Linkages between direct and securitized real estate

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Abstract

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LINKAGES BETWEEN DIRECT AND SECURITIZED REAL ESTATE

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Using data for the 1978-2008 period, this study presents evidence for cointegration between securitized (NAREIT) and direct (NCREIF) total return indices. Cointegration between the indices indicates that REITs and direct real estate are substitutable in the portfolio of a long-horizon buy-and-hold investor. Since the real estate indices are not found to be cointegrated with the stock market, REITs and direct real estate are likely to have similar long-term diversification benefits in a stock portfolio. In line with prior expectations, only direct real estate is found to currently adjust towards the cointegrating relation, with NAREIT returns leading NCREIF returns. However, giving support to the often stated argument regarding weaker informational efficiency of the REIT market prior to the “new REIT era”, the results show evidence for the predictability of NAREIT returns during the 1980s. It is also found that at the beginning of the “new REIT era” a large and long-lasting deviation from the long-run relation between NAREIT and NCREIF emerged. However, there is no evidence of a permanent structural break in the long-run relation since the deviation appears to have been only temporary.

Keywords: Cointegration, Vector Error-Correction Models, Direct Real Estate, Securitized Real Estate, REITs, Diversification

JEL Classifications: G11, G14, C32
Introduction

The contemporaneous correlation between the returns on direct and indirect real estate investments is typically found to be weak (Mueller and Mueller 2003; Brounen and Eichholtz 2003). Instead, indirect real estate returns have generally been found to closely resemble general stock market returns, although their correlation has been declining (Khoo et al. 1993; Ghosh et al. 1996; Fugazza et al. 2007; Hoesli and Serrano 2007). Several factors may explain the lack of significant contemporaneous correlation between securitized and unsecuritized real estate returns. For instance, in several studies the use of appraisal-based real estate indices is likely to bias the contemporaneous correlations downwards. Furthermore, securitized real estate prices may embed stock market noise that is not related to the fundamentals driving real estate returns.

Nevertheless, much of the low correlations observed can probably be attributed to the sluggish adjustment of direct real estate prices to shocks in the fundamentals. Due to the higher liquidity, greater number of market participants, smaller transaction costs and the existence of a public market place in the securitized market, the indirect real estate market is generally more informationally efficient than the direct market. Therefore, the prices of indirect real estate investments should react faster to shocks in the fundamentals than those of direct real estate. Indeed, empirical evidence shows that the securitized market leads the direct real estate market (Gyourko and Keim 1992; Myer and Webb 1993; Barkham and Geltner 1995; Eichholtz and Hartzell 1996; Seiler et al. 1999).

A positive lead-lag relation between securitized and direct real estate returns diminishes the short-horizon correlations relative to the longer-horizon correlation figures. As in the long run both markets should adjust to shocks in the fundamentals and the impact of noise in securitized real estate prices should vanish, the return correlation is likely to increase
as the investment horizon increases. That is, the long-horizon returns on securitized real estate should strongly co-vary with the returns on a portfolio composed of equivalent direct real estate investments (in terms of type, size, location, etc.), since the fundamental asset is essentially the same in both markets. In fact, the theory expects the return indices of similar indirect and direct real estate portfolios to be cointegrated. However, the detection of cointegration between indirect and direct indices may be disrupted by the leverage used in the indirect portfolios. Considerable alterations in the leverage over time may also lead to an absence of cointegration between the indices. Moreover, the returns on securitized real estate are affected by factors such as management quality and cost of debt, which may also influence the relationship between the return indices.

Cointegration between the direct and securitized return indices would imply that the correlation between the returns converges towards one as the investment horizon is extended. That is, if the markets are cointegrated, the long-horizon diversification gains of adding real estate to a mixed-asset portfolio are expected to be similar whether it is direct or securitized real estate that is included. This is of importance to a large number of long-horizon portfolio investors such as pension funds or other institutional investors, as real estate securities could offer new opportunities, especially at an international level, to enhance their buy-and-hold portfolios.

The relative inefficiency of the direct real estate market suggests that direct real estate returns can be predicted by historical returns on equivalent real estate securities. This predictability can materialize through the short-run dynamics or via the long-run cointegrating relation, or both. Nevertheless, given the potential existence of speculative, non-fundamental related noise in securitized real estate prices in the short run, a cointegrating relationship between direct and indirect return indices might also be used to predict returns in the indirect market. It is essentially an empirical question to find out whether the potential long-run
relation can be used to predict returns on securitized real estate. Previous research suggests that there is no such predictability (Giliberto 1990; Myer and Webb 1993; Li et al. 2009). However, studies exploring the long-term dynamics between direct and indirect real estate are limited, and existing studies use relatively short sample periods.

This study contributes to the literature by investigating both the short-run and long-run dynamic relations between securitized (NAREIT) and direct (both appraisal-based and transaction-based NCREIF) real estate returns and by examining the impact of the “new REIT era” on these dynamics. The analysis is carried out using a longer sample period (1977Q4-2008Q4) than in previous related studies. The results support the existence of a cointegrating relationship between NCREIF and NAREIT total return indices. In line with the assumption of greater efficiency of the securitized real estate market, only direct real estate appears to currently adjust towards the long-run cointegrating relation, with NAREIT returns leading NCREIF returns. However, giving support to the often stated argument regarding weaker informational efficiency of the REIT market prior to the “new REIT era”, the results show evidence for the predictability of NAREIT returns during the 1980s but not after that. It is also found that at the beginning of the “new REIT era” a large and long-lasting deviation from the long-run relation between NAREIT and NCREIF emerged. However, there is no evidence of a permanent structural break in the long-run relation, since the deviation appears to have been only temporary.

