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Real Estate Equities - Real Estate or Equities?

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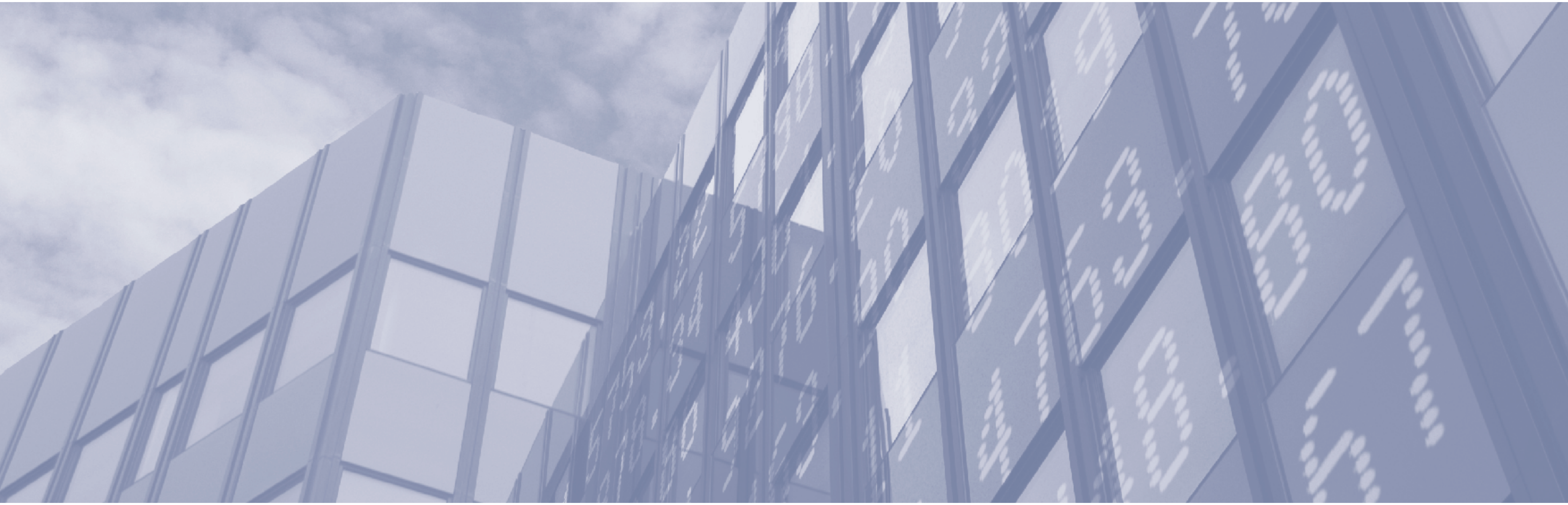

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Content

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Foreword

What is the main influence on the price and direction of an investment exposure to listed real estate? This is a long-contested question which goes to the heart of any decision on property investment.

The critical factor that distinguishes listed real estate from any other investment sector is the fundamental tangible nature of the investment – bricks and mortar. The asset class draws a regular, attractive income, underlying direct property performance over the medium to long term, and possesses the additional benefit of liquidity - unlike direct property investment. This report goes a some way laying to rest a long-term debate concerning the performance of listed real estate – is it equities or is it real estate? The result is clear – listed real estate performance is significantly influenced by the direct real estate market over the medium to long-term.

This conclusion suggests that an investment in listed property delivers the accepted security, appreciation and inflation hedge characteristics of bricks and mortar. However, as investors look to diversify risk in their multi-asset portfolio, allocations to listed real estate allow a balance of property exposure across country, sector and markets in an efficient and cost-effect way. The liquid nature of listed real estate also enables the investor to spread risk across property management teams, tenant profile and industry.

Representing European listed real estate, EPRA commissioned this study to determine the relationship between these pressures.

Executive summary

For years, experts have discussed the question whether the performance of listed real estate is primarily driven by real estate markets or by stock markets. A recent study commissioned by EPRA and produced by IREBS International Real Estate Business School at the University of Regensburg resulted in a clear answer: The medium to long-term performance of listed real estate correlates significantly with the development of direct real estate markets. However, in the shorter term performance is influenced by stock market developments.

These unambiguous findings are the result of research conducted on markets in the US and in the UK. For the first time, the approach selected for the research included macroeconomic data. In addition to the clear conclusion with regard to the performance of listed real estate, the study identified serious dependencies between the development of US direct real estate markets and the development of the non-monetary US economy. The results compiled for the UK were not as pronounced as the US. In the UK, development of the stocks and listed real estate indices led to the conclusion that financial and real estate markets mutually influence each other.

Research on the principal behaviour of listed real estate is anything but new. Questions in this context are raised particularly by those who are looking for an investment alternative to direct real estate ownership. Due to its low correlation with other asset classes, real estate will offer stronger diversification benefits in an investment portfolio. As a tangible fixed asset, direct real estate offers a high stability of investment, and thus displays effective inflation-hedging qualities. However, lot sizes mean potential buyers need to vault high hurdles in order to enter the direct real estate market. It is clear that high investment sums and the long-term commitment (lock-up) of the equity, means that direct real estate investment is not as fungible as stock. Moreover, the international direct real estate markets are not nearly as sophisticated compared against the markets for equities and bonds in terms of liquidity and transparency.

In recent years, the scope of options for indirect real estate investment has expanded significantly, and now constitutes a viable alternative to direct real estate investment. Institutional investors have the choice of a wide range of investment and diversification options for their portfolios: open and closed-end real estate funds, listed real estate operating companies (REOCs), listed real estate investments trusts (REITs) or real estate private equity funds.

Past surveys have failed, however, to draw clear conclusions about the behaviour of listed real estate. Ultimately, inconsistent data, methodology selection, sample size and market choice, have all combined to hamper results. When answering the question whether or not listed real estate behaves like the direct real estate market or the equities market, we must highlight two principal presuppositions:

1. Under the environment of continuous trading and constant recalculation of share prices, it could be assumed that the performance of listed real estate and its subsequent risk/return profile is influenced by developments on the general stock markets.
2. In addition, the latest economic developments are factored into the latest share prices along with other factors such as analyst expectations and valuations.

On one hand, listed real estate companies consequently expose themselves to market risk generated by the stock market trends, and on the other hand, the core business of listed real estate companies remains the long-term management of property. The question is which hand is the strongest?

Within the framework of the study, research for the first time included macroeconomic conditions. The focus of this new analytic approach did not rest exclusively on the contexts of the three asset classes traditionally studied to address the issue – namely, real estate equities, direct real estate, and general stock. Rather, the selection of the markets investigated took into account internationally diversity with regard to structural conditions and parameters.

The US and the UK real estate markets similarly have high levels of transparency and offer low-level transaction costs. In addition, the large trading volume of both markets underlines their advanced development stage and suggests a higher level of liquidity compared to the real estate markets of other industrialised nations. Data and indices of the US and UK markets for direct and indirect real estate investments are deemed reliable and representative for both countries, and this was a prerequisite for the research methodology selected. That said, the results for less developed markets indicate that the survey findings apply there as well. The more developed and transparent the market, the more likely the market is to behave along similar lines. An excellent example in this case is Australia.

To assess the degree of transparency in the US and UK markets, one may also study their existing indices. They are meant to provide an overview of price and performance figures, and to delineate trends for the markets covered. However, the direct real estate indices of other nations do not compare to US and UK indices which have the well-known and widely used NCREIF and IPD, respectively, with their comprehensive market coverage and long history. Calculation of the NCREIF Property Index (NPI) in the US started as early as 1978. In Q1 2008, it covered a total of 5,976 properties covering all types of uses with an aggregate market value of USD 328 billion. It is disseminated on a quarterly basis, and measures – being a valuation-based index – the total return of net cash-flow return and capital growth for the mapped, predominantly commercial real estate.

The UK equivalent is the monthly adjusted direct real estate index of the Investment Property Database (IPD), which represented exactly 3,695 properties with a combined market value of approximately GBP 41 billion as of August 2008. The US listed real estate market was represented by the Equity REITs index of the Nation Association of Real Estate Investment Trusts (NAREIT). This index also reflects the average total return of its roughly 110 constituent companies with a market capitalisation of nearly USD 277 billion.. The general stock markets in the study are represented by the S&P 500 Composite index in the US, and by the FTSE 100 Index in the UK. Like the aforementioned indices, the general equity indices are weighted according to the companies' capitalisation.

The selection of macroeconomic factors is rooted in theoretical assumptions, integrating the key drivers of the macroeconomic environment without overloading the model with parameters. The three factors under review were economic growth, inflation, and influence of the money market. The benchmark used to reflect economic growth in the surveyed US and UK markets was the respective gross domestic product (GDP). The consumer price indices (CPI) of the two countries provided the determinants for the respective inflation rate, enabling the researchers to appraise to what extent property does hedge inflation. Interbank rates were used in turn to gauge the role played by the money market. These interest rates permit inference of the resulting loan costs, which impact the investment climate.

The evaluation started in 1992, once the US data for the years between 1978 and 2008 in addition to data from the UK from 1988 through 2008 had been screened for structural breaks. Such breaks could qualify trend assumptions in the analysed time series, and eventually lead to misinterpretations. In both countries, the records suggested just such a break in 1992, and it was explained by the foregoing recessive cycle. The recovery of both national countries was boosted through a characteristic cut in the key interest rates by the respective central banks. While the key interest rate in the US dropped from 9.75%down to 3% between 1989 and 1993, the expansive monetary policy pursued in the UK bottomed out at 5.25% in early 1994. One needs to remember that the Bank of England's key lending rate had stood at 15% as late as the end of 1990.

With the observation periods selected, a complex Vector Error Correction Model (VECM) was used to evaluate the data. This econometric procedure helps to evaluate time series such as stock quotes/prices. The variables taken into consideration are part of a meaningful, yet – unlike with simple linear regression models – initially unknown context. Whenever they mutually influence each other, they are called co-integrated. These co-integration models are particularly well suited for the study of long time horizons with fewer data points widely spaced along the time axis. After all, a key objective of the study was to avoid distortions possibly caused by the specific characteristics of the selected time series. Indices for the general stock market and real estate equities are continuously calculated on a daily basis.

