Income vs. Appreciation: The Investment Value of Real Estate Investment Trusts *

Tobias Mühlhofer

London School of Economics and Political Science †

December 16, 2004

Abstract

In this paper, we address the dichotomy in short-term performance between REITs and direct property by arguing that REITs are primarily income vehicles, and that an end investor in a REIT does not have access to short-term appreciation opportunities contained in direct property prices. In order to do this, we compare the useful incremental information content contained in property-level income to that contained in property-level appreciation. We find that over our entire 1978-2003 sample both income and appreciation provide useful information content in explaining REIT returns, but over any subsample periods that we analyze, only income provides useful information and appreciation does not. These findings support our hypothesis and provide a possible explanation for the short-term pricing dichotomy. [1]

*Research Papers in Spatial & Environmental Analysis, No. 97. Dec 2004, ISBN 0 7530 1825 X

†e-mail: t.muhlhofer@lse.ac.uk

[1] This paper is available for download under:
http://tobias.muhlhofer.com/working-paper-inc-v-app-dec04.pdf

1 Introduction

Equity Real Estate Investment Trusts are widely considered by analysts and institutional investors as additions to a diversified multi-asset portfolio, as a more liquid and more easily accessible alternative to holdings of direct real estate. However, as is widely documented, equity REIT returns do not strictly follow the movements and returns of the underlying direct property market: while in the long run a fundamental relationship between securitized and unsecuritized real estate seems to exist, in the short run REIT returns do not follow those of the underlying property market.

This paper attempts to further explore the relationship (or apparent lack thereof) between the two markets. We do this by examining the relationship of equity REIT returns with property-level income returns (or changes in property-level Net Operating Incomes), and property-level appreciation returns (or changes in property prices). We argue that REITs are income vehicles, rather than appreciation vehicles. In other words, by investing in a REIT, an investor only receives exposure to its rental cashflows and very little exposure, at best, to its short-term property value growth[2]. In particular, property prices contain forecastable short-term growth opportunities (even if these are not yet capitalized in rents) to which REIT investors do not have access. This hypothesis may offer a possible explanation for the short-term dichotomy between REIT price movements and property price movements.

This paper will proceed as follows. Section 2 will present a brief review of past literature specific to this topic. Section3 will then outline the theoretical elements that underlie this paper. Section 4 presents the data sources and implements some necessary adjustments to certain series. Section 5 presents preliminary results and outlines the need for further data adjustments which are implemented in section 6. Section 7 presents the final results for the paper and section 8 concludes.

[2]A possible explanation for why this might be so is offered without proof in the conclusion, as a full proof would be too extensive to include as part of this paper

2 Previous Literature

There exist a large number of studies that investigate the correlation of REITs with other asset classes. The studies that incorporate a decomposition of direct property returns into income and appreciation are, however, very few. The most pertinent works to this paper are Capozza and Lee (1995) and Pagliari and Webb (1995).

Capozza and Lee construct REIT NAVs by using property-level income, in order to then determine what REITs trade at discounts and what REITs trade at premia to NAV. Pagliari and Webb, on the other hand, perform an investigation that is somewhat similar to this one. They try to equate property and REIT market return components, comparing direct-property income to REIT dividends and direct-property appreciation to REIT share prices. While this comparison seems very elegant and appealing, their results are generally inconclusive, at least on the income question. The problem here seems to be that dividends are managed, and that, therefore, despite the high dividend payout requirements that REITs face, property-level net operating income that enters the REIT is not necessarily carried through to the end investor purely as a dividend.

For this reason, in this study, we take a more relaxed view than Pagliari and Webb and analyze REIT total returns, consisting of both share price changes and dividend payouts. The reason for this is that, similar to the mechanisms governing coupon bonds, if investors perceive a different return to a REIT stock than is paid out in dividends, prices will simply adjust to reflect what is not paid out directly. Thus, only by examining total return series, can we deduce what the market perceives about REIT returns.

3 Theory

3.1 Property Markets

Traditionally, there are two separate components to owning property for rent. Primarily, by owning a property, one has a right to the rental cashflows generated by that property. Traditionally (and most simplistically) this is the only investment value of a property, and property prices are determined this way: in this frame of reference, one simply perpetualizes the current level of income, discounting it forever, as follows:

$$P_t = NOI_t + \frac{NOI_{t+1}}{(1+r)} + \frac{NOI_{t+2}}{(1+r)^2} + \frac{NOI_{t+3}}{(1+r)^3} + \cdots \tag{1}$$

Here P_t is the price of the property at time t, NOI_t is the property's net operating income, and r is a discount rate representing the required rate of return. Through the properties of infinite geometric series, equation 1 can be reduced to the well-known formula for a perpetuity.

$$P_t = \frac{NOI_{t+1}}{r} \tag{2}$$

If the NOI increases at a constant rate of g, we have the Gordon Growth model:

$$P_t = \frac{NOI_{t+1}}{r-g} \tag{3}$$

While property prices are often determined in this way in their most basic form, there is a vital component missing here. In order to investigate this component, we need to use the concept of market efficiency, or informational efficiency, which will be central to the methodology of this paper. Specifically, we assume that today's prices already contain all of today's information, which implies that, given today's information, it is impossible to form a profitable trading strategy based upon this information.

By simply perpetualizing today's rent to determine a property price, we have not taken into account forecastable growth opportunities which we buy into by buying the property, but which are not yet shown in rents. In an informationally efficient market, prices must include all signals known today, including those concerning forecastable future events. However, in an ideally liquid rental market, this information will only be present in rents once the forecast event actually occurs. We have thus identified a second component to property prices beyond pure NOI: that of forecastable growth opportunities. This component can be likened to what is expressed by fluctuations in capitalization rate.

It is important to note that this component will only be present in the short run, as in the long run prices and rents should contain the same information. It is often said that direct property markets are not efficient and there may be some truth to that. However, even in a market with such poor pricing information as the property market, it is not unrealistic to assume the existence of some information that is quasi-public (it is sufficient that both the buyer and the seller in each transaction have it) to guarantee the existence of an expectations-based component in property values, such that property values contain information that is not contained in NOIs.

