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HOW DOES APPRAISAL SMOOTHING BIAS REAL ESTATE RETURNS MEASUREMENT?

By

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How Does Appraisal Smoothing Bias Real Estate Returns Measurement?*

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Abstract

This paper examines and clarifies several related issues about real estate return indexes. Specifically, even if real estate valuation smoothing exists at the individual property level, such errors may offset in the aggregate. Using data from commercial property appraisals and transactions, it is shown that appraisal smoothing errors engender an underestimation of both mean returns and volatility. After adjusting for these "underestimations," real estate returns and volatility appear to be quite similar to those of stocks for the sample period.

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1. Introduction

A substantial, respected existing literature, spanning the 1970s and 1980s, concludes that real estate provides a higher risk-adjusted return compared with other investment alternatives¹. These studies imply that the inclusion of real estate in a portfolio of investments can substantially reduce portfolio risk; and find that real estate is a hedge against inflation. In contrast, more recent research, utilizing extended similar methodologies, but subsequent market data, has found more modest real estate performance². The differing results, in part, may be attributable to cyclical sample specific effects as well as secular real estate market changes. The conclusion of both views in the literature depends upon the construction of one or more real estate return series which can be compared with similar return indexes for other investments. In the case of real estate, professional appraisals are generally used to represent market values. Indeed, this is the standard practice.

Several difficulties greatly restrict the usefulness of real estate return series computed from unadjusted appraisal data. The strongest criticism alleges that the aggregate real estate rate of return index is smoothed because it employs smoothed individual property appraisals³. A smoothed index will reduce the variance of returns reported for a sample of appraisals relative to a sample of sales transactions for identical properties. If this assertion were true, it would be disquieting, since the usual metrics of risk and diversification are based on measures of dispersion. An artificially smoothed series will necessarily underestimate the riskiness of the real estate asset class, and will distort its correlation with the returns of other assets.

The analysis of this paper, utilizing a sample of 71 large commercial real estate parcel arms length market transactions between 1979 and 1984, shows that individual property appraisal smoothing does not necessarily engender smoothed return indexes. The relationship between appraisal smoothing and index smoothing is indeterminant a priori, and is ultimately an empirical issue. To the best of our knowledge, no one has statistically modeled and quantified the effects of aggregation errors upon real estate rates of return indexes⁴.

¹Such studies include, among others, Fama and Schwert (1977), Miles and McCue (1984), Ibbotson and Siegel (1984), Brueggeman, et al (1984) and Hartzell (1986).

²See, for example, Dokko, Edelstein, Pomer and Urdang (1991).

³See for example Giliberto (1988), Geltner (1989a, 1989b, 1991) and Ross and Zisler (1991).

⁴There have however been numerous attempts to model such errors via simulations. See, for

The proposed method uses observed arms length sales transactions to infer the statistical reliability of the appraisal based index. In this context, the appraisal index is a random variable subject to sampling errors. For a random sample of transaction prices, appraisal errors and their distribution can be estimated⁵. Based on the sample distribution, subject to a transformation to convert the information to a return index, the error distribution for the appraisal based rate of return index can be derived. Once characterized, confidence intervals can be used to determine the region of reliability.

In the next section, the empirical model is motivated by demonstrating that even if appraisers “smooth” their estimates, as often is conjectured, the resulting aggregate index may exhibit varying degrees of smoothing. In the absence of information about how appraisal practices differ, the determination of smoothing at the aggregate level is largely an empirical issue, requiring a procedure for estimating the error distribution. A proposed procedure is delineated and applied to a sample of commercial real estate transactions. Subsequently, for this sample the findings demonstrate that the mean return of the aggregate index is on average biased downwards by 9%; supporting the often held view that real estate is a high yielding asset.

