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Are securitised real estate markets efficient? New international evidence based on an improved automatic Portmanteau test

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ABSTRACT

We re-examine the efficiency of real estate markets based on the Escanciano-Lobato (2009) autocorrelation test which we improved by means of wild bootstrapping. Through Monte Carlo simulation, we find that the wild bootstrap-based autocorrelation test has very good performance even in small samples. We apply the improved test to examine the efficiency of 14 international securitized real estate markets—Australia, Canada, France, Germany, Hong Kong, Italy, Japan, Netherlands, Norway, Singapore, Sweden, Switzerland, United Kingdom and the United States. Our results show that only six of these markets—Australia, Hong Kong, Italy, Japan, Sweden and the United States are efficient while the rest are inefficient. We also find that the degree of efficiency or inefficiency of each of these markets varies considerably across time. These findings indicate that real estate markets are relatively less efficient as compared to stock and bond markets in general and may also offer an explanation as to why existing studies on real estate market efficiency have mixed results.

1. Introduction

This paper re-examines the issue of efficiency of the real estate markets based on the use of a new methodology—the automatic portmanteau test of Escanciano and Lobato (2009; EL, hereafter) for no autocorrelation, which we improve through wild bootstrapping. In doing so, this paper makes two contributions to the literature—first, to the financial economics literature and additionally, to the econometrics literature.

First, in relation to the economics and finance literature, we contribute by providing new and more robust evidence relating to market efficiency in the context of the real estate market. The issue of market efficiency is one that is very important and one that continues to be debated in the literature since it is at the core of financial economics theories and models. It has also very important practical implications. If markets are found to be efficient, then prices are not predictable and it is not possible to gain abnormal returns (Reilly and Brown (2009)). If markets are efficient, it also means that resources are efficiently allocated since prices reflect rational and fundamental factors.

Ever since the issue of market efficiency was brought to the forefront by the work of Fama in the 1970s, a voluminous amount of studies has been conducted on this issue in different financial and economic markets ever since. Overall, the evidence show that markets, particularly developed ones, are efficient, although some pockets of inefficiencies exist, especially in less developed markets (Reilly and Brown (2009)). The scale of research on this issue in the real estate markets, however, is still much less as compared to those in other markets (Schindler et al. (2010) and Schindler (2011)). Furthermore, the research on efficiency in this market has yielded mixed results depending on the specific real estate markets and time period covered and methodology used (Schindler (2011); Schindler et al. (2010) and Serrano and Hoesli (2009)). Thus, there is a need for further research on market efficiency in the real estate market. Our paper therefore addresses this need in the literature.

It is well-accepted that real estate is very important as it can affect very significantly the performance of the economy and financial markets. The recent global financial crisis is a clear testimony to this. The crisis started as a real estate crisis but it then developed into a financial market and economic crisis (Hellwig (2008) and Greenlaw et al. (2008)). Real estate is an important financial asset of households, particularly in developed countries but even in less developed economies (The Economist, March 5th-11th 2011 issue). It is one that differs from other economic commodities or investment products as it serves both as an investment and consumption good. Unlike other investments such as stocks, it is also lumpy and hence, is more illiquid. Investors are also not able to short sell it. There is now, however, the existence of securitised real estate markets which in a sense overcome some of the limitations associated with real estate. The behaviour of prices of these securitised real estate markets would still, of

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course, factor in the basic properties of real estate. Hence, prices in these markets would still reflect the nature of real estate to a certain extent. Given these unique properties of real estate, the real estate markets provide a good new laboratory for the testing of market efficiency.

Autocorrelation test is highly utilised as a test of market efficiency. If prices are random and exhibit no autocorrelation, then this is taken as an indication that the market is efficient (Fama (1970)). However, it is well-known in the econometric literature that standard autocorrelation tests could suffer from a number of problems due to, among others, heteroskedasticity and the need of (autocorrelation) lag selection (which can be quite arbitrary). Thus, as a result of these limitations, it is possible that the results of autocorrelation tests may show that markets are efficient (inefficient) when in fact they are inefficient (efficient). This situation could have been one of the major sources of the variation in evidence produced by existing studies on the efficiency of real estate markets as it is well-recognised that many economic and financial time series exhibit conditional heteroskedasticity or stochastic volatility (see Chunchachinda et al. (1997); Liu et al. (2003); Poon et al. (2004), among others).

The second contribution of this paper is to the econometric literature. As mentioned earlier, this paper examines the issue of market efficiency in real estate markets through the application of a new test—the EL (2009) automatic portmanteau test for no autocorrelation, which we improve through wild bootstrapping. As discussed in the methodology section, the EL autocorrelation test overcomes a number of limitations associated with standard autocorrelation tests, such as heteroskedasticity and the use of automatic (data-driven) lag selection. However, this test is subject to non-trivial over-rejection in small-sample size applications under the null hypothesis of no autocorrelation (market efficiency). We show by Monte Carlo simulation evidence in this paper that the small-sample properties of the test improve with wild bootstrapping. In particular, the wild bootstrap-based test has desirable size properties and shows a competitive power. The wild bootstrap is a re-sampling method that approximates the sampling distribution of a (test) statistic and has been found useful in econometrics — such as autoregressions with heteroskedasticity in Goncalves and Kilian (2004), multiple variance ratio test in Kim (2006), spectral tests for the martigale difference hypothesis in Escanciano and Velasco (2006) and unit root tests in Cavaliere and Taylor (2008). In theory, as shown in Liu (1988) and Davidson and Flachaire (2008), the wild bootstrap can yield asymptotic refinements in the distributions of pivotal statistics. Also, small-sample simulations in many studies such as Kim (2006) and Cavaliere and Taylor (2008) show that wild bootstrap-based tests are accurate in size and with good power properties.

