A Structured Model Approach to Estimating Return and Volatility for Commercial Real Estate

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Section 1. Introduction

An understanding of the performance characteristics associated with commercial real estate is important for a number of reasons. Arguably, one of the more important reasons is that commercial real estate is typically construed as an asset class to be included for consideration in a mixed-asset context. As a result, institutional investors are concerned with the expected performance of this asset class in order to implement strategies to create efficiently diversified investment portfolios. Performance characteristics are also important to real estate portfolio managers who seek to acquire, manage and dispose of assets in such a way as to meet the investment objectives of the overall portfolio. Moreover, during the past decade, a great deal of interest has also been generated in an attempt to more fully understand the performance of this asset class for purposes of benchmarking and manager performance. A better understanding of the risk and return characteristics of commercial real estate can help us more fully understand the ex ante performance characteristics of this asset.

There exist a number of studies which examine the performance of real estate using the National Council of Real Estate Investment Fiduciaries (NCREIF) data (see for example Fisher et al. [1994], [2000], Geltner [1993], Geltner et al. [1994], Geltner and Ling [2001], Geltner [2002], Ciochetti and Fisher [2002], Fisher et al. 2002]), or other forms of real estate data (Ball et al [1998], Bruggeman et al. [1984], Farragher et al. [1996], Miles and McCue [1982], Miles et. al. [1994], Sirmans and Sirmans [1997]).

A common concern of studies using NCRIEF data is the well-documented appraisal smoothing issue, resulting in several potential problems. First, property values are updated asynchronously, thus potentially understating the true standard deviation of returns. Second, the use of appraisals may create biased estimates of property value because of behavioral effects (Barberis and Thaler [2001]), and the appraisal process itself may create additional noise in the return series.

A common approach to dealing with the bias introduced by the appraisal process is to use an ‘unsmoothing’ technique (see for example Fisher, Geltner and Webb [1994] and Geltner

[1998]). An alternative technique in estimating the volatility of real estate returns is to use heuristic techniques to manipulate the observed volatility from the appraisal based NCREIF data, resulting in standard deviations for commercial real estate that are somewhere between stocks and bonds.

Transactions indices have also been used as a way of estimating the volatility of commercial real estate. See for example Fisher, Geltner and Webb [1994], Geltner and Fisher [2000] and Fisher, Geltner, Gatzlaff and Haurin [2003]. This approach is promising but suffers from limited number of transactions that makes it difficult to construct transactions indices disaggregated by property type or geographic area.

Publicly traded real estate securities have provided an alternative source of data with which to examine the return characteristics of commercial real estate (see for example Chan et al. [1990], Gyourko and Keim [1991], Liu and Mei [1992],). While these data provide another view of the performance characteristics of commercial real estate, concerns exist about the use of public real estate data as a proxy for direct real estate investment. Moreover, publicly traded real estate securities are shown to behave more like equities than private real estate, and therefore may not capture the true underlying performance of the asset class (Lizieri and Ward [2000]).

The main objective this study is to estimate the risk and return characteristics of privately held commercial real estate over the period 1978 through 2002. By imposing a structured model on the return generating characteristics of commercial real estate, and by using property level cash flow information, we are able to simultaneously estimate the risk and return for selected groupings of real estate from disaggregate holding period data as provided by the National Council of Real Estate Investment Fiduciaries (NCREIF). This avoids the use of appraised values and provides an alternative to other techniques such as appraisal unsmoothing models that have generally been used in prior research.

Our results indicate that for a sample of 4,093 sold properties, ex ante returns on institutional grade real estate have averaged 8.05 percent annually over the period 1978 to 2002. We also

find the standard deviation of expected return to average 5.89 percent. When stratified by property type and geographic division (NCREIF division), significant variation of expected return is also observed. More specifically, expected returns on apartment properties are found to be the highest of all property types under examination over the study period, at 11.47 percent. Expected apartment returns are followed by industrial, retail, and office properties, at 9.40, 9.11, and 6.14 percent, respectively. Standard deviation of returns, as stratified by property type, is found to average between 7 and 13 percent.

Properties located in the Northeast division of the country are found to have significantly greater average expected returns than other divisions of the country at 13.74 percent. Properties located in the East North Central, Southeast, Pacific, and Mideast divisions exhibit similar expected returns, at 9.82, 9.34, 9.16, and 9.00 percent, respectively. Properties located in the Southwest and West North Central divisions show the lowest expected returns, at 6.45 and 6.19 percent. Volatility of returns across division are found to be slightly higher than those reported by property type, ranging from 11 to 23 percent.

We also calculate realized returns for this sample by aggregating cash flows across selected categories, thereby creating pooled, holding period returns (IRRs). In all cases, we find expected returns to be greater than, or equal to, realized returns. The close similarity between expected and realized returns suggests that our structured model provides a reasonable approximation of not only expected returns, but also the standard deviation of expected returns.

We also employ a much larger data set of 10,680 properties from the NCRIEF index that includes properties that have not yet been sold or were transferred from the database for other reasons than a sale, e.g., transfer of ownership to a new manager. Since not all of these data have transaction prices, we use the last appraisal as a proxy for property value in order to estimate the IRR and standard deviation using the structured model. Results using this much larger data set indicate that commercial real estate exhibits an expected return of 7.53 percent, slightly lower than that found with the smaller sample, a result attributable to not only the larger sample size, but also to the efficiency in convergence of the structured model. Using this expanded data set, we find the standard deviation of expected return to average 5.58

percent, slightly lower than the smaller sample and consistent with the lower expected return for the smaller sample. This suggests more diversification in the larger sample. While expected returns as stratified by property type and division are similar to those found in the smaller sample, we do observe a slight reduction in the standard deviation of expected returns through the use of this larger data set.

