Using Non-Linear Tests to Examine Integration Between Real Estate and Equity Markets

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USING NON-LINEAR TESTS TO EXAMINE INTEGRATION BETWEEN REAL ESTATE AND EQUITY MARKETS

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ABSTRACT

In this study we present an alternative approach to test whether the real estate and equity markets are cointegrated. We develop a nonlinear test which allows for a stochastic trend term as opposed to a deterministic drift term. This is a reasonable approach, because if the real estate market is related to the equity market then it is desirable to incorporate the stochastic nature of the equity market into the model. We compare the results of the nonlinear model to the results obtained using conventional cointegration tests. The cointegration results support the view that the real estate and equity markets are segmented, whereas the nonlinear model support the view that the markets are fractionally integrated. A possible reason for this apparent discrepancy between the results could be due to the underlying assumption of a linear relationship between the variables for the cointegration. It is possible that the tests of cointegration will reject that the two variables are related even though the relationship may be nonlinear.
INTRODUCTION

The notion of market integration/segmentation across the economy is of central importance. Disturbances in market fundamentals in a given market generates movements of capital into and out of the affected market. If various markets are well integrated then it is expected that a high degree of asset substitution will take place, such substitution having a significant impact on price fluctuations in the relevant markets. On the other hand, if markets are not integrated, then this has significant implications for portfolio investment where managers seek to develop well diversified portfolios. Recent literature has recognized the need to understand and measure the degree of market integration and research has focused on techniques to do this. Studies have attempted to measure the degree of integration in money and bond markets [Dumas (1990), Errunza (1992)], real assets markets [Madura (1991)], as well as amongst international real estate investment trusts [Asabere (1991)].

Activity on both the real estate and stock markets form significant elements in business cycle fluctuations. A common approach in trying to analyse and understand the impact of these markets has been to study the separate influences of each on business cycle activity. The study of price volatility on the stock market has a rich history with recent research tending to focus on (a) the use of single equation time series models in the identification of speculative bubbles [cf. Diba et.al. (1988a, 1988b), Cameron (1989), Dezhbaksh et.al. (1990), Evans (1991), Topol (1991)] as well as (b) tests of the mean reversion hypothesis and its use in predicting stock market volatility [cf. Poterba et.al. (1988), Cecchetti et.al. (1990), Randolph (1991), Engel et.al. (1991), Jegadeesh (1991), Kim et.al. (1991)].

Research on real estate price fluctuations is less extensive than stock market analysis. However, real estate price fluctuations of between 20 and 30 percent in the US in the 70s, 80s and 90s [Green and Hendershott (1993), Case and Shiller, (1988), Abraham and Hendershott (1994)] and even greater volatility in some Asian property markets [Fu et. al. (1994)] has generated an increasing interest in the movements and determinants of real estate prices. Although there are a number of different strands to this research - such as the development of
structural models of supply and demand as part of a simultaneous system [Topel and Rosen (1988), DiPasquale and Wheaton (1990)] or the development of reduced form equation models that combine demand and supply factors [Abraham and Hendershott (1992), Peek and Wilcox (1991)] - the area of most interest for this paper is that which develops models that attempt to explain price movements either in terms of deviations from market fundamentals or in terms of asset substitution between real estate and financial markets [Liu, Hartzell, Greig and Grissom (1990), Ross and Zisler (1991), Fu, Leung and Lo (1994).

Much of the evidence which relates to the real estate and equity markets seems to support the notion that the two markets are segmented. For example, Schnare and Struyk (1976), Goodman (1978, 1981), Richardson and Thalheimer (1982), Miles, Cole and Guikey (1990), Liu, Hartzell, Greig and Grissom (1990) and Geltner (1991) have documented the existence of segmentation within various real estate markets and with equity markets. Liu, Hartzell, Greig and Grissom (1990) find evidence of market segmentation between real estate and equity markets when using appraised based returns. These findings are also supported by Geltner (1991) who finds the noise component of real estate and equity returns are different and concludes that the two markets are segmented. However studies by Liu, Hartzell, Greig and Grissom (1990) and Ambrose, Ancel and Griffiths (1992) have produced contrary results in that the real estate and equity markets are integrated. Liu, Hartzell, Greig and Grissom (1990) found that equity Reit and equity markets were integrated when using an alternative approach to appraised based returns, and Ambrose, Ancel and Griffiths (1992) employed a rescaled range analysis to test deterministic nonlinear trend in the return series. Their results showed that Mortgage and Equity Reits displayed similar return generating characteristics to the equity market and they concluded the real estate and equity markets were integrated. It is apparent from the above discussion that is unclear whether the real estate and equity are segmented or integrated. We contribute to the debate by providing an alternative test which supports integration between the two markets.

