New NCREIF Value Index and
Operations Measures

by

Michael S. Young
NCREIF Consultant
1928 Eucalyptus Road, Nipomo, California 93444
phone: 623-523-3855 / e-mail: myoung@ncreif.org

Jeffrey D. Fisher
NCREIF Academic Consultant
200 E. Randolph Street, Suite 5135, Chicago, Illinois 60601
phone: 312-819-5890 / email: fisher@indiana.edu

Joseph D'Alessandro
NCREIF Director of Real Estate Performance Measurement
200 E. Randolph Street, Suite 5135, Chicago, Illinois 60601
phone: 312-819-5890 / email: joed@ncreif.org

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Abstract. Since its inception, the NCREIF Property Index (NPI) has achieved preeminence as an indicator of the investment performance of institutionally-held commercial property in the United States. This paper introduces three new and refined series derived from NCREIF property data: the Market Value Index (MVI), Free Cash Flow Yield (FCFY), and Capital Expense Ratio (CXR). While the NPI was designed to measure the risk and returns of the real estate asset class, these series optimize the property-level data in the NCREIF database to provide better indications of real estate value changes and operating performance.

Since its inception over thirty-five years ago, the NCREIF Property Index (NPI) has achieved preeminence as an indicator of the investment performance of institutionally-held commercial property in the United States. The NPI formula is:

$$R_t = \frac{MV_t - MV_{t-1} + PS_t + NOI_t - CI_t}{MV_{t-1} - (PS_t / 2) - (NOI_t / 3) + (CI_t / 2)}$$

Where:

R_t is the Total Return for period t,

MV_t is the Market Value at the end of period t,

MV_{t-1} is the Market Value at the beginning of period t,

PS_t is any Partial Sales in period t,

NOI_t is the Net Operating Income in period t, and

CI_t is the Capital Expenditures (Improvements) in period t.

This NPI formula is designed as an approximation of a quarterly Internal Rate of Return (IRR) when NOI is assumed to be received monthly during the quarter and any Capital Expenditures (CapEx) or Partial Sales occur mid-quarter. Brueggeman and Giliberto (1987) presented a derivation of this formula using a Taylor Series Expansion of the formula for an IRR under these assumptions. The formula can also be derived from the Modified Dietz formula developed by Dietz (1966) and commonly used for performance measurement in the institutional arena. The assumption that NOI occurs at the end of each month is what results in the 1/3 adjustment in the denominator and the assumption that CapEx and Partial Sales occur mid-quarter is the reason for the ½ adjustment. For the purpose of this article, the main point is that this formula was designed for *returns*, i.e., to provide an approximation of an IRR.

The practice in the real estate industry has been to also compute two components of the total return — a so-called Income Return and an Appreciation Return (also called a Capital Return). The Income Return just uses the NOI in the numerator of the formula and the Appreciation Return uses the remaining terms, which include the CapEx and Partial Sales terms.

I. Rationale for the New Series

The NPI is widely-reported and used by real estate investment owners, investors, managers, and consultants as well as by academics. It has become the de facto yardstick that the industry uses for a variety of performance and analytical purposes including portfolio construction, monitoring, and attribution analysis. But, the NPI was designed as a measure of returns for institutional real estate. Although Total Return has historically been broken down into Income Return and Appreciation Return components, this can be problematic for several reasons:

1. The Income Return is based on NOI and *not* net cash flow and thus is not comparable with a "dividend yield" for common stocks.

2. The Appreciation Return is net of capital expenditures and thus is not comparable with other price indices such as the Moody's/RCA CPPI.[1]

It should be noted that separating Total Return into components is common for real estate as investors typically associate less risk with income and more risk with appreciation. However, the Income Return is not a cash return. The Income Return is analogous to a Capitalization (Cap) Rate, commonly defined as NOI divided by Market Value. For the Appreciation Return, CapEx is subtracted from the end-of-quarter Market Value because you cannot have a "return" by simply adding capital. That is, the value change would at least, in part, be due to making additional investment. But, the Appreciation Return is not a price change. As noted above, what is also desirable for real estate is both a measure of the cash flow yield, analogous to stock and bond yields, and a measure of a true price index that captures how values change over time.

Young, Geltner, McIntosh, and Poutasse (1995 and 1996) and Young (2005) proposed changes to the NPI formula that address some of the above issues. But, after considerable research, NCREIF decided that there was a need for several different types of indices, each optimized for their intended purpose. As noted above, the NPI was designed for returns. While there may be ways to improve the NPI formula (currently under consideration at NCREIF), there is also a need for better measures of price changes (a price index) as well as better measures of cash yield from ongoing property operations.

To address these objectives, a new Free Cash Flow Yield measure has been developed that reflects the net cash flow from a property available for distribution to investors. Also, the current NPI Appreciation Return is enhanced by the new Market Value Index that measures property value change irrespective of capital expenditures, which is a more strict and unambiguous measure of market value change. We will see that these new measures differ from the NPI in several ways:

1. Because the new measures are not intended as estimates of a quarterly IRR, no adjustment has to be made to the denominator of the NPI's formula. The denominator is simply the Beginning Market Value.

