). In contrast, stock markets are very efficient and react almost immediately to current events and to justified expectations of market participants. It would not be surprising if relevant information about the real estate industry, as well as future forecasts, were reflected early in real estate stock returns, but not until much later in direct real estate prices or rents.

In the light of these considerations, even relatively long time lags between private and public real estate indices seem likely. The time period of several quarters obtained for the United States seems very long and implies that REIT investors may be able to predict the development of real estate markets up to two or more years in advance. In comparison, the lag of only 6 months obtained for the United Kingdom seems relatively short.

There are several possible reasons for the difference in the lag times of the two countries. It may be a result of the different sizes of the US and UK real estate markets. Total wealth invested in real estate in the United States is five times higher than in the United Kingdom. Thus, it is plausible that it would take longer to reflect the development of the US market in one national index than it would be in the British market. The difference in the lag length may also be caused by differences in the indices used in the study—better congruity between the properties held by property companies and the properties included in the real estate index should improve the relationship measured between the respective indices. In any case, it seems certain that no uniform, worldwide time shift between securitized and direct real estate can be assumed; a separate analysis is necessary for each local market.

9 Conclusion

In summary, it appears that the answer to the question posed in this paper's title is highly dependent on the investment horizon. Short-term investments in real estate stocks cannot truly be considered as real estate investments. In fact, random price fluctuations, which are often attributable to investor sentiment, are typical for stocks. For longer investment horizons, the influence of real estate as a value driver increases distinctly, so the return characteristics of REITs held for several years are likely to resemble those of the direct real estate market. Thus, in terms of a long-term investment, listed real estate stocks can be classified as the alternative asset class "real estate" providing institutional as well as private investors with the corresponding return characteristics and diversification benefits.

However, this similarity does not mean fully synchronous development. In fact, REITs tend to lead property markets. The existence of such a lead, and whether it is economically justified or simply the result of index imperfections, raises the question of whether real estate stock returns can be used to forecast direct property investment returns. If this can, indeed, be done, it would indicate the possibility of a low-risk arbitrage by investing in real estate when REIT returns are high. The fact that we do observe leads of public real estate in the historical data can either mean that market participants were not aware of this possibility in the past, or that there are some serious barriers to its practical implementation. It is also possible that the lead structures are not stable over time, which would diminish their prediction value substantially.

The answers to these and related questions are beyond the scope of this paper and require further research. Thus, despite the recent, enormous academic interest in the topic, the nature of securitized real estate is still not entirely clear.

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