The statistical results indicate that real estate returns are comparable to the CRSP and S&P returns at the 95% confidence interval for the sample period. However, the findings reject the hypothesis that real estate returns are comparable to small stock returns. Real estate, also, exhibits substantial smoothing at the aggregate level. On average, the “inferred” volatility of real estate returns is approximately 60% larger than volatility measures based on appraisal returns. This reaffirms the real estate practitioner shibboleth that conventional measures have largely underestimated real estate investor risk.

example Quan and Quigley (1989) and Giaccotto and Clapp (1992). For studies using actual transaction prices, Webb, Miles and Guilkey (1992) attempted to construct an index using only sold properties. The discrepancy between appraisals and prices has been investigated by Cole, Guilkey and Miles (1986) and Miles, Guilkey, Webb and Hunter (1991) for commercial properties, and Dotzour (1988) for houses. However, the influence of such errors on the return index has not been explored in these studies.

⁵Although there is some evidence that transaction prices may not be representative of unsold property values in residential housing markets (Quan, 1994), our analysis ignores this complication.

2. The Nature of the Problem

The appraisal based return of a real estate portfolio is constructed using the averages of appraisal based returns for each property in the portfolio. Since individual appraisals and their associated errors are averaged, one cannot a priori determine whether the resulting index will over-or under-estimate the true return index. Similarly it does not necessarily follow that variance measures of portfolio performance based on appraisals are necessarily biased even if individual appraisals exhibit such biases; that is, individual property appraisal biases may offset in the aggregate⁶. A simple numerical example demonstrates these relationships. Consider an appraisal based aggregate index and its standard deviation computed using 2 properties with appraisal “smoothing.”

In Tables 1 and 2, appraisals for the two properties over 3 periods are “smoothed” relative to the true unobservable values as indicated by the standard errors. This corresponds to the case when appraisers smooth property appraisals individually, and the degree of smoothing is independent over the two properties. In the construction of the aggregate rate of return index based only on the appraised values, the returns from each property are determined and averaged to form the aggregate index values for each time period. By construction, from this simple example, even though appraisals may be “smoothed” for each individual property, the resulting index will not exhibit “smoothed” behavior. In fact, in the example, by construction, the errors exactly offset such that the appraisal based index is identical to the “true” market value based return index. This hypothetical situation offers a clear counter-example to the seemingly widely accepted view that individual property appraisal smoothing will necessarily lead to smoothing in the aggregate property rate of return index.

Clearly, smoothing in the aggregate can occur if appraisal errors are identical for each property in the portfolio at each time. In this case, any given observed error can be viewed as an error from a representative property in an identical pool and if smoothing occurs for the representative property, then smoothing occurs for the pool. Alternatively, if all properties in a portfolio were appraised by the same appraiser, then systematic errors may exist. However, if systematic appraisal errors exist, this does not necessarily imply smoothing in the aggregate. Since errors are also a function of the true price movements, the true market value

⁶The notion of aggregate smoothing is distinct from the intertemporal smoothing concerns of Geltner (1993) who considers the possibility of smoothing as a consequence of averaging appraisals done over different periods. This analysis focuses on the aggregation of contemporaneous appraisals.

of properties in a portfolio may change in a manner such that the resulting errors are offset. In practice, the possibility of systematic errors is unlikely. The 1992 Frank Russell index of real estate returns is based upon the performance of 1892 commercial properties diversified by regional and land use and held by several independent institutional real estate investment funds. The appraised values are determined by independent appraisers chosen by each fund. It is implausible that systematic errors exist for all properties in the sample⁷.

In sum, without detailed information about how each appraiser forms his estimates *and* how such estimates differ between appraisers, the detection of smoothing of the rate of return or the standard deviation of returns at the aggregate level is largely an empirical issue.

3. The Data

The sample contains appraised value and sales data for nonresidential properties between 1975 and 1984, which are 100% equity owed. Each of these parcels is held in one of six large commingled Real Estate Funds for Pension Trusts.⁸ Within the sample, 71 properties were sold between 1981 and 1984.

