



# Non-linear causality between the stock and real estate markets of Western European countries: Evidence from rank tests

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## ABSTRACT

Using the non-parametric rank tests proposed by Breitung (2001), we set out in this study to determine whether any non-linear long-run equilibrium relationship exists between the stock and real estate markets of Western European countries. We go on to adopt the threshold error-correction model (TECM) to determine whether a similar relationship is discernible possibly non-linear functions of the log-price of these two markets. The findings clearly point to the existence of long-run unidirectional and bidirectional causality between the real estate market and the stock market in regions both above and below the threshold level. Finally, we find the existence of both wealth and credit price effects in the real estate markets and stock markets of Western European countries, which thereby offer financial institutions and individual investors in their construction of long-term investment portfolios within these two asset markets.

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## 1. Introduction

It has been clearly demonstrated within the prior literature that any attempt at precisely determining the relationship between the stock market and the real estate market remains somewhat contentious; and indeed, regardless of whether this relationship is examined over the short-term or the long-term, it remains unsettled as to whether the two markets are segmented or integrated. Of special interest to anyone observing the fluctuations are stock and real estate markets. For investors, whilst the growth of stock market alliances and mergers within the European Union signals increased institutional integration in European capital markets, there has also been growing interest in the implications of this process for investment decisions and strategies. Where consequences are identified for the level and pattern of business and investment activity, there will also be significant effects on the level and pattern of real estate performance.

The massive fluctuations that are discernible in European asset prices have often been considered to be a boom and subsequent bursting of the bubble (boom and bust cycle); however, in the second half of the current decade, a much bigger boom–bust cycle has been experienced by the asset markets of Europe (primarily the stock and

real estate markets) than by any other sector of the economy. Not only do these tremendous shifts in asset prices have a huge impact on the net worth of property assets, but they also have significant and persistent effects on real economic activities. Such major fluctuations may come about through relatively infrequent, but nevertheless important events, notably oil shocks or changes in fiscal and other policy regimes, with such events ultimately affecting the macro- and micro-economic performance of a country, and also changing the very nature of its economic relationships. Perron (1989) concludes that business cycles are in fact transitory fluctuations around a more or less stable trend path, thereby resulting in non-linear phenomena.

On the other hand, in point of methodology, conventional cointegration methods may be inappropriate, essentially because they assume a unit as the null hypothesis, and a linear process under the alternative. It is, nevertheless, clear that the theory is not always capable of providing any precise specification of the functional form, such that non-parametric tools for use in estimation and inference are clearly desirable. The majority of the models adopted in the prior empirical studies addressing the issue of equilibrium have generally failed to take into account the non-linear properties of the adjustment process; however, as noted by Laxton et al. (1993), both bias and mistakes are increasingly likely when a linear and symmetrical methodology is adopted to test economic variables that are non-linear and asymmetric. In similar fashion, we argue that a non-linear relationship may exist within Western European countries. Furthermore, we note that in the majority of the prior empirical studies addressing the issue of equilibrium, most of the models fail to take

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into consideration the asymmetric properties of the adjustment process in both the real estate market and the stock market.

The present study differs from these earlier examples by providing non-linear cointegrational evidence on Western European countries based on the non-parametric rank tests developed by [Breitung \(2001\)](#), which demonstrate power in both linear and non-linear frameworks, and which are also applicable to whatever the data generating process of the variables under examination. It is worth noting that in the non-linear evidence referred to in the previous studies; the tendency has been to adopt parametric residual-based tests in a cointegrational approach to the testing of the relationship between stock and real estate markets. In contrast, parametric testing procedures assume that the data generating process is already known in advance; and thus, there is some danger of misspecification if the wrong parametric models are used to characterize the variables of interest.

There are, therefore, several important issues that are of particular interest to this study. Firstly, our primary objective in this study is to ascertain whether there is indeed any significant non-linear relationship between the real estate and stock markets in Western European countries using rank tests proposed by [Breitung \(2001\)](#). Whilst some empirical evidence of the relationship between real estate and stock markets seems convincing, unfortunately thus far none has been proven to be conclusive. This method demonstrates more power than traditional linear or non-linear parametric testing procedures. Secondly, we go on to apply asymmetric error-correction models to describe the short-term dynamic adjustments with the asymmetric price transmissions between the stock and real estate markets. Our results should facilitate an investigation into the causal relationships between the real estate markets and stock markets of Western European countries. As a result, two mechanisms are proposed within the prior literature for the interpretation of the relationship between these markets. The first of these is the well-known 'wealth effect', which indicates that the stock market is capable of influencing the real estate market. The second contrasting theoretical interpretation of the relationship between the two markets is the 'credit price effect', which claims that a rise in real estate prices can stimulate economic activity, the future profitability of firms, and, as a consequence, stock market prices, as a result of raising the value of collateral and reducing the cost of borrowing for both firms and households. Granger causality will enable us to determine whether the 'wealth effect' or the 'credit price effect' exists within any of the Western European countries that are either above or below the threshold. Our purpose then is to determine the relationship between these markets and what implications it may have for active market traders. One fundamental motivation behind our study is that our findings can yield considerable insight for both investors and speculators that may facilitate forecasting future performance from one market to the other. To the best of our knowledge, this study is the first of its kind to utilize the long-run relationship with rank test and threshold error-correction model to test non-linear cointegration and Granger causality between real estate and stock markets.