The findings are of importance to long-term portfolio investors such as pension funds or other institutional investors. In particular, cointegration between NAREIT and NCREIF indicates that REITs and direct real estate are substitutable in a mixed-asset portfolio of a long-horizon buy-and-hold investor. In other words, the correlation between NAREIT and NCREIF returns approaches one as the investment horizon lengthens. Since the real estate indices are not found to be cointegrated with the U.S. stock market, REITs are likely to bring
equivalent long-term diversification benefits to a stock portfolio as direct real estate. In the short-run, the diversification benefits of REITs and direct real estate may differ substantially, however. Moreover, the cointegrating relation found is in line with the argument of Pagliari et al. (2005) according to which returns on NCREIF and de-leveraged NAREIT indices do not notably differ in the long term. The predictability implications regarding direct real estate returns, in turn, may be of importance not only to investors, but also to various financial institutions and to economic policy makers.

The next section provides a review of the literature on the dynamics between direct and indirect real estate markets and discusses the long-run relationship between the two markets. Then, the data used in the empirical analysis are described. The fourth section presents the econometric methodology employed in the analysis. Empirical results are reported in the fifth section. Finally, the findings and implications of the study are summarized.

Review of the literature

Dynamics between direct and securitized real estate

It is well known that the contemporaneous correlation between indirect and direct real estate returns is low (Mueller and Mueller 2003; Brounen and Eichholtz 2003). However, it has also been established that over long horizons, the linkages between indirect and direct real estate are substantially stronger than suggested by the simple contemporaneous correlation figures (Giliberto 1990, Geltner and Kluger 1998).

Goetzmann and Ibbotson (1990) and Ross and Zisler (1991) were among the first to note that returns on REITs are only weakly correlated with returns on direct real estate
investments. Since then, the low correlation between the two set of returns has been confirmed in a number of studies and in several countries even when appraisal-based direct real estate indices have been unsmoothed (Gyourko and Keim 1992; Barkham and Geltner 1995; Geltner and Kluger 1998; Corgel and deRoos 1999; Newell et al. 2005).

Instead of co-moving with direct real estate returns, early empirical evidence, mainly concerning the U.S. market, identified a similar return behavior between securitized real estate and the general stock market (Goetzmann and Ibbotson 1990; Ross and Zisler 1991). Ling and Naranjo (1999) find that REITs are integrated with stocks (i.e., that the risk premia for the macroeconomic factors are the same in both markets), but segmented from direct real estate. Giliberto (1990), on the other hand, finds that the residuals from regressions of direct and indirect real estate returns on financial asset returns are significantly correlated. This implies that there is a common factor (or factors) associated with real estate that influences both direct and indirect real estate returns. Also Mei and Lee (1994) present some evidence for the same real estate factor to drive both equity REITs and direct real estate.

Anyhow, there is substantial evidence showing that the correlation between REITs and the general stock market has weakened since the early 1990s (Hoesli and Serrano 2007). Furthermore, according to Clayton and MacKinnon (2001 and 2003) and Pagliari et al. (2005) the difference between indirect and direct real estate returns has diminished in the U.S. It has been stated that this is because the REIT market has matured informationally and, therefore, REITs have begun to better reflect their “true” nature (Clayton and MacKinnon 2001).

Since the direct real estate market is generally considered less informationally efficient than the securitized market, direct real estate returns may well lag those of the indirect market. Therefore, it is reasonable to assume that the actual linkages between direct and indirect real estate are stronger than implied by the relatively short-horizon contemporaneous correlations only. Furthermore, because of their similarity with stock returns over the short-horizon,
securitized real estate returns may include non-fundamental related noise that vanishes in the long run. If this holds, the correlations between direct and indirect returns over longer investment horizons are expected to be larger than the conventionally reported short-term correlations. Indeed, Giliberto (1990) and Geltner and Kluger (1998) show that the relationship between REIT and direct real estate returns is notably stronger when a lead in the REIT returns is considered. The findings by Morawski et al. (2008), in turn, support the argument about the increasing correlation between direct and indirect returns as the investment horizon is extended.\footnote{Morawski et al. employ unadjusted appraisal-based return indices of direct real estate, though. This diminishes the reliability of the analysis.}


In a recent paper, Li et al. (2009) study the linkages between the appraisal-based NCREIF returns and the NAREIT returns. Consistent with the above mentioned results, they find a unidirectional Granger causality from NAREIT to NCREIF. However, their analysis, just like all of the above mentioned studies, lacks one factor that might be of major importance regarding the dynamics between direct and indirect real estate returns. That is,
they do not include any long-run dynamics in their model neither do they examine whether such long-term dynamics exist.

Note that, generally, Granger causality from securitized to direct real estate is implied even when the influence of appraisal smoothing has been extracted from the direct return series. Moreover, Geltner and Kluger (1998) and Pagliari et al. (2005) find that REIT returns lead the direct returns even after making adjustments for leverage and appraisal smoothing. Pagliari et al. also control for the potential effect of property-type mix. Also Li et al. (2009) reconstruct a NAREIT series that is free of leverage and matches the property mix of the NCREIF index, but that exhibits appraisal smoothing. The results based on the reconstructed NAREIT index closely resemble the ones based on the original index.

Long-run dynamics

Theoretically, one would expect the return indices of similar indirect and direct real estate portfolios to be cointegrated since securitized real estate returns are derived from direct real estate assets. However, the existence of strong long-run interdependence requires that the leverage used in the indirect portfolio does not exhibit notable permanent alterations over time. An additional factor that may “disturb” the expected cointegrating relation is the impact of management quality on securitized real estate returns.

Even in the absence of leverage, returns on indirect real estate might differ somewhat from those on direct real estate on average. For instance, the required return on indirect real estate may be smaller than on direct property due to the generally better liquidity of securitized real estate. On the other hand, the better diversification properties (at least in the short run) of direct real estate may cause just the opposite. Nevertheless, Pagliari et al. (2005) do not reject the hypothesis that direct real estate returns (NCREIF) are equal to the returns of
de-leveraged securitized real estate returns (NAREIT) over the 1981-2001 period. In any case, cointegration between the return indices would imply that correlation between the returns approaches one as the investment horizon increases, i.e. that direct and indirect real estate are substitutable assets in the long term in a mixed-asset portfolio as they provide the same diversification benefits.