A feature of the data is the similarity of the property composition to that of the FRC data base. Hence, one can use the data to estimate the distribution of the difference between appraised value and the actual sale price from the sample; and then use the estimates to make inferences about the FRC index. To verify this similarity, a sample of 102 properties with complete appraisal information are employed to construct an overall return index as well as sub-indexes corresponding to the income and capital components using the FRC index methodology. Consistent with the FRC's calculations, the income and capital return components are calculated as follows:⁹

$$IncomeReturn_t = \frac{Y_t}{A_{t-1} + .5(C_t - Y_t)} \text{ and } CapitalReturn_t = \frac{A_t - A_{t-1} - C_t}{A_{t-1} + .5(C_t - Y_t)}$$

A_t corresponds to the appraised value at time t , C_t is the capital expenditure for year t , and Y_t is the net operating income (cash flow) in year t . The total index

⁷A similar analysis can be applied to the standard deviation for returns generated from the appraisal values vis-a-vis the true market values.

⁸The database used for this study encompasses the one reported in Dokko, Edelstein, Pomer and Urdang (1991) and the interested reader is referred to that article for additional data information.

⁹The FRC return includes partial sales which are not available in this data sample. For this reason, this category is deleted in our index.

is the sum of both components. The results are provided in Table 3. From an examination of Table 3 and Figure 1 (containing plots of the two indexes), one can see that our index is highly correlated ($\rho = .98$) with the FRC index, and that the mean levels are similar. However, our index appears to exhibit more volatility than the FRC index, with much of this excess volatility arising from the capital component. In Figures 2 and 3, we display each index along with the corresponding income and capital components. The bulk of the variability originates from the capital component. Figure 4 contains the capital components for both indexes, which move together ($\rho = .97$) even though our overall index is more volatile¹⁰.

3.1. The Relationship Between the Index and Appraisals

For the overall return indexes (Figures 2 and 3 and Table 3), the bulk of the volatility originates from the capital component which is appraisal based. The low volatility of the income component is likely the effect of long term tenant lease contracts that restrict income variability.

Because of our data base and the index construction methodology, there is no way to isolate the total index (or the capital component) from a term reflecting the appraisal influence. For this reason, certain simplifying assumptions about how appraisals influence the aggregate index are necessary.

Because the bulk of the index volatility is engendered by the capital component, it is important to identify to what extent this component is influenced by the rate of change of appraisals. The percentage change in appraisals in our sample is calculated and is recorded in the last column of Table 3. Within our sample, the appraisals follow very closely to the capital component ($\rho = .99$). The mean real estate rate of return for appraisals (8.98) is higher than the mean rate of return (7.95) of our capital component. However, the volatilities are quite close, a standard deviation of 7.01 for the capital component of our sample versus 6.55 for the appraisals. Because of this similarity, one approach would be to substitute the appraisal return for the capital component in our sample to calibrate the error in our overall index. Furthermore, utilizing the assumption that the capital component of the FRC index is also similar to our appraisal index, one can then substitute our appraisal index for the FRC's capital component to calibrate its error.

¹⁰Since one of the tasks is calibrating appraisal errors, our index's high volatility may severely limit the applicability of our estimates in correcting for the effects of smoothing in the FRC index.

To further see the influence of the appraisal only index on the aggregate index, both our aggregate index and the FRC aggregate index are regressed on our appraisal only return index. The results are reported in Table 4. In both cases, the high R^2 s suggest that the variability of both the FRC real estate return index and our constructed return index are highly correlated with the rate of change of the appraisals (which in turn strongly correlate the capital component of the index¹¹). Thus, based on these results, the subsequent analysis is simplified by assuming that the aggregate return index = income return + appraisal return. By determining the bias in the appraisal return and assuming that the income component is relatively constant over our sample period, one can determine the error in the aggregate return index. The next section describes how the error in the appraisal return is determined, and computes its distribution.