2. Unlike the NPI Income Return component that is based on NOI, the Free Cash Flow Yield is calculated by subtracting the CapEx from the NOI to get a measure of cash flow.

3. Unlike the NPI Appreciation Return component that has CapEx deducted from the Ending Market Value, there is no deduction for CapEx so that the measure is simply the price change.

4. While some CapEx is necessary to maintain a constant utility for the property, a price index should not reflect an increase in the value of the property due to a major expansion or renovation of the property that involves new capital investment. Similarly, the Free Cash Flow Yield measure should not have major CapEx deducted. Thus, for both of these measures, a property is excluded from the calculation during any quarter where expansion or major renovations are taking place.

The details of the calculations for these new measures are covered in the following sections.

II. Market Value Index (MVI)

The Market Value Index (MVI), like the other two new measures, has a denominator that is simply the Beginning Market Value at the beginning of the quarter: MV_{t-1}. This treatment is more consistent with the way price indices are calculated for other asset classes.

Thus, the MVI is simply an equal-weighted average of quarterly changes in reported market value for those properties that are not undergoing a major capital expansion. However, if a property is undergoing expansion or contraction into some new physical, functional, or economic condition, then the property is excluded from the computation and reporting during these quarters. The property re-enters the index once the expansion or major renovation is complete, i.e., during periods when the property retains its utility.

The Market Value Index (MVI) is computed for each property as the sum of Ending Market Value and Partial Sales[2] divided by Beginning Market Value minus 1 for each quarter. For properties having a Full Sale in a quarter, the MVI is based on the difference between the Sale Price and the beginning-of-quarter Market Value.

To deal with the constant utility issue discussed above, in any quarter where the *absolute value*[3] of specified capital expenditures exceeds a fraction of Beginning Market Value the property's MVI computation shall be excluded from the data series. We call this process of identifying quarterly data for exclusion a "filter rule" and provide its definition and application below.

The MVI formula is:

$$(MV_t - MV_{t-1} + PS_t) / MV_{t-1}$$

or alternatively:

$$[(MV_t + PS_t) / MV_{t-1}] - 1$$

where MV is Market Value and PS is Partial Sales reported to NCREIF in quarter t and MV_{t-1} is the Market Value at the end of the prior quarter, in other words, at the beginning of the current quarter.

III. Operating Measures

The Free Cash Flow Yield (FCFY) is a measure of the amount of a property's quarterly operating net cash flow available for distribution to investors/owners expressed as a fraction of market value. The FCFY, like the MVI, excludes properties with major capital expenditures for expansion or renovation when such expenditures exceed the filter rule described below, and that more accurately reflects the cash that could be distributed to investors in a quarter. This measure is similar to the concept of "free cash flow" used in the finance literature and in corporate financial reporting.

The FCFY is a periodic measure that is not indexed. In some sense, the FCFY is a measure of cash that investors can expect after all operating and everyday capital expenses have been paid. To many investors, the cash available for distribution is one of the principal reasons for investing in commercial real estate, an asset that has a relatively stable net cash flow stream owing to the terms of leases that underpin a property's economic performance. Stability and

reliability of this net cash flow stream is important to a wide range of institutional investors who must have cash available for distribution to plan beneficiaries. With the introduction of the FCFY, those investors have, for the first time, a way of assessing the history of net cash flow available for distribution from the real estate asset class.

Lastly, the Capital Expense Ratio (CXR) is a measure of the quarterly expenditures for on-going costs of business not accounted for in the Net Operating Income (NOI) including leasing commissions, tenant improvements, and other expenditures for replacement of long-lived equipment or physical structures, mostly tenant spaces, expressed as a fraction of market value. Also, the CXR is a *periodic measure* and is *not indexed*.

The Free Cash Flow Yield (FCFY) is computed for each property as the quantity Net Operating Income minus Capital Improvements divided by Beginning Market Value for each quarter. Notice that major capital expenditures for expansions or renovations are not included in the formula, only ordinary capital expenses related to leasing commissions and tenant improvements. Accordingly, in quarters where the *absolute value* of capital improvements defined in the filter rule exceed a fraction of Beginning Market Value, the property's FCFY computation shall be excluded from the data series.

Thus, the FCFY formula is:

$$(NOI_t - CI_t) / MV_{t-1}$$

Notice that Market Value Index and Free Cash Flow Yield are components of total return for a quarter when substantial capital expenditures have not occurred and that the denominator for both is simply the Beginning Market Value as proposed in Young, et al. (1995 and 1996). Thus, expressed in algebraic form, the total return for a property in a quarter would be simply the sum of the components:

$$TR_t = MVI_t + FCFY_t$$

The Capital Expense Ratio (CXR) is computed for each property as Capital Improvements (excluding major capital investments as described above) divided by Beginning Market Value for

each quarter. In quarters where the *absolute value* of Capital Improvements defined in the filter rule exceed a fraction of Beginning Market Value, the property's computation CXR computation shall be excluded from the data series.