Despite the appealing intuition and practical importance of cointegration between direct and securitized real estate return indices, only a few studies have examined the existence of long-run dynamics between the two markets. In an early study, Ong (1995) does not find support for cointegration between indirect and direct real estate return indices in Singapore. However, Wang (2001) reports a cointegrating relation between direct real estate returns and securitized real estate returns in the U.K. Using quarterly total return indices over 1977-1993, Wang’s results suggest that only direct property prices adjust towards the long-run relation. The coefficient found by Wang on the securitized real estate index implies that the average leverage of real estate companies is approximately 40%. As expected, Granger causality tests imply that securitized real estate returns Granger-cause direct real estate returns also through the short-run dynamics. Wang does not find any feedback from the direct market to the securitized market.

More recently, Morawski et al. (2008) find a cointegrating relation between NAREIT, NCREIF and the S&P 500 stock index over the 1978-2006 period. Their results suggest that the stock index cannot be excluded from the long-run relation. That is, the results imply that there is no pairwise cointegrating relation between NAREIT and NCREIF.

Overall, the empirical literature on the long-term dynamics between direct and securitized real estate is limited. This article contributes to the literature on both short- and long-run co-movement and on lead-lag relations between direct and indirect real estate. This
paper also investigates the impact of the “new REIT era” on the dynamics between direct real estate and REITs.

**Data**

The data used in this study were sourced from *Thomson Datastream* and cover the period 1977Q4-2008Q4. For securitized real estate, the FTSE/NAREIT All REITs index (NAREIT) is used and for direct real estate two versions of the NCREIF Property Index are employed. One is the conventional appraisal-based NCREIF index (NCREIF), and the other is the transactions-based NCREIF index (TBI) that is available since 1984Q1. The shorter TBI index is included in the analysis, since the conventional NCREIF index is likely to exhibit considerable appraisal smoothing. Furthermore, overall stock market performance is depicted by Datastream’s U.S. total market index. The stock data are included in the dataset in order to check whether REIT returns resemble stock returns also in the long run or whether REITs are more tightly related to direct real estate in the long horizon. In addition, the stock data enable the examination of the potential long-run diversification benefits of adding securitized or direct real estate to a broad U.S. stock portfolio. All the indices employed in the analysis are total return indices and natural logarithms of the indices are used throughout the analysis.

While NAREIT includes the impact of leverage, the NCREIF indices consist of unleveraged properties. The magnitude of leverage naturally affects the mean and volatility of securitized real estate returns. The greater the leverage, the higher are the mean and standard deviation of returns (assuming that the return on assets is greater than the cost of debt, on average). Therefore, an indirect return index is expected to grow faster than a corresponding direct real estate index over the long run. Consequently, the coefficient of an indirect index in

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2 For details on the latter index, see Fisher et al. (2007).
a cointegrating long-run relation between direct and securitized return indices is expected to be less than one in absolute value. Furthermore, if the leverage of securitized real estate varies substantially and permanently over time, a stable cointegrating relation will probably not be observed since the coefficient of the indirect index is expected to be time-varying.

Moreover, together with time variation in the inflation rate, leverage can cause instability of the ratio between NAREIT and NCREIF returns when real returns are considered. This could hinder the examination of long-run dynamics between the indices. For instance, if the average leverage of REITs was 50%, we would expect the average nominal return on REITs to be twice that on a corresponding unleveraged (direct) portfolio, abstracting from the other potential sources of divergence between the returns. However, the ratio between real returns would be dependent on the inflation rate. Therefore, we use nominal indices in the analysis.

In addition to leverage, there are also other reasons why the two indices are not perfectly equivalent to each other. First, the property mix of the NAREIT index constituents somewhat differs from that of the NCREIF (see Pagliari et al. 2005). If property type is a determinant of return behavior, then the comparison between NAREIT and NCREIF returns may be problematic. Second, management may affect the performance of REITs to some extent. Nevertheless, the aim of the empirical analysis in section five is to investigate if the NAREIT and NCREIF returns reflect the same “real estate factor” in the long run and to examine the predictability of the overall NAREIT and overall NCREIF returns. Concerning these aims, the above mentioned complications should be only of minor relevance.

The appraisal-based NCREIF is used in section five to estimate a long-run relation between NCREIF and NAREIT. The complications with the appraisal-based index are well known. However, appraisal smoothing should not notably influence the cointegration test results or the long-run parameter estimates, since in the long run the appraiser’s views cannot
diverge from the actual price level in a systematic manner, i.e., the appraisal-based return index and the actual (unobservable) returns should be cointegrated. Anyhow, since appraisal smoothing is likely to bias the estimation of the short-run dynamics, the transactions-based NCREIF index is also included in the analysis.

The four total return indices used are depicted in Figure 1, while the descriptive statistics of the returns (i.e., the differenced indices) are reported in Table 1. As can be seen, the total returns and return volatilities of REITs (including the effect of leverage) and stocks have been practically the same over 1977Q4-2008Q4. As expected, the NCREIF returns have been somewhat lower. According to Pagliari et al. (2005), however, there is no statistically significant difference between the unleveraged NAREIT and NCREIF returns. Figure 1 also shows that during 1984Q1-2008Q4 the growth rate of the appraisal-based NCREIF has equaled that of the TBI on average, as anticipated. The volatility of the transaction-based index has been twice the volatility of the appraisal-based index. None of the return series appear to be normally distributed and there is evidence for seasonal variation in the returns on the TBI.

[Figure 1 here]

[Table 1 here]

The correlation coefficients between the returns are reported in Table 2. The contemporaneous correlation of NCREIF returns with REIT returns is surprisingly similar to the correlation between TBI returns and REIT returns. When the sample from 1984Q1 onwards is employed for NCREIF as well, the figures are even closer. That is, the appraisal smoothing does not seem to diminish the contemporaneous quarterly correlation all that much. The greatest observed correlation is that between REITs and stocks (0.58).