In this study we present an alternative approach to that employed by Ambrose, Ancel and Griffiths (1992). We develop a nonlinear test which allows for a stochastic trend term as opposed to a deterministic drift term. This is a reasonable approach, because if the real estate market is related to the equity market then it is desirable to incorporate the stochastic nature of the equity market into the model. We compare the results of the nonlinear model to the results
obtained using conventional cointegration tests. The cointegration results supports the view that the real estate and equity markets are segmented, whereas the nonlinear model support the view that the markets are fractionally integrated. A possible reason for this apparent discrepancy between the results could be due to the underlying assumption of a linear relationship between the variables for the cointegration. It is possible that the tests of cointegration will reject that the two variables are related even though the relationship may be nonlinear.

The format of the paper follows. Section 1 outlines a nonlinear relationship between the equity and real estate markets. The empirical results are presented in section 2, and section 3 summarizes the findings of the paper.

1. Model Specification

We commence by modeling the relationship between the real estate and equity markets by adopting an approach which is consistent with the techniques employed in modelling mean reversion of stock prices. See for example, Poterba and Summers (1988), Campbell and Shiller (1988), Fama and French (1988) and Campbell and Kyle (1993). In order to operationalise the process we need to specify the return generating process of the stock index variable. We make the assumption that the movements in the stock index may be described by a Geometric Brownian motion and is given by:

\[ \frac{dP(t)}{P(t)} = \mu dt + \sigma dw(t) \]  

(1)

\footnote{The assumption that stock returns can be described by a geometric motion has been widely adopted in the literature. See Black and Scholes (1973) and Merton (1973). That is returns follow a random walk with drift.}
where: \( \frac{dP(t)}{P(t)} \) is the return of the stock index,
\( \mu \) is the instantaneous expected return,
\( \sigma \) is the standard deviation per unit time of the return, and
\( dw(t) \) is a Wiener process with mean zero and unit variance.

A possible model to examine whether the real estate market is affected by movements in the equity market may be described by the following model. A similar approach has been adopted by Amihud and Mendelson (1987) and also by Chiang, Liu and Okunev (1995) in relation to modelling movements of stock prices towards the fundamental value of the stock.

\[
dS(t) = \lambda [P(t) - S(t)] dt + \phi dq(t)
\]

(2)

where:
\( dS(t) \) is the instantaneous change in the real estate index,
\( P(t) \) is the value of the stock index at time \( t \)
\( S(t) \) is the value of the real estate index at time \( t \)
\( \lambda \) is the speed of adjustment coefficient,
\( \phi \) is the standard deviation of \( dS(t) \) per unit time, and
\( dq(t) \) is a Wiener process with mean zero and unit variance.

The intuition behind equation (2) is that movements in the real estate market and equity markets move together in time. However a movement in the equity market may not be instantaneously transmitted to the real estate market but adjusts partially. The speed of adjustment coefficient \( \lambda \) determines how quickly a movement in the equity market is transmitted to the real estate market. The extent of mean reversion is also dependent upon the difference between the equity and real estate values. The greater the difference between \( S(t) \) and \( P(t) \) the greater the restoring force back to equilibrium. For example, if \( \lambda = 1 \) this means the change in
the real estate value will converge back to the equity value in one period. However if $\lambda = .1$ then
the change in the real estate value will be only 10% of the difference between $S(t)$ and $P(t)$ and
therefore movements of the real estate market towards the equity market will be slow. On the
other hand if $\lambda = 0$ this means that the real estate and equity markets are not related, and
therefore movements in the equity market will not be transmitted to the real estate market.