By contrast, macroeconomic data are published at best once a month or more regularly once a quarter – as is the case with GDP. Moreover, data on the national economy are often revised after their publication. The indices for direct real estate markets are compiled even less frequently because they are based on the valuations of individual properties. Economic developments or fluctuations that may impact real estate prices thus do not enter into these indices except with a time lag. Obviously, this hardly constitutes a sensible basis for a monthly analysis of direct real estate price trends. The study ultimately used quarterly data so as to take the peculiarities of the direct real estate market into account.

The large number of factors posed yet another problem for the analyses. The more factors are fed into a co-integration model, the higher the likelihood that the findings become too unstable to derive meaningful conclusions from them. However, the data proved to be very consistent, remarkably meaningful, and clear. Stable findings demonstrated the suitability of the selected macroeconomic data. Moreover, they confirmed the selection of the time increments between the data. The conclusion derived from the long-term survey, though, were these:

- The performance of real estate equities in both countries is significantly impacted by the development on the underlying direct real estate markets.
- The longer the time period under consideration - the stronger the influence of the direct real estate market. This escalates to the point where you can deduct with reasonable certainty that the performance of listed real estate over a very long investment horizon will ultimately match the performance of direct real estate ownership.
- While a short-term study of listed real estate reveals their susceptibility to the trends of the general stock market, they are definitely driven in the longer run by the performance of the actual or underlying real estate held in the respective portfolio.
- The study also shows how strong these dependencies are over differing time horizons.

Aside from having profiled the characteristics of listed real estate, the study confirmed the following economic-theory assumptions for both economies:

- Rising quotes/prices on the general stock market will in turn prompt a positive performance for direct real estate investments
- Negative performance, by contrast, is explained by an increase in the inter-bank rate, as real estate tends to be financed with a large share of debt capital. Whenever loan costs go up, the investment climate deteriorates and demand for direct real estate investment declines.

That said, there are manifest differences between the countries studied. In the US, the development of the real estate market is more closely intertwined with the macroeconomic development than is the case in the UK. For instance, the findings suggest strong reciprocal relationships between GDP and interest levels in the US. Over the entire observation period, elevated growth rates of the overall economy coincided with low interest rates. The latter encouraged additional, debt-financed investments, and thereby precipitated an increase in real estate prices.

In the UK, the observed development of the indices for stocks and listed property companies suggested that financial and real estate markets mainly influence each other. The US figures revealed a positive influence of the CPI on the development of listed real estate, which thus benefited from rising inflation rates. The figures for the UK, by contrast, failed to suggest either a positive or a negative influence in the same context. Any statement on effective inflation hedging of real estate investments needs to take the economic environment and its linkage to the real estate sector into account.

Real estate investments are particularly suitable for investors with multi-asset portfolios because of their low correlation with other asset classes. Direct real estate investments, however, are constrained by entry barriers such as high transaction costs, transparency gaps, and poor liquidity. Assuming that listed real estate serve as adequate medium to long-term substitute, or proxy for direct real estate investments, investors with an extended investment horizon can profit from the advantages of both asset classes – from the liquidity, transparency, and management of listed real estate, on one hand, and from the diversification qualities and the risk/return profile of direct real estate, on the other hand.

The study shows that listed real estate can not only act as a proxy for direct real estate investment, but also illustrates how this investment approach pans out over various investment horizons. Anyone wishing to invest long-term in real estate, and having sufficient degree of flexibility, will find listed real estate a sound alternative to direct real estate ownership.

Abstract

This study examines whether real estate stock indices in the US and the UK are predominantly driven by the underlying property markets or by progress on general stock markets. In the process, we abandon the conventional approach of focussing only on the three assets, namely real estate equities, direct real estate and stock indices. Instead, we conduct an analysis which explicitly takes into account the macroeconomic environment in each country.

Based on vector error correction models (VECM) and variance decompositions, we detect a significantly stronger linkage among the real estate assets compared to the equity assets in the long run. However, despite these long-term similarities, we also identify differences concerning the linkage to the respective economic environment. Accordingly, we find a close nexus of the US real estate market with the real economy, while the financial market indices in the UK are predominantly focused on each other.

JEL Classification Codes: C32, G11, L85
Key words: real estate investments, co-integration, vector error correction model (VECM), macroeconomics

Introduction

Real estate as an asset class describes a considerable investment vehicle for private, commercial and institutional investors. Primarily thanks to their nature as a real asset, investments in properties reveal different features compared to conventional assets like stocks and bonds. In particular, this applies to long-term investment horizons and is recognisable by low correlations and a distinctive risk/return structure, which in turn is accountable for being classified as an alternative asset. With respect to issues of asset allocation, investments in real estate therefore provide remarkable potential for diversifying an investor's portfolio. Earlier studies measuring the diversification benefits, such as Eichholtz (1996), Eichholtz *et al.* (1998), Liu and Mei (1998) or Liu *et al.* (1997), find favourable characteristics of real estate investments, including high stability of value, comparatively low volatilities and opportunities to hedge against inflation.

Investments in direct real estate nevertheless suffer from several disadvantages. Unlike stocks or bonds, neither the market volume nor the spectrum of the international real estate market has been developed to a sufficient extent up to now. In addition to issues of illiquidity, property investments are characterised by low information efficiency and insufficient market transparency. These drawbacks are noticeable in comparatively high information costs and thus increasing transaction costs, which in turn significantly reduce profit margins.

In the recent past, however, we have observed an ongoing expansion of securitised real estate.[1] By this time, investors are faced with a wide range of products related to real estate investments. Besides the conventional investment in direct real estate (residential or rental properties) investors have opportunities to invest in several forms of securitised real estate, such as closed and open-end funds, listed real estate companies, REITs or real estate private equity. In this context, listed real estate in particular provides opportunities to adjust the disadvantages outlined above.

Accordingly, the listing on stock exchanges ensures that prices are calculated in real time and favours transparency on markets for real estate investments in this way. In addition, the division into shares reduces the minimum investment amounts and, by implication, the market entrance barriers for potential investors.

[1] According to Brounen et al. (2006) the market capitalisation for securitised real estate rose to USD 800 billion as of the end of 2005.

As a result, listed real estate provides an easier way for investors – in particular for private investors – to participate in the progress of the real estate sector.

A further consequence of listing on stock exchanges is that additional drivers –besides the development of the underlying properties – affect the performance and the risk/return structure of the listed asset to a significant extent. Consequently, the asset´s performance is dependent on current economic news, which implies that the company value is not spared from the general stock market risk, including incorrect analyst expectations and valuations.

As the equity price is subject to supply and demand, it might therefore suffer from irrational behaviour on stock markets, for example due to exaggerations in phases of boom and bust, or caused by the well-known herding behaviour of investors.[2] As a result, listed companies are faced with the risk that market values are predominantly driven by developments on general stock markets, although the main business of real estate companies remains unchanged and is still focused on trading and renting real estate objects.

For this reason, it is worthwhile to analyse whether real estate equities can still be characterised as real estate investments in their primary meaning and whether their distinctive features as an alternative investment still persist despite listing on stock exchanges.[3] Previous studies, such as Liu and Mei (1992), Li and Wang (1995), Karolyi and Sanders (1998), Pagliari *et al.* (2005) and Hoesli and Serrano (2007), among others, examined this question and reached inconsistent results which are largely dependent on the selected method or the sample under consideration. Therefore, despite considerable research, there is still no incontrovertible evidence on this issue.

[2] In this context, several irrationalities on capital markets were detected by different studies within the research branch of behavioural finance. For example, the findings of Kahneman and Tversky (1979) contradict the basic tenets of utility theory. Accordingly, the authors detected a value function that is normally concave for gains, but commonly convex and generally steeper for losses. Furthermore, Shiller (1981) discussed the stock market´s efficiency and found that volatility of stock prices is much higher than fundamentally justified. For an overview concerning further possible irrationalities and their distinctions from current economic theory please refer to Andrikopoulos (2007).

[3] Generally, the term "property" is used in British English and "real estate" in American English, respectively. For the purposes of our examination, however, we use the term "property" in order to denote direct real estate investments, while the term "real estate" denotes real estate as an asset class in general including securitised real estate.

Macroeconomic systems

Using a different approach, our study is focused exactly on this issue and examines whether real estate stock indices in the US and the UK are primarily driven by the progress on property markets or by developments on general stock markets. Deviating from the conventional procedure of only focussing on the three financial market indices, namely real estate equities, direct real estate and general stocks, we conduct an analysis which explicitly takes into account the macroeconomic environment in each country. Following this approach allows us to consider the effects resulting from interdependencies between the macroeconomy and the three asset classes mentioned above.

According to Lizieri *et al.* (1998), real estate markets are generally considered to be cyclical in nature. Therefore, it is possible that the structure of market behaviour differs across phases of boom and bust. This might be recognisable by lower adjustment velocities after deviations from the equilibrium or by different volatilities of property values depending on the economic situation.[4] For this reason, we presume a significant contribution of the macroeconomy to the explanation of developments on real estate markets in general and for analysing the features of real estate equities in particular.

Co-integration and VECM

For the purposes of this examination we conduct a co-integration framework and the Johansen (1988) procedure.[5] The use of this method facilitates the consideration of the dynamic character among the selected risk factors. Moreover, the use of an appropriate lag structure within the implemented VEC models takes into account that macroeconomic variations might affect assets – especially appraisal-based indices – predominantly with a delay.

Deviating from the existing studies concerning the features of securitised real estate, we additionally take into account the case of multi-dimensional co-integrating relationships. Consequently, the evaluation of the implemented VEC models is not limited to the long-term relationships in the β-vectors. Instead, the adjustment process (α-vectors) and cross-vectoral effects are also considered. This procedure

[4] With regard to general stock markets, this issue was analysed by Black (1976), who found that falling prices are more volatile than rising prices.

[5] As several papers contribute to the development of the Johansen procedure as it is used within the scope of this study, the denoted year refers to the first paper of the VECM series by Johansen and Juselius.

ensures that the relevance of real estate equities is assessed by evaluating the VEC models in their entirety. Moreover, by following the approach of taking into account the economic environment within the scope of vector error correction models, it is possible to examine the relevant channels which are responsible for the adjustment process after deviations from the long-term equilibrium.