[Table 2 here]
**Econometric methodology**

In the empirical section, the dynamic interdependences between securitized real estate, direct real estate and stocks are examined econometrically. First, the existence of cointegrating relationships between the total return indices is tested employing pairwise Johansen tests. Cointegration between two indices would indicate that tight long-run interrelations exist between the series. In this article, the cointegration tests are based on the following conventionally used Vector Error-Correction Model (VECM):

\[
\Delta X_t = \mu + \Gamma_1 \Delta X_{t-1} + \ldots + \Gamma_{k-1} \Delta X_{t-k+1} + \alpha \beta' X_{t-1} + \varepsilon_t \tag{1}
\]

where \(\Delta X_t\) is \(X_t - X_{t-1}\), \(X_t\) is a two-dimensional vector of total return index values in period \(t\), \(\mu\) is a two-dimensional vector of drift terms, \(\Gamma_i\) is a 2 x 2 matrix of coefficients for the lagged differences of the return indices at lag \(i\), \(k\) is the maximum lag, i.e. the number of lags included in the corresponding vector autoregressive (VAR) model, \(\alpha\) is a vector of the speed of adjustment parameters, \(\beta'\) forms the cointegrating vector and \(\varepsilon\) is a vector of white noise error terms. The long-run relationship (cointegrating vector) in (1) includes only the two indices included in the test and no deterministic variables.

The maximum lag (ML) is selected based on the Hannan-Quinn information criteria (HQ) as suggested by Johansen et al. (2000). Furthermore, since some of the series seem to exhibit seasonal variation, the need for seasonal dummies is detected based on HQ. Finally, the selection of the number of cointegrating vectors (\(r\)) is done by comparing the estimated Trace statistics with the quantiles approximated by the \(\Gamma\)-distribution (see Doornik 1998). Because asymptotic distributions can be rather bad approximations of the finite sample distributions, the Bartlett small sample corrected values suggested by Johansen (2002) are
employed. Weak exogeneity and exclusion of the variables are tested by the Bartlett small-sample corrected likelihood ratio (LR) test reported in Johansen (2000). Furthermore, because of the possible structural break in the long-run dynamics due to the “new REIT era”, the stability of the estimated long-run relations is examined employing a recursive estimation analysis explained in Juselius (2006).

Based on the estimated long-run relations, VECMs are estimated to study the dynamics more carefully. The direction of the possible Granger causality is tested by a standard F-test to examine the existence of lead-lag relations between the assets.

**Empirical results**

In this section, the short- and long-run dynamics between direct real estate (NCREIF and TBI) returns, REIT (NAREIT) returns and the overall stock market returns are examined in detail by testing for the existence of cointegrating relations and by estimating Vector Error-Correction Models (VECM). The order of integration of the variables is checked first. Then cointegration tests are conducted. Finally, Granger causalities are examined based on the estimated VECMs.

The ADF unit root test indicates that all the indices are I(1). This finding is in line with the majority of previous related empirical work. The unit root test results are reported in Table 3.

![Table 3 here](image-url)

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3 Weak exogeneity of a variable indicates that the variable does not react to deviation from the long-run relation (i.e., to disequilibrium). In other words, the speed of adjustment parameter of a weakly exogenous variable is zero.
Long-run relationship

Since the NCREIF series is longer than the TBI series, NCREIF is first used to study the existence of long-run dynamics between direct real estate and REITs. The Johansen Trace test results, reported in Table 4, reject the hypothesis of no cointegration between NCREIF and NAREIT. That is, despite the potential complications caused by the property mix and leverage, the two indices appear to be tightly related in the long-run.

The estimated long-run coefficient of -0.65 on NAREIT implies that REITs have had an average leverage of 35%. This estimate is similar to the 40% average loan-to-value ratio reported by Pagliari et al. (2005) over the 1981-2001 period. According to the LR test, NAREIT can be restricted to be weakly exogenous. This suggests that, as expected, only NCREIF adjusts towards the long-run relation. The weak exogeneity restriction does not alter the long-run coefficient on NAREIT.

The finding of cointegration based on the conventionally employed VECM that does not include a trend in the long-run dynamics suggests that NAREIT does not outperform NCREIF in the long run if the impact of leverage is controlled for. If the de-leveraged NAREIT had outperformed NCREIF, there would be a trend in the long-run dynamics that would require the inclusion of a trend term in the long-run model in order to find a cointegrating relation between the indices. Hence, in line with Pagliari et al. (2005), this

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4 The Trace test statistics would actually imply that \( r = 2 \). This would mean that both indices are stationary. This is obviously not the case. Neither of the indices can be excluded from the long-run relation, i.e., the long-term relation needs to include both indices in order to be stationary. Furthermore, the ADF statistics suggest that all the indices are non-stationary. Hence, it is concluded that \( r = 1 \).
analysis suggests that the returns on NCREIF and on the de-leveraged NAREIT are the same in the long-term.

A plot of the deviation of NCREIF from the estimated long-run relation, presented in Figure 2, shows that there was a large and long-lasting deviation from the long-run relationship during the 1990s. The aim of this article is not to examine the reasons behind the substantial and persistent deviation. Nevertheless, we suggest a potential explanation behind the finding. The emergence of this deviation coincides with the beginning of the “REIT boom” (Clayton and MacKinnon 2003) or the “new REIT era” (Pagliari et al. 2005). It has been often stated that in the early 1990s the REIT market went through a maturation process. This included an increase in the institutions’ and analysts’ interest towards the REIT market, thereby leading to more widely distributed and reliable information about REITs being available. The increased and more sophisticated investor base, together with the growth in REIT market capitalization, may well have improved the informational efficiency of the market, thereby inducing REIT prices to better reflect current and expected market fundamentals. In line with this argument, the forthcoming analysis supports an increase in the REIT market efficiency.

[Figure 2 here]

The notable and relatively long-lasting deviation from the long-run relation may have been caused by the adjustment of REIT prices to better reflect future expectations. According to Pagliari et al. (2005) it seems plausible to argue that the large premiums to net asset values observed in the REIT marketplace of the mid 1990s coincided with the real estate market’s recovery from the real estate recession of the late 1980s and early 1990s. The recovery of the direct market started later, which can be seen from Figure 1. That is, positive future expectations could have led to an upwards correction in NAREIT relative to NCREIF due to the typically very sluggish adjustment of the direct real estate market. Hence, the remarkable
deviation from the long-run relation is not unexpected given the notable frictions in the market for direct real estate. The fact that it appears to have been NCREIF that adjusted towards the long-run relation supports the claim that the REIT market is more informationally efficient than the direct market, rather than the idea of a transitory over-valuation of REITs in the 1990s.