While equation (2) is intuitively appealing in that it models changes in the real estate
index as mean reverting towards a stochastic equity index variable, the process does not
satisfactorily describe movements in the real estate index for two reasons. Firstly, the process
permits values of the real estate index to be negative, and secondly, the volatility of changes
in the real estate index is assumed to be constant, while empirical evidence suggests that the
volatility of changes of the real estate market is not constant.\(^2\) Therefore, equation (2) may be
inappropriate for modelling movements in the real estate market. We suggest as an alternative
the following process as a possible candidate which overcomes these deficiencies. The proposed
model represents one possible representation that movements in the equity market are translated
into corresponding movements in the real estate market.

$$\frac{dS(t)}{S(t)} = [\beta \mu - \lambda \log \frac{S(t)}{P(t)^{\beta}}]dt + \delta dz(t) + \sigma dw(t)$$

(3)

where $\lambda$ is the speed of adjustment coefficient,

$\delta$ is the standard deviation of $d\sigma(t)$ which is an Ornstein Uhlenbeck process
defined in equation (4),

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\(^2\) It is well established that the volatility of real estate index is not constant. See Abraham and Hendershott
\( dz(t) \) is a Wiener process with mean zero and unit variance,
\( \beta \) is a parameter determining the nonlinear nature of mean reversion, and
\( \rho \) is the correlation coefficient between \( dw(t) \) and \( dz(t) \).

In adopting the process described by equation (3) we note that the instantaneous return of the real estate index is dependent upon how far the current real estate index is from the equity index. The greater the deviation from the equity market the greater the economic forces moving the current value of the real estate index towards the equity values. The speed of reversion is not only dependent upon the magnitude of the difference between \( \log P(t) \) and \( \log S(t) \), but also on the speed of adjustment coefficient, \( \lambda \). The larger the value of the speed of adjustment the stronger the restoring force back to equilibrium. If the speed of adjustment coefficient is small, then mean reversion of the real estate market towards the equity market may be quite slow, even though deviations from the equity market may be large. If \( \beta = 0 \), this means that movements in the real estate market are not related to movements in the equity market.

The solution to equation (3) is given by:

\[
S(t) = P(t)^{\beta} e^{[\alpha(0) - \frac{\beta^2 + 2\rho\beta - \rho^2(\beta - 1)}{2\lambda}]} \tag{4}
\]

where: \( \alpha(t) \) is a mean reverting process governed by \( d\alpha(t) = -\lambda \alpha(t) dt + \delta dz(t) \).

The attractive features of the process described by equation (4) are that \( S(t) \) is always non-negative and that the variance of changes in the real estate index is a function of the level

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3 The mathematical workings are available from the authors upon request.
of the index. This overcomes the criticisms of the process described by equation (2). Furthermore, equation (4) displays the same type of mean reversion towards the equity market as is characterized in equation (2). Mean reversion is governed by \( \alpha(t) \) which ensures that the real estate market reverts to the equity market in time. Furthermore, the parameter \( \beta \) permits the possibility of nonlinear mean reversion of the real estate market towards the equity market.

In order to use discrete time data it is necessary to transform the continuous time process of equation (3) into a discrete time formulation. This is accomplished by substituting \( t + \Delta t \) for \( t \) into equation (4) and then subtracting \( S(t) \). The discrete time return of the real estate market is given by:

\[
\log \frac{S(t+\Delta t)}{S(t)} = (e^{-\lambda \Delta t} - 1) \left[ \delta^2 + 2 \rho \sigma \delta \beta + \sigma^2 \beta (\beta - 1) \right] \frac{2\gamma}{2\lambda} \\
+ \beta \log \frac{P(t+\Delta t)}{P(t)} + (e^{-\lambda \Delta t} - 1) [\log S(t) - \beta \log P(t)] \\
+ e^{-\lambda (t+\Delta t)} \int_t^{t+\Delta t} e^{\lambda s} \delta dz(S)
\]  

(5)

We note from equation (5) that the return on the real estate market is not only a function of the return on the equity market but is also a function of the difference between \( \log S(t) \) and \( \log P(t) \) which has a speed of adjustment coefficient of \( (e^{\lambda t} - 1) \). This means that the change in the real estate market is not only mean reverting towards the equity market, but it is also dependent upon the changes in the equity values. Note that for mean reversion to exist we must have \( \lambda > 0 \).