Our results suggest that the use of a structured model to generate the performance and volatility of commercial real estate may be a viable alternative to techniques currently in use in the academic literature. The remainder of the paper is organized as follows. In Section 2 we describe the methodology used to estimate expected returns. The data employed in the study are presented in Section 3. Results for two different data sets as stratified by selected categories are presented in Section 4. A comparison of expected returns to realized returns is also provided in this section. In Section 5 we discuss implications of the study and conclude the paper.

Section 2. Methodology

The value of commercial real estate is derived from its ability to generate cash flows. These cash flows, along with acquisition and sale price allow for the estimation of an overall holding period return (IRR). Yet, since real estate transaction data are only observed at time of acquisition and sale, the holding period return (IRR) cannot be used to proxy for a time series of returns for each property. However, the quarterly cash flow information that is generated by a particular property can be a valuable source of information for the investigation of the periodic property value process. To facilitate such an investigation, a link between the property's value and the cash flow that is generated by the property must be established. This link can be established by imposing a structured model that uses joint cash flow and transaction value observations to estimate the expected risk and return of selected property categories.

Assume the continuously compounded expected return per period, μ, is constant for a particular type and geographic location of property. In addition, assume the cash flow per period follows a geometric normal process, i.e.

$$d(t+1) = d(t)e^{g+\sigma\varepsilon-0.5\sigma^2}. \qquad (1)$$

where g and σ are the growth rate and the standard deviation of cash flows, and ε is a standard normal variable.

The value of the property, $V(t)$ is equal to the discounted expected future cash flows, $d(t)$, i.e.

$$\begin{aligned} V(t) &= E_t\left[\sum_{n=1}^{\infty} e^{-n\mu} d(t+n)\right] \\ &= \sum_{n=1}^{\infty} e^{-n\mu} E_t[d(t+n)] \quad . \\ &= d(t)\sum_{n=1}^{\infty} e^{-n(\mu-g)} \end{aligned}$$

And by algebraic rearrangement property value is represented by:

$$V(t) = \frac{d(t)e^{g}}{1-e^{-(\mu-g)}} = \frac{d(t)}{e^{-g}-e^{-\mu}}. \qquad (2)$$

The valuation equation in (2) resembles a traditional dividend discount model with constant dividend growth rate. The interesting aspect of this equation is that it establishes a direct link between the cash flow and the property value, which allows for an investigation of the property dynamics based on the cash flow dynamics. In particular, the realized cash flow and transaction price information allows us to estimate the expected return and the standard deviation of the expected returns. This is because that the structured valuation model (2) shows that the property value follows the same log-normal distribution as the cash flow with the same standard deviation, σ, and can easily be represented as follows:

$$\text{var}[r] = \text{var}\left[\frac{dV}{V}\right] = \text{var}[d\ln V] = \text{var}[d\ln d] = \sigma,$$

where r is the instantaneous return of the property.

For a particular property, the beginning value, ending value and all interim cash flows are observable. Based on the above model, we have equivalent observations of

$$d(0), d(1), \cdots, d(N)$$

where

$$\begin{aligned} d(0) &= V(0)[e^{-g} - e^{-\mu}] \\ d(N) &= V(N)[e^{-g} - e^{-\mu}] \end{aligned}.$$

Recall that equation (1) shows that given current cash flow $d(t)$, and the cash flow growth rate, the expected (log) cash flow for next period is $\ln d(t) + (g - 0.5\sigma^2)$, and the realized cash flow will have an error from the expected value, i.e.

$$\varepsilon_t = \frac{1}{\sigma}\left[\ln d(t+1) - \ln d(t) - (g - 0.5\sigma^2)\right]. \qquad (3)$$

Since the error term follows a standard normal distribution, it follows that for a given property with N quarters of observations, the loglikelihood function is given by

$$\ln f(\mu, g, \sigma) = -N\ln(2\pi\sigma) - \ln\sum_{t=1}^{N}\frac{1}{2}\left(\frac{\ln d(t+1) - \ln d(t) - (g - 0.5\sigma^2)}{\sigma}\right)^2 . \qquad (4)$$

Since the initial and ending cash flow depends on the value through μ, all parameters of interest μ, g, and σ can be estimated through the minimization of the log likelihood function $\ln f(\mu, g, \sigma)$ for each individual property.

There are two problems with this estimation methodology. First, the methodology is subject to problems associated with the noisy data associated with individual properties, especially when the periodic cash flow is close to zero or drops to a negative level. Second, it does not accommodate the cash flows resulting from additional capital expenditures and occasional partial sales, both of which are discretionary and do not conform to the cash flow dynamics assumed in equation (1).

To address the first problem, we aggregate the sample data according to the desired level of analysis such as property type or division of location. While this aggregation minimizes the first problem, it exacerbates the second problem because of the non-synchronous nature of transactions of the underlying properties. To address this second issue, we provide a modification to the model. For any property or portfolio of properties, there are cash flows generated by the property itself as well as those generated through the discretionary process of purchase, capital expenditures, and partial sales. Cash flows generated by the property are labeled $d(t)$, while purchases, capital expenditures, sales, and partial sales are labeled $c(t)$. Thus, for a property (or portfolio of properties), we observe

$$d(0), d(1), \cdots, d(N)$$
$$c(0), c(1), \cdots, c(N)$$

Keep in mind that we use a positive sign for cash flows out of the property and a negative sign for cash flows into the property, so that new purchases and capital expenditures have negative signs, and property sales and partial sales possess positive signs. Thus, at time t, the property has cash flow $d(t)$. With no additional capital spending, equation (3) holds. However, with additional capital adjustments $c(t)$, the property value has been adjusted and $d(t+1)$ is a cash flow generated by this *adjusted* property. In order to obtain the proper error term representation, we need to make the following change,