The CXR formula is:

$$CI_t / MV_{t-1}$$

IV. A Closer Look at CapEx

To ensure that, within reasonable bounds, a particular property retains its physical continuity throughout a quarter, there must be a way to identify properties that have not had substantial, material changes to the physical asset within the quarter. If the changes are substantial, the property should be excluded for that quarter or for subsequent quarters until such time as the property becomes stable physically, functionally, or economically, i.e., when the property returns to a state of constant utility.

Prior to 2000, only total Capital Improvements were reported to NCREIF. Subsequently, additional subcategories of capital improvements gave us more information on the composition of total Capital Improvements. In particular, the subcategories included Additional Acquisitions Costs, Leasing Commissions, Tenant Improvements, Building Improvements, Building Expansion, and Other Capital Improvements.[4]

We divide these subcategories into two groups: those that are typical recurring capital expenses related to changing tenancy and ordinary repairs, and those that are occasional, high-dollar-value capital expenditures that alter the physical, functional, or economic condition of a property. Leasing Commissions, Tenant Improvements, and Building Improvements fall into the former group and are included in Capital Expenses in the FCFY and CXR series. Additional Acquisitions Costs, Building Expansion, and Other Capital Improvements fall into the latter group and are all candidates for filtering properties for exclusion within all three series.

We can use the detailed data on capital expenditures from the post-2000 era to create filter rules for excluding properties undergoing substantial capital expenditures prior to 2000. We are not able to say with certainty that properties filtered will be 100% accurately identified. We must strike a reasonable balance based on indicators we find in the existing data and judgments about the reasonableness of the filter ratio.

Thus, we have chosen to filter only those subcategories of capital expenditures in the subcategories of Additional Acquisitions Costs, Building Expansion, and Other Capital Improvements that show an absolute value greater than 5% of Beginning Market Value of a property in any quarter. First, we compute for each property type the fraction of post-2000 observations that are filtered and then use that fraction to establish a filter rule for the pre-2000 era where we have only one statistic for total Capital Improvements.

We tried several filter rules for pre-2000 data and found that an absolute value of total Capital Improvements greater than 10% of Beginning Market Value provided the most similar fraction of excluded quarters for most property types and for the aggregate of all properties in the NPI. Exhibit 1 shows the observations and fractions of properties excluded in both the pre-2000 and post-2000 eras. In the post-2000 era, 2,079 of the 289,543 quarterly observations for all properties in the NPI were filtered (satisfied the rule for exclusion from the data set), a total of 0.72% of all observations. Interestingly, in the pre-2000 era, 958 of the 132,635 quarterly observations for all properties in the NPI were filtered, also a total of 0.72% of all observations despite some differences in percentages pre- and post-2000 when disaggregated by individual property type.

The largest absolute and relative difference in the percent filtered pre-2000 versus post-2000 is found in the Apartment category. We note that the number of observations pre-2000 is only about one-quarter as many as post-2000, a fraction far smaller than in all other property types other than Hotel. Had we filtered pre-2000 Apartment observations with a 5% filter rule, the percent of filtered Apartment observations pre-2000 would have been 0.64%. The number of excluded Apartment observations would have increased from 41 to 104 out of a full sample of

16,336 quarters of Apartment data, an average of about 1.2 observations per calendar quarter over the 88 quarter span from 1978 to 2000.

V. Equal-Weighted versus Value-Weighted

The NPI returns have always been value-weighted as they represent the universe of properties reported to NCREIF. There is not, nor has there ever been the suggestion that the value-weighted NPI series are representative of the larger population of domestic commercial real estate.

Value-weighted series have merit in particular analytical situations. For example, in attribution analysis, the goal is to identify deviations plus or minus of a particular portfolio of real estate assets from a benchmark portfolio representative of the theoretically investable universe. In other words, attribution analysis attempts to show how a portfolio has performed on say selection of property types versus a benchmark that includes all investable property types.

Also, analyses that employ Modern Portfolio Theory or its variants invariably involve value-weighted statistics because that represents the investment choices available to participants in the market. This is arguably even more true among investments in real estate assets where purchase of fractional interests is difficult, if not impossible, owing to the ownership structures available to investors.

However, when dealing with sample statistics from a universe of, in this case, domestic commercial real estate, equal-weighted statistics are preferable.[5] By averaging all the sample changes in market value in a quarter, for example, the resulting MVI will give equal weight to each property's change. The lowest valued properties will be given equal weight to the highest valued properties.

Thus, for statistical reasons and for qualitative reasons such as the fact that some properties are excluded in some quarters by the filter rule, the "headline" published versions of the three series will be equal-weighted.[6] These are statistics from a sample of domestic commercial real estate. That the data are derived from properties owned by tax-exempt institutions is interesting

but, unless proved otherwise, the data are considered representative of the universe of domestic commercial real estate regardless of ownership.

VI. Price Index Comparisons

As discussed above, the purpose of the MVI is to have a better measure of how property values are changing over time that is more comparable with other price indices. The NPI data has been misused by many researchers when creating a price index. One approach that has been used in the past is to use the published NPI capital appreciation return. As noted previously, the NCREIF capital return is net of all capex. Thus it understates the price changes for properties.

Another approach that has been used is to simply add back ALL capital expenditures to the capital return. But this includes capital expenditures for property expansion that is new investment and not recurring capital expenditures. This overstates the price change for properties.