In this context, the results detect remarkable deviations between the economies in the US and the UK. Accordingly, we find a strong orientation towards the macroeconomy in the US, where disequilibria do affect neither the real estate assets nor the general stock market. In contrast, the financial market indices in the UK, namely the real estate equity index, the general stock market and the direct property index, are predominantly focused on each other.

In order to achieve convincing results we conduct further analyses in order to gain more detailed insights into whether real estate equities are predominantly driven by properties or equities. For this reason, we additionally employ variance decompositions and verify our VECM results in this way. Nevertheless, both implemented procedures indicate that real estate equities are primarily driven by their underlying property markets in the long run, rather than by the progress of general stock markets.

The remainder of this paper proceeds as follows. Section 4.2 reviews the related literature. Section 4.3 introduces the selected data and outlines the progress of the macroeconomic environment during the examination period. Section 4.4 presents the model framework. Section 4.5 provides empirical evidence and Section 4.6 concludes.

Literature review

The scope of this examination covers a wide range of research branches. Besides the analysis of the distinctive features of real estate assets, it is also necessary to consider the literature on the impact of the macroeconomy on the real estate sector.

Nature of real estate assets

The benefits of both direct and listed real estate with respect to diversification in a multi-asset portfolio have been discussed in various studies. Particularly in terms of geographical diversification, several authors certify favourable features of real estate investments.

In this context, real estate provides even more attractive advantages than international diversification through stocks and bonds. For example, Eichholtz (1996) detects significantly lower correlations between national real estate returns compared to common stocks or bond returns and therefore concludes that international diversification reduces the risk of a real estate portfolio to a larger extent than conventional asset portfolios. Case *et al.* (1997) find that geographical diversification within different types of commercial real estate, namely industrial, office and retail, is profitable. Furthermore, the study of Eichholtz *et al.* (1998) examines the impact of continental factors on real estate returns and verifies the existence of attractive international diversification potential for European and US investors. These favourable features of international real estate diversification are additionally confirmed by the studies of Newell and Webb (1996) and, with respect to industrial real estate, by Goetzmann and Wachter (2001).

Concerning the issue of whether real estate equities are dominated by properties or general stocks, previous studies reach inconsistent results which are largely dependent on the selected method, market or sample. In this context, related literature on integration characteristics of listed real estate is primarily focused on US markets using REIT data (see e.g. Liu and Mei, 1992, Karolyi and Sanders, 1998, and Ling *et al.*, 2000). In the process, several studies detect high correlations of securitised real estate to common stocks. For instance, Li and Wang (1995) conduct a multifactor asset pricing (MAP) model and find that the US REIT market is integrated with the general stock market. Oppenheimer and Grissom (1998) use frequency space correlations and come to the same conclusion, according to which US REITs show significant co-movement with stock market indices. Moreover, by using regressions Quan and Titman (1999) detect significant relations between stock returns and changes in property values and rents in 17 different countries.

This finding is additionally confirmed by the analysis of Ling and Naranjo (1999), who also examine whether commercial real estate markets are integrated with equity markets. Using multi-factor asset pricing (MAP) models, the study finds that the risk premium of the market for exchange-traded real estate companies is integrated with the equity market. The authors additionally note that the degree of integration has significantly increased during the 1990s. By contrast, the integration hypothesis does not apply to real estate portfolios which are based on appraisal-based investments.

Another cluster of studies find that correlations between direct real estate and securitised real estate have increased over time (see e.g. Gosh *et al.* (1996) for the US market). Clayton and MacKinnon (2001) examine the sample between 1978 and 1998 for the US market by the use of a multi-factor approach. Although direct real estate does not contribute to the explanation of REIT returns over the entire sample, the study shows time-varying results concerning the link between REITs, direct real estate and financial assets. Nevertheless, they also find increasing correlations among direct and indirect real estate. Time-varying correlations are also detected by Hoesli and Serrano (2007), who analyse the relationships between securitised real estate, stocks, bonds and direct real estate in 16 economies.

The international analysis reveals decreasing regression betas over time, indicating that the influence of the financial assets on securitised real estate has become less important in recent years. Nevertheless, the general stock market and bonds still explain a significant fraction of the variance of securitised real estate. As this does not apply to direct real estate, the results suggest that securitised real estate is driven by stocks and bonds rather than by their underlying property markets.

A third cluster of more recent studies, however, contradicts the results of the earlier studies outlined above and indicates that real estate securities behave more like properties than like general stocks in the long run (see e.g. Pagliari *et al.*, 2005, Westerheide, 2006, Tsai *et al.*, 2007, or Morawski *et al.*, 2008). These findings point to opportunities for investors to combine the advantages of listed real estate with those of direct property investments and would have remarkable implications with respect to asset allocation in a multi-asset portfolio.

As there is still no undisputed evidence concerning this question, we contribute to the literature by analysing this issue through a different approach. Accordingly, we assume that strict observation of econometric requirements as well as the consideration of the macroeconomic environment ensures reliable results.

Real estate and macroeconomics

Real estate research linking the real estate sector with its economic environment has up to now primarily focused on the existence of inflation-hedging characteristics of real estate assets. In this context, Hartzell *et al.* (1987) find that portfolios of commercial real estate hedge both expected as well as unexpected inflation. Gyourko and Linneman (1988), however, distinguish between direct investments in non-residential property and REIT investments. While non-residential property investments are mostly positively correlated with inflation, REIT investments are similar to conventional equity or bond investments and thus strongly negatively correlated with inflation.

Using regressions, limited opportunities were also detected by Liu *et al.* (1997) for the sample between 1980 and 1991. They found that real estate securities do not represent a better hedge against inflation than common stocks in the five examined countries.

In contrast, Quan and Titman (1999) and Hoesli *et al.* (2008) detect favourable features of real estate investments to hedge against inflation. Quan and Titman (1999) use regressions and attest that real estate is positively driven by inflation as well as by the GDP. By employing a vector error correction (VEC) approach, Hoesli *et al.* (2008) examine the interactions between the economy, stock indices and public and private real estate in the 1977-2003 period. Considering the impact of real and monetary variables, the authors find a positive long-run linkage between commercial real estate returns and anticipated inflation in the US and the UK, while the converse holds for inflation shocks.

Further empirical studies have been conducted in order to identify the most important macroeconomic determinants for the progress of real estate indices. In this context McCue and Kling (1994) use VAR models and find significant influences of the factors inflation and three-month treasury bills on US REIT returns. Ensuing variance decompositions indicate that nearly 60% of the variation in real estate prices is explained by the macroeconomy and that it is the nominal short-term interest rate that explains the majority of the variation in real estate series.

More studies, such as those by Liang *et al.* (1995) or Mueller and Pauley (1995), focus on the linkage between real estate prices and interest rates by assuming that this linkage is time-varying and differs depending on periods of high and low interest rates. Using a threshold autoregressive (TAR) model for the real estate markets in the US and the UK, Lizieri *et al.* (1998) distinguish between two interest rate regimes. In general, their results clarify that decreases in real estate prices are more extreme in a high real interest environment than the increases associated with lower real rates.

In their study on the risk/return structure of publicly-traded real estate companies, Bond *et al.* (2003) find that the consideration of country-specific market and value risk factors in particular provide additional explanatory power, although this finding is not universally valid over all 14 countries under consideration. Therefore, the authors conclude that the potential of international diversification with real estate companies cannot reliably be assessed without having regard to the standards for regulation and disclosure as well as governance standards of the related companies. According to Bond *et al.* (2003), the results of Hamelink and Hoesli (2004) point to a dominance of the country factor compared to property-type factors. A further highly significant role is also detected for the value/growth factor, which is characterised by substantial levels of volatility.

Using multi-factor asset pricing (MAP) models, Sing (2004) examines the effects of systematic market risk factors and common risk factors on the variations in excess returns of securitised and direct real estate investments. For this purpose, the author uses the SUR estimation technique and the standard Fama and MacBeth (1973) two-pass regression technique to estimate the risk premiums in the proposed MAP models.

The evaluation of the test results shows that macroeconomic risk factors are priced notably different in securitised and direct real estate markets. In contrast, Wang (2006) follows another approach whereby he uses the functional relationships between real estate returns and economic activities in the UK to infer the extent to which an appraisal-based index is smoothed. Using this method enables the correction of appraisal-smoothing and the detection of the true market volatility information.

Real estate and stock market data

With respect to regulation, disclosure and accounting standards, we still find remarkable differences across international real estate markets.[6] As these country-specific distinctions significantly influence results, reduce comparability and therefore affect inferences, using a reliable and consistent data set is particularly important for the purposes of our examination.

Real estate markets in the US and the UK are characterised by high transparency and low transaction costs compared to other real estate markets in industrialised countries. Furthermore, the market for US and UK property companies is much more actively traded than other national real estate markets, and in this way highlights the higher level of development and liquidity. As a consequence of this, real estate markets in the US and the UK supply reliable data and representative indices for both direct as well as indirect real estate investments, which is mandatory if using our approach to analyse the features of real estate equities.

Admittedly, this does not apply to further national real estate markets, as the according direct property indices in particular are not comparable to the well-known and widely-used US NCREIF and the UK IPD, or do not cover the required period. The NCREIF Property Index (NPI) has been published since 1978 and currently covers 5,976 US properties; including all types of real estate presenting a market value of USD 328 billion (as of 2008:q1). The UK counterpart is represented by the property index of the Investment Property Database (IPD), which incorporates monthly adjustments or appraisals of the underlying properties and contains 3,695 properties with a market value of GBP 40.8 billion as of August 2008 (Investment Property Database (IPD), 2008).

In the US model we further use the equity REITs index of the National Association of Real Estate Investment Trusts (NAREIT) as a proxy for the American real estate stock market. This index is a sub-index of the FTSE NAREIT US Real Estate Index series and only includes companies which own or operate income-producing real estate, such as apartments, shopping centres, offices, hotels and warehouses. Currently, this index contains 110 constituents with a net market capitalisation of USD 276,638 million (as of January 2008). In the UK model we use the capitalisation-weighted UK FTSE 350 Real Estate Index to cover the British real estate sector. The general stock market is represented by the S&P 500

[6] For a discussion see Bond et al. (2003).

