The Efficiency of Equity REIT Prices

Executive Summary. *Given the broad array of investment vehicles that investors can choose from in today's financial and capital markets, the knowledge of the efficiency of asset prices and the relative price volatility is essential to informed decision making. The purpose of this research is to determine if real estate investment trust (REIT) prices have been efficient. In order to test the efficiency of REIT prices, two statistical tests were performed—a runs test and an autocorrelation test. The results of both tests suggest a degree of inefficiency in REIT prices.*

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Introduction

Equity real estate investment trusts (EREITs) are public companies that invest and manage portfolios of commercial property and whose stock is traded in one of the major stock exchanges. They provide individual and institutional investors interested in including real estate assets in their portfolios an alternative to direct investment in properties. The liquidity of EREIT shares is attractive to individual and institutional investors since it enhances their ability to make adjustments in their portfolios. During the 1990s, the liquidity of EREIT shares increased due to the growth in size and scope of the real estate securities market in general, and of the real estate equities in particular.[1] As a result, EREIT shares are part of a broad array of investment vehicles available in the market today. Therefore, it is important that investors have access and knowledge about the efficiency of EREIT share prices.

The main implication of an efficient market is that investors are unable to consistently earn abnormally high rates in excess of expected market rates of return. The majority of investors are interested in "beating the market." Therefore, this research will examine whether EREITs within the equity market are efficiently priced.

One way of determining if an EREIT security is inefficiently priced is by examining whether EREIT price changes follow a deliberate pattern or are distributed randomly based on the random infusion of new information. Statistical tests can be performed to determine if EREIT security prices are indeed random.

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Purpose

An efficient market is consistent with the random walk hypothesis since an efficient market is defined as a market in which security prices adjust rapidly to the announcement of new information about the firm so that current market prices fully reflect all available information regarding the security. In addition, a large number of profit-maximizing individuals analyze and value securities acting independently of one another. Second, new information about the securities arrives in a *random* fashion. And, investors, reacting quickly to new information, cause security prices to change so they reflect the influence of all available information.

Further, there are three different forms of efficiency. The weak form efficient market suggests that current prices fully reflect all past information concerning the asset. The semi-strong form of efficiency states that security prices rapidly adjust to the infusion of new market information. And, the strong form suggests that current prices fully reflect all public and private information about a security.

This research attempts to determine if the EREIT market is efficient. In order to determine if it is, two statistical tests are performed—a runs test and an autocorrelation test. These tests have been traditionally used in efficient market studies to determine if security price changes are dependent or independent of each other. Independent price changes are consistent with the random walk and efficient market theories, whereas, dependent price changes would indicate inefficiently priced securities. Daily and monthly data are used. Two samples were created from the data. One sample includes monthly EREIT price data of 108 randomly selected EREITs and the other sample consists of daily REIT price data of 102 that were randomly selected.

Literature Review

The majority of previous studies on market efficiency focus on stock and bond price inefficiencies. Most of these studies conclude that security price changes do follow a random walk pattern that is consistent with the efficient market hypothesis.

Fama (1965) empirically tested the random walk model of stock price behavior. The random walk model makes two assumptions. First, successive price changes are independent. Second, price changes conform to some probability distribution. Of these two assumptions, Fama points out that the first one is the most critical because if successive price changes were not independent then the random walk theory would not be valid. The data Fama used consisted of daily prices for each of the thirty stocks of the Dow Jones Industrial Average, from the end of 1957 to September 26, 1962. Fama generated thirty samples with 1,200 to 1,700 observations per sample. Tests for serial correlation and a runs test were conducted on the data. He concluded that there was little evidence from the serial correlations and the runs tests to suggest any large degree of dependence between reported daily prices.

Fama (1970) reviewed the theories and empirical work done with respect to efficient capital markets. He explains, "There is consistent evidence of positive dependence in day-to-day price changes and returns on common stocks, and the dependence is of a form that can be used as the basis of marginally profitable trading rules. However, he points out that any trading system that attempts to turn short-term price dependence into trading profits generates so many transaction costs that their expected profits are more than absorbed by minimum transaction costs. Therefore, he argues that this slight positive dependence is not of sufficient importance to warrant rejection of the efficient market model. Obviously, day trading has altered this historic conclusion.

Hagerman and Richmond (1973) tested the independence implication of the random walk hypothesis of securities traded in the OTC market. The reason for choosing the OTC market was that the companies listed had greater geographic dispersion that those on the NYSE. The authors conducted a serial correlation test and concluded that price changes are serially independent in the OTC

market and are consistent with the random walk hypothesis.

In addition, there have been a significant number of EREIT studies performed over the last ten years that have bearing on the question of efficiency. The majority of these studies examine the relationship between the risk and return of EREITs. While findings of these studies in some cases imply an inefficient EREIT market, no studies examine the specific theory of random walk as it applies to EREITs.

Giliberto (1990) examined the residuals from regression analysis of EREITs. His study found that the residuals of real estate return series on EREITs and real estate returns are significantly correlated, supporting the notion that there is a common factor(s) associated with real estate that affect both sets of returns. While correlations were not calculated over time for either series, this study might suggest that there is a relationship among prices from one category of real estate to another.