The new MVI adds back capital expenditures but is also excludes properties in quarters where there are major capital expenditure events that are not recurring capital expenditures based on the filter rules discussed previously. This results in a price index that is just right. As shown in Exhibit 2, it falls between the other two indices discussed above. All the indices ini Exhibit 2 are equal weighted to have an apples-to-apples comparison.

VII. Some Summary Statistics

The MVI, FCFY, and CXR series are reported in various NCREIF publications on the public web site, in printed quarterly reports and so-called flash reports, in spreadsheet form to NCREIF members and subscribers, and in an ad hoc query facility on the organization's web site available to members. Additionally, the series are available in customizable form often used by researchers when special disaggregations or computations from proprietary data are required.

In a departure from the format of NPI detailed statistics, NCREIF now includes percentile statistics (5th, 25th, 50th or median, 75th, and 95th) for each series each quarter. This may be helpful to researchers because the distributions of the series, especially the FCFY and CXR, are certainly non-normal and skewed with boundaries more likely on the downside than on the upside.

Exhibit 3 shows quarterly and four-quarter annual statistics for MVI, FCFY, and CXR over the 1978.1 to 2014.4 period for all qualifying properties and for individual subsets by five property types: Apartment, Industrial, Office, Retail, and Hotel. In the columns headed "Quarterly," the mean of the 148 quarters of statistics (136 quarters in the case of Hotels) are shown along with standard deviation of the quarterly means and the median of the quarterly means. In other words, each quarterly set of results is a sample and the means, standard deviations, and medians are not the statistics for all the thousands of individual quarterly property data over the 37-year period.

Also, in Exhibit 3, the Market Value Index four-quarter annual results are derived from chain-linked quarterly statistics, while the Free Cash Flow Yield and Capital Expense Ratio four-quarter annual results are the sum of four quarterly statistics. These computations produce sets of 145 samples (or 133 in the case of Hotels) and the means, standard deviations, and medians are derived as described above.

For all quarterly results for all properties, the average quarterly MVI was 0.71% for the 1978.1 to 2014.4 period or approximately 2.87% annualized [100 * (1.00714 − 1) = 2.87%, other annualized figures that follow are computed in this manner]. With a quarterly median MVI of 0.93% the sample data indicate some positive skewness.

One of the principal reasons investors chose to own commercial real estate is the likelihood of a stable stream of net cash flow (income after deductions for ordinary operating expenses and routine capital expenses) available to investors for which the FCFY statistic is a good measure. From Exhibit 3, the average quarterly FCFY for all qualified properties was 1.49% for the 1978.1 to 2014.4 period or approximately 6.09% annualized, which bears comparison to similar statistics for other asset classes like common stocks or bonds, a subject for further research. Real

estate investors desirous of a relatively stable stream of net cash flow may be pleased to see that the standard deviation of the quarterly samples is a low 0.34%.

Capital expenditures are both an ordinary cost of doing business for commercial property and an occasionally substantial sum to remodel, to renovate, to expand, or to repurpose a property. The CXR accounts for the ordinary capital expenses like tenant improvements and leasing commissions. These capital expenses as a fraction of market value vary considerably across property types owing in large measure to the expectations of tenants and the length and characteristics of the leases. Hotel and Office properties have the highest reported CXR figures at 0.78% and 0.59% per quarter on average, respectively. In annualized terms, the CXR results are approximately 3.16% for Hotel properties and 2.38% for Office properties.

Property-type differences among the series and across time are more easily depicted in graph form. Exhibits 4 and 5 show the MVI by property type for the period 2000.1 to 2014.4. In particular, Exhibit 4 shows the MVI in terms of rolling four-quarter computations where a high degree of correlation is evident across market cycles. From time to time, one property type or another will lead the pack, but it is a little difficult to see the differences in this exhibit.

Another way to depict the changing pattern of MVI is to index all the property type statistics to 100.0 at some point and graph the changes over subsequent periods. This is what is shown in Exhibit 5 where all properties are indexed to 100.0 in 2000.1. Over the next 15 years, the Apartment sector shows the highest growth rate of market value followed by the Retail sector. It may be interesting to note that these two property types showed nearly identical capital value change from 2000.1 up until the industry-wide value bottoming in 2010. Afterwards, Apartment market value change accelerated at a pace that far outstripped the other property types in this sample.

Exhibit 6 shows the generally downward trend in rolling four-quarter FCFY across all property types since 2000. How these patterns compare to free cash flow performance in common stocks over the same period, is another promising topic for research.

VIII. Conclusion

Since its inception over thirty-five years ago, the NCREIF Property Index (NPI) has achieved preeminence as an indicator of the investment performance of institutionally-held commercial property in the United States.

The data underlying the NPI have been repurposed to shed light on market value change and operating performance in a set of three new data series called the Market Value Index (MVI), the Free Cash Flow Yield (FCFY), and the Capital Expense Ratio (CXR). All three are available to NCREIF members and subscribers in formats well-suited to research.

These new series provide a nice complement to the NPI, expand our understanding of the behavior of equity real estate as an investable asset class, highlight fundamental operating characteristics, create greater conformity with performance statistics used in the stock equity asset class, focus on "same store" or "constant utility" property information for greater consistency across time, and display results in equal-weighted form rather than the NPI value-weighted form to serve as sample statistics from the universe of domestic, commercial real estate.