$$\varepsilon_t = \frac{1}{\sigma}\left[\ln d(t+1) - \ln d'(t) - (g - 0.5\sigma^2)\right], \qquad (5)$$

where $d'(t)$ is the adjusted cash flow at time *t* with

$$d'(t) - c(t)\left[e^{-g} - e^{-\mu}\right].$$

Equation (5) can be interpreted in the following manner. Given cash flow *d*(*t*), the value of the property is given by (2). However, if additional capital adjustment, *c*(*t*), is made to the property, the value of the property becomes *V*(*t*) – *c*(*t*). The minus sign accounts for the nature of the outflow associated with the capital expenditure. The new property value is therefore equivalent to an adjusted cash flow

$$\begin{aligned} d'(t) &= (V(t) - c(t))\left[e^{-g} - e^{-\mu}\right] \\ &= d(t) - c(t)\left[e^{-g} - e^{-\mu}\right] \end{aligned}$$

The equation for the adjusted error terms is used in the log likelihood function formation (4) and minimization of this log likelihood function yields our estimated results.

Interpretation of the model may be summarized as follows: We first assume that property operating cash flows follow a geometric normal process. This implies that property values follow a log normal distribution. Property value at any point in time is simply represented by the present value of the remaining expected cash flows based on equation (2). This valuation process is essentially a dividend discount model with a constant dividend growth rate. The error term is the difference between the actual cash flow and the expected cash flow. The model then allows us to estimate the expected return, expected cash flow growth rate, and the standard deviation of the expected return by minimizing the error between the actual observed cash flow and the expected cash flow.

Section 3. Data

The data employed in the study come from the National Council of Real Estate Investment Fiduciaries (NCREIF). NCREIF was founded in 1977 for the purposes of collecting and maintaining data on the performance of commercial real estate as owned by or managed on behalf of institutional investors. Approximately 11,000 properties have either been added to, or sold from the NCREIF index over the period 1978 through 2002. For purposes of this study, we are initially concerned with only those properties for which we have complete ownership information, including acquisition price, sale price, all operating cash flows associated with ownership, property type, division of property location, and fund type. All properties employed in the sample are unlevered, i.e., they have no debt. Given these criteria, we are able to collect complete information on 4,093 properties. In Table 1 we provide a summary of this initial sample.

Panel A of Table 1 provides a distribution of the sample by property type. Note that the sample is dominated by industrial properties at 1,517, slightly over 37 percent of the sample. Office properties constitute nearly 28 percent of the sample, at 1,138, followed by retail at 19 percent (788 properties), and apartments at 16 percent (650 properties). The sample compares favorably with the overall distribution of the NCRIEF data base where industrial properties represent approximately 36 percent of the sample, office 28 percent, retail 18 percent, and apartments 17 percent of the total. This sold sample has a value of over $65 billion based on the initial acquisition cost of the properties.

In panel B of Table 1 we provide the distribution of the sample as stratified by division of property location. The sample is well represented by divisional location, with properties in the Pacific division dominating the sample with 988 properties (24 percent). Those located in the Southeast, East North Central and Southwest have similar representation, at 568 (14 percent), 549 (13 percent), and 548 properties (13 percent), respectively. Properties located in the West North Central division have the lowest representation in the sample with 243, or 6 percent or the sample. As with property type, divisional variation matches well with the overall NCREIF

sample, where 25 percent of properties are located in the Pacific division, 14 percent in the Southeast, and 13 percent in the East North Central divisions.

Panel C of Table 1 provides a description of the sample as categorized by fund type. There are 881 properties that have been sold that were in open-end funds and 3,212 properties in other funds. These include 438 properties in closed-end funds, 698 properties in separate accounts, and 2,076 properties that do not fall into these categories.

In panel D of Table 1 we provide a breakdown of the sample as stratified by both property type and division of location. As discussed above, industrial properties dominate the sample, followed by office and then retail. By location, apartments are most prevalent in the Southeast division of the country, with approximately 23 percent of all apartments being located in this division. Apartments have a similar distribution in the Mideast, Southwest, Mountain and Pacific divisions of the country, at approximately 15 percent, while the Northeast and West North Central divisions have significantly lower numbers of apartments. Industrial properties dominate in the Pacific division of the country, with 30 percent of industrial properties located in this division. The Southwest and East North Central divisions have similar concentrations of industrial properties, both with concentrations in the low teens. Office properties are most heavily concentrated in the Pacific division, with 21.2 percent of the category. The Mideast division are is also found to have a relatively high concentration of office properties. As with office and industrial product, retail is most heavily concentrated in the Pacific division, with over 22 percent of this product type being located in this division.

The distribution of the sample as stratified by property type and division compares favorably with the overall NCREIF sample. There, apartments are found to be more highly distributed in the Southeast division of the country, with 24 percent of all apartments being located in this division. The Pacific, Mountain, Southwest and Mideast divisions of the country have similar concentrations of apartments, with 15 percent, 13 percent, 15 percent and 13 percent, respectively. Industrial properties appear to be concentrated in the Pacific division, with 34 percent of all industrial properties being located in this division. The East North Central, Southeast, and Southwest divisions have similar distributions, at 16 percent, 10 percent, and 13

percent, respectively. Office properties also appear to be most concentrated in the Pacific division, with 22 percent of all office properties located in this division.

