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Asymmetric dynamics in REIT prices: Further evidence based on quantile regression analysis

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ABSTRACT

This study examines whether mean reversion in REIT prices presents an asymmetric behavior across various quantiles. Distinguished from previous literature that applied the traditional linear unit-root test, a state-of-the-art quantile unit-root test is employed to identify financial asset predictability in five real estate investment trust (REIT) classifications. Our empirical results reveal a distinct pattern that mean reversion is found for those relatively high REIT prices, while random walk properties only exist for those relatively low REIT prices. More specifically, the higher the price is, the faster the speed of mean reversion of REIT toward its long-run equilibrium will be.

1. Introduction

The issue of whether financial asset prices follow a random walk or revert to the long-run trend has relevant financial implications. This conflict of interest is motivated by the predictability of financial market returns and implication on investment strategies and decisions. In the case of random walk, price level adjustments are random and unpredictable. On the other hand, mean reversion demonstrates that investors are able to develop a trading strategy to profit from the predictable returns. Therefore, empirical research studies in finance have long presented a great deal of attention on the time-series properties of financial asset prices — for example, Stevenson (2002), Narayan and Smyth (2007), Goddard et al. (2008), Lee et al. (2010), Chien (2010), Lee and Chien (2011), and Chen et al. (2011), to mention a few.

Despite this extensive research, the empirical evidence on mean reversion in financial asset prices is still inconclusive. Yet another investment vehicle appears to be on the way, in the form of real estate securities. Real estate investment trusts (REITs) have played an increasingly key role in US real estate investment. REITs not only provide alternative investment channels to investors, but also enable individual investors to invest in real estate or real estate-related assets. As discussed by Payne and Zuehlke (2006), the cyclical behavior of REITs has become a critical issue as their increasing growth to be an investment vehicle for investor. Our motivations for the present study are rooted in whether REIT prices can be characterized as unit-root (random walk) or mean reverting (trend stationary) processes. If REITs are mean reverting, then a series should return to its long-run trend whose path is determined by structural fundamentals over time and it should be possible to forecast future movements in REITs based on past behavior, providing information for financial investment decisions and strategies. By contrast, if REITs are a unit-root process, then any shock to REITs is likely to be permanent. Thus, the random walk (non-stationary) properties also imply that the volatility of asset prices can grow without boundaries in the long run. These time-series properties have important implications not only for determining the effects of random shocks, but also for helping to shed light on asset pricing.

The nonlinearity of financial time series processes is becoming an increasingly important issue at both the theoretical and empirical levels. As such, we have no reason to assume that the mean reverting process is, or has to be, linear. Traditional unit-root tests are computed assuming a linear specification and suffer from low power to reject the non-stationary hypothesis if the series mean reverts in a non-linear fashion (Taylor et al., 2001). Many studies in the literature may explain such non-linear dynamics for financial variables and we summarize them as follows: transaction costs or the existence of market frictions (Chen et al., 2014; Dumas, 1992; Lee et al., 2013; Sercu et al., 1995), heterogeneity of buyers and sellers (Taylor and Allen, 1992), noisy traders causing abrupt changes (De Long et al., 1990), and heterogeneity of central banks' interventions (Dominguez, 1998). All the above articles imply that there is either a non-linear relationship between the financial

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variables and the economic fundamentals, or a non-linear adjustment effect with time-dependence properties. Consequently, the impact of a transitory shock may last for a long period of time when the non-linearity of the series is significant.

This paper attempts to fill this vacuum. Whereas the presence of nonlinearity would put a priori constraints on examinable theories, we deem it important that researchers know whether certain REIT series contain a linear or a nonlinear structure. Our paper takes a different route. A unit-root test based on the *quantile autoregression* (QAR) approach, which is widely applied to time-series analysis including Koenker and Zhao (1996) for quantile ARCH models, Clements et al. (2008) for the conditional autoregressive VaR model, Koenker and Xiao (2006), Zietz et al. (2008), Lima et al. (2008), and Baur et al. (2012) for the QAR approach, and Koenker and Xiao (2004) and Nikolaou (2008) for unit-root QAR inference, is used to examine the stationary properties of REIT prices. In contrast to the existing financial literature on mean reversion, the REIT prices are modeled as quantile-dependent where episodes of stationarity or non-stationarity can be identified and analyzed. The QAR approach provides a way to directly examine how past information affects the conditional distribution of a time series. Our study offers novel insights on REITs' mean reverting behavior.