4. A Characterization of Aggregate Error

Our position is that errors in the aggregate real estate rate of return index are determined by fundamental errors in appraisals. There have been several studies which have quantified appraisal errors (Dotzour 1988, Cole, Guilkey and Miles 1986 and Miles, Guilkey, Webb and Hunter, 1991). However, none of these studies attempts to relate appraisal or transaction value errors to return errors. In this study, the relationship between appraisal error and the aggregate rate of return error is derived. In order to obtain a tractable closed form expression for the bias, several key assumptions are required about the error distribution.

Let t denote the period for which the return is defined and i is the index for properties to time t . Appraisal error is defined multiplicatively.

$$P_{it} = A_{it}\epsilon_{it} \quad (4.1)$$

where P_{it} represents property i 's price at time t and A_{it} is its appraisal. Assume that the error term is independent and lognormally distributed:

$$\epsilon_{it} \sim LN(\mu, \sigma^2) \quad (4.2)$$

Both cross-sectional and time series independence are assumed for the appraisal errors. Thus for the purposes of estimating its distributional parameters, no

¹¹The coefficients of these regressions are biased estimates because appraisals are measured with error causing an errors in variable bias. The purpose of this exercise is to show that the bulk of the volatility of the index can be approximated by the volatility of the returns based on appraisals.

distinction is made between cross-sectional and time series data. The lack of data within our sample precludes the estimation of potentially interesting time varying moments¹². Also, assume that the appraisal estimate A_{it} is independent of its error ϵ_{it} . This condition is justifiable if the appraiser is viewed as an optimal processor of information, both private and public, in making his estimate (as described in the Quan and Quigley's (1991) appraiser model). Under such an interpretation, the appraiser forms an expectation of the random variable $\log(P)$ conditional on his information set. In these circumstances, an appraisal will be independent of his errors. Similarly, if the appraiser utilizes a regression estimated with all available information, the conditional expectation of the error term must be 0. The independence assumption may not hold if the appraisers in our sample err due to a common inappropriate appraisal methodology, a condition unlikely to hold in our sample since our data is geographically diverse.

Since the analysis is concerned with the time series moments of the periodic average returns, one needs to distinguish between expectations taken across properties and time. Consistent with the manner in which the aggregate index is constructed, and letting $E_t[\cdot]$ and $E_i[\cdot]$ denote the expectations taken over time and across properties within each time period respectively, the desired time series moments for our appraisal return index are:

$$E_t \left[E_i \left[\frac{P_{it}}{P_{it-1}} \right] \right] = E_t \left[E_i \left[\frac{A_{it}\epsilon_{it}}{A_{it-1}\epsilon_{it-1}} \right] \right] \quad (4.3)$$

Based on our independence assumption, equation 4.3 can be rewritten as equation 4.4:

$$E_t \left[\frac{P_t}{P_{t-1}} \right] = E_t \left[\frac{A_t\epsilon_t}{A_{t-1}\epsilon_{t-1}} \right] \equiv E_t[R_P] = E_t[R_A\epsilon] \quad (4.4)$$

where P_t is the expected value of P_{it} taken over i for period t , and A_t and ϵ_t are similarly defined. For ease of exposition, delete the time subscript from the expectation and assume that R_A is independent of ϵ to obtain the following result:

$$E[R_P] = E[R_A] E[\epsilon] \quad (4.5)$$

By Jensen's inequality, $E[\epsilon] > 1$ thus $E[R_P] > E[R_A]$. This source of bias is strictly due to the manner in which returns are calculated, and suggests that the

¹²This may be particularly relevant in light of our sample which spans from 1979 to 1984, a period when property values appear to be increasing, but not uniformly over time.

mean returns from an appraisal determined rate of return index will overestimate the return for a series based on transaction prices.¹³