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4 This point is evident from equation (3).
The process described by equations (4) and (5) can be directly related to the area of cointegration which has been widely used in examining possible long term relationships between the equity and real estate markets. Equation (4) represents the long term equilibrium relationship between the equity and real estate markets. If $\beta=0$ then the two markets are segmented, and if $\beta$ was significantly different from zero then the equity and real estate markets would be integrated. For $\beta=1$ then there exists a linear relationship between the equity and real estate markets, however if $\beta$ lies between zero and 1 then the markets would be fractionally integrated. Equation (5) represents the corresponding short term partial adjustment model. The advantage of the present approach over using the method of cointegration is that in this case we can model a nonlinear relationship between the equity and real estate markets, whereas the method of cointegration only applies if there is a linear relationship between the variables. Secondly, we are able to infer meaning to the parameters estimated from the regression equations.

2.0 Empirical Evidence

We initially tested whether the various real estate indices were cointegrated with the equity market using traditional unit root tests. The data employed were monthly observations of the Reit, Hybrib Reit, Equity Reit and Mortgage Reit which reflected different aspects of the real estate market. The Dow Jones Index was used to reflect movements in the equity market. The sample period was from January 1979 to December 1993. Table 1 presents results of the Phillips Perron (1988) (PP) and augmented Dickey Fuller (1981) (ADF) unit root tests on the individual series. This is a necessary prerequisite to testing for cointegration. It is evident that
each series is integrated of order one, that is each series is an I(1) process. As all of the series are I(1) it is possible that a linear combination of the real estate series and the equity series may be stationary. If this is the case then the two variables are linearly cointegrated. Table 2 presents results of the cointegration tests using the PP and ADF tests. It is apparent that none of the real estate series are cointegrated with the equity market. Thus the tests of cointegration suggest that the real estate market and the equity market are segmented.

One of the drawbacks of using the cointegration tests is that the technique relies upon the assumption that the two series are linearly related. It is possible that the tests of cointegration will reject that the two variables are related even though the relationship may be nonlinear. We proceed to determine whether there exists a nonlinear relationship between the real estate and equity markets.

From the previous discussion in section 1 we estimate the regression model based on equation (5), which is given by:

\[
\log \frac{S(t+1)}{S(t)} = \gamma_0 + \gamma_1 \log \frac{P(t+1)}{P(t)} + \gamma_2 \log P(t) + \gamma_3 \log S(t) + \epsilon(t) \tag{6}
\]

In equation (6), $\gamma_1$ provides an estimate of the nonlinear nature of mean reversion, since $\beta = \gamma_1$. The coefficient $\gamma_2$ relates the change in the mean reversion characteristics of the real estate index towards the equity index. The speed of adjustment of mean reversion towards equity market can be calculated from $\gamma_3$ since $\gamma_3 = (e^{-\lambda t} - 1)$, where $\lambda$ is the speed of adjustment.

Equation (6) was used to determine whether there existed a relationship between the various real estate indices and the equity market for the period 1979-1993. Initially we
examined whether there was a relationship between the Reit and equity indices. The results from Table 3 suggest that there is a relationship between the two variables. The coefficient $\gamma_1$ represents an estimate of $\beta$ and indicates that $\beta = .54$ and is significantly different from zero and one at the 5% level of significance. This value of $\beta$ suggests that there is a nonlinear relationship between the Reit index and the equity market. The estimate of $\gamma_3$ indicates there is weak evidence of mean reversion. Mean reversion occurs at a rate of 2% per period, which means that movements of the real estate market back towards the equity market are very slow and hence divergence between the two markets may be quite large and prolonged. As mentioned previously application of the Phillips Perron (1988) and Augmented Dickey Fuller (1981) tests indicated no relationship existed between the two variables. We suggest that a possible reason for this disparity may be due to the nonlinear association between the two variables.

Adopting the functional form of equation (6) we investigated the possibility of a relationship between the Hybrid Reit and the equity markets. Table 4 indicates that there is a nonlinear relationship between the Hybrid Reit and equity markets. The estimate of $\beta = .59$ is significantly different from zero and one at the 5% level. Recall from the model, if $\beta = 0$ then there is no relationship between the two markets and if $\beta = 1$ then there is a linear relationship between the two variables. Hence the use of cointegration tests in this situation may provide misleading results, as the tests of cointegration assumes a linear relationship between the variables. The extent of mean reversion is similar when compared to the Reit and equity indices. The speed of adjustment coefficient is .02 which means that if there is a divergence between the two indices then the two will converge at a rate of 2% per period.