Composite Index in the US, while the FTSE 100 Index is used to cover the general stock market in the UK.

Macroeconomic data

The selection of the macroeconomic factors is based on theoretical assumptions and represents a good combination of covering the most important influences resulting from the economic environment without over-parametrising the models. The determinants are represented by the consumer price index (CPI) as a proxy for the inflation, the real gross domestic product (GDP) as a proxy for the economic growth and the interbank rates (three months) in order to consider the influences of the money market. Interbank rates represent a major indicator for the resulting credit costs and in this way primarily cover aspects of bank lending. As interbank rates can furthermore be taken as an indicator for the aggregate investment climate of an economy, we prefer the use of this time series to long-term interest or mortgage rates.

The implemented approach allows the analysis of possible inflation-hedging characteristics of investments in real estate. According to economic theory, real estate is largely classified as a hedging instrument against inflation, because owners benefit from increasing nominal income and capital growth, while the real value of their debt is eroded (Lizieri *et al.*, 1998). Furthermore, due to the characteristic as a real asset, the net asset value of the related property is not subject to depreciation of money to such an extent as conventional assets like equities or bonds. Furthermore, particularly with respect to commercial properties, rental contracts largely contain inflation subscripted rental payments.

In this way, the adverse effects of growing inflation can be compensated to a significant extent. Nevertheless, our results clarify that passing a blanket judgement is pointless in this context. Instead, considering the complete business environment and its interrelationship to the real estate sector is indispensable for each country under consideration.

Different nature of selected time series

Within the scope of our examination, one main issue is to reduce the risk of possible distortions which could be caused by the different natures of the selected time-series. Indices representing the general stock markets and the real estate equities are calculated in real-time, while the macroeconomic data is only released on a monthly or – as in the case of the gross domestic product – on a quarterly basis. Moreover, it is normal that macroeconomic releases are subsequently revised.

The appraisal-based direct property indices represent an exception in this context, as their valuation is executed by an appraiser. Due to the low-frequency appraisals, variations or economic development affecting real estate prices are only considered with a delay. This issue highlights the necessity of using low-frequency data for the purposes of our examination. For this reason, we use quarterly data to examine the distinctions of real estate assets. Furthermore, we conduct vector error correction models (VECM) which are said to provide more reliable results if covering a longer time horizon compared to a shorter sample with a huge number of high frequency data points.

All time series are denominated in local currencies and are transformed into natural logarithms. Due to their interest character, interbank rates represent the only exception in this context and are therefore used without any transformation. Furthermore, the consumer price index and the real gross domestic product time series as well as the direct property indices are seasonally adjusted. Time series based on appraisals are known to be subject to artificial smoothing. However, as there is currently still no incontrovertible evidence on how to unsmooth real estate data, we use the original time series in order not to bias our results.[7]

Testing for structural breaks

In order to preclude misinterpretation and consequently incorrect economic implications due to instability in the deterministic trend, we examine the dataset for structural breaks. Taking into account structural breaks is particularly important when applying co-integration techniques. The omission of structural breaks leads to unreliable unit root test decisions and consequently to the risk of misspecified estimation models (Perron, 1989).

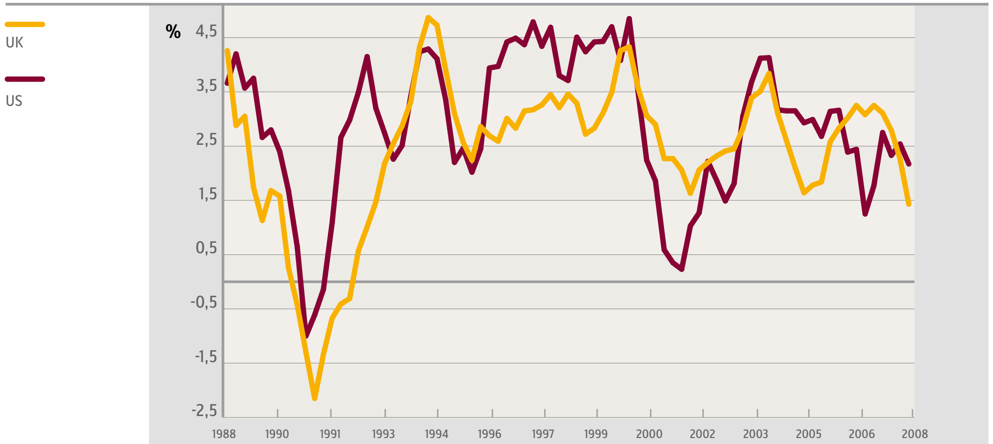
As illustrated in Figure 4-1, the periods at the beginning of the 1990s, after the collapse of the new economy in 2000 and around '9/11' in 2001 are particularly worth testing, because the recessions and their consequences for credit markets ought to be closely linked to our real estate-related macroeconomic model.

[7] For a discussion see Bond and Hwang (2007).

We prefer to apply stability tests on the basis of dynamic multivariate models if employing co-integration techniques. In so doing, we abandon the approach of the related studies, which primarily use CUSUM and CUSUMQ tests or Chow tests on the basis of OLS regressions. As the stability hypothesis is rejected far too often for multivariate dynamic models with many parameters relative to the number of available observations, we use the bootstrap versions of the Chow test according to Candelon and Lütkepohl (2001).[8] We examined the data from 1978:q1 to 2008:q2 for the US model and from 1988:q1 to 2008:q2 for the UK model for structural breaks. The splitting sample Chow tests are applied on the basis of VEC models.[9]

In both economies, the results of the tests for structural breaks divide the sample in 1992:q1 (see Figures 4-4 and 4-5 in Chapter 4.7.1). As a result, the examination period is set from 1992:q1 to 2008:q2 for both economies and therefore allows for comparisons of the results between both national datasets. The identified date for the structural breaks can reasonably be explained by the recessions that occurred at that time and their tremendous consequences for credit markets.

Figure 0-1 Real GDP in the UK and the US.



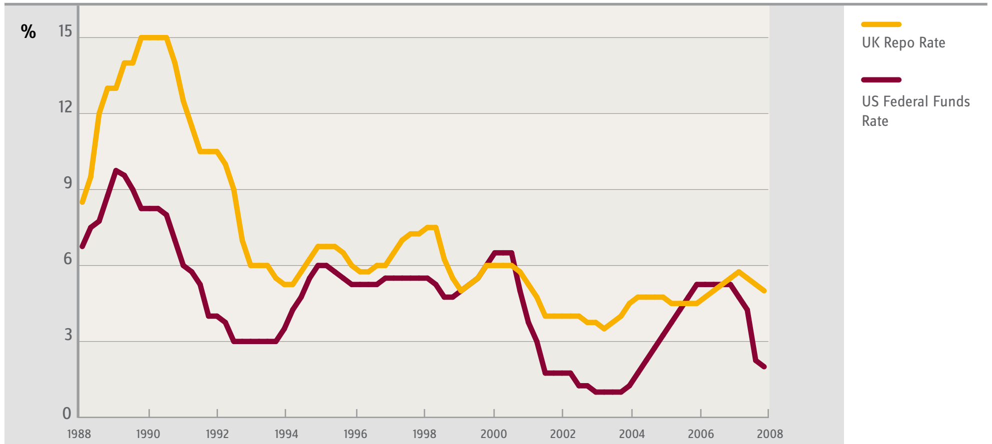
Source: Datastream.

[8] For further details see Candelon and Lütkepohl (2001).
[9] The date for the structural break is verified using different VECM orders in order to minimise the impact of individual model specifications. Nevertheless, these alternative specifications are in line with the evaluation principles as outlined below. As all test orders indicate structural breaks at the end of 1991 or at the beginning of 1992, we start our sample in 1992:q1.

The US recession began in July 1990 and was worsened by a credit crunch which primarily affected the financial sector. In the UK, however, a boom in the housing market during the 1980s and the consequential increases in house prices stimulated consumer spending, which in turn resulted in remarkable increases in the rate of inflation. Consequently, the Bank of England increased interest rates to as high as 15% in 1989: q4 in order to protect the value of the British pound (see Figure 4-2). The costs of mortgage payments increased and led to a rising number of home repossessions and falling house prices. As a consequence of this, consumer spending decreased and caused an economic slowdown which finally ended in the 1991 UK recession.

Nevertheless, the recovery in both countries was supported by a remarkable decrease in the key interest rates of the corresponding central banks (see Figure 4-2). While the US federal funds rate amounted 9.75% in 1989:q1, the ongoing expansive monetary policy ended at the 3% level at the end of 1993. The same applies to the monetary policy of the Bank of England.[10] The reduction of interest rates began at the 15% level at the end of 1990 and ended at 5.25% at the beginning of 1994.

Figure 0-2 Key Interest Rates in the US and the UK.



Source: Datastream.

[10] In addition, immense currency speculation imposed pressure upon the British pound during that time. In particular, this applies to September 16, 1992, the date which came to be known as the "Black Wednesday". Subsequently, despite considerable intervention measures by the Bank of England (BoE), the deterioration of the UK currency could not be stopped and ultimately resulted in the UK opting out of the European Exchange Rate Mechanism (ERM).

Descriptive statistics

Table 4-1 outlines all time series used and presents the corresponding descriptive statistics for their first differences. A comparison between both economies reveals several similarities and we therefore assume a comparable economic environment during the examination period in the two economies under consideration.

Table 0-1 Descriptive Statistics (1992:q1 to 2008:q2).