Section 4. Results

4.1 Aggregate Results

In Table 2 we provide the aggregate results of our analysis, initially using the sample of 4,093 properties. Recall that to estimate results for any category, all sample data cash flows are combined, effectively creating a 'portfolio' of institutional grade commercial real estate for the category under examination. This portfolio of real estate is adjusted for partial sales and capital expenditures pursuant to equation (5). As shown, the expected return for the overall sample over the period 1978 through 2002 is 8.05 percent, with an expected cash flow growth rate of -0.97 percent, and a standard deviation of expected return of 5.89 percent. The overall expected return of 8.05 percent is generally consistent with the returns on commercial real estate as reported in earlier studies, but lower than survey results as conducted from institutional investors.[1] The standard deviation of 5.89 percent is greater than the standard deviation of commercial grade real estate when using appraisal based returns of 3.41 percent for the same time period covered in this study.[2] The standard deviation of 5.89% is less than the 8.33% standard deviation found by Fisher, Gatzlaff, Geltner and Webb (FGGH) [2002] using a transaction-based index based on sold properties in the NCREIF database.[3] The FGGH

[1] For example see the Korpacz report published quarterly by Price Waterhouse Coopers. In this survey, institutional investors are asked about expectations for real estate returns on a prospective basis. Expected returns for commercial real estate in this survey are generally in the 10% to 12% range.

[2] Based on calculating the standard deviation using quarterly data and multiplying by 2 to annualize as was done for all standard deviations in this paper. This may understate the annual standard deviation for NCREIF due to the autocorrelation of appraisal-based returns. Converting the quarterly returns to annual returns first and then calculating the standard deviation results in a standard deviation of about 5.5%.

[3] The FGGH results cited above are for the "variable liquidity index" which provides a standard deviation that is most comparable to that estimated in this study.

index was constructed annually (not quarterly) which could account for some of the difference.[4]

These findings suggest that the implementation of a structured model, which estimates expected real estate returns and volatility of returns may indeed be a useful tool for those interested in estimating the ex ante performance of commercial real estate. One interesting result of our analysis is the finding that the expected cash flow growth rate is slightly negative, at -0.97 percent. Since expected cash flows are mapped directly to values through equation (2), this suggests that capital values declined slightly over the study period, and that expected returns consisted primarily of the cash flow component associated with the operations of the underlying properties. This result appears reasonable, given the severe nature of the real estate cycle over the past decade.[5]

4.1.1 Stratified by Property Type

We next examine results as stratified by property type, with results presented in Table 3. Apartment properties exhibit the greatest expected return at 11.47 percent, nearly 200 basis points greater than the expected returns for industrial and retail properties, and nearly 550 basis points greater than office properties. This in part may be attributed to the relatively long term nature of office leases as compared to those in the multi family sector, as well as the severe over supply of office product that was experienced in the mid to late 1980s. This oversupply led to significant pricing adjustments for this property sector in the early to mid 1990s. Industrial and retail properties are shown to have similar expected returns of 9.40 percent, and 9.11 percent, respectively, while office properties had an expected return of 6.14 percent.

When examined by standard deviation of expected returns, industrial properties are shown to have the lowest implied standard deviation at 7.13 percent. As a result, the industrial sector

[4] As noted in footnote 2, the standard deviation based on annual cash flows from the NCREIF data tends to be higher than the standard deviation based on quarterly data and then annualized. An extension of this paper would be to estimate the model using annual cash flows rather than quarterly cash flows.

[5] In fact over this time period, the geometric mean of capital value returns for the overall NCRIEF index was only slightly positive, at 0.307 percent, and providing supporting evidence of the nature of returns on commercial real estate.

appears to have offered the best risk adjusted returns on a relative basis. The long-term nature of industrial leases, and thus the lower variability of actual cash flows, may help explain the superior risk adjusted performance of this property type. The office sector exhibits not only the greatest volatility of expected return, but also the lowest expected cash flow growth rate, at 13.62 and -3.55 percent, respectively. While apartments offer a relatively high expected return, they also exhibit a high standard deviation of return, at 13.31 percent, as well as a high cash flow growth rate of 2.98 percent.

4.1.2 Stratified by Divisional Location

Significant variation in expected performance is also observed by division of property location. As presented in Table 4, expected returns for properties located in the Northeast division of the country are more than twice as high as those in the West North Central division of the country, at 13.74 percent as opposed to 6.45 percent. We also note that volatility of expected return is greatest in the Northeast, at 23.22 percent, as is the expected cash flow growth rate, at 3.32 percent. The high returns and standard deviation of returns as exhibited in the Northeast may be associated with the relatively poor performance of office properties, a sector which experienced a rapid decline in both values and rents in the early 1990s. Offsetting the performance of office product in this division was the comparatively good performance of other product types in this division. With the exception of the Southwest division of the country, expected returns in most other divisions were similar, with the East North Central, Southeast, Pacific and Mideast divisions revealing expected returns of 9.82, 9.34, 9.16, and 9.00 percent, respectively. Volatility of expected returns is also quite similar for these divisions of the country, ranging from 15 to 19 percent. We should note that as stratification category sizes become smaller, fewer observations are available from which to minimize the log likelihood function of equation (4), in turn lowering the precision of the performance estimates. This will have a tendency to increase the estimates of volatility.

Standard deviations are generally higher when stratifying either by property type or by division as compared with the national sample. This is consistent with the reduction in unsystematic risk when property types and divisions are combined in a portfolio.

4.1.3 Stratified by Fund Type

We next stratify the sample by fund type. Results are presented in Table 5, Panels A and B. Note that a number of properties are classified as "other" that could not be identifies as either closed-end or separate account.[6] Expected returns as stratified by fund type are found to similar, with the exception of separate accounts that had a significantly higher expected return and a significantly higher standard deviation. Perhaps this is due to the fact that separate accounts make more "opportunistic" investments (higher risk-return strategy) than the others, especially open-end funds that tend to focus on "core" investments. We hesitate to generalize from this result due to the missing historical fund classifications for the non-open end funds. Note that the standard deviation drops significantly when the non-open end fund types (closed end funds and separate accounts) are combined with the others that are classified as "other" but include all non-open end funds that could not be specifically categorized. This suggests that there may be diversification benefits associated with diversifying across the non-open end funds.