3.2 Stock Markets

Market efficiency is even more important in the stock market than in the property market, as the former market is generally thought to be much more efficient than the latter, and we will be making use of this efficiency of the stock market as well.

In fact, in order to assess whether REITs are income vehicles or appreciation vehicles we will simply examine the REIT market's response to changes in the respective direct market series. If REITs depend on direct property market information, any relevant information from the direct property market should be shown in REIT prices, as soon as it is available. Conversely, we can assume that, due to the efficiency of the market, information that is public, but not shown in REIT prices, is not relevant to the pricing of REITs.

Thus, in order to address whether REITs can realize the forecast short-term appreciation opportunities priced into property, it suffices to examine whether changes in this component of property prices are reflected in REIT prices. If they are not, we can infer that investors perceive this component to be irrelevant, which can only be the case if REITs cannot realize such appreciation opportunities.

3.3 The Model

In our examination of REIT prices we will look for the *incremental information content* contained in each series. In other words, if an investor is examining a certain number of explanatory variables, we will be asking the question of whether adding another explanatory variable to the model increases the model's useful information content. If not, the last added variable is not priced into REITs. This closely mirrors a REIT analyst's information gathering process in the face of costly information.

Specifically, we will examine, initially, the explanatory power of a two-factor model of trend – and market – control variables:

$$REIT_t = \alpha_1 + \beta_{11} stock_t + \beta_{21} int_t + \epsilon_{1_t} \tag{4}$$

Here, $REIT_t$ is a REIT index returns series, $stock_t$ is a general stock market index return series and int_t is changes in the interest rate, with ϵ an error term. The fact that REIT performance is strongly correlated with that of the general stock market is an idea that is quite common in the REIT literature and has often been observed (Mengden and Hartzell (1986), Peterson and Hsieh (1997), Oppenheimer and Grissom (1998), Clayton and MacKinnon (2003), to name a few). It is thus important to put the effect that specific information about the underlying market has into perspective, compared to what can be explained without any such information, among other things, also to avoid omitted-variable bias.

Subsequently we will add the first direct-market variable, changes in property-level income (inc):

$$REIT_t = \alpha_2 + \beta_{12} stock_t + \beta_{22} int_t + \beta_{32} inc_t + \epsilon_{2_t} \tag{5}$$

Finally, we will add changes in property-level appreciation app to the model:

$$REIT_t = \alpha_3 + \beta_{13} stock_t + \beta_{23} int_t + \beta_{33} inc_t + \beta_{43} app_t + \epsilon_{3_t} \tag{6}$$

This process closely mirrors the investor's information-gathering process from the public general information to the semi-private income series to the intrinsic property value series. At each step we will examine the significance of each variable, as well as each new variable's contribution to the model's explanatory power. If any added variable does little to help the model's explanatory power, we can infer that the information it gives is not relevant to REIT pricing.

The REIT boom of the 1990s substantially altered the REIT industry, increasing the level of institutional investor participation in the market (and therefore increasing investors' general understanding thereof), as well as generally causing enormous growth in the size of the industry and that of certain individual firms. These changes suggest that we may see a difference in our results between *old* and *new* REITs and we will therefore test time-period subsamples of the data as well as the entire 1978-2003 sample.

4 Data

4.1 REITs

As data for our REIT price series, we take total returns for the NAREIT Equity-REIT index. Thus, this includes both share price changes and dividend returns of the index constituents. As mentioned previously, this approach differs from that of Pagilari and Webb (1995), but, as dividends are managed, it is not possible to separate the share-level income and appreciation components. In using a REIT index as our dependent variable we are proxying for a well-diversified REIT portfolio held by an investor.

4.2 The Direct Real Estate Market

For direct market data we use the National Property Index from the National Council of Real Estate Fiduciaries (NCREIF). This quarterly index is based on a database of institutionally-held non-agricultural investment-grade real estate currently valued at $138 Billion. The index returns data is split into two components, income, and appreciation, both of which we use as data for the respective direct market variables. The income return component is computed purely on the basis of net operating income each property generates.

The appreciation component is computed as the scaled difference between each property's market value at the beginning of a quarter and at the end. However, due to infrequent trading in this market, market prices can only be observed seldomly and collecting such data becomes problematic. Furthermore, the property market is heterogeneous so that even when transactions are observed on a building other than the one being examined, the translation of the implications of such a transaction to the value of the building in question is often nontrivial. The common solution to this problem is to retain the services of a professional appraiser who will regularly estimate a valuation for a building. The appraisal process and the compiling of appraised data, however, implies many problems which must be accounted for. The issues associated with data such as this can be classified into two categories: *stale appraisals*, and appraisal *smoothing* or *anchoring*. We will address both of these issues in turn suggesting a remedy which we apply to our data.

4.2.1 Stale Appraisals

The problem of *stale appraisals* comes from the fact that the NCREIF's NPI is a quarterly index, yet many properties in its database are only appraised annually, respectively at different times throughout the year. Thus, while the database records quarterly observations, many of the appraisals it contains are up to a year old. This way, in each new observation we are observing a mixture of new and older information. This gives the series a temporal lag bias, causing it, for example, to miss market turnarounds.

4.2.2 Appraisal Anchoring

Appraisal *anchoring* or *smoothing* comes from the event of a renewed appraisal. If the same appraiser values a property which he has valued before, he will take his old valuation of the property as a starting point and then make adjustments according to market events that have occurred in the meantime. Through this procedure, appraisers will tend to give too much weight to their old valuation, which will cause the appraised values to understate volatility and, once again, miss market turnarounds. This phenomenon of appraisal smoothing has been widely documented in the literature, most notably so in Clayton, Geltner, and Hamilton (2001).