Commercial property capital expenditures has been the subject of research inquiry in recent literature as well as in papers presented at annual meetings of the Real Estate Research Institute (RERI). NCREIF has been the principal source of data used in these research efforts. With the refinements of NPI property data that resulted in the CXR series, research into capital expenses by property type in response to changing macro or microeconomic conditions can be pursued with better data than previously available. Exhibit 7 shows that patterns of CXR are generally distinguishable by property type. Further, these patterns have relatively low correlations across property types suggesting perhaps that variabilities within property types may or may not be tied to changing market conditions affecting the property type nationally. Again, this may be a productive field for research.

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Exhibit 1
Quarterly Observations and Number and Fraction Filtered by Property Type
Pre- and Post-2000, for the Period 1978.1 to 2013.4

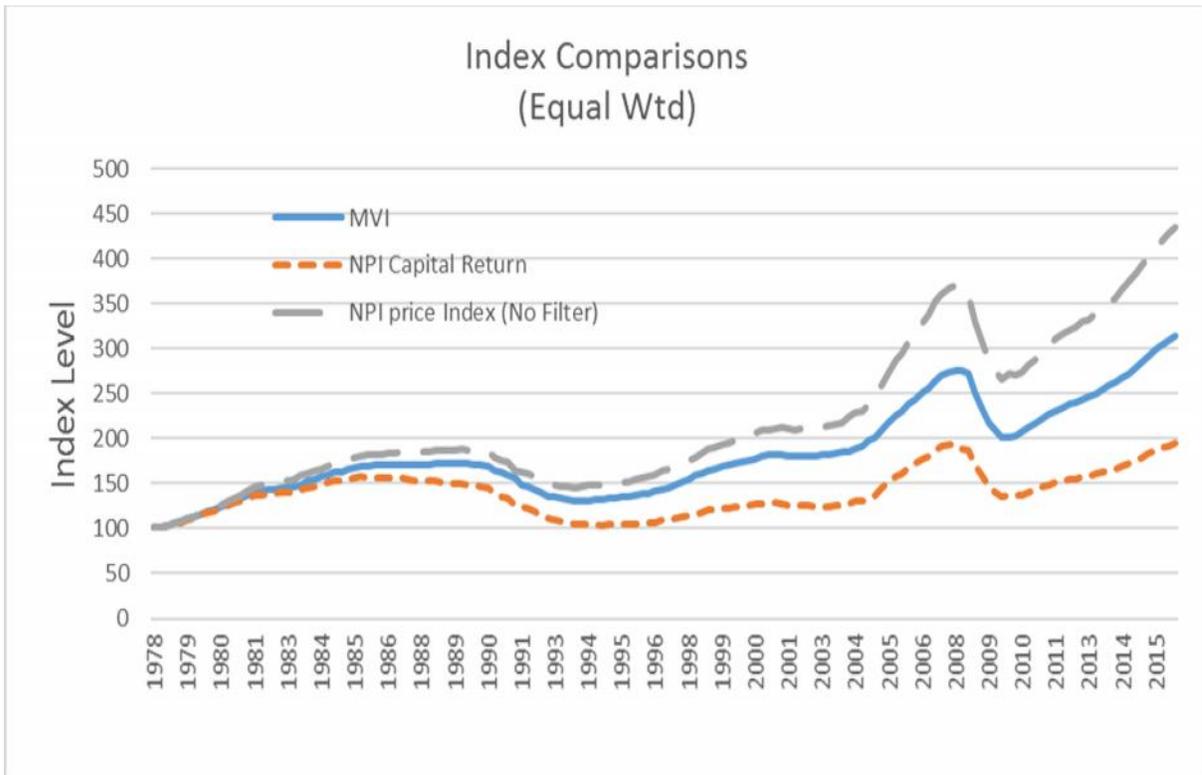| | Pre-2000 Observations | | | Post-2000 Observations | | |
	Total	Filtered	% Filtered	Total	Filtered	% Filtered
All Properties	132,635	958	0.72	289,543	2,079	0.72
Apartment	16,336	41	0.25	63,484	444	0.70
Industrial	55,153	411	0.75	105,254	725	0.69
Office	33,502	281	0.84	70,563	479	0.68
Retail	26,083	206	0.79	44,472	347	0.78
Hotel	1,561	19	1.22	5,770	84	1.46

Exhibit 2
Price Index Comparisons

Exhibit 3
Quarterly and Four-Quarter Annual Data Series Statistics in Percent
All Properties and By Property Type, 1978.1 to 2014.4