4.1.4 Stratified by Division and Property Type

In an attempt to further refine the categories under examination, we next stratify the sample by both division and property type. Results are presented in Table 6. Note that for apartments, we have four divisions for which incomplete data series precludes interpretation of results (ENC, ME, NE, MTN). Apartment properties have a smaller sample size in the NCREIF database and there are only 650 sold apartment properties included in the sample. In general our examination of apartment properties as stratified by division, tend to exhibit higher levels of expected return as well as higher levels of volatility. Again, the size of these categories suggests that we view the results with some level of caution. For example, only 19 apartment properties are located in the West North Central Division. For industrial properties, results are

[6] NCREIF did not collect data on fund type until recently. It was possible to identify what properties that were in the database from inception were in open end funds, but it was not possible to determine the exact fund type for all of the other properties (due to sales, change of manager, etc.) so we can only determine if the fund was in an open end fund or not over the history of the index.

more encouraging, both due to a much greater sample size (1,517 industrial properties), but also a longer sample period, both of which allow for more efficient convergence of the model. Note the general similarity in expected returns across divisions for industrial properties, ranging from a low of 8.79 percent in the Southwest division to 12.22 percent in the Northeast division. Volatility of expected returns ranges from 13 percent to slightly greater than 24 percent.

Two divisions in the office category suffer from a lack of convergence of the model; the East North Central and Mountain divisions. For the remaining divisions, we observe a range of expected returns from slightly greater than 6 percent in the West North Central division, to slightly over 9 percent in the Southeast division. Note the increased levels of implied volatility as we stratify into categories with smaller counts. We note a similar pattern for retail properties; higher expected returns, ranging from 13 to 20 percent, and much greater levels of implied volatility, ranging from 17 to over 50 percent.

4.2 Comparison to Realized Returns

In order to provide a frame of reference for the results as generated by the structured model, we next compare our results to the realized holding period returns for all properties included in the sample. In order to generate realized returns, we aggregate (or pool) all cash inflows and outflows for each property in a particular category (e.g., by property type, division, etc.). This allows us to solve for a single portfolio (or pooled) holding period return. Given that property level cash flows are aggregated, the holding period return (IRR) is dollar weighted.[7] The value of this comparison will be to assess if a structured model can be validated by the realized performance of institutional grade commercial real estate.

In Table 7, we present comparative results as stratified by property type, divisional location, and fund type. We denote the returns as generated by the structured model as expected returns,

[7] In a related study, Ciochetti and Fisher (2002) estimate the property level holding period returns (IRRs) on a nearly identical sample to that being used in the present study. These are then aggregated based on the category under consideration. As such, these holding period returns may be thought of as equally weighted returns, in contrast with the dollar weighted returns as calculated in the present study.

while those generated from the actual pooled cash flows received as realized returns. We first present returns for the overall sample. Note that in Panel A, the average expected return of 8.05 percent is approximately 80 basis points higher than the average realized return of 7.21 percent.

We next compare expected and realized returns as stratified by property type in Table 7, Panel B. When compared across property type, in all cases we observe that expected returns, as estimated from the return-generating model, are greater than realized returns, ranging from 140 basis points higher (retail) to 25 basis points higher (office). This provides evidence to support our general conjecture that expected returns are higher (ex ante) than realized returns, and is consistent with earlier work that examines this same relationship.[8]

In Panel C of Table 7, we compare expected and realized returns as stratified by division of location. As with property type, results again confirm that in nearly all cases, expected returns are larger than realized returns. We do note, however, that in that in the West North Central division, expected and realized returns are nearly similar suggesting less volatility of returns.

Finally, in Panel D we compare expected and realized returns as stratified by fund type. Again, realized returns tend to be slightly lower than expected returns. In fact, it is interesting that in almost every breakout that we examined, realized returns are lower than expected returns. This may be a result of the decline in cash flows and values that occurred during the late 1980s and early 1990s that was generally greater than had been anticipated.

4.3 Expanded Sample

A potential issue associated with a structured return model is that in order for the model to converge efficiently, large samples of data need to be employed. In an attempt to examine the efficiency of the structured return model, we employ an expanded sample that consists of the

[8] See Shilling (2003) where expected returns, as proxied by the quarterly expected capitalization rates reported by the Korpacz survey, are found to be nearly 200 basis points higher than realized returns, as reported the NCRIEF performance index.

entire NCREIF database, and includes 10,680 properties. Note that in using the overall NCREIF sample, many properties may leave the index for a variety of reasons in addition to a sale of the property. For example, there may be a transfer of ownership of the property to a different manager. In addition, many properties in this expanded sample are not sold as of the end of the study period. While we are able to observe all operating cash flows, capital expenditures, and partial sales, we are unable to observe transaction sale prices for all properties. As a proxy for sale price we use the last appraised value for the property prior to the property leaving the index, or as of the end of the study period for properties still in NCREIF property index. This methodology has been used in prior studies to calculate IRRs for properties in the NCREIF database (see Geltner [2002]).[9]

4.3.1 Results for Expanded Sample

In Table 8 we report aggregate results for the alternative sample. In this case, the use of a much larger data set results in an overall expected return of 7.53 percent, down slightly from the 8.05 percent as reported when using the sample with 4,093 properties. Interestingly the standard deviation of the expanded sample also decreases to 5.58% suggesting a lower expected return but a lower risk for the expanded sample. The expected growth is also lower at -1.31 percent versus -.97 percent for the smaller sold property sample. Results using this larger data set may reflect more accurately the true estimate of the expected returns on commercial real estate, as well as the volatility of expected returns. Alternatively, it may be the case that the use of appraised values as a proxy for property values may introduce 'noise' into the estimation procedure, thus increasing the standard deviation of expected returns.