4.2.3 Corrective Measures to *Smoothing* and *Stale Appraisals.*

Because these issues exist, we must take corrective measures to account for them. This is known as reverse-engineering of the appraisal-based data, and different methodologies for this can be found in the literature. A common such methodology is the following, first presented in Blundell and Ward (1987), and refined in Geltner (1989), Ross and Zisler (1991), Geltner (1991), and finalized in Fisher, Geltner, and Webb (1994). The appraisal process can be described in the following model:

$$P_t^* = w_0 P_t + b(B) P_{t-1}^* \tag{7}$$

where P_t^* is the series of smoothed prices and P_t the unobservable true prices. w_0 is a weight between 0 and 1 and $b(B)$ is a polynomial function of the lag operator, B:

$$b(B) = b_1 + b_2 B + b_3 B^2 + \cdots \tag{8}$$

where B refers to one lag ($BP_{t-1} = P_{t-2}$), B^2 refers to two lags ($B^2 P_{t-1} = P_{t-3}$), etc. The appraiser thus combines new and old information to form his appraisal to proxy for today's unobservable price. Taking first differences, we obtain returns:

$$r_t^* = w_0 r_t + b(B) r_{t-1}^* \tag{9}$$

where r_t^* is the series of smoothed index returns, and r_t is the underlying unobservable true return. Conceptually, this model can be estimated as

$$r_t^* = b(B) r_{t-1}^* + e_t \tag{10}$$

with $e_t = w_0 r_t$, consisting of white noise, so that the autoregressive parameters (b_i) can be estimated. This fits nicely into the framework of unobservable true returns. The implied true returns are then simply the scaled residuals from this autoregression, namely:

$$r_t = \frac{\left(r_t^* - b(B)r_{t-1}^*\right)}{w_o} \tag{11}$$

One further condition must then be applied in order to evaluate w_0 and obtain the true return series, a condition limiting the volatility. In this case, Fisher, Geltner, and Webb stipulate simply that the standard deviation of the true returns be half that of the S&P 500, or

$$\sigma(r_t) \equiv \frac{\sigma(S\&P)}{2} \tag{12}$$

which, although rather arbitrary, seems to be the case in practice. Thus we have:

$$w_0 = \frac{2\sigma\left(r_t^* - b(B)r_{t-1}^*\right)}{\sigma(S\&P)} \tag{13}$$

A simplification can be applied to this model. As Quan and Quigley (1989 and 1991) have demonstrated, a simple AR(1) process will capture appraiser behavior at the disaggregate level. Ross and Zisler (1991) and Geltner (1989 and 1993) have shown that at the index level, for a quarterly index we can do this through an AR(1,4) process: as most properties are reappraised only annually, the 4th-order autoregression term corrects for anchoring of single appraisals. The 1st-order term now corrects for stale appraisals, with the implication that after one quarter not enough new information has entered the index.

The central assumption in Fisher, Geltner, and Webb's procedure is that property prices follow a random walk and that therefore returns should not be serially correlated. The model can thus be summarized by the following set of equations:

$$r_t^* = b_1 r_{t-1}^* + b_2 r_{t-4}^* + w_0 r_t \tag{14}$$

$$r_t \sim N(0, \sigma^2) \tag{15}$$

$$r_t^* = b_0 + b_1 r_{t-1}^* + b_2 r_{t-4}^* + \epsilon_t \text{ with } b_0 \approx 0,\ E(\epsilon_t) = 0, \text{ and } \sigma^2(\epsilon) = w_0^2 \sigma^2 \tag{16}$$

$$w_0 = 2\sigma\left[r_t^* - \left(b_1 r_{t-1}^* + b_2 r_{t-4}^*\right)\right] / \sigma(S\&P) \tag{17}$$

A further improvement on this reverse engineering procedure is formulated by Cho, Kawaguchi, and Shilling (2003). The basic model is specified in a very similar way, with the same construction as in 14 above. However, the condition imposed by expression 15 and 16 is reformulated, to allow for a random walk with drift, and some serial correlation to allow for long-run mean reversion of prices. Instead of condition 15 above, Cho, Kawaguchi, and Shilling impose the following:

$$r_t = \alpha + \rho r_{t-1} + \epsilon_t \text{ with } E(\epsilon_t) = 0 \text{ and } \sigma^2(\epsilon) = \sigma^2 \tag{18}$$

By substituting from the new solution for ϵ, equation 16 now becomes a model of generalized differences:

$$r_t^* - \rho r_{t-1}^* = \alpha w_0 + b_1 (r_{t-1} - \rho r_{t-2}) + b_2 (r_{t-4} - \rho r_{t-5}) + \epsilon'_t \text{ where } \epsilon'_t = w_0 \epsilon_t \tag{19}$$

Instead of equation 17, which, despite seeming to be the case in reality, seems somewhat arbitrary, Cho, Kawaguchi, and Shilling simply impose the condition that the weights given to each piece of information should add to 1, giving:

$$w_0 = 1 - b_1 - b_2 \tag{20}$$

They test this model's performance compared with that of Fisher, Geltner, and Webb, on the appreciation component of the NCREIF NPI. They find that, in the previous model, the desmoothed index seems plausible from 1978 until 1992, after which it completely divorces itself from the smoothed index. They ascribe this to the non-stationary error term used in Fisher, Geltner, and Webb. Their own model does not show such a bias, throughout the entire time window.