United States	NCREIF	NAREIT	CPI	INTER	GDP	SP500
Mean	0.023980	0.030561	0.006693	-0.027538	0.007535	0.019328
Median	0.025793	0.033473	0.007194	-0.010000	0.007327	0.023570
Maximum	0.050291	0.195899	0.015374	0.990000	0.018049	0.174682
Minimum	-0.015398	-0.135524	-0.003782	-1.770000	-0.003519	-0.166637
Std. Dev.	0.014615	0.069323	0.003130	0.497905	0.004762	0.061566

United Kingdom	IPD	REEI	CPI	INTER	GDP	FTSE
Mean	0.023745	0.021959	0.004837	-0.070909	0.006795	0.013089
Median	0.025312	0.045027	0.004672	-0.010000	0.006741	0.017144
Maximum	0.077325	0.248814	0.019581	0.700000	0.014147	0.119784
Minimum	-0.090169	-0.227301	-0.005356	-2.650000	-0.002439	-0.195991
Std. Dev.	0.023908	0.103840	0.005566	0.501597	0.003059	0.064034

Notes: NCREIF = direct property index in the US, NAREIT = real estate equity index in the US, IPD = direct property index in the UK, REEI = FTSE 350 Real Estate Index as a proxy for the real estate equity market in the UK, CPI = domestic consumer price index, INTER = interbank rates (3 months), GDP = real gross domestic product, SP500 = Standard & Poor´s 500 Stock Index, representing the general stock market in the US, FTSE = FTSE 100 Index, representing the general stock market in the UK.

Due to their nature as interest rates we observe that the interbank rates show comparatively high standard deviations. In addition to equal algebraic signs of the means, the CPI, the GDP and the general stock market display comparable values in both economies. As the examination sample after the recessions is congruent with a long-term upward trend in the real estate sector, we furthermore find comparatively high mean values of the direct and indirect real estate indices in each country.

Methodology

In order to analyse the dynamic interactions between the selected macroeconomic variables and direct as well as indirect real estate indices in the US and the UK, this study applies the co-integration concept to vector autoregressive (VAR) models using the vector error correction (VEC) framework according to Johansen (1988).

The concept of co-integration is traced back to Granger (1981, 1986) and Engle and Granger (1987). It combines time series analytical procedures with the concept of economic equilibrium, and facilitates the analysis of long-term equilibrium relationships between non-stationary variables. The co-integration analysis is based on the observation that economic variables often display common trend behaviour. This implies that linear combinations of these variables converge towards a common equilibrium in the long term, even though individual time series fluctuate over time.

According to Engle and Granger (1987), time series are co-integrated if they display the same degree of integration and a linear combination of these variables is stationary. Furthermore, the use of the time series in their levels guarantees that information losses due to the conventional use of first differences are avoided. According to the Granger representation theorem the dynamic adjustment process of co-integrated variables towards the long-term equilibrium path can be represented by an error correction model (ECM). In this way, long-term equilibrium relationships are combined with short-term dynamics.

Co-integration analysis

Unit root tests facilitate the determination of the stationary nature of time series. Here, the null hypothesis of non-stationarity is tested against the alternative hypothesis of stationarity of the present time series. Within the scope of this paper we prefer the results of the Phillips-Perron (PP) test (Phillips, 1987, and Phillips and Perron, 1988) to those of the augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979, 1981) in case of deviating results.[11] By virtue of the correction procedure according to Newey West (1994) as well as the Bartlett window, the PP test provides robust results both in the case of present autocorrelation and for time-independent heteroscedasticity (Perron, 1989).

[11] The test decisions are based on the critical values of MacKinnon (1991, 1996).

By considering the periods after the structural breaks, the PP tests indicate that the examined time series are non-stationary in their level specification and stationary in the first differences (see Table 4-4 and 4-5 in Chapter 4.7.2). Consequently, all variables display the same degree of integration. Therefore, the co-integration analysis can be conducted on the basis of a consistent dataset.

In order to detect the existence of co-integrating relationships, we employ the trace test and the maximum eigenvalue test. Determination of rank and estimation of the coefficients are performed as a maximum likelihood estimation. The corresponding likelihood-ratio test statistics are:

$$\lambda_{Trace} = -T \sum_{r+1}^{k} \ln(1-\lambda_i) \qquad (4\text{-}1)$$

$$\lambda_{max} = -T \ln(1-\lambda_i) \qquad (4\text{-}2)$$

λ represents the estimated eigenvalues of the reduced rank of the matrix ϖ. In the process, the sequential test strategy begins with r = 0 and is continued until the null hypothesis for the 5% significance level cannot be rejected for the first time. The related value of r ultimately corresponds to the co-integration rank. In this way there are (n-r) stochastic trends in the system.

In this study the corresponding critical values are used in accordance with Osterwald-Lenum (1992).[12] The applied co-integration tests display the existence of three co-integrating relationships within the VAR model for the US economy and two for the UK counterpart.

[12] The choice of the underlying lag structure of the VAR models is based in the first stage on the information criteria of Akaike (AIC), Schwarz (SC) and Hannan-Quinn (HQ). We furthermore test the models for heteroscedasticity and autocorrelation. Should both or either occur in the consequential VEC models we choose the next highest order. In all models examined the use of this approach enables misinterpretation of the test results to be avoided at the tolerable expense of losing a few degrees of freedom. Prior to this decision, it was necessary to conduct further analyses in order to preclude the possibility, that other reasons, such as, for instance, high values of correlation among the selected variables, are responsible for the significant deviations from the null hypothesis of the White (1980) test.

Modelling of the non-stationary variables as a vector autoregressive (VAR) process Y_t of finite order k forms the basis of the Johansen (1988) procedure. If at least two of the variables are co-integrated of the order of one, then the VAR(k) process can be re-parametrised and written as a vector error correction model:

$$\Delta Y_t = \mu + \pi Y_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \, \Delta Y_{t-i} + \varepsilon_t \qquad (4\text{-}3)$$

ΔY_t is a (n × 1) vector of the first differences of stochastic variables Y_t, and μ is a (n × 1) vector of the constants. The lagged variables are contained in vector Y_{t-1}. The (n × n) matrices Γ_i represent the short-term dynamic. The coefficients of the co-integrating relationships (co-integration vectors) and of the error correction term are contained in the matrix π.

π can be decomposed as follows:

$$\pi = \alpha\beta' \qquad (4\text{-}4)$$

β represents a (n × r) matrix of the r co-integrating vectors. The (n × r) matrix α contains the so-called loading parameter, i.e. those coefficients that describe the contribution of the r long-term relationships in the individual equations. Here α and ß have full rank. It should be noted that the analysis of π is not definite. If in Equation (4-3) π is replaced by the Equation (4-4), then the error correction representation follows (vector error correction model, VECM):

$$\Delta Y_t = \mu + \sum_{i=1}^{k-1} \Gamma_i \, \Delta Y_{t-i} + \alpha\beta' Y_{t-1} + \varepsilon_t \qquad (4\text{-}5)$$

Evaluation principles

Within the scope of this examination we choose equal evaluation principles in order to allow for comparisons between both countries. The approach of evaluating the VEC models in their entirety facilitates the gaining of deep insights into the intensity of linkages among variables as well as into the relevant channels which are responsible for the adjustment process after deviations from the long-term equilibrium.

In the process, the case of multi-dimensional co-integrating relationships is explicitly taken into account. For this purpose, we apply hypotheses tests in order to verify whether individual coefficients can be restricted to zero without accepting significant losses of information. In so doing, only a single regressor is eliminated in each step. The identification of those individual factors which significantly contribute to explaining the country-specific equilibrium is based on the results of the tests for linear restrictions (LR tests). If individual variables do not significantly contribute to the detected equilibrium, these factors are restricted to zero within the corresponding vector. In this case information is only provided via the coefficients related to the adjustment process.

Variance decomposition

Employing variance decompositions provide further information on the relative significance of the individual variables in explaining index development. To do this, the variance of the errors discovered ex post is allocated proportionately to the examined variables. As this method is also conducted on the basis of vector error correction models, we once more take into account the dynamic character of the interrelations among the considered variables.

By determining the Cholesky order, a causal structure is implicitly assumed among the variables of the system. This is expressed in the distribution of the common components of the interference terms in favour of the variables preceded in the Cholesky order. This fact could have a major influence on the results especially in the case of a strong correlation between the original error values. As a consequence of this, we verify the results of the variance decompositions as outlined in Chapter 4.7.4 (Figure 4-6 and 4-7) by choosing alternative Cholesky orders. However, the results are robust, i.e. although the absolute values fluctuate slightly the rank order among variables remains unchanged.

Empirical results

Prior to the analysis of the features of real estate equities, we evaluate the implemented model framework with respect to econometric requirements and economic plausibility. Despite the well-known disadvantage of vector error correction models, namely their sensitivity, both implemented models meet the econometric requirements which have been defined prior to the estimation. Additionally, the signs of the macroeconomic factors can reasonably be explained by economic theory. As a result, this VECM framework, including the implemented model specifications, is adapted for examining and evaluating the features of real estate equities.

VECM results – technical evaluation

The VECM results for the examination period between March 1992 and June 2008 are summarised in Tables 4-2 and 4-3. Based on the co-integration test results we find three co-integrating relationships in the US and two co-integrating relationships in the UK model. In each model, the first and second β-vector are normalised to the direct and securitised real estate index, respectively, while the third one in the US model is normalised to the CPI index.[13]

The implemented restrictions are accepted by the LR tests. Furthermore, the p-values of the White tests consistently indicate that the risk of heteroscedasticity is eliminated.[14] Both VEC models are additionally tested for stationary by the Dickey-Fuller (DF) test using the critical values according to Banerjee *et al.* (1993). Although not being significant in each case, the adjustment coefficients for the error correction terms display negative signs, indicating a return to the long-term equilibrium path. Due to the decomposition of the ϖ matrix, the use of the error correction approach allows the evaluation of long-run relationships as well as the adjustment mechanism separately (see Equation 4.4). Accordingly, the vectors for the long-term relationships are outlined in Table 4-2 and the vectors with reference to the adjustment processes are displayed in Table 4-3.

[13] The outlined evaluation principles require that the normalised variable significantly contributes to the long-term equilibrium in the respective vector.
[14] The estimated models are free from possible hazards caused by occurring autocorrelation within the residuals, too, although not explicitly mentioned in Table 4-2.

Table 0-2 Long-Term Equilibrium Relationships (β-vectors).