In Table 9, we stratify the expanded sample by property type. In this case, we observe similar results, qualitatively, to those derived from the smaller sample, with expected returns on apartment properties dominating other product types, at 12.38 percent. Industrial real estate is shown to out perform retail, with an expected return of 8.39 percent as compared to 7.65 percent. Office properties continue to exhibit the lowest expected returns, at 6.45 percent. With the exception of industrial properties, all implied volatilities are shown to have fallen

[9] This study did not attempt to calculate volatilities.

slightly through the use of the larger sample. This is most likely a result of the combined effect of an increased sample size as well as the portfolio effects resulting from this increased sample size.

Results of the larger sample as stratified by division are presented in Table 10. As with property type, the general trend observed from these results is a decrease in the standard deviation of the expected return, as well as a slight decrease in the expected returns themselves.

In Table 11 we present the results for closed and open/separate accounts. As was the case for the sold property sample, the expected return and standard deviation is significantly higher for the separate accounts suggesting a higher-risk higher-return strategy.

We also provide results as stratified by division and property type in Table 12. As with the results stratified individually by property type or division, the general observed trend here is that expected returns stay qualitatively similar, or drop slightly, but standard deviation of expected return falls by a slightly greater amount. This is less apparent for apartment properties, and more pronounced for both retail and industrial properties.

4.3.3 Expanded Sample - Comparison to Realized Returns

Last, we provide a comparison of expected returns versus realized returns for the expanded sample of 10,680 properties. In Table 13, Panel A, we provide results for the overall expanded sample. Here, we observe expected returns of 7.53 percent, as compared to realized returns of 7.59 percent.

In Panel B, we stratify by property type. Note that we observe similar trends of returns by property type, with apartment properties showing the greatest expected returns, followed by industrial, retail, and office. While relative returns are similar to the smaller sample, we do observe a slight movement upward for apartment and office properties, and a slight downward movement for industrial and retail properties. Note that due to increased sample size, realized

returns are generally found to be slightly lower that with the smaller sample, in part reflecting the diversification offered by the large sample.

We provide results for the expanded sample, as stratified by division in Panel C of Table 13. Interestingly, increased sample size cause a pronounced shift in returns by division, with the East North Central division exhibiting the largest expected returns by division, at 14.76 percent. Similar expected returns are exhibited by both the Northeast and West North Central divisions, at 10.90 and 10.96 percent, respectively. Other divisions are found to offer expected returns in the high 6 to low 7 percent range. Qualitatively, realized returns are shown to be similar to those exhibited by the smaller sample, ranging from 5.74 percent (Southwest) to 8.39 percent (Northeast).

Expected and realized returns for the expanded sample, as stratified by fund type, are shown in Table 13, Panels D and E. It is interesting that realized returns were slightly higher for open-end and closed-end funds but lower for the rest, perhaps reflecting the fact that a more diversified strategy helped weather the downturn of the late 1980s and early 1990s. Note, however, that the "other" category is non-open end funds that could not be classified and the actual return was lower than the expected return for this group. The largest disparity between expected and realized returns was for the separate accounts which had a significantly lower realized return but still a higher realized return than the other categories. When open end funds are compared with all non-open end funds (panel E) the results of the two groups are very similar with open end funds having just slightly lower expected and realized returns.

The expanded sample provides results that are generally consistent with the results for the smaller sold-property sample. Both samples use the actual cash flows to estimate the model with the only exception being that the expanded model uses the appraised value as a proxy for the sale price in the final year if the property was not actually sold. The advantage of the larger sample is obviously that it is more likely to provide significantly significant results – especially when disaggregated by property type and geographic area.

Section 5. Implications and Conclusions

In this study, we have developed a structured model that allows for the simultaneous estimation of the expected return, risk, and growth rate of institutional grade commercial real estate over the period 1978 through 2002. This study differs from earlier work in that the model estimates expected returns over the study period and compares realized with expected returns to estimate the standard deviation. This provides an alternative to other techniques in the literature such as appraisal unsmoothing models that have generally been used. This may provide a more realistic measure of the volatility of commercial real estate since the model is based on actual cash flows and does not require any assumptions about appraiser behavior.

Using two large data sets, one representing all sold properties from the National Council of Real Estate Investment Fiduciaries (NCREIF), and the other representing all properties in the NCREIF data base, we estimate the first and second moments of expected return, as stratified by a number of select categories. Our results suggest that commercial real estate had an expected return of slightly over 8 percent during the period 1978 through 2002, a result consistent with prior research in the area. We find the standard deviation of expected return to have averaged slightly less than 6 percent over the study period. This statistic is higher than that reported when using the appraisal based NCREIF series, but slightly lower than reported form other studies, using either unsmoothing models or public forms of real estate ownership.

We find significant variation of expected returns by property type, with apartments exhibiting nearly twice the level of return as that for office properties. On a risk-adjusted basis, it appears that industrial properties have offered the best performance over the study period. When examined by division of location, the Northeast division is shown to have outperformed other divisions, with an expected return of greater than 13 percent. With the exception of the Southwest and West North Central divisions, other divisions in the study performed on a similar basis.

When compared to realized returns, the expected returns generated from our model in the present study are generally found to be slightly higher than ex post realized returns. This

finding conforms to survey work conducted on institutional participants, where expected returns appear to be universally higher than realized returns.