Thus in this paper we will be using Cho, Kawaguchi, and Shilling's model to correct for temporal lag bias in our direct market appreciation data. Equation 19 cannot be estimated directly through OLS, so, in line with the authors' empirical application of their model, we will use an iterative process to obtain estimates for the parameters b_1 and b_2. The procedures goes as follows. We stipulate an initial value for ρ which we use to form the generalized differences of the lagged returns, in order to estimate equation 19. In doing so we obtain estimates for the parameters b_1 and b_2 which we then insert into equation 19,

Table 1: Regression results: Iterative estimation of $r_t^* - \rho r_{t-1}^* = \alpha w_0 + b_1 (r_{t-1} - \rho r_{t-2}) + b_2 (r_{t-4} - \rho r_{t-5}) + \epsilon_t'$

Variable	Coefficient	Std. Error	t-statistic	p-value
αw_0	0.0194794	0.0944057	0.2063	0.8370
b_1	-0.238997	0.0792469	-3.0159	0.0033
b_2	0.543328	0.0770052	7.0557	0.0000
ρ	0.737598	0.0675085	10.926	0.0000

Unadjusted R^2	0.433058
Adjusted $\bar{R}^2$	0.420995
$F(2, 94)$	35.9008

rearranged to get a parameter estimate for ρ:

$$\left(r_t^* - b_1 r_{t-1}^* - b_2 r_{t-4}^*\right) = \alpha w_0 + \rho \left(r_{t-1}^* - b_1 r_{t-2}^* - b_2 r_{t-5}^*\right) + \epsilon_t' \qquad (21)$$

The estimated new value for rho is then entered into equation 19 and so forth. With each iteration we obtain a better parameter estimate for ρ. We start with a guess of 0.5 for ρ and do 100 iterations, after which two consecutive estimates differ by less than the machine zero. After only 33 iterations the estimates differ by less than 10^{-6}. Table 1 presents the results and significance levels of the final iteration.

We thus have now adjusted our appraisal-based appreciation series for temporal lag bias.

4.2.4 More Corrective Measures: *Price Discovery.*

Conceptually, we have now brought this series from an appraisal-based level to a transactions level. There is, however, one further aspect that we must account for in our analysis, that of *price discovery.* This phenomenon, which, once again, is well-documented within the literature (Giliberto (1990), Myer and Webb (1993), and Barkham and Geltner (1995), among others), consists of a time lag between securitized and unsecuritized real estate, with the former being found to lead the latter by six months to two years, depending on the study. Once again this seems to contradict market efficiency as, surely, profitable trading strategies con be formed in the direct real estate market if it is known that the securitized market leads it. The fact that this is not so must be ascribed to frictions existing in the unsecuritized market. While the sale of a REIT shareis nearly instantaneous, a transaction in the direct market is quite slow, with legal teams working out contracts, etc. The lags between the securitized market and the direct market are due to the transaction time of the direct market and therefore no profitable trading strategies can be formed upon them.

While the market remains informationally efficient despite this price discovery effect, for the purposes of our study this is not sufficient: in fact, once a transaction is complete (and has appeared in the public record), the pricing information contained therein is already at least six months old, as price tends to be more or less locked in toward the beginning of a transaction. Thus our reverse engineered data shows us old pricing information. As a remedy to this, since money generally only changes hands once the transaction is official, we can liken a transaction in the real estate market to a forward contract. Assuming rational parties in the transaction, it is clear from general finance theory how a forward contract is priced. For our purposes, with this re-engineered (transaction-like) index we are observing the *forward price*, and we can thus deduce the *spot price*, or the pricing information at the time the price was set, using normal forward-pricing relationships. Only this way will we have pricing information that is comparable to that we receive from the REIT market.

The well-known forward pricing relationship for a security without dividends is as follows:

$$F_t = S_0(1+r)^t \tag{22}$$

where F_t is the forward price for a contract expiring at time t, S_0 is the spot price today of the underlying, and r is the risk-free interest rate per period. Solving for S_0 we get:

$$S_0 = \frac{F_t}{(1+r)^t} \tag{23}$$

In our case we want to obtain quarterly returns data, rather than price data, so we let $R_0 = \ln(S_0) - \ln(S_{-1})$. Using quarterly annualized 6-month treasury-note rate data, and a transaction time of three quarters we obtain:

$$R_0 = \ln\left[\frac{F_3}{(1+r_1)^{1/4}(1+r_2)^{1/4}(1+r_3)^{1/4}}\right] - \ln\left[\frac{F_2}{(1+r_0)^{1/4}(1+r_1)^{1/4}(1+r_2)^{1/4}}\right] \tag{24}$$

Reducing, we obtain

$$R_0 = \ln F_3 - \ln F_2 + \frac{\ln(1+r_0) - \ln(1+r_3)}{4} \tag{25}$$

or

$$R_0 = r_3 + \frac{\ln(1+r_0) - \ln(1+r_3)}{4} \tag{26}$$

where r_t is the reverse-engineered appraisal-based index, t quarters from the quarter being observed. The amount of lead time to be used was found by maximizing the time-displaced cross-correlation of this series with market income. Since the income series does not suffer from appraisal-related error, as there is no appraisal used in constructing it, we can use this to determine the optimal lead. We are thus monitoring at which lead value the income-related component of appreciation best reflects current market income. We can then examine the incremental information content the expectations component of appreciation provides in explaining REIT returns, once income is in the model.

4.3 Other data

For the stock market series, we take an S&P 500 quarterly total returns series. For the interest rate factor, we use changes in 3-year US treasury note rates.

5 Preliminary Results

White tests for heteroskedasticity were performed on the residuals, leading to a rejection of homoskedasticity at a 5% level or better in all cases. Therefore all the estimations presented here have been performed with Huber-White heteroskedasticity-adjusted standard errors. Throughout table 2 we assess the incremental information content that the two direct market variables (*income* and *apprec*) provide in explaining REIT returns.

From these results, we can draw some preliminary conclusions. Both the addition of *income* as well as that of *apprec* to the model raises the respective $\overline{R^2}$, from 21% to 26% and from 26% to 33% respectively, suggesting that over the entire sample the incremental information content added to the model by both of these variables is relevant. The signs of the coefficients of all variables look plausible. That of *d3yrtr* is negative due to the intrinsic discount factor in the valuation of both securitized and unsecuritized real estate being, linked closely to the underlying risk-free rate.

As for statistical significance level, we must approach these results with a large degree of caution. As is apparent from table 2, both the addition of *income*, and much more so that of *apprec* to the model, considerably alters coefficients and significance levels of other variables that were previously already present in the model. The addition of *income* changes the value of the intercept from 2.83 to -8.55 and considerably raises its standard error, making it insignificant. The coefficient and standard error of *S&P* are slightly affected and the coefficient of *d3yrtr* is also slightly affected while its standard error remains largely unaffected.