Economy	r	NCREIF	NAREIT	CPI	INTER	GDP	SP500	pWhite prob LR-Test
United States	3*	1.000	+0.544 [-12.294]	0	0	0	+0.281 [-11.682]	0.342 0.053
		+1.281 [17.985]	1.000	+19.435 [-20.444]	-0.075 [10.619]	0	0	
		0	+0.011 [-3.589]	1.000	+0.003 [-11.768]	-0.253 [10.912]	0	

Economy	r	IPD	REEI	CPI	INTER	GDP	FTSE	pWhite prob LR-Test
United Kingdom	2	1.000	+0.989 [-18.465]	0	-0.181 [8.989]	0	0	0.208 0.055
		+0.632 [-10.043]	1.000	0	0	0	+0.497 [-5.470]	

Notes: Coefficients are converted so that relationships between the normalised variable and the risk factors can be identified as positive or negative directly. For reasons of clarity we do not report the corresponding constant c and the ε as a proxy for the error term. *T*-statistics are included in parentheses, r = number of co-integrating vectors. * denotes that the VEC model includes a deterministic trend which displays significant coefficients in all three vectors. NCREIF = direct property index in the US, NAREIT = real estate equity index in the US, IPD = direct property index in the UK, REEI = FTSE 350 Real Estate Index as a proxy for the real estate equity market in the UK, CPI = domestic consumer price index, INTER = interbank rates (3 months), GDP = real gross domestic product, SP500 = Standard & Poor´s 500 Stock Index, representing the general stock market in the US, FTSE = FTSE 100 Index, representing the general stock market in the UK. pWhite denotes the p-values of the White test for heteroscedasticity, LR-Test denotes the probabilities of the tests for linear restrictions.

VECM framework: significance and signs

We find consistent signs of the macroeconomic variables in both examined economies which furthermore apply to economic theory. As expected, the real estate assets are positively affected by the general stock markets, while negative effects are detected due to an increase in the interbank rates in each economy.

For the purposes of our examination, the interbank rates are used as an indicator for the interest rate levels which are ultimately decisive for the resulting credit costs. Referred to individual projects, returns on properties and developments suffer from increasing interest rates and their adverse effects on project-specific debt financing. As investments in properties in particular are known to require a high ratio on dept capital, the increase in the interbank rates further leads to a decreasing demand for property investments, which in turn results in decreasing property prices. However, the positive sign of the interbank rates (in the third vector of the US model) also applies to economic theory, as in that case the vector is normalised to the consumer price index. In this context, our results confirm the findings of Geltner *et al.* (2007), who classify the money market as the best hedge against inflation on the condition that the investor reinvests in the money market. Moreover, our results indicate a negative relationship between the CPI and the GDP which once more clarifies the adverse long-term effect of rising inflation on domestic economic growth.

Nevertheless, the cross-country comparison reveals a difference in terms of possible inflation-hedging characteristics of real estate assets. According to the US model, a positive relationship is detected between the consumer price index and the NAREIT (vector 2 and 3), indicating that investments in real estate equities benefited from rising inflation during the examination period.

In contrast, this does not apply to real estate investments in the UK, as the estimations do not indicate significant coefficients of the CPI variable in both vectors, neither positive nor negative. These distinctions are in line with the inconsistent findings of the related studies outlined above. Therefore, our results affirm that conclusions on the issue of whether real estate represents an appropriate tool to hedge against inflation cannot reliably be drawn without considering the complete business environment and its interrelationship to the relevant real estate sector.

Linkage to the macroeconomy

With regard to the co-integrating relationships in their entirety, our results consistently feature distinctions between the markets in the US and the UK. While we find a stronger linkage to the macroeconomic environment in the US, the financial market indices in the UK are predominantly focused on each other. This distinction is recognisable by both the long-term relations and the observed adjustment processes as well.

According to this, the macroeconomic determinants CPI and GDP significantly contribute to the explanation of the long-term equilibrium in the US model (see Table 4-2). Furthermore, the third vector is primarily focused on the real economy indicating that the long-term equilibrium is determined by the CPI, the GDP, the interbank rates and the real estate equity index. In contrast, neither the former nor the latter aspect applies to the UK model, where the real economy, represented by the GDP and the CPI, does not significantly contribute to the long-term equilibria.

Table 0-3 Adjustment Processes (α-vectors).

Economy	Error Correction:	D(NCREIF)	D(NAREIT)	D(CPI)	D(INTER)	D(GDP)	D(SP500)
United States	CointEq1	-0.099	0.191	-0.054	**-12.418**	**-0.223**	-0.597
		[-1.596]	[0.194]	[-1.317]	**[-2.420]**	**[-5.780]**	[-0.739]
	CointEq2	-0.0390	-0.504	**-0.068**	-7.555	**-0.189**	-0.549
		[-0.752]	[-0.612]	**[-1.978]**	[-1.762]	**[-5.857]**	[-0.812]
	CointEq3	-0.981	2.894	**-1.530**	**-192.998**	**-3.253**	-19.978
		[-0.942]	[0.175]	**[-2.215]**	**[-2.241]**	**[-5.026]**	[-1.473]

Economy	Error Correction:	D(IPD)	D(REEI)	D(CPI)	D(INTER)	D(GDP)	D(FTSE)
United Kingdom	CointEq1	-0.007	0.163	0.000	**-1.683**	-0.004	**0.178**
		[-0.498]	[1.768]	[0.080]	**[5.506]**	[-1.707]	**[2.977]**
	CointEq2	**-0.040**	-0.052	**0.013**	-0.639	**-0.007**	**0.151**
		[-2.170]	[-0.453]	**[2.311]**	[-1.677]	**[-2.470]**	**[2.033]**

Notes: Bold type denotes significant results based on t-statistics (in parentheses). All values are first differences. For reasons of clarity we omit the corresponding constant c and the error term ε. NCREIF = direct property index in the US, NAREIT = real estate equity index in the US, IPD = direct property index in the UK, REEI = FTSE 350 Real Estate Index as a proxy for the real estate equity market in the UK, CPI = domestic consumer price index, INTER = interbank rates (3 months), GDP = real gross domestic product, SP500 = Standard & Poor´s 500 Stock Index, representing the general stock market in the US, FTSE = FTSE 100 Index, representing the general stock market in the UK.

In addition to the long-term relations (β-vectors), we take into account the results of the adjustment processes (α-vectors) and the corresponding co-integration graphs. The α-vectors describe the adjustment process when the linear combinations deviate from the long-term equilibrium path. In that case, the αvectors indicate in which way this disequilibrium affects the remaining model variables (see Table 4-3). The corresponding co-integration graphs for the observed paths are illustrated in Figure 4-6 (Chapter 4.7.3).

The evaluation of the α-vectors affirms the outlined differences concerning the long-term relationships (β-vectors) in both examined economies. In consequence, the mode of the adjustment process back to the long-term equilibrium is remarkably different in the US economy compared to the UK. Accordingly, deviations from the long-term equilibrium affect neither the real estate assets nor the general stock market in the US model. Instead, these disequilibria significantly affect the GDP, the consumer prices and the interbank rates. This mode of adjustment can therefore be interpreted as a remarkable orientation towards the US macroeconomy. In contrast, this does not apply to the UK model, where disequilibria affect the general stock index (in both vectors) and the property index (in vector 2) very significantly and therefore indicate a remarkable orientation towards the financial market indices.

The reason for these outlined distinctions between both economies can reasonably be explained by the interdependency among economic growth, credits and inflation. In principle, the sample from 1992:q1 to 2008:q2 is characterised by increasing demand for properties and increasing property prices in both real estate markets. Contemporaneously, this progress was enhanced by comparatively high GDP rates relative to low interbank rates. During that time period, the GDP rates only revealed one remarkable decline due to the collapse after the '9/11' terrorist attacks in 2001, even though still indicating positive rates of economic growth.

Despite the comparatively resistant economic growth, the interbank rates even feature negative mean values over the examination sample in both economies and in this way additionally stimulated loan-financed investments.[15] As a consequence, this instance particularly facilitates investments in properties which largely rely on a high ratio of debt capital and therefore benefit from decreasing credit costs by nature.

As this ratio has been even more extreme in the US economy over the whole sample, this instance results on the one hand in additional demand for loan-financed investments in the US. On the other hand, in accordance with economic theory, the functional chain of economic growth, low levels of interest and increasing property prices imply rising rates of inflation. This fact can easily be identified by the significant contribution of the CPI variable within the US VEC model (see Table 4-2 and 4-3). Moreover, this finding is additionally affirmed by larger US CPI mean values over the examination sample compared to the UK counterpart (see Table 4-1). As in this context inflationary expectations also increase by implication, loan-financed investments are as well stimulated in terms of inflation, because real indebtedness decreases over time on the basis of rising inflation.

As a result, via the channel of a more extreme ratio of high GDP rates relative to low interest rates and its consequential stimulating effects on real estate and inflation, this process results in self-intensifying effects and in this way affects the real economy and real estate markets as well. For that reason, the US economy is ultimately closer linked with its real estate sector compared to the UK, where this ratio has been slightly more moderate and in the end did not trigger self-intensifying effects.

Features of real estate equities

As mentioned above, due to the fact that both implemented models meet the econometric requirements and the macroeconomic influences can furthermore be reasonably explained by economic theory, we use the outlined VECM framework in order to analyse the features of real estate equities.

[15] Compared to the key interest rates of the corresponding central banks, the interbank rates reveal a spread as a risk premium for lending money to competitors. Nevertheless, the interbank rates are known to be largely influenced by these key interest rates. For this reason, the outlined effects are closely linked with the expansive monetary policy of the US Federal Reserve during the examination sample. However, examining the effects of monetary policy and the strategies on how to intervene in the money market is not the subject of the current paper, but of another one.

The real estate equity indices in both economies are significantly influenced by the progress on the underlying property markets. The model estimations show a strong linkage between the real estate equity indices and the direct properties, indicating that both real estate assets affect each other positively in the long run. This strong linkage is recognisable by their unalterable contribution to the long-term equilibrium (in vectors one and two in each model) with comparably high t-values. Restrictions of one of these two real estate assets are rejected by the LR test and would lead to significant losses of information within both VEC models. Moreover, this finding is robust if choosing alternative VEC specifications.[16]

In each economy, one co-integrating vector is determined by the examined financial market indices (vector 1 in the US model and vector 2 in the UK model). Independent of the implemented normalisation, the corresponding direct property index, the real estate equity index and the general stock market significantly contribute to the long-term equilibrium in these vectors indicating equal signs in both countries. Therefore, both the property index and the general stock index significantly determine the progress of the real estate equity index.