In order to calculate the time series variance bias of an appraisal based return index, assume the independence between R_A and ϵ to obtain the following expression for σ_P^2 , the time series variance of R_P :

$$\sigma_P^2 = E[R_A^2] E[\epsilon^2] - E[R_A]^2 E[\epsilon]^2 \quad (4.6)$$

Noting that $E[R_A^2] = \sigma_A^2 + \mu_A^2$ and $E[\epsilon^2] = \sigma_\epsilon^2 + \mu_\epsilon^2$ where σ_A^2 and μ_A^2 are the variance and the mean of A_t , respectively, and σ_ϵ^2 and μ_ϵ^2 are similarly defined for the error terms, (4.6) simplifies to (4.7):

$$\sigma_P^2 = \sigma_A^2 (\sigma_\epsilon^2 + \mu_\epsilon^2) + \mu_A^2 \sigma_\epsilon^2 \quad (4.7)$$

In order to compute (4.7), one needs to derive the distribution for ϵ . Our assumption of lognormality and intertemporal independence allows the computation of the moments of the aggregate return errors. If ϵ_{it} is lognormally distributed with mean μ and variance σ^2 , then $\bar{\epsilon}_{it} \equiv \log \epsilon_{it} \sim N(\bar{\mu}, \bar{\sigma}^2)$ such that

$$\mu = e^{(\bar{\mu} + \frac{1}{2}\bar{\sigma}^2)} \text{ and } \sigma^2 = e^{(2\bar{\mu} + \bar{\sigma}^2)} (e^{\bar{\sigma}^2} - 1) \quad (4.8)$$

Using the above results, it can be shown that the ratio of i.i.d. lognormal random variables will also be lognormally distributed with the following moments:

$$\epsilon \equiv \frac{\epsilon_{it}}{\epsilon_{it-1}} \sim LN[e^{\bar{\sigma}^2}, e^{2\bar{\sigma}^2} (e^{\bar{\sigma}^2} - 1)] \quad (4.9)$$

Jensen's inequality will produce $E[\epsilon] = e^{\bar{\sigma}^2} > 1$ since $\bar{\sigma}^2 > 0$ and therefore implying that expected returns based on appraisals will always overestimate the transaction based expected return.

5. Empirical Results

Since the ϵ_{it} 's are assumed to be lognormally distributed, its distribution parameters can be estimated by calculating the errors for each observation, taking its natural log and calculating its sample mean. The first two moments of the return

¹³Similar biases have been reported in studies which measure stock returns when they are constructed using the last daily traded prices (Blume and Stambaugh, 1983). Since the traded price can reflect either the bid or the ask price, the resulting return index will similarly overstate the true returns.

error are recovered from the appraisal return index via (4.8). Using our sample of 71 properties which have both appraisals and transaction prices, the mean and standard deviation of the natural log errors are $-.0329$ and $.3897$, respectively.

5.1. Mean Returns

With the fitted error distribution and the simplifying assumption that the appraisal return is identical to the capital component, one can construct confidence intervals for the mean return for both the FRC as well as our index. Since $R_P = R_A \epsilon$ and by assumption $E[R_P] = E[R_A] E[\epsilon]$, one derives the return error by evaluating $E[\epsilon]$ and determines its confidence interval. Using the previously calculated standard deviation of log errors yields $E[\epsilon] = e^{.3897^2} = 1.164$. To derive the confidence interval, use the well known result that $\frac{\sqrt{N}(\bar{\epsilon} - \mu)}{S} \sim t\text{-distribution}$ with $N - 1$ degrees of freedom where S is the sample standard deviation and $\bar{\epsilon}$ and μ are the sample and population means, respectively.

Based on these assumptions, $E[Total\ Index] = E[income] + E[R_A \epsilon]$. Also, by assumption, one can either use the mean return in our capital component or the mean return from the appraisal only index for determining $E[R_A]$. This expression is evaluated at the mean, $R_A = 7.95\%$ for the capital component and income = 7.85% . The corresponding error adjusted mean return for our overall index is 17.10% as opposed to the unadjusted index value of 15.83% . The 95% confidence interval bounds are 15.78% and 18.42% . If $R_A = 8.98$, the mean of the appraisal only return, the corrected mean total index return is 18.3 and its 95% confidence interval is bounded by 16.82 and 19.78 . By using the same methodology to infer a confidence interval on the FRC index, the error corrected return is 15.88 as opposed to the reported 15.21 value; and its 95% confidence interval is between 14.77 and 16.99 . These results imply that the adjusted returns as well as their confidence interval bounds are still relatively large.