Table 5 and 6 presents results of modeling the relationship between the Equity Reit,
Mortgage Reit and equity market. These results are similar in nature to those of the Reit and Hybrid Reit results. Also note that the parameter estimates are essentially the same as found from Table 2.

The results from Tables 3, 4, 5 and 6 suggest there is a nonlinear relationship between the real estate and equity markets. Furthermore, changes in the equity market are only partially translated into changes in the real estate market and reversion of the real estate market towards the equity market occurs at rate of 2% per month. This implies that deviations between the two markets may become large and prolonged. If the equity market can be reasonably described by a geometric brownian motion then movements of the various real estate indices will also appear to be a geometric brownian motion as reversion to the equity market will be quite slow. In this context it becomes apparent why the tests of cointegration found no evidence of a functional relationship between the two markets. Our results support the findings of Ambrose, Ancel and Griffiths (1992) that Mortgage Reit and Equity Reits are cointegrated with the equity market.

3.0 CONCLUSIONS

This paper has presented the results of an exploration into the issue of whether real estate and equity markets are integrated. Previous research between the real estate and equity markets, was unable to produce conclusive evidence on whether the markets were (partially) integrated or segmented. One reason suggested for the failure of standard cointegration tests to produce conclusive evidence of integration was that the relationship between real estate and financial assets markets may be nonlinear rather than linear.

The paper proposed one possible nonlinear model of the relationship between real estate
and stock markets and used this model as a basis for testing the degree of integration. The various real estate indices can be reasonably regarded as being related to the equity market. There was evidence the real estate market was nonlinearly related to the equity market. The results overall suggest the real estate markets are related to the equity market, but the extent of mean reversion between the two is quite slow and deviations between the two markets can prolonged.
REFERENCES


Table 1

Unit Root Tests of Reit, Mortgage, Equity Reit, Hybrid and Dow Jones Indices for the Period 1979-1993

<table>
<thead>
<tr>
<th>Variable</th>
<th>PP Test</th>
<th>ADF Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reit</td>
<td>-2.07</td>
<td>-1.46</td>
</tr>
<tr>
<td>Mortgage</td>
<td>-1.72</td>
<td>-1.81</td>
</tr>
<tr>
<td>Equity Reit</td>
<td>-2.22</td>
<td>-1.43</td>
</tr>
<tr>
<td>Hybrid</td>
<td>-1.95</td>
<td>-1.53</td>
</tr>
<tr>
<td>Dow Jones</td>
<td>-3.09</td>
<td>-2.89</td>
</tr>
</tbody>
</table>

After First Differencing

<table>
<thead>
<tr>
<th>Variable</th>
<th>PP Test</th>
<th>ADF Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reit</td>
<td>-11.07</td>
<td>-4.61</td>
</tr>
<tr>
<td>Mortgage</td>
<td>-11.36</td>
<td>-4.58</td>
</tr>
<tr>
<td>Equity Reit</td>
<td>-11.26</td>
<td>-4.22</td>
</tr>
<tr>
<td>Hybrid</td>
<td>-11.77</td>
<td>-4.44</td>
</tr>
<tr>
<td>Dow Jones</td>
<td>-12.83</td>
<td>-3.99</td>
</tr>
</tbody>
</table>

Critical values at the 10% level of the PP and ADF test are -3.13
Table 2
Cointegrating Regression t Statistics of the Residuals Between Various Property Indices and the Dow Jones Index

<table>
<thead>
<tr>
<th>LHS Variable</th>
<th>PP Test</th>
<th>ADF Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reit</td>
<td>-2.09</td>
<td>-1.36</td>
</tr>
<tr>
<td>Mortgage</td>
<td>-1.72</td>
<td>-1.86</td>
</tr>
<tr>
<td>Equity Reit</td>
<td>-2.32</td>
<td>-1.32</td>
</tr>
<tr>
<td>Hybrid</td>
<td>-1.98</td>
<td>-1.40</td>
</tr>
</tbody>
</table>