From a study of REIT market microstructure, Wang, Erickson, Gau and Chan (1992) postulate that the relationship of REIT returns and market attention actually have an indirect relationship. Their findings conclude that shares of REITs tend to have small turnover ratios, lower institutional investor participation and a smaller following among security analysts compared to other types of traditional stocks. Also, it is suggested by their research that REITs that are followed more closely tend to perform better than those REITs that are relatively obscure. This would suggest that the more scrutinized REITs might tend to be more efficiently priced.

A further study by Goebel and Ma (1993) dealt with the perception that REITs trade at discounts from their net asset values and thereby suggest relative price inefficiencies. The authors perform a cointegration analyses that confirms a long-term, equilibrium relationship between REIT returns and their underlying fundamental value. Specifically, the authors further demonstrate that REITs, in this study, traded at approximately 77% of net asset values. Suggesting that there may be price inefficiencies in play at least for the given time period of the study (1972–1992).

In a more recent study by Hun and Liang (1995), the authors examine the long-term (1970–1993) performance of REITs and investigate the stability of REIT return performance over time. In addition, Hun and Liang investigate the sensitivity of a specific performance measure, the Jensen Index, to two general performance benchmarks and two REIT samples. Their results indicate that the performance of REIT portfolios was consistent with the security market line for the long-term period. Thereby suggesting that REITs are efficiently priced in the long run.

Nelling and Gyourko (1998) examined the predictability of monthly returns on EREITs over the period 1975–1995 and compare that predictability with that for small and mid-cap firms. Using a time series approach, evidence is found that monthly EREIT returns are predictable based on past performance. This would suggest that the REIT market is inefficient. However, the authors are quick to point out that the predictability is not substantial enough to cover typical transaction costs, so that there is no evidence of unexploited arbitrage opportunities.

Methodology and Data

The purpose of this study was to either support or refute the hypothesis that the EREIT market is efficient. If the EREIT market is efficient, security price changes should be independent over time due to the random nature of new information entering the market and thereby affecting price changes.

Traditionally, two types of statistical tests have been used to investigate whether security price changes are random. The first test is a runs test, which is a non-parametric test, and the second test is an autocorrelation test, which is a parametric test.

The runs test was performed using the monthly and daily price data. The runs test examines a series of price changes, and designates each change

as a (+), (−) or (0). Positive price changes are designated by (+), negative changes by (−) and no change as (0). Thus, a possible result of the test might be: $++++----00++++---$, which would represent five runs. A run occurs when consecutive positive or consecutive negative price changes occur more than once. When the price changes to a different sign, the run is completed and a new run is started. The expected number of runs in a random series is the equivalent of $E = 1/3(2n - 1)$. Where E is the expected number of runs, and n is the number of observations.

If there are too many or too few runs in the price series, then the series is not a random series, and it would then be possible for investors to predict future prices by means of a trading rule. Too few runs may infer that security price changes respond rather slowly with regard to the infusion of new information in the market, whereas, too many runs may indicate that prices over adjust when new information is made available to investors.

In order to determine if the actual number of runs is significantly different than the expected number of runs, a p-value is calculated and compared to the alpha values used in the study. The p-value is the area of rejection in a statistical distribution, and it is the smallest value of alpha for which one can reject the hypothesis being tested. To disprove the random walk theory, the p-value would have to be less than the alpha value selected for the study. If the p-value is larger than the alpha value, the random walk theory holds. However, the opposite conclusion is reached if the p-value is less than the alpha value. For the purposes of this study, two alpha values were selected—05 and .01.

Using an alpha value of .05 indicates that on the average no more than 5% of the securities tested should have a p-value lower than .05 in order to substantiate the random walk hypothesis. If there is a much larger proportion than 5% of the securities having p-values lower than .05, the price changes are not random, and some degree of inefficiency exists. Using an alpha value of .01 dictates that on the average no more than 1% of the securities tested should have a p-value lower than .01. Thus, price inefficiency can be assumed if significantly more than 1% of the securities tested have a p-value below .01.

If the test results indicate that the price series is independent or random, then the research hypothesis should be accepted, thus suggesting the efficient market hypothesis with regard to EREIT prices for the period studied. If the test results indicate that the price series is dependent or nonrandom, then the research hypothesis is rejected.

The autocorrelation test was performed using the daily price data of the EREITs, and it tests for significant positive or negative autocorrelation in price changes over time by determining whether a price series is random through examining the autocorrelation function of the series of first differences in each security's price. This test will determine if the price change on day t is correlated with the price change on day t_{-1}, t_{-2}, t_{-3}, etc. through twenty-four time periods. Each of the time periods, also referred to as lags, will be analyzed for price correlations or dependence. Insignificant autocorrelations between all such lags will suggest price independence, and validate the random walk theory, and this research hypothesis. Whereas significant autocorrelations will suggest price dependence, and will refute both the random walk theory and this research hypothesis.