5.2. Measuring Variability

As in the last section, several simplifying assumptions are required to approximate the variability of our aggregate rate of return index as well as the FRC index. Since the overall index is the sum of the income and the capital components, a simplifying and reasonable approximation for the variability of the aggregate index is that the standard deviation is also additive:

$$std.dev.[Total\ Index] = std.dev.[Income] + std.dev.[Capital]$$

Using standard deviation values from Table 3 for our index, the sum of the income and capital component standard deviations is 7.7 as opposed to the standard deviation for the total index which is 7.49; using the FRC index values, the sum is 4.04 as opposed to the actual value of 4.12. Both of these results suggest that the approximation is reasonable and provides an adequate representation of this relationship.

By examining our index, the relationship between lognormal random variables indicates that $\sigma_\epsilon^2 = e^{2(.3897)^2} (e^{2(.3897)^2} - 1) = .4809$, $\mu_\epsilon^2 = (e^{(.3897)^2})^2 = 1.355$ and $\mu_A^2 = (.0898)^2 = .0081$ if one uses the mean return from the appraisal only index. Using these values and noting that σ_A^2 , the variance of the appraisal based only index, is $(.0655)^2 = .0043$, using (4.7) we can determine that $\sigma_P = .1086$. Adding this value to the standard deviation for the income component yields an adjusted standard deviation of 11.55 as opposed to the reported 7.49. If we were to use the mean and the standard deviation of the capital component as opposed to the appraisal only series, we would obtain the similar result of 11.64. Using the same methodology for the FRC index, the appraisal adjusted standard deviation is 7.22 as opposed to the 4.12 reported value based on appraisals. These results suggest that the true variability may be much larger than the variability measures based on indexes constructed from appraisals.

5.3. Comparison with Stocks

The results of the previous calibration for the FRC and our indexes reported in Table 5. From inspection, the corrected mean returns from our real estate index is comparable with the mean returns for the CRSP and the Ibbotson S&P stocks over the same period. As expected the mean small stock return was significantly larger than all reported stock returns. Furthermore, given the 95% confidence bounds for both our sample as well as for the FRC index encompass both mean stock returns. Using a one tailed t-test, at the 95% confidence level, the true mean return using the capital, the appraisal and the FRC component is greater than 16.01, 17.07, and 14.96, respectively. Similarly, the true mean return is less than 18.19, 19.53, and 16.81, respectively, at the 95% confidence level. These results imply that, adjusting for the appraisal effect, commercial real estate returns are comparable to those of stocks. With the one-sided test, one cannot reject the null hypothesis that appraisal based real estate rates of return are not distinguishable statistically from the CRSP and S&P returns. However, one can reject the null hypothesis that real estate returns are comparable to those of small stocks.

The corrected volatilities of our index as well as the FRC index are much

larger than those calculated values based on appraisals. The corrected standard deviations for our index using our sample are on average 61% larger than those commonly calculated using appraisals. Despite the underestimation of the variability, the corrected standard deviations for the various real estate indexes are smaller (but similar) for those calculated for the CRSP and S&P stock return indexes. However, real estate return variability appears to be much smaller than the variability of small stock returns. These results taken together imply that real estate performance is very similar to the risk-return characteristics of stocks over our sample period.

6. Conclusion

This paper examines how appraisal smoothing affects the accuracy of real estate performance indexes. Prior studies allege that “smooth” individual parcel appraisals engender “smoothed” aggregate indexes. This conclusion does not necessarily follow since individual errors may offset in the aggregation process; and the impact of appraisal smoothing is ultimately an empirical issue.

Combining a sample of sales transactions and appraisals, the statistical reliability of the aggregate real estate return index is determined. Two key assumptions are required to conduct the analysis. First, appraisal errors over our sample period are random draws from a common distribution. Second, the capital component of the aggregate index can be adequately proxied by appraisals.