Critical values at the 10% level of the PP and ADF test are -3.50

Right hand side variable is the Dow Jones Index
TABLE 3

Modelling the Relationship Between the Reit Index and the Dow Jones Index for the Period 1979-1993 Using:*

\[
\log \frac{P(t+1)}{P(t)} = \gamma_0 + \gamma_1 \log \frac{E(t+1)}{E(t)} + \gamma_2 \log E(t) + \gamma_3 \log P(t) + e(t)
\]

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>(\gamma_0)</th>
<th>(\gamma_1)</th>
<th>(\gamma_2)</th>
<th>(\gamma_3)</th>
<th>(\lambda)</th>
<th>(R^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reit Index</td>
<td>0.092</td>
<td>0.541</td>
<td>0.009</td>
<td>-0.023</td>
<td>0.023</td>
<td>0.41</td>
</tr>
<tr>
<td></td>
<td>(2.75)**</td>
<td>(9.47)</td>
<td>(0.96)</td>
<td>(-2.1)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* P(t) represents the value of the Reit index at time t, and E(t) represents the value of the Dow Jones index at time t.
** Figures in parenthesis are t statistics.
TABLE 4

Modelling the Relationship Between the Hybrid Reit and the Dow Jones Index for the Period 1979-1993 Using:*

\[
\log \frac{H(t+1)}{H(t)} = \gamma_0 + \gamma_1 \log \frac{E(t+1)}{E(t)} + \gamma_2 \log E(t) + \gamma_3 \log H(t) + e(t)
\]

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>( \gamma_0 )</th>
<th>( \gamma_1 )</th>
<th>( \gamma_2 )</th>
<th>( \gamma_3 )</th>
<th>( \lambda )</th>
<th>( R^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hybrid Reit</td>
<td>0.135</td>
<td>0.592</td>
<td>0.0002</td>
<td>-0.022</td>
<td>0.022</td>
<td>.35</td>
</tr>
<tr>
<td>(3.05)**</td>
<td>(7.54)</td>
<td>(0.004)</td>
<td>(-2.39)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* \( H(t) \) represents the value of the Hybrid Reit index at time \( t \), and \( E(t) \) represents the value of the Dow Jones index at time \( t \).
** Figures in parenthesis are \( t \) statistics.

TABLE 5

Modelling the Relationship Between the Equity Reit Index and the Dow Jones Index for the Period 1979-1993 Using:*

\[
\log \frac{ER(t+1)}{ER(t)} = \gamma_0 + \gamma_1 \log \frac{E(t+1)}{E(t)} + \gamma_2 \log E(t) + \gamma_3 \log ER(t) + e(t)
\]

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>( \gamma_0 )</th>
<th>( \gamma_1 )</th>
<th>( \gamma_2 )</th>
<th>( \gamma_3 )</th>
<th>( \lambda )</th>
<th>( R^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apartment Index</td>
<td>0.048</td>
<td>0.528</td>
<td>0.022</td>
<td>-0.027</td>
<td>0.027</td>
<td>.38</td>
</tr>
<tr>
<td>(1.83)**</td>
<td>(8.60)</td>
<td>(1.54)</td>
<td>(-2.1)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* \( ER(t) \) represents the value of the Equity Reit index at time \( t \), and \( E(t) \) represents the value of the Dow Jones index at time \( t \).
** Figures in parenthesis are \( t \) statistics.
TABLE 6
Modelling the Relationship Between the Mortgage Reit Index and the Dow Jones Index for the Period 1979-1993 Using:

\[
\log \frac{MR(t+1)}{MR(t)} = \gamma_0 + \gamma_1 \log \frac{E(t+1)}{E(t)} + \gamma_2 \log E(t) + \gamma_3 \log MR(t) + e(t)
\]

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>(\gamma_0)</th>
<th>(\gamma_1)</th>
<th>(\gamma_2)</th>
<th>(\gamma_3)</th>
<th>(\lambda)</th>
<th>(R^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apartment Index</td>
<td>0.132</td>
<td>0.49</td>
<td>-0.0014</td>
<td>-0.023</td>
<td>0.023</td>
<td>.29</td>
</tr>
<tr>
<td></td>
<td>(2.29)**</td>
<td>(6.87)</td>
<td>(-0.21)</td>
<td>(-1.72)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* MR(t) represents the value of the Mortgage Reit at time t, and E(t) represents the value of the Dow Jones index at time t.
** Figures in parenthesis are t statistics.