Morawski et al. (2008) also perceive a significant change in the relation between NCREIF and NAREIT in the beginning of the 1990s. They split the sample period into two sub-periods and argue that there was a structural break due to a change in investor perception of REITs and of property companies. The results reported in this paper, however, imply that there was no permanent structural break in the long-run relationship between direct and indirect real estate. Instead, there was a temporary large deviation from the relation that ended around 1999. Based on recursive estimation, the stability of the relation throughout the sample period cannot be rejected (see Figure A1 in the Appendix).

Interestingly, the deviation shown in Figure 2 is strikingly similar to the one reported by Oikarinen (2009) concerning the long-run relation between housing and stock prices in Finland. Oikarinen relates the deviation to the enhanced stock market efficiency induced by the abolishment of foreign ownership restrictions. The abolishment of the restrictions led to a remarkable growth in interest towards and of market participants in the Finnish stock market, thereby increasing the efficiency of the market. This reminds the development in the U.S. REIT market during the early and mid 1990s.

Note that a substantial deviation from the estimated long-run relation has emerged again since 2007. This time the deviation of NCREIF from the relation is positive. The deviation is due to an almost 50% drop in the NAREIT index since its peak in 2007Q1. While prices in the securitized market have responded rapidly to the financial crisis, the direct real estate market appears to have been slow in its adjustment to the economic downturn. That is,
similarly to the deviation in the 1990s, this recent sharp increase in the deviation from the long-term relationship is likely to be temporary and can be probably attributed to informational factors and market efficiency.

Similarly to the appraisal-based NCREIF case, the hypothesis of no cointegration between the transactions-based TBI index and the NAREIT index can be rejected based on a sample period from 1984 to 2008. However, the estimated coefficient on NAREIT appears to be overly large (0.90). More so, the deviation from the relationship seems to be trending during the early sample period. It is likely that the relative shortness of the sample period together with the observed deviation from the long-run relation between NCREIF and NAREIT during the early and mid 1990s bias the parameter estimate.

Nevertheless, the two NCREIF indices should be cointegrated with long-run coefficients of 1 and -1, since the indices are based on the same properties. In the short run, the appraisal smoothing of the NCREIF together with the facts that the TBI is likely to exhibit some short-run noise and that its quarterly changes are based on transactions of only a small sample of all the properties of the NCREIF database, may cause deviation from the one to one relation. However, in the long term this deviation should vanish and the indices should not diverge. Indeed, Figure 1 and Table 1 show that the growth rates of the appraisal-based and transaction-based indices have been the same over 1984-2008. Probably due to the notable deviation in the series during the late 1980s and the early 1990s, the Trace test is unable to reject the hypothesis of no cointegration between the indices, though. Anyhow, as explained above, it seems reasonable to assume that the series are cointegrated with long-run coefficients of 1 and -1. Hence, in the forthcoming analysis it is also assumed that the TBI is cointegrated with NAREIT, the coefficient on NAREIT being -0.65.\footnote{This assumption is made even though the LR test rejects the hypothesis.} In line with this assumption, the TBI appears to adjust towards the relation. NAREIT, instead, is restricted to
be weakly exogenous, since its speed of adjustment parameter has the wrong sign. As expected, the deviation of the TBI from this long-run relation closely resembles that of the appraisal-based NCREIF, as shown in Figure 3.

[Figure 3 here]

Table 5 reports the Trace cointegration test results between the overall stock market returns and the real estate indices. The test statistics clearly accept the hypothesis of no cointegration between stocks and NAREIT or NCREIF. This implies that there are diversification benefits obtainable by including REITs or direct real estate in a broad stock portfolio even when a very long horizon is considered. The perceived cointegration between NAREIT and NCREIF indices, on the contrary, suggests that REITs and direct real estate are substitutable assets in a portfolio of a long-horizon buy-and-hold investor. In other words, the correlation between NAREIT and NCREIF returns approaches one as the investment horizon lengthens. The horizon has to be very long, though, since the adjustment of REITs towards the long-run relation is negligible and even the speed of adjustment of the direct market is low, around 3%-4% per quarter. The reported results are in contrast with those of Ling and Naranjo (1999), according to which REITs are integrated with the stock market but segmented from direct real estate.

[Table 5 here]

Granger causalities

The dynamics between NAREIT, NCREIF and the stock market are further investigated by Granger non-causality tests. The tests are based on VECMs that employ the above estimated long-run relations as the long-run dynamics. Lag length in the models is decided based on the
Sim’s small-sample corrected LR test. The Granger non-causality tests results, which are based on basic F-tests, are reported in Tables 6-8. In Tables 6-8, (we) signifies weak exogeneity of the variable and eqe denotes equilibrium error, i.e., deviation from the long-run relation.

[Tables 6-8 here]

As expected, changes in NAREIT appear to lead movements in both NCREIF indices without feedback from NCREIF to NAREIT. However, before the “new REIT era” there is some evidence for the predictability of NAREIT as well. In particular, based on a sub-period from 1984Q1 to 1990Q4 the results suggest that both TBI and NAREIT performance as well as the deviation from the long-run relation could be used to predict NAREIT performance. Concerning the predictive power of the TBI, this predictability is only hypothetical since the index was not available during that period. Anyhow, this finding proposes that the direct market led the REIT market prior to 1991. After 1990, instead, NAREIT has clearly led both NCREIF indices and REIT returns have not been predictable by past information on real estate market performance. Despite the relatively small p-value (0.18), NAREIT has clearly not adjusted towards the long-run relation during 1991-2008, since the speed of adjustment parameter would have the wrong sign.

The reported findings are in line with the argument that the REIT market has become more informationally efficient since the early 1990s. However, even though the reported statistics generally apply to other lag lengths as well, the results regarding the first sub-period should be taken cautiously due to the small number of observations. Note also that at longer lags there is some evidence for feedback from NAREIT to TBI. Although a similar

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6 Based on HQ, seasonal dummies are not included in any of the VECMs. The results would not change notably even if seasonal dummies were included.
inefficiency of REITs cannot be observed during 1977Q4-1990Q4 based on the model including NCREIF, these results apply also to the NCREIF model if sub-period 1984Q1-1990Q4 (which corresponds to the TBI analysis) is employed.