Our analysis, while subject to certain limitations¹⁴, provides new insights about measuring real estate performance using appraisal indexes. Three principal results emerge from the study:

1. The appraisal based rate of return index is biased downwards, understating for our sample period the mean return for real estate by approximately 9%.
2. The rate of return for real estate is comparable to those achieved by CRSP and S&P indexes, but less than those for small stocks.
3. The variance of appraisal based return indexes is substantially understated; the variances are undervalued by 55% for our sample overall real estate return index and 75% for the FRC overall return index.

¹⁴These results should be interpreted with caution. The findings for our sample period, 1979-1984, may not generalize to other time periods, and sample data limitations preclude testing for time varying moments in the error distribution. In addition, the sample database may not be indicative of other commercial real estate samples (e.g., the FRC sample) or the universe of commercial real estate.

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Table 1

	Prices			
	<i>t=1</i>	<i>t=2</i>	<i>t=3</i>	σ
Property 1				
True Market Value	106	150	160	23.5
Appraised Value	110	115	120	4.1
Property 2				
True Market Value	160	50	60	49.7
Appraised Value	96	65	80	12.7

Table 2

	Property Return		
	<i>t=1 to 2</i>	<i>t=1 to 3</i>	σ
Property 1			
True Return	1.42	1.07	.18
Appraisal Return	1.05	1.04	.01
Property 2			
True Return	.31	1.20	.45
Appraisal Return	.68	1.23	.28
	Aggregate Index Return		
	<i>t=1 to 2</i>	<i>t=1 to 3</i>	σ
True Return	.87	1.14	.14
Appraisal Return	.87	1.14	.14

Table 3
Comparison of FRC and Our Sample's Property Index

Year	FRC Index	Our Index	FRC Income	Our Income	FRC Capital	Our Capital	$\frac{A_t - A_{t-1}}{A_{t-1}}$
1979	20.8	26.8	9.0	8.7	11.1	18.0	18.0
1980	18.1	22.3	8.3	8.4	9.1	13.9	14.6
1981	16.8	15.9	8.1	7.8	8.3	8.1	8.9
1982	9.4	6.8	7.8	8.0	1.4	-1.3	-0.4
1983	13.2	12.2	7.8	7.4	5.1	4.8	6.4
1984	13.0	11.0	7.3	6.8	5.4	4.2	6.4
Mean	15.21	15.83	8.05	7.85	6.73	7.95	8.98
σ	4.12	7.49	0.58	0.69	3.46	7.01	6.55

Table 4
Regression of Index on Our Sample's Appraisal Return
(standard errors in parenthesis)

Dependent Variable	Constant	Our Sample's Appraisal Return	R ²
Our Aggregate Return Index	5.69	1.128 (.092)	.974
FRC Aggregate Return Index	9.69	0.616 (.064)	.957

Table 5
Return and Variability Comparisons

	Mean Return	Corrected Mean Return	Lower Bound	Upper Bound	Standard Deviation	Corrected Standard Deviation
Our Sample (capital component)	15.83	17.10	15.78	18.42	7.49	11.64
Our Sample (appraisal index)	15.83	18.30	16.82	19.78	7.49	11.55
FRC Index	15.21	15.88	14.77	16.99	4.12	7.22
CRSP Return¹	16.65				13.34	
S&P Return²	16.02				13.26	
Small Stock Return²	26.37				19.50	

1 The CRSP returns are the annual returns with dividend on a value-weighted market portfolio.

2 These returns are similarly calculated from Ibbotson and Associates.

Figure 1

Real Estate Overall Rate of Return:
FRC Index versus Our Index

Figure 2

FRC Real Estate Rate of Return Index
and its Capital and Income Components

Figure 3

Our Real Estate Rate of Return Index
and its Capital and Income Components

Figure 4

Capital Components of
Real Estate Rates of Return Index