The addition of *apprec* to the model has an even more dramatic effect, making the intercept, *S&P*, and *income* insignificant, while drastically changing their coefficients. This effect is consistent with the presence of multicollinearity between the explanatory variables and constitutes the reason why we must call these results preliminary. The presence of collinearity between *income* and *apprec*, is suggested by the argument that the latter variable has a component that is purely income-determined, and that we constructed it by maximizing this component. There seem to be further collinearity relationships in our data, however, which we will now investigate thoroughly. The detrimental effects of the addition of the direct-market variables on the variables contained in the initial model (equation 4, or Model 1 in table 2) is undesirable in our investigation of incremental information content, as we wish to ascribe overlapping contribu-

Table 2: Regression results: Heteroskedasticity-corrected estimates.

Dependent variable: REIT. Standard errors in parentheses.

1978:1-2003:2. 102 observations.

	Model 1	Model 2	Model 3
const	2.8321	−8.5499	−0.7775
	(0.7225)***	(5.3593)	(5.1849)
S&P	0.2924	0.3132	0.1387
	(0.1064)**	(0.1059)**	0.0950
d3yrtr	−0.2826	−0.3288	−0.3206
	(0.0640)***	(0.0664)***	0.0533***
income		5.7331	1.6173
		(2.8232)*	(2.7127)
apprec			1.0643
			(0.3852)**
$\overline{R^2}$	0.2150	0.2640	0.3313
F	14.8374	13.0762	13.0170

S&P: The S&P 500 stock index.

d3yrtr: Changes in the 3-year treasury rate.

income: Property-level income returns.

apprec: Property-level appreciation returns.

*: significant at the 5% level.

**: significant at the 1% level.

***: significant at the 0.1% level.

tions of information content among variables to more *basic* or easily obtainable variables that were added to the model earlier in the process, rather than to the more expensive to obtain later variables.

6 Further Adjustment of the Data

We will investigate these collinearity relationships through the method of singular value decomposition. This procedure is thoroughly outlined in Belsley, Kuh, and Welsch (1980), Belsley (1991), and Board, Rees, and Sutcliffe (1992), and we will therefore not spend too much time on its fundamentals but will give a brief procedural outline of this technique.

Given any $n \times k$ matrix $\mathbf{X}$ of explanatory variables, this matrix can be decomposed into the product of three matrices as follows:

$$\mathbf{X} = \mathbf{UDV'} \tag{27}$$

where $\mathbf{U}$ is an $n \times k$ matrix and $\mathbf{V}$ is a $k \times k$ matrix with $\mathbf{U'U} = \mathbf{V'V} = \mathbf{I}$, the $k \times k$ identity matrix. It can be shown that the columns of $\mathbf{U}$ are the eigenvectors of $\mathbf{XX'}$ while the columns of $\mathbf{V}$ are the eigenvectors of $\mathbf{X'X}$. In this case, $\mathbf{D}$ will be a $k \times k$ diagonal matrix with positive diagonal elements called the *singular values* of $\mathbf{X}$, which we will denote by $\mu_i, 1 \leq i \leq k$, and which can be shown to be the square roots of the eigenvalues of $\mathbf{X'X}$. In the presence of exact linear dependency among columns of $\mathbf{X}$, one or several of these singular values will be zero, making $\mathbf{X'X}$ singular and making it impossible to compute the OLS estimator. With near linear dependencies, it will be possible to compute the OLS estimator, but one or several singular values will be *small*. To define *small*, we construct a condition index ϕ defined as:

$$\phi_i = \frac{\mu_{max}}{\mu_i} \text{ with } 1 \leq i \leq k \tag{28}$$

Belsley et al. (1980) suggest that a condition index of 5 to 10 indicates weak linear dependency among columns while an index of 15 to 30 indicates near dependencies.

Table 3: Singular Values, Condition Indices, and Variance Proportions, based on the 102 observations 1978:1–2003:2.

Singular Value	Condition Index	*const*	*S&P*	*d3yrtr*	*income*	*apprec*
1.1392	1.3057	0.0002	0.0054	0.2461	0.0002	0.011
0.8853	1.6802	0.0001	0.0162	0.0318	0.0001	0.0452
0.8378	1.7755	0.0005	0.0032	0.4763	0.0004	0.0389
0.0593	25.0817	0.9972	0.9750	0.2456	0.9972	0.9047

While by finding condition indices we detect the presence of collinearity in our matrix of explanatory variables, this does not tell us anything about the variables involved in this dependency. In order to find out this information, we can decompose the covariance matrix as follows. By equation 27 and the properties of $\mathbf{V}$ the covariance matrix can be rewritten as

$$\sigma^2(\mathbf{X}'\mathbf{X})^{-1} = \sigma^2\mathbf{V}\mathbf{D}^2\mathbf{V}' \tag{29}$$

In scalar notation, the ith diagonal element of the covariance matrix becomes

$$var(b_i) = \sigma^2 \sum_{j=1}^{k} \left(v_{ij}^2/\mu_{ij}^2\right) = \sigma^2 \sum_{j=1}^{k} n_{ij} \tag{30}$$

where $n_{ij} = v_{ij}^2/\mu_j^2$ and v is an element of $\mathbf{V}$. The proportion of the variance of the ith explanatory variable caused by the jth singular value is then simply

$$\pi_{ji} = \frac{n_{ij}}{\sum_{j=1}^{k} n_{ij}} \tag{31}$$

Note that these terms will all be positive and sum to 1. We can then construct a matrix $\mathbf{\Pi}$ of proportions of variances consisting of elements π_{ij}.

For our sample the results of this procedure are shown in table 3.

As table 3 shows, the largest condition index for our data is 25.0817, indicating a near dependence. It is a four-way collinearity relationship between the intercept, *S&P*, *income*, and *apprec*. Applying this technique to the subsamples we will be investigating, yields quite similar results, so these tables are not reported here to save space. Note, however, that over the 1998-2003 subsample, *d3ytr* is also part of the collinearity relationship. Conceptually, the fact that the intercept is involved in this relationship may seem surprising initially, although it can be explained quite plausibly by the smoothness of *income*: perhaps not surprisingly, there are quite small fluctuations in quarterly income returns over the entire time period. The fact that we have detected the involvement of the intercept in this relationship shows the effectiveness of this test for collinearity, as in many other types of test this important source of collinearity is often missed.