	Market Value Index		Free Cash Flow Yield		CapEx Ratio	
	Quarterly	Annual*	Quarterly	Annual	Quarterly	Annual
All Properties:						
Mean	0.71	3.04	1.49	5.97	0.40	1.60
SD of Means	1.89	6.63	0.34	1.31	0.12	0.40
Median	0.93	4.52	1.52	6.04	0.41	1.71
Apartment:						
Mean	1.15	4.83	1.48	5.90	0.29	1.15
SD of Means	2.01	6.64	0.36	1.39	0.11	0.29
Median	1.15	4.77	1.50	6.04	0.29	1.14
Industrial:						
Mean	0.75	3.20	1.57	6.30	0.36	1.43
SD of Means	1.94	6.79	0.33	1.27	0.12	0.41
Median	0.98	4.65	1.57	6.32	0.37	1.55
Office:						
Mean	0.54	2.44	1.26	5.05	0.59	2.36
SD of Means	2.45	8.52	0.39	1.49	0.21	0.75
Median	0.94	4.95	1.31	5.32	0.59	2.42
Retail:						
Mean	0.68	2.87	1.67	6.67	0.32	1.29
SD of Means	1.71	5.66	0.33	1.25	0.11	0.33
Median	0.85	4.47	1.67	6.73	0.31	1.23
Hotel:**						
Mean	0.44	1.99	1.25	4.99	0.78	3.12
SD of Means	2.86	8.96	0.81	2.37	0.38	1.09
Median	0.47	2.92	1.23	5.19	0.72	2.97

Notes: * Market Value Index four-quarter annual results are derived from chain-linked quarterly statistics, while the Free Cash Flow Yield and Capital Expense Ratio four-quarter annual results are the sum of four quarterly statistics

 ** Hotel data from 1981.1 to 2014.4

Exhibit 4
Four-Quarter Rolling Market Value Index (MVI)
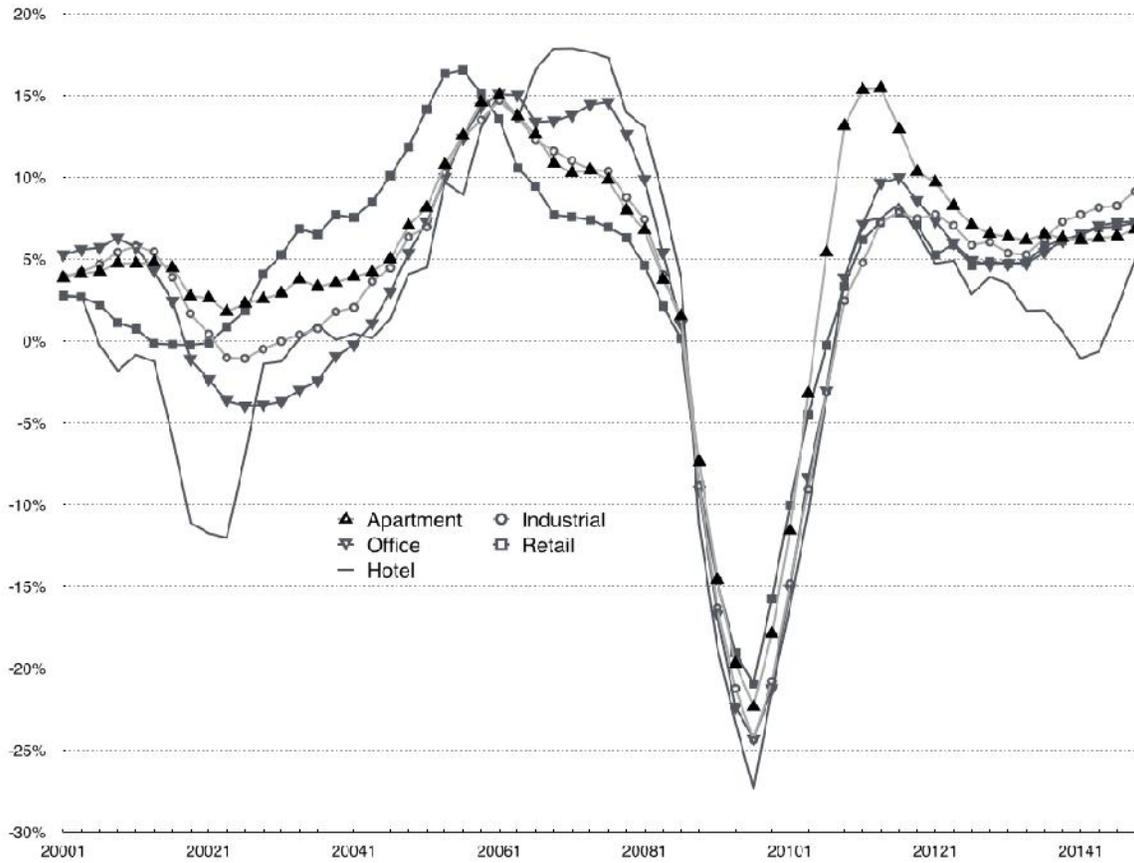By Property Type, 2000.1 to 2014.4