In order to analyse whether real estate equities primarily reflect real estate or equities, some studies take the comparison of the corresponding coefficients as a basis for their decision. The fact that the general stock market is only included in one vector in each model, while both real estate assets significantly contribute to the long-term equilibrium in at least two vectors, describes a further widely-used but not quite reliable criterion in this context.

With respect to the outlined VECM results, both aspects would suggest a closer linkage between the real estate assets compared to the equity assets and would therefore indicate that the distinctive features of real estate investments still persist despite the listing on stock exchanges. Nevertheless, we prefer to employ further analyses and therefore additionally conduct variance decompositions in order to verify the VECM results and to gain further insights into this issue.

[16] Although choosing alternative VEC specifications, we nevertheless keep the evaluation principles as outlined above.

Variance decomposition

As indicated in Figure 4-3, a comparatively substantial contribution to the variance of the US NAREIT is explained by the NCREIF (46.53%), while the S&P 500 only explains a significantly smaller fraction (13.43%).[17] This implies that the real estate equity index in the US is driven more by its underlying property market than by the general stock market. For that reason, we can take this result as a stronger linkage among the real estate assets compared to the equity assets.

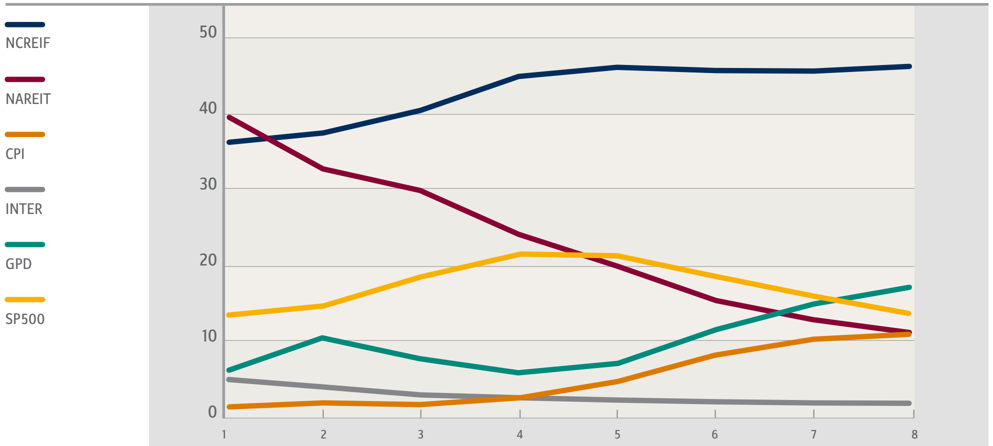
Although not indicating comparable values, the same applies to the UK. The real estate equity index is primarily influenced by the GDP (23.88%), while the IPD and the FTSE Composite Index explain 14.25% and 9.85%, respectively. In addition, we find a remarkable growth in influence of the property indices when considering longer periods in both economies. In contrast, the reverse applies to the impact of the general stock markets, as its measured contribution is characterised by a tendency to decline over time.

For this reason, the results of the implemented variance decompositions consistently indicate a closer linkage among the real estate assets compared to the equity assets in both economies. The long-term synchronicity between listed and direct real estate consequently implies that the distinctive features of real estate investments in their primary meaning still persist despite the influences of the general stock market.

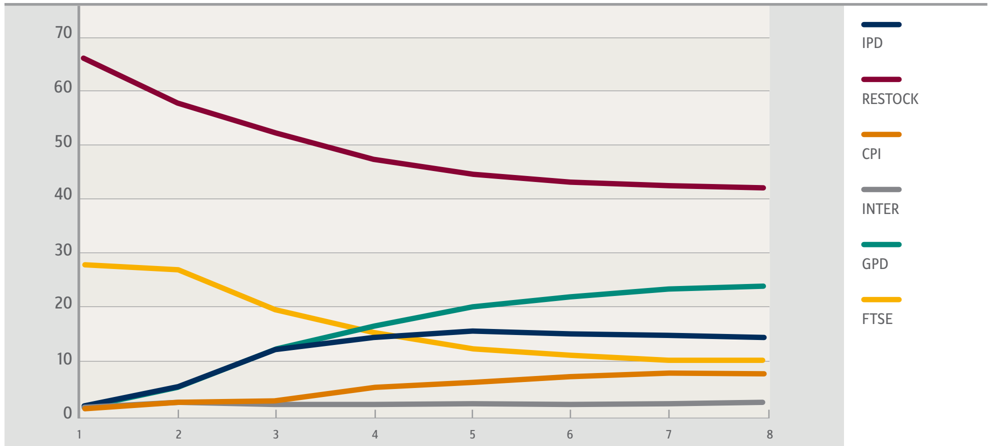
Accordingly, in spite of being subject to supply and demand, the developments of the underlying real estate objects remained the key driver of the performance of listed real estate during the examined sample. As a result, besides benefits in terms of liquidity, transparency and management, long-term investments in listed real estate offer opportunities to combine advantages of both direct and listed real estate, and therefore also provide remarkable potential for diversifying the investor´s portfolio.

Figure 0-3 Variance Decompositions.

United States - Variance Decomposition of NAREIT



United Kingdom - Variance Decomposition of RESTOCK



Notes: NCREIF = direct property index in the US, NAREIT = real estate equity index in the US, IPD = direct property index in the UK, REEI = FTSE 350 Real Estate Index as a proxy for the real estate equity market in the UK, CPI = domestic consumer price index, INTER = interbank rates (3 months), GDP = real gross domestic product, SP500 = Standard & Poor´s 500 Stock Index, representing the general stock market in the US, FTSE = FTSE 100 Index, representing the general stock market in the UK.

[17] The denoted values refer to the numerical output in Chapter 4.7.4.

Conclusion: Property not Equity

Investments in listed real estate imply that movement in the underlying property markets no longer represents the only driver for the performance and risk/ return structure of this asset. Instead, listed companies contend with market values being partly influenced by developments on general stock markets, while the main business of the constituents remains unchanged and is still focused on trading and renting real estate objects. For precisely that reason, it is critical to analyse to what extent developments on general stock markets influence the progress of listed real estate.

Answering this question is of particular importance with respect to issues of asset allocation in a multi-asset portfolio. If it was found to be predominantly driven by progress on general stock markets, the benefits of listed real estate in terms of portfolio diversification would be considerably limited. By implication, the intended risk/return structure of an investor´s portfolio would be significantly distorted because the consideration of listed real estate would involuntarily increase the proportion of investments that are subject to general stock market risk. Consequently, this case would finally result in a portfolio allocation which is riskier than requested. However, the research findings refute this scenario.

For the purposes of this examination, we analyse the real estate markets in the US and the UK in the period since 1992. Deviating from the conventional procedure of exclusively focusing on the three financial market indices, namely real estate equities, direct real estate and general stocks, we follow the approach of taking into account the macroeconomic environment in each country. As real estate markets are considered to be cyclical in nature, the consideration of the macroeconomy avoids the ignoring of information resulting from the business environment and thus the impact of the cyclical trend.

Using a vector error correction framework and variance decompositions, in both economies we consistently find a significantly stronger linkage among real estate assets compared to the linkage among the examined equity assets. The real estate equity markets are therefore predominantly driven by the progress of the underlying properties, which can therefore still be interpreted as the key driver of listed real estate in the long run. Long-term investments in listed real estate therefore not only provide opportunities for portfolio diversification, but additionally allow the combination of advantages of both real estate assets, including benefits in terms of liquidity, transparency and management. As a result, investments in real estate equities can still be classified as an alternative investment and therefore still present a favourable tool in terms of asset allocation.

In addition to examining the features of real estate equities, the approach of taking into account the economic environment for the purposes of this study allows comparisons with respect to the relevance of the real economy in the examined real estate markets. In this context, the cross-country comparison reveals one striking distinction according to which the progress of the real estate sector in the US is more closely linked to the macroeconomy compared to the UK. This distinction is recognisable by both the determination of the long-term relationships and during the observed adjustment process in case of disequilibria as well. In contrast, we do not detect comparable linkages to the British economy, where the financial market indices predominantly stimulate each other.

In this context, we identify the ratio of GDP and interest rates as the principal reason for the closer linkage to the macroeconomy in the US. During the whole examination sample, we find higher GDP rates relative to lower interest rate levels in the US economy, which was responsible for additional demand for loan-financed investments and in this way additionally increased property prices. Accordingly, via this channel and its consequential stimulating effects on inflation, the economic environment in the US is more severely affected by these developments, which ultimately results in the closer nexus with its real estate sector.

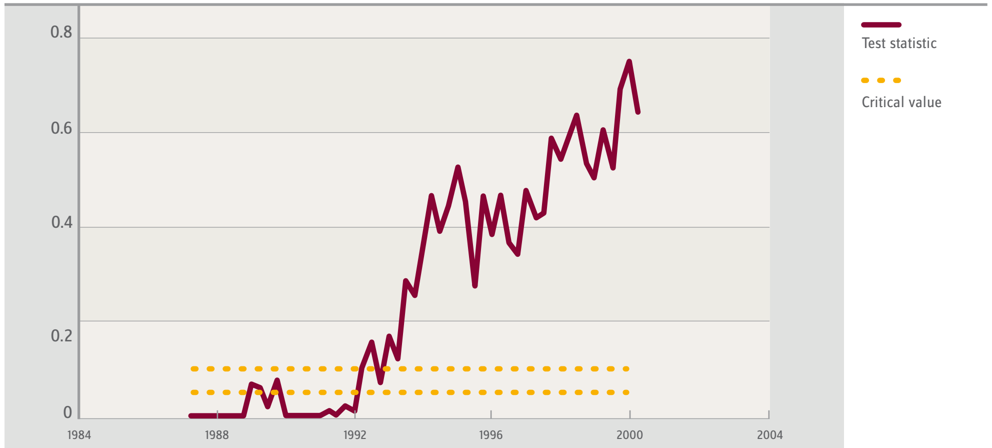
This study clarifies that long-term investments in real estate equity indices still fulfil their function as an alternative investment in order to diversify an investor´s portfolio. For that reason, we further on assume lower correlations to conventional assets and a more defensive risk/return structure compared to investments in general stocks. Nevertheless, if considering shorter investment horizons, passing a blanket judgement is pointless in this context, despite the consistent long-term results. Instead, considering the distinctive features of the respective real estate sector and its linkage to the complete business environment is indispensable in order to be able to assess influences on real estate equity indices in the right way.