Among the remedies often suggested in a case of ill conditioning is to drop an explanatory variable, or to try to get better data. Neither of these two solutions is acceptable in this case, as dropping enough variables to eliminate the collinearity in this case would prevent us from testing our hypothesis of whether appreciation contains useful incremental information in the presence of income, in explaining REIT returns, and it should be impossible to find property-level appreciation data that does not contain income information. Were there such data, we would need to think hard whether this is reliable data, as, conceptually, part of the value of a building today must be determined by its current rent.

Instead, we will adjust our data through the method of orthogonalization or orthogonal projection. This is a technique often used in the financial asset pricing literature (most notably, perhaps, Fama and French (1993)) and some times in the REIT literature (Chatrath, Liang, and McIntosh, (1996)). The former study uses this technique to find a pure cross effect of stock market factors on the bond market, as bond market and stock market factors tend to be correlated, a purpose not dissimilar in nature to the problem we are facing. The latter study uses this technique to create a *pure industry factor* of REITs, orthogonal to the general stock market.

This technique consists of regressing one collinear variable on the other, and then using the residuals from this regression in the model. Due to the nature of OLS, the residuals will be orthogonal to the explanatory variables, removing the collinearity issues we are facing. This method is similar to a Gram-Schmidt orthogonalization (often also referred to as QR decomposition) used to form an orthogonal basis for a vector space[3]. In our case we estimate the following models:

$$
\begin{aligned}
income_t &= \gamma + \psi_1 SnP_t + \iota_t & (32)\\
apprec_t &= \delta + \zeta_1 SnP_t + \zeta_2 income_t + \xi_t & (33)
\end{aligned}
$$

Model 6 (page 6) then becomes

$$
REIT_t = \nu + \varphi_1 SnP_t + \varphi_2 d3yrtr_t + \varphi_3 \widehat{\iota_t} + \varphi_4 \widehat{\xi_t} + \tau_t \qquad (34)
$$

It is easy to show that this is nothing but a reparameterization of model 6 and that therefore $\tau = \epsilon_3$. To do this, we substitute into 34 from 32 and 33:

$$
\begin{aligned}
REIT_t = {} & \nu + \varphi_1 SnP_t + \varphi_2 d3yrtr_t + \\
& + \varphi_3 \left(income_t - \gamma - \psi_1 SnP_t \right) + \\
& + \varphi_4 \left(apprec_t - \delta - \zeta_1 SnP_t - \zeta_2 income_t \right) + \tau_t \qquad (35)
\end{aligned}
$$

Combining, we obtain

$$
\begin{aligned}
REIT_t = {} & \left(\nu - \varphi_3 \gamma - \varphi_4 \delta \right) + \left(\varphi_1 - \varphi_3 \psi_1 - \varphi_4 \zeta_1 \right) SnP_t + \\
& + \varphi_2 d3yrtr + \left(\varphi_3 - \varphi_4 \zeta_2 \right) income_t + \varphi_4 apprec_t + \tau_t \qquad (36)
\end{aligned}
$$

Since we have merely reparameterized the model there should be no statistical concerns associated with performing this technique in terms of explanatory power, as the residuals remain the same, subject to the computer's rounding error. We altered the t-tests we perform, however, specifying how significance should be allocated. It must be noted here that it does matter in which order these orthogonal projections are performed. For us, however, only the order described above makes sense in the framework of our assessment of incremental information content. By removing the component in *income* which is explained by simple trend and by *S&P* we are testing for the significance of the information content of *income* that is unique to this variable. Similarly, having removed the trend as well as the effects of the stock market and of *income* from

[3] See Seber and Lee (2003) for further information on this technique

apprec we test for the significance of the information content that is unique to this variable. Once again, here we mirror the information gathering process of a REIT investor: first we look at trend, then general economic variables, then we collect rental data, and lastly we employ an appraiser to derive property values. The improvement we have here over our results in table 2 is that we can draw meaningful conclusions about variable significance and therefore relevance of information content in an incremental sense, in a multiple regression containing all factors. This will be somewhat more illustrative than simply examining contributions to $\overline{R^2}$.

7 Results

Table 4 shows the results of this investigation using the orthogonal projections *income_o* and *apprec_o* derived above, to proxy for the variables *income* and *apprec* respectively.

In this orthogonalized framework, in Model 4, all variables are significant over the entire sample. While the significance level of *apprec_o* is slightly above 1%, those of the other variables lie well below that, making the incremental information content of appreciation the least relevant, relatively speaking. We must say, however, that even the significance level of *apprec_o* cannot be considered poor, an observation which, together with the strong contribution to $\overline{R^2}$ of appreciation information that we saw in table 2 (page 16), suggests the conclusion that appreciation content is relevant in explaining REIT prices in the long run. In the long run, the expectations-based component of property value that differs from income information disappears, as all shocks are capitalized into rental cashflows sooner or later. We must look at the time-period subsamples to determine whether this is the case in the short run, also because our full sample contains both *old* REITs as well as *new* REITs which may behave quite differently from each other, with respect to the phenomenon in question.

Table 4 examines the following subperiods: 1978-1991, the pre-boom period; 1992-2003, the boom and post-boom period; 1998-2003, a strictly post-boom

Table 4: Regression results.Dependent variable: REIT.Heteroskedasticity-corrected standard errors in parentheses.