Exhibit 5
Indexed Market Value Index (MVI) with Index = 100.0 in 2000.1
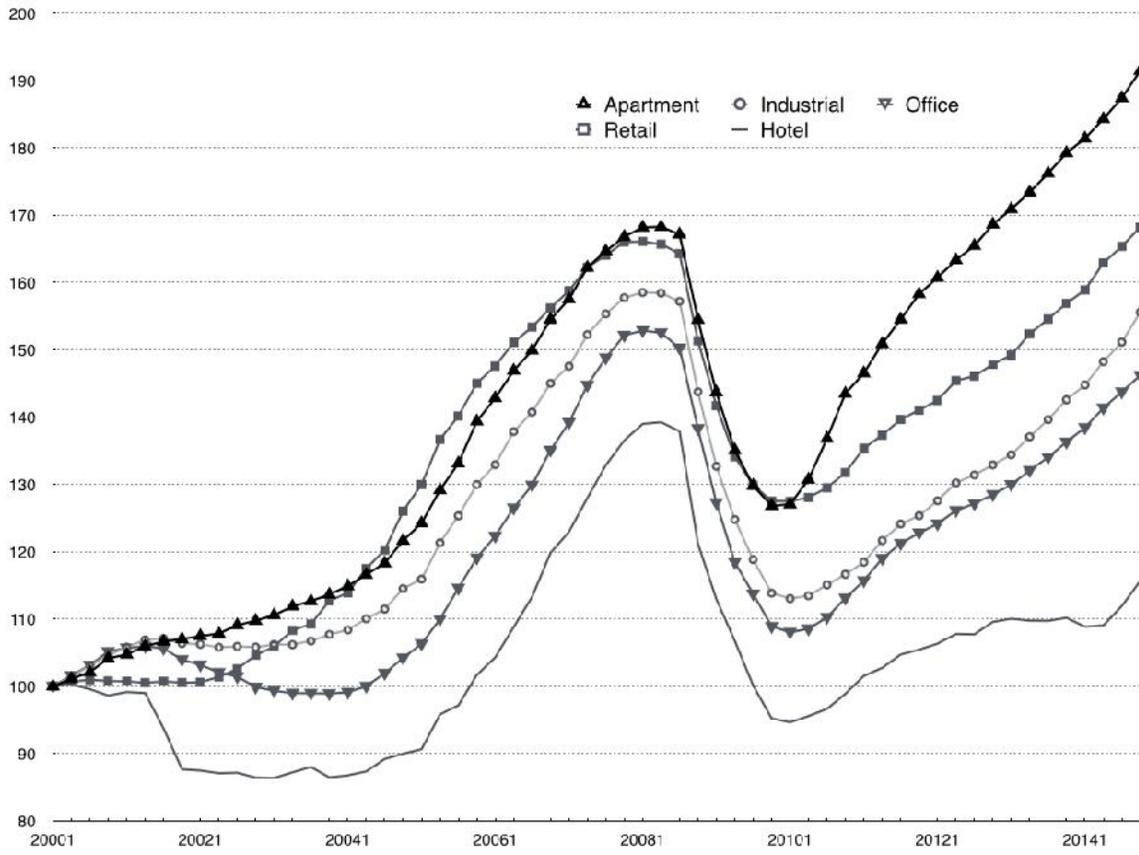By Property Type, 2000.1 to 2014.4