Specifically, it is one of the first to examine the non-linear mean reversion in five REIT classifications for the period from January 1972 to March 2010 by using the advanced QAR models. A key feature of a QAR model is the examination of data distribution rather than a single measure of a central tendency in the REIT prices' distribution. It offers a more flexible modeling by relaxing restriction on particular distribution, thereby allowing for different and possibly asymmetric adjustment speeds of mean reversion at various quantiles of distribution and providing information to detect local persistence in time series. Koenker and Xiao (2004) point out that many empirical applications, especially with respect to economics and finance, exhibit a heavy-tailed behavior, causing the conventional unit-root tests to perhaps have misleading inferences which are based on the conditional mean. This difficulty can be readily solved by the QAR method, which allows us to explore a whole range of conditional quantiles.[1]

In addition, econometric modeling and financial theories require knowledge on the unit-root properties of REIT data. For the case of rational speculative bubbles, the presence of a cointegration relationship between prices and their fundamentals is often taken as evidence in favor of the absence of bubbles. When examining for cointegration, a prerequisite is that both series contain a unit-root — that is, not rejecting the null hypothesis is a primary step toward conducting a test for a long-run relationship (Lee, 2013). If relevant econometric works lack a diagnostic analysis of the order of integration, then this could result in misleading inferences as well as the conduct of cointegration analysis being perhaps inappropriate, thereby losing the meaning of bubble detection (Lee et al., 2010; Manning, 2002). Thus, it is also crucial for bubble detection to fully understand the unit-root properties.

The present study contributes overall to the existing literature with a more comprehensive and accurate analysis. It not only extends the sample period from January 1972 to March 2010, but also broadens the scope of analysis by dividing the REITs into five REIT classifications – all, equity, mortgage, hybrid, and composite REITs – in order to investigate the presence of the mean reversion property across different REITs. Most importantly, with the quantile unit-root test, our empirical results are more capable of identifying the mean reversion properties under different quantiles. This study further posits heterogeneity in the conditional density of REIT prices, and these heterogeneous distributions can be effectively represented by the QAR models. Finally, to provide a complete analysis of short-run adjustments and the mean reversion process of REIT prices, we proceed by measuring the half-lives when stationarity is confirmed. The half-life provides a summary measure of how long it takes for REIT prices to dissipate by one-half after facing a unit of shock.

The rest of the paper is organized as follows. Section 2 provides a brief summary of the literature. Section 3 outlines the econometric methodology used in this paper. Section 4 illustrates the data and performs an empirical application using a quantile unit-root test on five REIT classifications, while Section 5 examines the robustness of the results. Section 6 presents the conclusions drawn plus a few salient policy implications as well as directions for future research based on the empirical findings from this extensive research.

2. Literature review

As is well known in asset pricing theory, the basic premise of the present value model is that financial asset prices are determined by the discounted values of expected future cash flows. However, in the case of asset prices which always deviate from fundamentals can be interpreted as rational speculative bubbles. In this regard, investors should be concerned about whether the deviations will return to its long-run equilibrium over time. This issue has been widely discussed using various financial assets in many empirical studies, such as Kleiman et al. (2002) for real estate share prices, Evans (2006) for future prices, and Lee et al. (2010) for stock prices, ever since the seminal works of Fama and French (1988), Lo and MacKinlay (1988), and Poterba and Summers (1988). If the mean reversion property holds, then asset prices should be characterized by a stationary process. This implies that random shocks have temporary effects on asset prices and future returns are predictable from historical price movements. The opposite is true when we are unable to reject the unit-root hypothesis for asset prices.

Even though there is a large body of literature that investigates the issue of mean reversion in financial markets, there is no consensus among analysts due to the inconclusive results therein. Some previous studies, for instance, support the mean reversion behavior (e.g., Chaudhuri and Wu, 2004; Lee et al., 2010), while others do not (e.g., Evans, 2006; Kleiman et al., 2002; Narayan and Smyth, 2007) or even support asymmetric mean reversion (Koutmos and Philippatos, 2007; Nam et al., 2002). Different findings on the validity of mean reversion depend on different techniques, time periods, and different financial assets.

For REITs, like any other financial assets, it may reasonably be expected that the analogous statement mentioned above applies to REIT markets. As discussed in Jirasakuldech et al. (2006) and Payne and Waters (2007), for example, a study of REIT markets presents three main reasons of interest as follows. First of all, there is a close link between REITs and the stock market from an empirical standpoint. As for the analogy to the stock market, rational speculative bubbles should be addressed in the REIT markets. Indeed, numerous empirical researchers note the existence of speculative bubbles in the housing market. Thus, REITs may be sensitive to speculative bubbles. The second reason is with regard to liquidity in REIT markets. According to the findings of Diamond and Verrecchia (1987) and Desai et al. (2002), short selling can be regarded as a signal of overvaluation in markets where prices continually rise beyond fundamental values. However, the REITs lack the capability to provide enough liquidity in support of short selling to signal overpricing or even a bubble forming in the market (Li and Yung, 2004). The third concern relates to the presence of asymmetric information, leading to the under-pricing of REITs' seasoned equity offerings such that market overvaluation is hard to detect (Ghosh et al., 2000). This study presents a detailed statistical analysis of the time-series properties to investigate the possible existence of the unit-root hypothesis in the REIT markets.

[1] For instance, Koenker and Xiao (2004) and Nikolaou (2008) respectively show asymmetries in the dynamic adjustment of interest rates and real exchange rates. In these cases, the characteristics of financial assets are described differently across the distribution of asset prices.