In this paper, we therefore address the gap that we have identified in the real estate markets efficiency literature through the use of an improved portmanteau test that overcomes the limitations associated with standard autocorrelation tests. We improve the small-sample properties of the EL (2009) autocorrelation test by means of wild bootstrapping which we then utilise in our analysis of 14 securitised real estate markets — Australia, Canada, France, Germany, Hong Kong, Italy, Japan, Netherlands, Norway, Singapore, Sweden, Switzerland, United Kingdom and the United States. As far as we know, our paper is the first to apply this improved autocorrelation test in the study of market efficiency. Furthermore, in addition to the use of a more reliable test, we also utilised a more updated and longer data set as compared to recent studies on this issue such as those of Schindler, et al. (2010) and Schindler (2011). Thus, the results from this paper provide new and more robust evidence on efficiency in real estate markets.

As an overview, first, our results show that by means of wild bootstrapping, we were able to improve the small-sample size properties of the EL (2009) autocorrelation test. When we applied this improved test to the analysis of the efficiency of 14 securitised real estate markets, we found that only six of these markets are efficient — Australia, Hong Kong, Italy, Japan, Sweden and the United States and the others are not. In line with Schindler et al. (2011), our findings show that real estate markets seem to be less efficient as compared to stock and bond markets in general. We also find that the degree of efficiency (inefficiency) of each of the markets varies across time which may explain why existing studies on real estate market efficiency have mixed results.

The rest of the paper is organised as follows. Section 2 discusses the methodology while Section 3 presents the empirical results. Section 4 concludes the study.

2. Methodology

In this section, we discuss the EL (2009) test—its strengths as well as limitations and how we improve its small size properties through wild bootstrapping. We present the results of the Monte Carlo simulation which demonstrate the improvement. We then apply this improved test in the analysis of the efficiency of real estate markets.

Let us explore the shortcomings of standard autocorrelation tests. Take for example, the Box–Peirce Q_p test (cf. Box and Peirce (1970)), defined as $Q_p = n\sum_{j=1}^{p}\hat{\rho}_j^2$, which examines serial correlations $(\hat{\rho}_j)$ up to p lags. In practice, performing the Q_p test requires the choice of a fixed lag number (p). On the one hand, choosing a p too small might cause inconsistency as the test may fail to detect serial correlation at lags higher than p; on the other hand, choosing a p too large could cost the power of the test as many unnecessary lags are brought in. Accordingly, the outcomes of the Box–Pierce test may possibly contradict to each other when different lags are considered.[3] Aside from the lag choice issue, tests for market efficiency may be subject to substantial size-distortion (usually, over-sized) when applied to series that are actually serially uncorrelated but with some kind of non-linear dependence, such as conditional heteroskedasticity.

Recently, the two aforementioned issues are simultaneously dealt in EL (2009). First, instead of using the standard measure of autocorrelation $(\hat{\rho}_j)$ a hetroskedasticity-robust estimate of autocorrelation due to Lobato, et al. (2001) is used in the construction of the test statistic. Second, an automatic (data-driven) lag selection is implemented to avoid the issue concerning an arbitrary choice of lag. According to the simulation results in EL (2009), the new automatic Box–Pierce test works well in terms of size and power when applied to series with relative large sample size (say, more than 1000). The test, however, tends to be over-sized if the sample size is only moderate or small (say, less than 300). This raises the question whether the critical values derived from the asymptotic distribution is valid for the cases with a smaller sample size.

2.1. The EL (2009) test

Let Z_t be the asset price for t = 1,…,n and $Y_t = \ln(Z_t) - \ln(Z_{t-1})$ be its log return. Define the j[th] sample autocorrelation $\hat{\rho}_j = \hat{\gamma}_j/\hat{\gamma}_0$ where $\hat{\gamma}_j = (n-j)^{-1}\sum_{t=1+j}^{n}(Y_t-\bar{Y})(Y_{t-j}-\bar{Y})$ and $\bar{Y} = n^{-1}\sum_{t=1}^{n}Y_t$. EL (2009) suggest an automatic (data-driven) Box–Pierce Q test, defined as

$$AQ_{\tilde{p}} = n\sum_{j=1}^{p*}\tilde{\rho}_j^2, \quad (1)$$

where

$$\tilde{\rho}_j = \frac{\hat{\gamma}_j}{\sqrt{\hat{\tau}_j}} \text{ where } \hat{\tau}_j = \frac{1}{(n-j)}\sum_{t=1+j}^{n}(Y_t-\bar{Y})^2\left(Y_{t-j}-\bar{Y}\right)^2 \quad (2)$$

[3] Another commonly used test for market efficiency: the variance ratio test (cf. Cochrane (1988) and Lo and MacKinlay (1989)), also bears the same problem as it requires the choice of a fixed number—the holding period.