	Model 4	Model 5	Model 6	Model 7	Model 8
Time Window	1978:1-2003:2	1978:1-1991:4	1992:1-2003:2	1998:1-2003:2	1998:1-2003:2
Number of Obs.	102	55	43	19	19
const	2.3848	2.7093	2.8984	1.7226	1.1566
	(0.7023)***	(0.9742)**	(0.8819)**	(1.2601)	(1.2506)
S&P	0.2465	0.2431	0.2609	−0.2437	
	(0.0883)**	(0.1140)*	0.1287*	0.1689	
d3yrtr	−0.3194	−0.3829	−0.0922	0.3473	0.1646
	(0.0550)***	(0.0771)***	0.0650	(0.1328)*	(0.0532)**
income_o	8.0204	16.1144	−13.4540	31.7021	32.6459
	(2.2964)***	(3.8276)***	(6.1528)*	(15.0055)*	(14.6598)*
apprec_o	0.9773	0.0964	0.7053	0.6579	−0.1200
	(0.3818)*	(0.5660)	(0.8216)	(1.2989)	(1.1536)
$\overline{R}^2$	0.3944	0.4454	0.1644	0.7485	0.6045
F	15.1426	11.8399	3.0653	14.3937	10.1695

S&P: The S&P 500 stock index.

d3yrtr: Changes in the 3-year treasury rate.

income: Property-level income returns.

apprec: Property-level appreciation returns.

*: significant at the 5% level.

**: significant at the 1% level.

***: significant at the 0.1% level.

period. The orthogonalized versions of the direct market variables have been recomputed over each subperiod as, while the general nature of the collinearity relationships remains unchanged, there may have been small changes in the sizes of the coefficients involved.

As is clearly visible from the results in table 4, *old* REITs (Model 5) seem to have undoubtedly been income vehicles. Compared to the results over the entire sample, the coefficients maintain the same signs and the constant, *S&P*, and *d3yrtr* have approximately the same magnitudes and magnitudes of standard error. The coefficient for *income_o* doubles, with only a slight increase in standard error, while the coefficient for *apprec_o* is reduced by a factor of 10 and becomes insignificant. This makes a rather strong statement about the accuracy of our hypothesis in the case of old REITs. The data shows that the non-income information content of property appreciation is not contained in REIT prices and that therefore *old* REITs were perceived by investors as pure income vehicles.

The results over the 1992-2003 (Model 6) time period listed in table 4 do not look very promising in terms of helping us in our investigation. While the coefficient for *income_o* is still much more significant than that for *apprec_o*, it has a negative sign, a result which is difficult to rationalize economically, as property-market income should positively affect REIT returns, by most theories. We must keep in mind that throughout the REIT boom, especially between 1992 and 1998 the industry saw an enormous amount of capital inflow that was due to the changing institutional landscape aided by the amendments in tax legislation, and thus a change in REIT investor clientele. Many changes in the market during this time period were caused by factors other than property fundamentals, and thus the most likely explanation for these results seems to be that a fundamentals-based models would be generally misspecified over this time period.

In the 1998-2003 or strictly post-boom subsample (Model 7), the coefficient for *income_o* is now positive again, as we would expect it to be. Furthermore, even in this sample, *income_o* is significant once again, while *apprec_o* is not.

Based on this, we can cautiously accept the hypothesis that appreciation does not provide relevant incremental information content to REIT investors even in post-boom times, suggesting that even *new* REITs are income vehicles, at least in the short run. We must be cautious about this, mainly because these results are based on only 19 observations. However, only with time will more data become available, so we can only improve on this problem by waiting. This point also may apply to the R^2 and $\overline{R^2}$. While these values would indicate an extremely good model specification in terms of explanatory power, this may be partly due to the low sample size sacrificing statistical power in this case.

Something that may be worth looking into briefly is the low significance level on *S&P* in Model 7. This is consistent with economic rationale and with previous literature: a plausible argument can be made for the fact that since *new* REITs are better understood and more closely followed by institutional investors than *old* REITs, the industry should somewhat divorce itself from the general stock market, with more trading being based on industry- or even company-specific factors. In any case, due to its low significance level, we could expect to encounter little omitted-variable bias by estimating our model without it which we will do in model 8 for the sake of exhaustiveness. It must be noted that here *income_o* and *apprec_o* are recomputed without being orthogonalized to *S&P*, as *S&P* is not part of the model anymore.

As can be seen from table 4, Model 8, it is not much to the detriment of the model to omit *S&P* in this case. The previous result remains, in any case, namely the poor significance level of *apprec_o*, suggesting the conclusion that even for a sample consisting of strictly *new* REITs property-level appreciation does not contain useful incremental information for REIT pricing.

From these results we can thus infer, albeit cautiously, that both *old* and *new* REITs are income vehicles rather than appreciation vehicles. There generally seems to be a reversion of REIT prices to property values in the long run, where the expectations component of appreciation is less pronounced.

8 Conclusion

Throughout this paper we have investigated the question of whether short-term property-level appreciation is realizable to a REIT end-investor. In order to do this we have applied many corrections to our data, especially those sources reflecting the direct property market: this was necessary due to the nature of the direct property market and its poor liquidity and transparency. Throughout the study we have examined incremental information content of different explanatory variables, arguing that if a variable provides no useful additional information in explaining REIT returns, investors perceive that this variable is irrelevant to REIT returns and that therefore it is not a fundamental which is realized therein.

We found that over our entire 1978-2003 sample, which includes both *new* and *old* REITs, both property-level income and property-level appreciation are positive and significant. Once we divide the sample and examine period subsamples these conclusions change: over the *old* REIT sample of 1978-1991, income remains extremely statistically significant, while appreciation becomes extremely insignificant, supporting our hypothesis for *old* REITs, that investors are not able to realize appreciation returns through these vehicles. Over the 1992-2003 subperiod, our results are inconclusive. We ascribe this fact to the *REIT boom* of the mid 1990s during which the REIT industry grew enormously, in large part based on factors other than property market fundamentals. Over the post-boom sample of *new* REITs (1998-2003) we find income returns to be significant while appreciation remains insignificant. We further find that we can eliminate the general stock market index from the model in this time period, without much deterioration in results, which is consistent with the rise of the *new* REIT industry, and investors' better understanding thereof. We must be cautious about accepting the findings over this time period, however, due to the few observations it contains.