What then might explain the perceived adjustment of NAREIT towards the unobservable (at that time) long-run relation with the direct market? As widely stated in the literature, prior to the 1990s the REIT market was immature and appeared to co-move with the stock market rather than to reflect the actual real estate market fundamentals. Therefore, due to a potentially substantial short-term speculative, non-fundamental related, component in REIT prices, the direct market prices might have reflected the real estate market fundamentals (even the expectations) better than REIT prices. If the direct market, indeed, reflected better the fundamentals, then it is expected that it was the REIT market that adjusted towards the long-run relation.

As noted above, the adjustment speeds of the NCREIF indices are slow: for the appraisal-based index 4.6% and 3.7% in the first and second sub-periods, respectively, and for the transaction-based index 3.1% in the latter period. Concerning the post 1980 period, it is the fourth lag of NAREIT returns that is relatively large and significant in the equation for the appraisal-based NCREIF returns. This suggests that movements in NCREIF lag NAREIT performance by as long as one year. The lag of the transaction-based returns, in turn, is two quarters based on the estimated VECM.

In theory, the reported lead-lag relation between NAREIT and NCREIF may be caused by different property mixes. However, Li et al. (2009) argue that the lead-lag relation between NAREIT and NCREIF indices is caused by something other than the property mix, and Pagliari et al. (1999) find NAREIT to lead NCREIF even when the property-mixes are

---

7 The sample period is divided into two sub-periods based on the Akaike Information Criteria in the model including the TBI.
modified to be similar. A likely reason for the observed lead-lag relation would be better informational efficiency of the REIT market. This is suggested already by Barkham and Geltner (1995). They also argue that, since the fundamental asset is essentially the same in both the direct and indirect markets, the type of lead-lag relation found here is not likely to be caused by changes over time in investor perceptions and preferences. Anyhow, this analysis shows that the NCREIF indices cannot be used to predict the evolution of the NAREIT index even through the long-run relationship, whereas NAREIT performance can be employed to predict future movements in the NCREIF indices.

Note also that based on the LR(1) and LR(4) tests for heteroscedasticity, the residuals from neither the NCREIF nor the NAREIT equations appear to be heteroscedastic. Li et al. (2009) find an ARCH effect in the NCREIF return series, but the explanatory variables of the models estimated here make this effect vanish.

Table 8 reports Granger non-causality test results when the overall stock market is included in the estimated models. As it is especially the relationship between the stock market, REIT market and the actual (non appraisal-based) direct real estate market that is of interest here, only the test results including the TBI as a proxy for the direct real estate market are reported.

Employing the whole sample period from 1984Q1 to 2008Q4, the inclusion of stock market returns in the model does not alter the findings presented in Table 7. Moreover, the stock market does not seem to have significant predictive power with respect to either of the real estate indices. Expectedly, the model also implies that stock market performance is not predictable.

The result according to which the REIT market appears to have been less informationally efficient prior to 1991 applies also when stock returns are in the model. In particular, the results imply that NAREIT adjusted towards the long-run relation with direct
real estate. However, this model suggests that both NAREIT and stock market performance could be used to predict the direct market returns during the first sub-period. Moreover, after the inclusion of stocks, there is also evidence for a significant adjustment of the TBI towards the long-run relation. The estimated adjustment speed is rather fast, 17% per quarter, and its p-value is relatively low. Hence, this model does not show evidence for a leading role of direct real estate with respect to REITs in the 1980s. Instead, there appears to have been a two-way Granger causality between the markets during that period.

Anyhow, the results indicate that since the early 1990s NAREIT returns have predicted future direct real estate returns, supporting the hypothesis of a more informationally efficient securitized market. The speed of adjustment parameter on TBI is small (2.2%) and statistically insignificant during the latter sub-period. However, if two more lags are added to the equation for TBI returns (there is some evidence for higher order autocorrelation), the adjustment parameter grows (3.3%), its statistical significance increases (0.13) and there is some support for the TBI returns series to Granger cause itself. Surprisingly, the latter sub-period model shows some predictability in the stock market performance. Note also that the inclusion of stock returns slightly improves the fit of the models for NAREIT returns.

The Granger causality results clearly show that both previous returns on REITs and the deviation from the long-run relation between NAREIT and NCREIF can be used to predict future NCREIF and TBI returns. Whether this predictability can be employed to gain abnormal returns in the direct real estate market depends crucially on the transaction costs and liquidity of the market.

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8 Due to apparent residual heteroscedasticity at the fourth lag, test values for ΔTBI model in the early sub-period are based on a covariance matrix that is computed allowing for heteroscedasticity as in White (1980).
Summary and conclusions

This study examines the short-run and long-run dynamic relations between securitized real estate (NAREIT) and direct real estate (both appraisal-based and transaction-based NCREIF) returns in the U.S. market employing a sample period over 1977Q4-2008Q4. The study contributes to the related literature especially by scrutinizing the existence of cointegration between NAREIT and NCREIF total return indices and by discussing the portfolio and predictability implications of such long-term relationship. Furthermore, the impact of the “new REIT era” on the dynamics between securitized and direct real estate is investigated.

The results support the existence of a cointegrating relationship between NCREIF and NAREIT total return indices despite the impact of leverage on REIT returns and the differences between the property-mixes of NAREIT and NCREIF. Cointegration indicates that the same “real estate factor” is driving both REIT and direct real estate returns in the long horizon. In line with the assumption of greater efficiency of the securitized real estate, currently only direct real estate appears to adjust towards the long-run cointegrating relation and NAREIT returns lead NCREIF returns. Since REIT returns lead also the transaction-based NCREIF returns, the perceived lead-lag relation cannot only be attributed to appraisal smoothing effects. Moreover, it is also argued that the property-mix is not a likely reason for the lead-lag relation found. The lead-lag relation is consistent with the notion that the securitized real estate market is more efficient than the direct market, i.e., that news about real estate fundamentals are reflected more rapidly in securitized real estate prices.