An autocorrelation for any given lag will be considered to be significant if the absolute value of the estimated autocorrelation value is at least twice as large as the standard error for the test (Box, 1970). Again, a significant autocorrelation with respect to any lag will indicate price dependence with respect to that security, and refute the random walk theory. If the absolute value of the estimated autocorrelation value is less for all lags, then price independence will be confirmed for that security, and the random walk theory will be accepted.

To test the efficiency of EREIT prices, daily and monthly samples are used. It was hypothesized that by using both monthly and daily price changes, market inefficiencies might be detected at different time intervals. The sample of monthly EREIT prices includes 108 randomly selected

EREITs from January 1989 through October 1998 and allowed for 130 possible price observations for each security. The sample of daily REIT price consists of 102 randomly selected EREIT data from November 2, 1997 through February 1999, allowing for 324 possible price observations for each security. The data was obtained from price/return data supplied by COMPUSTAT data files, Value Line Investment Survey, Standard and Poors stock reports and various Internet sources such as the National Association of Real Estate Investment Trusts website.

Analysis of Data

A runs test was performed for both the monthly and daily REIT price data. The calculated *p*-value from the test were rounded to the nearest ten thousandth for each security.

For both the monthly and daily price data, significantly more than 5% of the securities tested have alpha levels below .05. With regard to the monthly data, roughly 75% of the securities tested have calculated *p*-values below .05, which would support an inefficient EREIT market. Approximately 63% of those securities tested have calculated *p*-values less than .05 (see Exhibit 1).

For both the monthly and daily price data, significantly more than 1% of the securities tested had alpha levels below .01. With regard to the monthly data, 68% of the securities tested had calculated *p*-values below .01, which would again support an inefficient EREIT market. Furthermore, the daily data sample also supports an inefficient EREIT market since approximately 55% of those securities tested have calculated *p*-values less than .01.

In summary, at both alpha levels of .05 and .01, there are a significant number of EREITs with unexpectedly low calculated *p*-values that support the idea that REIT markets, may at times, be inefficient.

In addition, an autocorrelation test was conducted for the daily EREIT sample (see Exhibit 2). A security was considered to be price dependent (inefficiently priced) if that security's autocorrelation indicated a significant price dependency in any of the twenty-four lags tested with regard to that security. If the absolute value of the estimated autocorrelation value is at least twice as large as the

Exhibit 1
Calculated *p*-Values for Runs Test

Calculated *p*-Value Range	Monthly Sample	Daily Sample
<.0001	41	29
.0001–.0099	32	27
.0100–.0499	8	8
.0500–.1000	4	9
>.1000	23	29
Total	108	102

Note: Monthly and daily data samples rounded to ten thousandths.

Exhibit 2
Daily Data Sample: Significant Lags for Autocorrelation Test

Lag #	# of REITs
1	49
2	36
3	4
4	8
5	4
6	3
7	4
8	6
9	3
10	4
11	2
12	5
13	3
14	3
15	1
16	3
17	2
18	0
19	4
20	3
21	0
22	1
23	1
24	1

standard error of the test for any lag, then that security will demonstrate significant price dependency. Of all EREITs tested, 48% demonstrated price dependency at lag one. This means that 48% of the securities tested had some degree of price dependency with regard to their own price on the prior day; hence, the price of a security on day t is dependent on the price of that same security on day t_{-1}. Additionally, 35% of the EREITs tested indicated a two-day price dependency, *i.e.*, the price of a security on day t is dependent on the price of that same security on day t_{-2}. Finally, at least one security demonstrated dependency for all but two of the time periods tested for each EREIT.

Short-term price dependency may be an indication that new information is not being made available to all investors at the same time or that many EREIT investors react rather slowly to the infusion of new information. Whatever the case, one might conclude that the autocorrelation test provides some support that a certain degree of inefficiency existed in the EREIT market during this time period.

Conclusion

The results of both the runs test and the autocorrelation test would suggest a degree of inefficiency in the EREIT market, at least for the time period examined. This can certainly be claimed in the short-term. In this context, the short-term would refer to the one and two day price dependencies that were derived from the autocorrelation test. The runs test provided evidence of general price dependency, and the autocorrelation test supports this conclusion based on the evidence of strong price dependencies with respect to lag one and lag two, which refers to one- and two-day price dependencies.

One possible explanation for this phenomenon is that investors may respond slowly to new market information or information is slowly and inefficiently spread throughout the marketplace allowing only a small portion of the investment community to benefit from newly arriving information.

Other plausible explanations for this phenomenon may be related to the characteristics of real estate assets and markets. For example, because of the predictable cash flows from leases, REIT pricing is more bond-like in nature and thus more serially correlated. In addition, the REIT market is very small and thinly traded, thus market makers may have an influence on prices. In either case, at least for the period examined here, there is a demonstrated degree of inefficiency in the EREIT market.

Endnote

1. The spectacular growth experienced by REITs during the 1990s can be attributed to changes introduced with the 1986 Economic Recovery Tax Act, the difficulties faced by private real estate companies to obtain capital during the late 1980s and early 1990s, and changes in the structure of REITs. For a detailed explanation see Mullaney (1998).

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