By employing a much larger data set of all properties in the NCREIF database, we find that our model results change only marginally with respect to expected returns, in most cases in a downward direction. We do find, however, a noticeable reduction in the standard deviation of expected returns, a result we posit comes from the increase in sample size, and the resulting efficiencies in model estimation.

The results of this study suggest that the use of a structured model which estimates not only expected returns, but also volatility of returns and growth rates may be of benefit to those interested in understanding the risk and return of institutional grade commercial real estate. We believe that these results warrant continued research in the area.

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Table 1 – Panel A

Sample Distribution by Property Type

Property Type	N	Percent
Apartment	650	15.9
Industrial	1,517	37.1
Office	1,138	27.8
Retail	788	19.3
Total	4,093	100.0

Table 1 – Panel B

Sample Distribution by Division

Division	N	Percent
ENC	549	13.4
ME	462	11.3
NE	361	8.8
SE	568	13.9
SW	548	13.4
MTN	374	9.1
WNC	243	6.0
PAC	988	24.1
Total	4,093	100.0

Table 1 – Panel C

Sample Distribution by Fund Type

Fund Type	N	Percent
Open End	881	21.5
Closed End	438	10.7
Separate	698	17.0
Other	2,076	50.8
Total	4,093	100.0

Table 1 – Panel D

Sample Distribution – Division by Property Type

	Property									
	Apartment		Industrial		Office		Retail		Total	
Division	N	%	N	%	N	%	N	%	N	%
ENC	56	8.6	268	17.7	132	11.6	93	11.8	549	13.4
ME	91	14.0	110	7.3	176	15.5	85	10.8	462	11.3
NE	42	6.5	118	7.8	145	12.7	56	7.1	361	8.8
SE	153	23.5	143	9.4	124	10.9	148	18.8	568	13.8
SW	88	13.5	210	13.8	140	12.3	110	13.9	548	13.4
MTN	92	14.2	120	7.9	89	7.8	73	9.2	374	9.1
WNC	19	2.9	87	5.7	91	8.0	46	5.8	243	5.9
PAC	109	16.8	461	30.4	241	21.2	177	22.5	988	24.1
Total	650	15.8	1,517	37.1	1,138	27.8	788	19.3	4,093	100.0

Table 2 – Aggregate Results – Overall Sample

	N	Return (%)	Growth (%)	Std. Dev. (%)
Overall Sample	4,093	8.05	-0.97	5.89

Table 3 – Performance by Property Type

Property Type	N	Return (%)	Growth (%)	Std. Dev. (%)
Apartment	650	11.47	2.98	13.31
Industrial	1,517	9.40	0.19	7.13
Office	1,138	6.14	-3.55	13.62
Retail	788	9.11	0.74	10.37

Table 4 – Performance by Division

Division	N	Return (%)	Growth (%)	Std. Dev. (%)
ENC	549	9.82	2.08	19.04
ME	462	9.00	-0.05	14.45
NE	361	13.74	3.32	23.22
SE	568	9.34	0.37	11.42
SW	548	6.45	-2.17	15.89
MTN	374	8.42	-0.42	15.32
WNC	243	6.19	-2.41	17.03
PAC	988	9.16	-0.66	10.31

Table 5A – Performance by Fund Type

Fund Type	N	Return (%)	Growth (%)	Std. Dev. (%)
Open End	881	7.93	-1.87	11.50
Closed	438	7.47	-2.60	17.21
Separate	698	10.35	-1.50	28.83
Other	2,076	7.66	-1.59	11.24

Table 5B – Performance by Fund Type

Fund Type	N	Return (%)	Growth (%)	Std. Dev. (%)
Open End	881	7.93	-1.87	11.50
Non-Open	3,212	8.24	-.76	6.30

Table 6 – Performance by Division and Property Type

	Apartment				Industrial				Office				Retail			
Division	N	Return	Growth	Std. Dev	N	Return	Growth	Std. Dev	N	Return	Growth	Std. Dev	N	Return	Growth	Std. Dev
ENC	56	14.99*	6.32*	27.25*	268	10.37	2.04	22.52	132	-1.91*	-8.70*	106.96*	93	13.96	5.08	24.48
ME	91	28.17*	22.96*	42.76*	110	10.68	-0.20	21.58	176	7.19	-2.66	22.39	85	14.70	6.08	33.21
NE	42	21.41*	12.50*	46.18*	118	12.22	2.69	19.18	145	19.34	8.86	33.80	56	16.01	6.54	37.50
SE	153	49.11	33.95	71.83	143	10.04	-0.43	17.27	124	9.44	-0.15	27.09	148	12.24	4.44	24.50
SW	88	9.86	1.12	26.42	210	8.79	-0.62	19.09	140	8.38	0.16	31.48	110	22.33	15.56	43.28
MTN	92	17.63*	7.94*	39.78*	120	11.47	0.86	24.98	89	7.43*	-1.21*	30.39*	73	14.12	4.92	30.67
WNC	19	16.59	7.29	35.15	87	9.05	-2.53	24.26	91	6.16	-3.56	26.34	46	16.47	8.19	59.01
PAC	109	32.81	25.95	56.58	461	13.11	3.06	12.97	241	8.71	-3.22	32.55	177	10.42	1.68	17.75

Note: * denotes series with incomplete data

Table 7 – Panel A - Comparison of Returns – Expected versus Realized

	N	Expected Return (%)	Realized Return (%)
Overall Sample	4,093	8.05	7.21

Table 7 – Panel B – Comparison of Returns – Expected versus Realized

Stratified by Property Type

Property Type	N	Expected Return (%)	Realized Return (%)
Apartment	650	11.47	9.81
Industrial	1,517	9.40	8.32
Office	1,138	6.14	5.73
Retail	788	9.11	7.56