We have thus found that, at least over shorter time periods, REIT returns primarily consist of property-level income and not property-level appreciation. Over the long run, on the other hand, there seems to be a reversion of REIT values toward property values. This seems consistent with previous literature, in that REIT returns have often been found to diverge from direct property total returns in the short run, but to conform to these in the long run. Thus, we may have found a possible explanation for the short-term dichotomy between the performance of REITs and direct real estate. In line with these findings, it seems to be a fallacy to declare REITs as *property* vehicles, as all they are is property *income* vehicles.

There are many possible explanations for why this is so, and we will offer one here, leaving the reader to consult forthcoming papers by the author, in this series for proof. The suggested explanation takes as its basis the trading constraints imposed on REITs in order to obtain tax-exempt status. In order to qualify as a REIT, a firm must, among other things, hold each of its properties in its portfolio for at least four years. Furthermore, REITs may only sell 10% or less of their asset base at a time, and, until 1997, only 30% of a REIT's annual income could come from such sales. REITs are thus somewhat limited in their ability to enter and exit the market, making it difficult for them to *time* the market. Thus, it may be impossible for a REIT to realize a predictable short-term growth opportunity, which, however, has been priced into the direct property market. It should be possible to construct a rigorous empirical proof of whether this is the correct explanation for this phenomenon, but doing so will be the purpose of forthcoming papers by this author.

References

[1] Barkham, R., and Geltner, D. (1995). "Price Discovery in American and British Property Markets." *Real Estate Economics*, 23(1), 21-44.

[2] Belsley, D.A. (1991) *Conditioning Diagnostics. Collinearity and Weak Data in Regression.* New York: Wiley, 1991.

[3] Belsley, D.A., Kuh, E., and Welsch, R.E. (1980). *Regression Diagnostics: Identifying Influential Data and Sources of Collinearity.* New York: Wiley, 1980.

[4] Blundell, G. and Ward, C. (1987). "Property Portfolio Allocation: A Multi-Factor Approach." *Land Development Studies*, 4, 145-156.

[5] Board, John, Rees, Bill, and Sutcliffe, Charles (1992). "Measuring the Incremental Information Content of Multiple Accounting Signals: A Note on the Use of the Singular Value Decomposition." *Journal of Business Finance & Accounting*, 19(3), 447-454.

[6] Capozza, Dennis R. and Lee, Sohan (1995). "Property Type, Size, and REIT Value". *Journal of Real Estate Research*, 10(4), 363-374.

[7] Chatrath, A., Liang, Y., and McIntosh, W.(1996). "Apartment REITs and Apartment Real Estate." *Journal of Real Estate Research*, 11(3), 277-289.

[8] Cho, Hoon, Kawaguchi, Yuichiro, and Shilling, James D. (2003). "Unsmoothing Commercial Property Returns: A Revision to Fisher-Geltner-Webb's Unsmoothing Procedure." *Journal of Real Estate Finance and Economics*, 27(3), 393-405.

[9] Clayton, J., Geltner, D., and Hamilton, S.W. (2001). "Smoothing in Commercial Property Valuations: Evidence From Individual Appraisals." *Real Estate Economics*, 29(3), 337-360.

[10] Clayton, Jim and Mackinnon, Greg (2003). "The Relative Importance of Stock, Bond and Real Estate Factors in Explaining REIT Returns". *Journal of Real Estate Finance and Economics*, 27(1), 39-60.

[11] Fama, Eugene F., and French, Kenneth R. (1993). "Common Risk Factors in the Returns on Stocks and Bonds." *Journal of Financial Economics*, 33, 3-56.

[12] Fisher, Jeffrey D., Geltner, D., and Webb, R. Brian (1994). "Value Indices of Commercial Real Estate: A Comparison of Index Construction Methods." *Journal of Real Estate Finance and Economics*, 9, 137-164.

[13] Geltner, D. (1989). "Estimating Real Estate's Systematic Risk from Aggregate Level Appraisal-Based Returns." *AREUEA Journal*, 17(4), 463-481.

[14] Geltner, D. (1991). "Smoothing Appraisal-Based Returns." *Journal of Real Estate Finance and Economics*, 4(3), 327-345.

[15] Giliberto, S. Michael (1990). "Equity Real Estate Investment Trusts and Real Estate Returns". *Journal of Real Estate Research*, 5(2), 259-263.

[16] Mengden, Anne E., and Hartzell, David J. (1986). *Real Estate Investment Trusts - Are they Stocks or Real Estate?*. New York: Salomon Brothers, Inc.

[17] Myer, F.C. Neil and Webb, James R. (1993). "Return Properties of Equity REITs, Common Stocks, and Commercial Real Estate: A Comparison". *Journal of Real Estate Research*, 8 (1), 87-106.

[18] Oppenheimer, Peter, and Grissom, Terry V. (1998). "Frequency Space Correlation between REITs and Capital Market Indices." *Journal of Real Estate Research*, 16(3), 291-310.

[19] Pagliari, Joseph L. and Webb, James R. (1995). "A Fundamental Examination of Securitized and Unsecuritized Real Estate". *Journal of Real Estate Research*, 10 (4), 381-425.

[20] Peterson, James D. and Hsieh, Cheng-Ho (1997). "Do Common Risk Factors in the Returns on Stocks and Bonds Explain Returns on REITs?" *Real Estate Economics*, 25(2), 321-345.

[21] Quan, D., and Quigley, J. (1989). "Inferring an Investment Return Series for Real Estate from Observations on Sales." *AREUEA Journal*, 17(2), 218-230.

[22] Quan, D., and Quigley, J. (1991). "Price Formation and the Appraisal Function in Real Estate." *Journal of Real Estate Finance and Economics*, 4(2) 127-146.

[23] Ross, S. and Zisler, R. (1991). "Risk and Return in Real Estate." *Journal of Real Estate Finance and Economics*, 4(2), 175-190.

[24] Seber, George A.F., and Lee, Alan, J. (2003). *Linear Regression Analysis*. Hoboken, NJ: Wiley, 2003.