Appendix

Testing for structural breaks

Figure 0-4 Sample Split Chow Test for the United States (1978:q1 - 2008:q2).[18]

Figure 0-5 Sample split Chow Test for the United Kingdom (1988:q1 - 2008:q2).



[18] The structural breaks are computed with the JMulti software. The output table is available on request.

Unit root tests

Table 0-4 United States: Unit Root Tests (1992:q1 - 2008:q2).

United States	Variable	PP-Test Newey-West bandwidth using Bartlett kernel			LI
		PP (none)	PP (intercept)	PP (trend + intercept)	
Direct Property Index	ln NCREIF			-2.328 (4)	I(1)
	Δ ln NCREIF	-1.769* (1)			
Real Estate Stock Index	ln NAREIT		-2.010 (0)	-2.521 (2)	I(1)
	Δ ln NAREIT	-5.575*** (0)	-5.777*** (2)		
Stock Index	ln SP500		-1.709 (3)		I(1)
	Δ ln SP500	-7.278*** (0)			
Gross Domestic Product	ln GDP			-1.314 (3)	I(1)
	Δ ln GDP		-5.597*** (0)		
Consumer Price Index	ln CPI			-2.562 (13)	I(1)
	Δ ln CPI		-13.110*** (1)		
3 Months Interbank Rate	INTER		-3.473 (3)		I(1)
	Δ INTER		-4.776*** (3)		

Notes: ***, ** and * denotes statistical significance at 99%, 95% and 90% level, respectively. PP= Phillips-Perron test for stationarity, LI = level of integration. The bandwidths are given in parentheses.

Table 0-5 United Kingdom: Unit Root Tests (1992:q1 to 2008:q2).

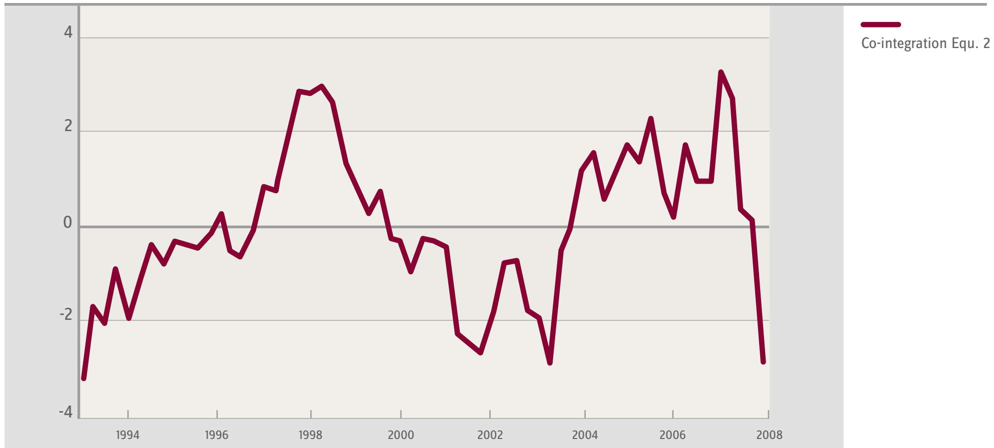
United Kingdom	Variable	PP-Test Newey-West bandwidth using Bartlett kernel			LI
		PP (none)	PP (intercept)	PP (trend + intercept)	
Direct Property Index	ln IPD			-3.299 (5)	I(1)
	Δ ln IPD		-2.586* (3)		
Real Estate Stock Index	ln REEI		-0.676 (3)	-2.206 (4)	I(1)
	Δ ln REEI	-7.190*** (4)	-8.175*** (3)		
Stock Index	ln FTSE		-1.569 (5)		I(1)
	Δ ln FTSE	-7.111*** (5)	-7.468*** (5)		
Gross Domestic Product	ln GDP			-1.027 (3)	I(1)
	Δ ln GDP		-6.812*** (2)		
Consumer Price Index	ln CPI			-0.809 (4)	I(1)
	Δ ln CPI		-6.971* (4)		
3 Months Interbank Rate	INTER		-1.823 (5)		I(1)
	Δ INTER	-4.008*** (2)			

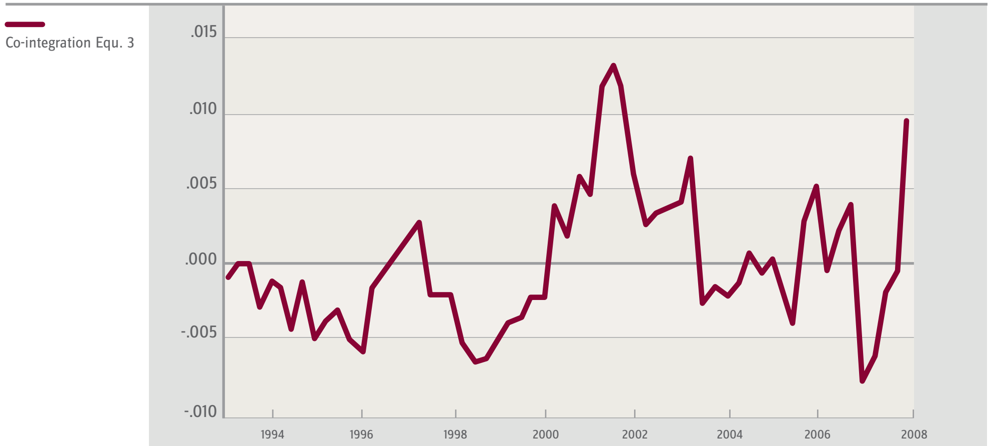
Notes: ***, ** and * denotes statistical significance at 99%, 95% and 90% level, respectively. PP= Phillips-Perron test for stationarity, LI = level of integration. The bandwidths are given in parentheses.

Co-integration graphs

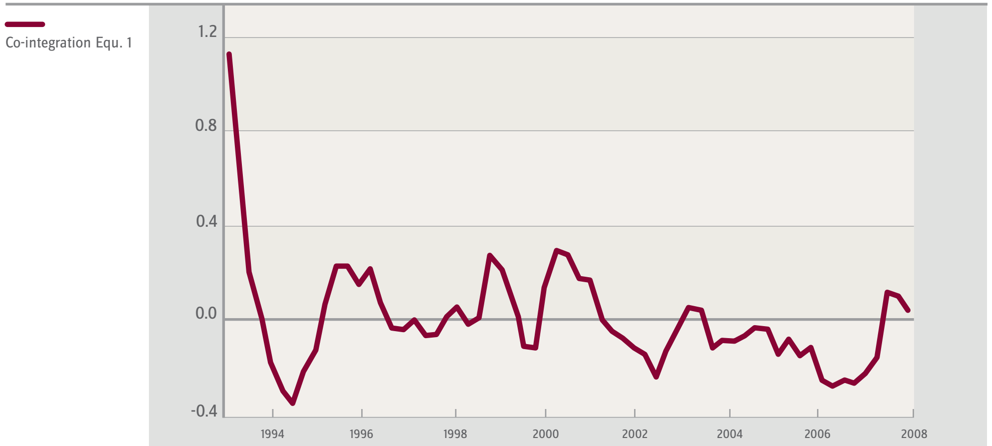
Figure 0-6 Co-integration Graphs for the US and the UK Models (1992:q1 - 2008:q2).

United States





United Kingdom



Notes: Here, the zero line presents the long-term equilibrium and the curve shows the deviations. In principle, the evaluation of the co-integration graphs reveals similarities between both real estate markets. According to the graphs, deviations from the long-term equilibrium range between a comparable order of magnitude in the co-integrating relations 1 and 2. Limited to the period between 1992 and 1993, relation 1 of the UK model displays the only exception in this context. The main distinction, however, is represented by the existence of a third co-integrating relationship within the US model which is furthermore primarily focused on the real economy. As indicated by the low scale values of this co-integrating relationship, deviations are kept within bounds and were quickly absorbed by the macroeconomy during the examination sample.

Variance decomposition

Table 0-6 Variance Decompositions (United States).

Period	NCREIF	NAREIT	CPI	INTER	GDP	SP500
1	36.212	**39.788**	0.870	4.592	5.520	13.017
2	37.500	**32.652**	1.528	3.623	10.170	14.524
3	40.508	**29.925**	1.395	2.576	7.328	18.265
4	45.046	**23.991**	1.978	2.154	5.553	21.275
5	46.256	**19.802**	4.321	1.834	6.754	21.031
6	45.730	**15.303**	7.940	1.485	11.228	18.311
7	45.714	**12.582**	9.936	1.425	14.606	15.734
8	46.524	**10.837**	10.759	1.427	17.024	13.426

Notes: This analysis is based on vector error correction models. NCREIF = direct property index in the US, NAREIT = real estate equity index in the US, CPI = domestic consumer price index, INTER = interbank rates (3 months), GDP = real gross domestic product, SP500 = S&P 500 Stock Index, representing the general stock market in the US.

Table 0-7 Variance Decompositions (United Kingdom).

Period	IPD	REEI	CPI	INTER	GDP	FTSE
1	0.950	**66.611**	1.872	1.796	0.898	27.870
2	5.3511	**58.049**	2.601	2.033	4.935	27.029
3	11.851	**52.274**	2.600	1.775	11.9721	19.525
4	14.315	**47.462**	4.904	1.879	16.339	15.098
5	15.351	**44.721**	5.821	1.847	19.904	12.353
6	15.048	**43.250**	6.888	1.948	21.839	11.024
7	14.695	**42.399**	7.385	2.048	23.219	10.252
8	14.249	**41.921**	7.832	2.261	23.881	9.852

Notes: This analysis is based on vector error correction models. IPD = direct property index in the UK, REEI = FTSE 350 Real Estate Index as a proxy for the real estate equity market in the UK, CPI = domestic consumer price index, INTER = interbank rates (3 months), GDP = real gross domestic product, FTSE = FTSE 100 Stock Index, representing the general stock market in the UK.

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