Supporting the often stated argument regarding weaker informational efficiency of the REIT market prior to the “new REIT era”, the results show evidence for the predictability of NAREIT returns during the 1980s but not after that. It is also found that at the beginning of the “new REIT era” a large and long-lasting deviation from the long-run relation between
NAREIT and NCREIF emerged. There is no evidence of a permanent structural break in the long-run relation, though, since the deviation appears to have been only temporary. A potential reason for the sudden emergence of a notable deviation during the 1990s is the increased informational efficiency of the REIT market.

The findings are of particular importance to long-horizon portfolio investors. Because of the tight long-run interdependence, the longer the investment horizon is, the greater the degree of substitutability between REITs and direct real estate in a mixed-asset portfolio. In other words, the correlation between NAREIT and NCREIF returns approaches one as the investment horizon lengthens. This long-term similarity is due to the adjustment of the direct market. Nevertheless, because the speed of adjustment appears to be low (around 3%-4% per quarter), the investment horizon has to be very long (a complete cycle, for instance) for direct and indirect real estate to exhibit exactly the same diversification properties. Since the real estate indices are not found to be cointegrated with the U.S. stock market, REITs are likely to bring equivalent long-term diversification benefits to a stock portfolio as direct real estate. In the short run, the diversification benefits of REITs and direct real estate may differ substantially, however. The long-horizon diversification benefits are of particular interest regarding real estate, since direct real estate is typically a long-horizon investment due to its high transaction costs and relatively low liquidity (e.g Collet et al. 2003).

The cointegrating relation found is in line with the argument of Pagliari et al. (2005) according to which NCREIF and de-leveraged NAREIT returns do not notably differ in the long horizon. The predictability implications regarding direct real estate returns, in turn, may be of importance not only to investors but also to various financial institutions and to economic policy makers. REIT performance, instead, does not appear to be predictable, at least not at the quarterly level using lagged NAREIT, NCREIF or stock market performance.
Finally, the notable deviation from the long-run relation that emerged since 2007 has certain implications for the future. If the REIT market does not recover from the almost 50% drop from 2007Q1 to 2008Q4 during the following years, the estimated long-run relation and the current deviation from it suggest that direct real estate prices should decrease by a third from the 2008Q4 level during the forthcoming years to reach the long-term relationship.

Based on the estimated speed of adjustment of NCREIF, this downwards correction would be highly sluggish, though. According to the preliminary figures regarding the transaction-based NCREIF index, direct real estate prices dropped by some 6% during the first quarter of 2009. REIT prices declined even more, 33%, inducing further deviation from the long-term relation.

References


Table 1  Descriptive statistics of returns over 1977Q4-2008Q4

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (annualised %)</th>
<th>Standard deviation (annualised %)</th>
<th>Jarque-Bera (p-value)</th>
<th>Ljung-box test for autocorrelation (p-value, 4 lags)</th>
<th>Seasonal variation (p-value, F-test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCREIF</td>
<td>9.3</td>
<td>3.9</td>
<td>0.00</td>
<td>0.00</td>
<td>0.99</td>
</tr>
<tr>
<td>NAREIT</td>
<td>11.3</td>
<td>16.6</td>
<td>0.00</td>
<td>0.59</td>
<td>0.39</td>
</tr>
<tr>
<td>Stocks</td>
<td>10.7</td>
<td>16.2</td>
<td>0.00</td>
<td>0.83</td>
<td>0.32</td>
</tr>
<tr>
<td>TBI (1984Q1-)</td>
<td>7.9</td>
<td>7.8</td>
<td>0.00</td>
<td>0.04</td>
<td>0.02</td>
</tr>
<tr>
<td>NCREIF (1984Q1-)</td>
<td>8.0</td>
<td>3.9</td>
<td>0.00</td>
<td>0.00</td>
<td>0.76</td>
</tr>
</tbody>
</table>

Table 2  Contemporaneous quarterly correlations between the returns over 1978Q1-2008Q4

<table>
<thead>
<tr>
<th></th>
<th>NCREIF</th>
<th>NAREIT</th>
<th>Stocks</th>
<th>NCREIF (1984Q2-2008Q4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCREIF</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NAREIT</td>
<td>0.30**</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stocks</td>
<td>0.15</td>
<td>0.58**</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>NCREIF (1984Q2-2008Q4)</td>
<td>0.33**</td>
<td>0.19*</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>TBI (1984Q2-2008Q4)</td>
<td>0.35**</td>
<td>0.29**</td>
<td></td>
<td>0.48**</td>
</tr>
</tbody>
</table>

* and ** denote statistical significance at the 5% and 1% level, respectively.

Table 3  Augmented Dickey-Fuller test results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Level (lags)</th>
<th>Difference (lags)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCREIF</td>
<td>-1.79 (6)*</td>
<td>-1.96* (5)</td>
</tr>
<tr>
<td>TBI</td>
<td>-0.00 (4)*</td>
<td>-3.49** (3)*</td>
</tr>
<tr>
<td>NAREIT</td>
<td>-1.98 (0)*</td>
<td>-8.20** (0)</td>
</tr>
<tr>
<td>Stocks</td>
<td>-1.91 (0)*</td>
<td>-8.96** (0)</td>
</tr>
</tbody>
</table>

* and ** denote the statistical significance at the 5% and 1% level, respectively. Critical values at the 5% and 1% significance levels are -1.95 and -2.58 if a constant is not included and -2.89 and -3.51 in the case where a constant is present. The number of lags included in the ADF tests is decided based on the general-to-specific method. A constant term (t) is included in the test for level variables, since all the indices are trending upwards. In addition, three seasonal dummies (s) are added to the test if recommended by the F-test.
Table 4  Test statistics on cointegration between the real estate indices\(^9\)