Table 7 – Panel C – Comparison of Returns – Expected versus Realized

Stratified by Division

Division	N	Expected Return (%)	Realized Return (%)
ENC	549	9.82	7.53
ME	462	9.00	7.36
NE	361	13.74	8.62
SE	568	9.34	7.56
SW	548	6.45	4.96
MTN	374	8.42	6.38
WNC	243	6.19	6.20
PAC	988	9.16	7.41

Table 7 – Panel D – Comparison of Returns – Expected versus Realized

Stratified by Fund Type

Fund Type	N	Expected Return (%)	Realized Return (%)
Open End	881	7.93	6.44
Closed	438	7.47	7.75
Separate	698	10.35	10.03
Other	2,076	7.66	6.55

Table 7 – Panel E – Comparison of Returns – Expected versus Realized

Stratified by Fund Type

Fund Type	N	Expected Return (%)	Realized Return (%)
Open End	881	7.93	6.44
Non-Open	3,212	8.24	7.37

Table 8 – Aggregate Results – Expanded Sample

	N	Return (%)	Growth (%)	Std. Dev. (%)
Overall Sample	10,680	7.53	-1.31	5.58

Table 9 – Expected Returns by Property Type

Expanded Sample

Property Type	N	Return (%)	Growth (%)	Std. Dev. (%)
Apartment	1,857	12.38	4.89	11.61
Industrial	3,887	8.39	-1.11	13.66
Office	2,968	6.45	-2.10	11.52
Retail	1,968	7.65	-1.38	7.08

Table 10 – Expected Returns by Division

Expanded Sample

Division	N	Return (%)	Growth (%)	Std. Dev. (%)
ENC	1,375	14.76	8.01	17.13
ME	1,225	6.69	-2.75	11.67
NE	1,044	10.90	1.26	19.76
SE	1,504	7.55	-1.41	12.31
SW	1,378	7.03	-1.21	13.97
MTN	918	7.08	-2.13	18.85
WNC	555	10.96	3.34	14.03
PAC	2,681	6.73	-2.75	7.75

Table 11 A – Expected Returns by Fund Type

Expanded Sample

Fund Type	N	Return (%)	Growth (%)	Std. Dev. (%)
Open End	2,151	6.83	-2.89	9.80
Closed End	987	4.14	-6.09	15.57
Separate	3,415	19.04	10.34	16.30
Other	4,127	8.28	-0.58	7.84

Table 11 B – Expected Returns by Fund Type

Expanded Sample

Fund Type	N	Return (%)	Growth (%)	Std. Dev. (%)
Open End	2,151	6.83	-2.89	9.80
Non-Open End	8,529	7.98	-0.85	5.82

Table 12 – Expected Returns – Division by Property Type

Expanded Sample

Division	N	Return	Growth	Std. Dev	N	Return	Growth	Std. Dev	N	Return	Growth	Std. Dev	N	Return	Growth	Std. Dev
ENC	170	8.90	0.23	21.52	606	13.30	6.24	18.67	353	7.28*	-9.85*	104.98*	246	12.80	3.59	18.95
ME	246	40.37	35.76	39.52	283	9.07	-1.23	15.12	420	4.84	-4.77	15.66	276	12.86	4.32	22.82
NE	145	33.63	26.80	48.10	307	11.23	2.08	17.58	426	11.56	1.34	24.05	166	18.55	9.29	36.66
SE	447	13.48*	-17.83*	131.44*	388	8.10	-1.63	16.01	324	10.25	1.36	24.34	345	9.53	0.23	24.30
SW	275	8.52	-1.62	33.98	503	11.27	2.89	18.07	362	8.50	0.81	25.33	238	24.48	17.44	41.37
MTN	243	15.10	5.86	39.08	256	11.02	1.98	17.91	235	31.46	0.60	91.30	184	12.40	3.10	22.99
WNC	58	18.95	11.65	33.90	210	7.60	-2.90	18.87	188	8.33	-0.41	21.93	99	16.01	5.79	56.35
PAC	273	38.42	31.51	56.08	1,334	9.74	0.03	9.68	660	6.19	-3.00	20.91	414	10.37	1.66	10.87

Note: * denotes series with incomplete data

Table 13 – Panel A - Comparison of Returns – Expected versus Realized

Expanded Sample

	N	Expected Return (%)	Realized Return (%)
Overall Sample	10,680	7.53	7.59

Table 13- Panel B – Comparison of Returns – Expected versus Realized

Stratified by Property Type

Expanded Sample

Property Type	N	Expected Return (%)	Realized Return (%)
Apartment	1,857	12.38	7.70
Industrial	3,887	8.39	8.14
Office	2,968	6.45	6.26
Retail	1,968	7.65	7.80

Table 13 – Panel C – Comparison of Returns – Expected versus Realized

Stratified by Division

Expanded Sample

Division	N	Expected Return (%)	Realized Return (%)
ENC	1,375	14.76	7.35
ME	1,225	6.69	8.05
NE	1,044	10.90	8.39
SE	1,504	7.55	7.78
SW	1,378	7.03	5.74
MTN	918	7.08	7.01
WNC	555	10.96	7.29
PAC	2,681	6.73	7.88

Table 13 – Panel D – Comparison of Returns – Expected versus Realized

Stratified by Fund Type

Expanded Sample

Fund Type	N	Expected Return (%)	Realized Return (%)
Open End	2,151	6.83	7.48
Closed	987	4.14	7.86
Separate	3,415	19.04	9.41
Other	4,127	8.28	6.43

Table 13 – Panel E – Comparison of Returns – Expected versus Realized

Stratified by Fund Type

Expanded Sample

Fund Type	N	Expected Return (%)	Realized Return (%)
Open End	2,151	6.83	7.48
Non Open End	8,529	7.98	7.62