The remainder of this study is organized as follows. A review of previous studies is presented in the next section. A description of the methodology adopted for this study is provided in [Section 3](#). This is followed in [Section 4](#) by the presentation of our empirical results. Finally, the conclusions drawn from this study are presented in [Section 5](#).

## 2. Literature review

In most of the early studies exploring this issue, the tendency has been to adopt linear models as the means of determining the existence of such segmentation or integration, with these studies typically using the 'capital asset pricing model' (CAPM) as their initial starting point; for example, based upon such a model, [Jorion and](#)

[Schwartz \(1986\)](#) conclude that segmentation influences asset pricing. [Liu et al. \(1990\)](#) also follow a similar framework in an attempt to further clarify the issue, exploring whether the commercial non-farm real estate market is integrated with, or segmented from, the stock market using Equity Real Estate Investment Trust (EREIT) extracted from COMPUSTAT tapes and Standard and Poor's (S&P) Security Owner's Stock Guide. Their evidence provides support for the hypothesis that segmentation does exist, albeit based upon indirect barriers such as the cost, amount and quality of information on real estate, as opposed to any legal constraints.

Using a cross-sectional regression analysis of real estate price indices and stock price data on seventeen countries, [Quan and Titman \(1997\)](#) examine the relationship between real estate stock portfolio returns and standard appraisal-based index returns for 17 countries; their results indicate a significantly positive relationship between both real estate valuations and stock returns. [Liu et al. \(1990\)](#) find further evidence of market segmentation between the real estate market and the stock market, with their results gaining additional support from the findings of [Geltner \(1990\)](#), who reported discernible differences between the noise component of stock and real estate returns, and thereby concluded that the two markets are probably segmented. In contrast, however, [Gyourko and Keim \(1992\)](#) report totally contradictory findings, with their results providing evidence to suggest that the stock market contains important information on real estate fundamentals and that S&P 500 returns have significant explanatory power in terms of predicting equity 'real estate investment trust' (REIT) returns.<sup>1</sup> Furthermore, [Myer and Webb \(1993\)](#) also note that the returns on equity REITs that data indices used from National Council of Real Estate Investment Fiduciaries (NCREIF) in conjunction with the Frank Russell Company (FRC) and Center for Research in Security Price (CRSP), appear to be very similar to the returns on common stocks, thereby suggesting a certain degree of integration between the two markets.

There may well be differences in the initial perspectives of the prior studies which, along with the different models and methodologies adopted, may lead to different empirical results being obtained, and therefore, quite diverse conclusions. It is also worth noting, however, that in many of the prior studies, both the real estate market and the stock market are assumed to exhibit linear behavior, despite the fact that there is growing recognition of the non-linear characteristics of the economic variables. Given that both segmentation and integration have been reported, the fact that the majority of the studies within the prior literature have tended to ignore the possibility that the relationship between the real estate market and stock market could be non-linear may well be the main reason for these different outcomes.<sup>2</sup> A number of the prior studies also suggest that many of the macroeconomic and financial time-series variables, including stock price, are organized by stochastic trends; thus, there is some general recognition that non-linear models are capable of fitting the data.<sup>3</sup>

[Liu et al. \(1990\)](#) suggest that the securitized real estate indices, such as REITs, behave very much like common stocks, exhibiting non-linear behavior; they also note that equity REITs are integrated with the stock market. Thus, the research focus is clearly shifting towards the possibility of non-linearity in both stock price and real estate price data; and indeed, based upon their use of non-linear models, both [Liu and Mei \(1992\)](#) and [Ambrose et al. \(1992\)](#) claim that the real estate

<sup>1</sup> This paper analyzes the risks and returns of different types of real estate-related firm trades on the New York and American stock exchanges (NYSE and AMEX). They examine relation between real estate stock portfolio returns and returns on a standard appraisal-based index, and find that lagged values of traded real estate portfolio returns can predict returns on the appraisal-based index after controlling for persistence in the appraisal series.

<sup>2</sup> Examples include: [Schnare and Struyk \(1976\)](#), [Goodman \(1978\)](#) and [Richardson and Thalheimer \(1982\)](#).

<sup>3</sup> See, for example, [Lee and Jeon \(1995\)](#).

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