<table>
<thead>
<tr>
<th>Variables: NCREIF, NAREIT; Sample Period: 1977Q4-2008Q4; ML = 5(^{10})</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>H(_0) (rank)</strong></td>
</tr>
<tr>
<td>(r = 0)</td>
</tr>
<tr>
<td>(r \leq 1)</td>
</tr>
<tr>
<td>P-value in the test for exclusion</td>
</tr>
<tr>
<td>P-value in the test for weak exogeneity</td>
</tr>
<tr>
<td>Estimated long-run relation</td>
</tr>
<tr>
<td>(standard error)</td>
</tr>
<tr>
<td>Speed of adjustment parameter</td>
</tr>
<tr>
<td>(standard error)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables: TBI, NAREIT; Sample Period: 1984Q1-2008Q4; ML = 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>H(_0) (rank)</strong></td>
</tr>
<tr>
<td>(R = 0)</td>
</tr>
<tr>
<td>(R \leq 1)</td>
</tr>
<tr>
<td>P-value in the test for exclusion</td>
</tr>
<tr>
<td>P-value in the test for weak exogeneity</td>
</tr>
<tr>
<td>Estimated long-run relation</td>
</tr>
<tr>
<td>(standard error)</td>
</tr>
<tr>
<td>Speed of adjustment parameter</td>
</tr>
<tr>
<td>(standard error)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables: NCREIF, TBI; Sample Period: 1984Q1-2008Q4; ML = 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>H(_0) (rank)</strong></td>
</tr>
<tr>
<td>(R = 0)</td>
</tr>
<tr>
<td>(R \leq 1)</td>
</tr>
</tbody>
</table>

---

\(^9\) Seasonal dummies are not included in any of the tested models.

\(^{10}\) Because of the lag length, the tests on the model including NCREIF and NAREIT are not small-sample corrected.
Table 5  Test statistics on cointegration between stock and real estate markets

<table>
<thead>
<tr>
<th>Variables: NAREIT, stocks; Sample Period: 1977Q4-2008Q4; ML = 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>$H_0$ (rank)</td>
</tr>
<tr>
<td>R = 0</td>
</tr>
<tr>
<td>R ≤ 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables: NCREIF, stocks; Sample Period: 1977Q4-2008Q4; ML = 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>$H_0$ (rank)</td>
</tr>
<tr>
<td>R = 0</td>
</tr>
<tr>
<td>R ≤ 1</td>
</tr>
</tbody>
</table>

Table 6  Granger non-causality test results including NCREIF and NAREIT

<table>
<thead>
<tr>
<th>Explanatory variable</th>
<th>Δ NCREIF</th>
<th>Δ NAREIT</th>
<th>eqe</th>
<th>Adj. $R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δ NCREIF</td>
<td>0.00</td>
<td>0.05</td>
<td>0.00</td>
<td>0.62</td>
</tr>
<tr>
<td>Δ NAREIT</td>
<td>0.91</td>
<td>0.78</td>
<td>0.83</td>
<td>-0.05</td>
</tr>
<tr>
<td>Δ NAREIT (we)</td>
<td>0.92</td>
<td>0.78</td>
<td></td>
<td>-0.04</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Δ NCREIF</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Δ NAREIT</td>
<td>0.59</td>
<td>0.88</td>
</tr>
<tr>
<td>Δ NAREIT (we)</td>
<td>0.66</td>
<td>0.88</td>
</tr>
</tbody>
</table>

The models include four lags in differences.
### Table 7  
Granger non-causality test results including TBI and NAREIT

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>$\Delta TBI$</th>
<th>$\Delta NAREIT$</th>
<th>$\Delta$ Equities</th>
<th>Adj. $R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta TBI$</td>
<td>0.02</td>
<td>0.01</td>
<td>0.16</td>
<td>0.24</td>
</tr>
<tr>
<td>$\Delta$ NAREIT (we)</td>
<td>0.78</td>
<td>0.59</td>
<td>-0.04</td>
<td></td>
</tr>
</tbody>
</table>

#### 1984-1990

| $\Delta TBI$ | 0.32 | 0.27 | 0.54 | 0.04 |
| $\Delta$ NAREIT | 0.04 | 0.05 | 0.01 | 0.23 |
| $\Delta TBI$ (we) | 0.17 | 0.12 |      | 0.07 |

| $\Delta$ NAREIT (we) | 0.94 | 0.66 | -0.07 | |

The models, except for the early sample-period model (one lag), include four lags in differences.

### Table 8  
Granger non-causality test results including TBI, NAREIT and stocks

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>$\Delta TBI$</th>
<th>$\Delta NAREIT$</th>
<th>$\Delta$ Stocks</th>
<th>$\Delta$ Equities</th>
<th>Adj. $R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta TBI$</td>
<td>0.01</td>
<td>0.03</td>
<td>0.58</td>
<td>0.07</td>
<td>0.19</td>
</tr>
<tr>
<td>$\Delta$ NAREIT (we)</td>
<td>0.67</td>
<td>0.22</td>
<td>0.33</td>
<td>-0.02</td>
<td></td>
</tr>
<tr>
<td>$\Delta$ Stocks</td>
<td>0.77</td>
<td>0.85</td>
<td>0.81</td>
<td></td>
<td>-0.07</td>
</tr>
</tbody>
</table>

#### 1984-1990

| $\Delta TBI$ | 0.70 | 0.01 | 0.01 | 0.14 | 0.20 |
| $\Delta$ NAREIT | 0.12 | 0.03 | 0.20 | 0.01 | 0.26 |
| $\Delta$ Stocks | 0.93 | 0.24 | 0.20 |       | -0.05 |

| $\Delta$ NAREIT (we) | 0.97 | 0.13 | 0.10 | 0.01 | |

The full-sample model includes four lags in differences, while early sample-period model includes one lag and the latter sub-period model two lags.
Figure 1  Total return indices

Figure 2  Deviation of the NCREIF from its estimated long-run relation with the NAREIT
Figure 3  Deviation of the TBI (continuous line) and of the NCREIF (dashed line) from their estimated long-run relationship with the NAREIT

Appendix

Figure A1  Plot of the recursive and backwards recursive Max Test statistics (in the R-form) of constancy of the estimated long-run relation scaled by the 5% critical value