Exhibit 6
Four-Quarter Rolling Free Cash Flow Yield (FCFY)
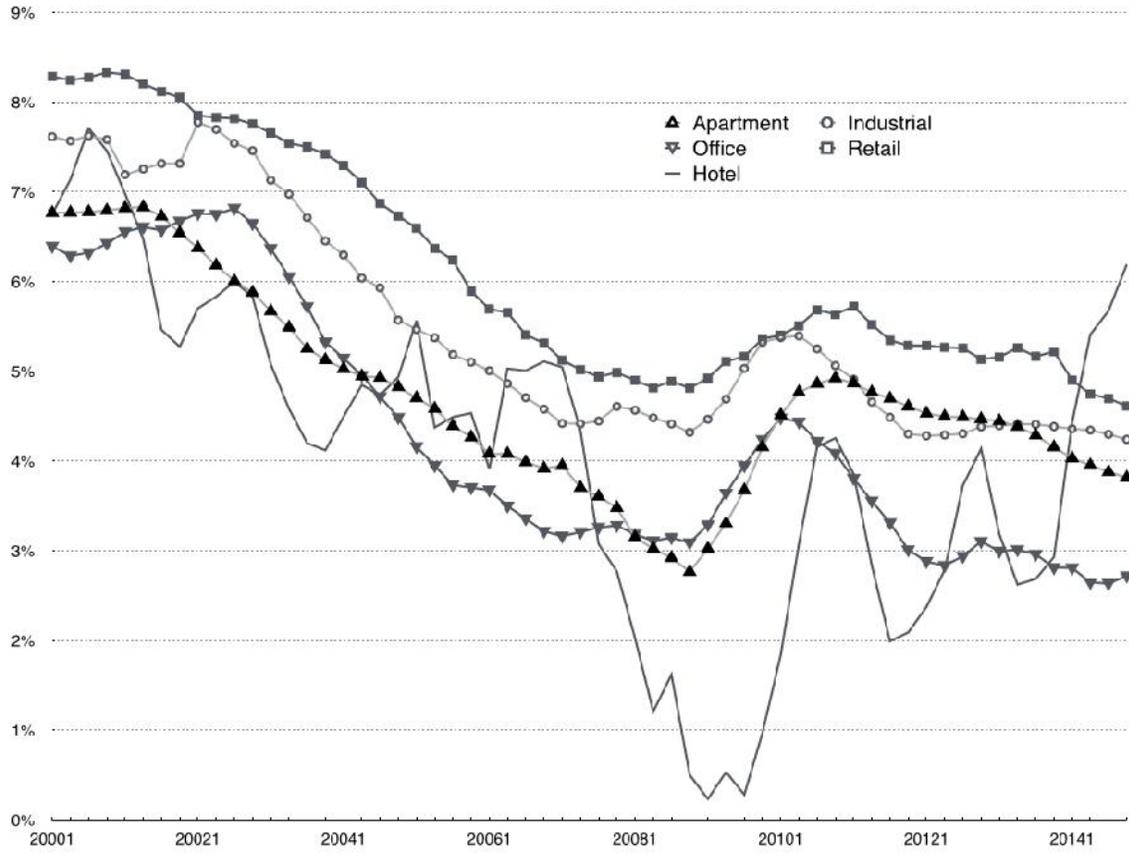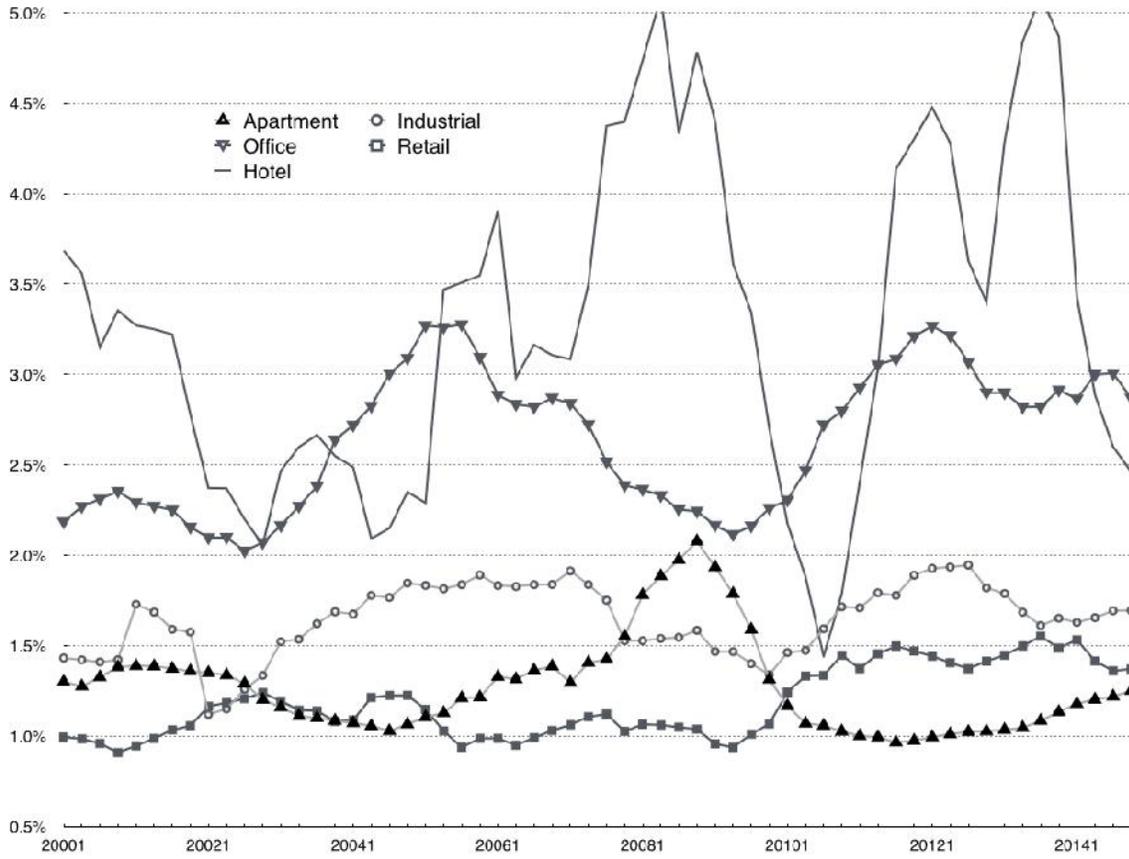By Property Type, 2000.1 to 2014.4

Exhibit 7
Four-Quarter Rolling Capital Expense Ratio (CXR)
By Property Type, 2000.1 to 2014.4

Footnotes

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[1]   See Geltner and Pollakowski (2007).

[2]   Examples of Partial Sales (PS) include the net sales price of one building from say a multi-building industrial park or the net sales price of an outparcel on the periphery of a shopping center.

[3]   Capital expenditures are generally reported as positive numbers, but occasionally there will be accounting "reversals" resulting in negative numbers for reported capital expenditures.

[4]   Additionally, NCREIF began collecting detailed information on four revenue items and eight operating expense items at the same time.

[5]   It should be noted that various data series from firms such as Wilshire Associates Incorporated and Standard & Poor's are equal-weighted when the statistics are intended to represent a ratio for a short period of time, a P/E ratio, for example. However, the total returns for equities reported by these firms are value-weighted.

[6]   Value-weighted versions of each series are available from NCREIF as custom reports.