Fully Liquid, Granular, Pure-Play

Commercial Property Investing

with Targeted Leverage

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Abstract: *Horrigan, Case, Geltner & Pollakowski [2009] developed a methodology to infer “pure-play” property appreciation and total returns, on both property (unlevered) and equity (levered) investments, from stock returns of exchange-traded equity real estate investment trusts (REITs). While the resulting indices provide information useful for investment management, risk management, and other purposes, they suffer from liquidity problems that reduce their practical value for pure-play commercial property investment. This paper advances on the earlier work by developing a methodology for fully liquid, fully investable products supporting investment in commercial property portfolios targeted by property type, region, and effective leverage. The methodology is currently being implemented for U.S. equity real estate investments. Adaptation for non-U.S. investments is straightforward, and the methodology could potentially be adapted for other asset types as well.*

I gratefully acknowledge the intellectual leadership and contributions of employees of FTSE including Josephine Gerkens, Peter Gunthorp, and Yang Wang, who should be thought of as “unaware co-authors.” The methodologies discussed in this paper are protected under existing and pending patents in the U.S. and other countries.

Income-producing real estate has long been an important component of institutional investment portfolios. Indeed, stocks and bonds were the original “alternative” asset classes for investors whose wealth would otherwise have been almost exclusively real estate. Real estate in the United States today constitutes the third largest asset class with an aggregate value of around $16.5 trillion,[[1]](#footnote-1) behind bonds at about $39.5 trillion[[2]](#footnote-2) and stocks at about $24.0 trillion.[[3]](#footnote-3) Yet real estate constitutes a surprisingly small share of the investment portfolios of most institutional investors. Funk, Weill & Hodes [2013] report an average real estate allocation of 8.8% among 198 institutional investors in 26 countries during 2013, while Beath [2014] reports an average allocation of just 3.9% among more than 300 U.S. defined benefit pension plans across the 1998-2011 study period.

This underallocation to the real estate asset class is particularly surprising given what appear to be extraordinarily strong risk-adjusted returns for commercial properties as well as extraordinarily low correlations between commercial properties and other asset classes. For example, over nearly 37 years (1978Q1-2014Q3) the widely used NCREIF Property Index (NPI) published by the National Council of Real Estate Investment Fiduciaries suggests that institutionally owned core commercial properties produced unlevered gross total returns with an annualized simple average of 8.99% but an annualized volatility of just 4.33%, implying a Sharpe ratio of 1.05 that dwarfed those of large-cap U.S. stocks (0.49 according to the S&P 500 Stock Index) and U.S. bonds (0.47 according to the BC US Aggregate Bond Index) over the same period.[[4]](#footnote-4) During the same period the data suggest that commercial property returns had a correlation of just +0.09 with large-cap U.S. stocks and -0.12 with U.S. bonds, suggesting truly impressive diversification benefits: in fact, a simple Markowitz mean-variance analysis based on the published returns (Graph 1) suggests that real estate should consistently form about 60% of a three-asset-class portfolio except at the high end of the risk/return spectrum.

Graph 1: Implied Optimal Portfolio Allocation by Expected Net Total Return

Several possible reasons for the relative underallocation to the real estate asset class, in the face of such attractive investment attributes, include the following:

* Commercial property returns are extraordinarily difficult to measure, and are insufficient to compensate for uncertainty regarding true returns, true volatilities, and true correlations with other portfolio assets.
* Commercial properties are extraordinarily illiquid, and produce returns insufficient to compensate investors for the associated illiquidity risks.
* Investment-grade commercial properties are extraordinarily non-granular, and produce returns insufficient to compensate investors for the disadvantages of non-scalability.
* Commercial property investors cannot use short-sales, options, futures, or other risk management tools, and returns are insufficient to compensate for the inadequacies in risk management capabilities.

To the extent that these shortcomings explain the relative underallocation to the real estate asset class by institutional investors, the implication is that an approach to real estate investing that combined accurate return measurement, liquidity, granularity, and access to risk management tools could be expected to result in greater institutional allocations.

Such an approach does exist in the common stocks of exchange-traded equity real estate investment trusts (REITs), assets whose values are determined primarily by the value of the portfolio of the commercial properties owned by each REIT. Investing in exchange-traded REITs combines accurate return measurement (based on multiple homogeneous transactions throughout each market day), liquidity (average daily dollar trading volume of about $4.3 billion since January 2007), and granularity (typical single-share prices less than $100), with access to short-sales, options, futures, and other risk management tools. Furthermore, listed equity REITs have provided strong total returns averaging 12.22% per year (compounded) since the end of 1971.[[5]](#footnote-5) Yet institutional allocations to exchange-traded equity REITs are small even by the standards of the real estate asset class: Beath [2014], for example, reports an average allocation to listed equity REITs during the period 1998-2011 of just 0.6% compared to 3.3% for private real estate.[[6]](#footnote-6)

Several possible reasons for the relative underallocation of institutional real estate portfolios to listed equity REITs—given their accurate return measurement, liquidity, granularity, access to risk management tools, and strong returns—include the following:

* Listed equity REIT investments have much greater volatility than is reported for private real estate, and their returns are insufficient to compensate investors for the difference in volatilities.
* Listed equity REITs manage their capital structures without significant input from their investors, and institutional investors may have preferences for less-leveraged investments.
* Listed equity REIT portfolios may be diversified by property type, and institutional investors may prefer property exposures that are targeted by property type.
* Listed equity REIT portfolios typically are geographically diversified, and institutional investors may prefer property exposures that are geographically targeted.

To address at least the last three of these concerns, Horrigan, Case, Geltner & Pollakowski [2009] (HCGP) developed a methodology to infer the capital appreciation and total returns for a portfolio of commercial properties, targeted by property type and/or geographically, from the stock price appreciation and total returns of listed equity REITs.[[7]](#footnote-7) In addition to measuring the returns on “pure-play” exposures to commercial properties through exposures to the REITs owning such properties HCGP also developed “property” versions of their indices, de-levering the targeted property returns implied by REIT stock price returns by reversing the effects of leverage employed by the REITs. The methodology was patented jointly by the co-authors and licensed to FTSE, a commercial index provider, for use in the FTSE NAREIT PureProperty® Index Series, which has been published daily since June 2012.

Market-testing of the PureProperty series, however, revealed two methodological issues that, while not affecting the value of the indices for informational and benchmarking purposes, would severely constrain their applicability for investment purposes. This paper outlines the methodological issues and proposes solutions that are expected to produce a fully investable version of the PureProperty index series, potentially addressing many of the problems that may have retarded the growth of institutional investment in the real estate asset class. After presenting the revised index methodology we consider some prospective uses of the PureProperty index series for risk management purposes in real estate portfolios.

The HCGP PureProperty Methodology

Stocks are derivative assets whose market values are driven by the market values of the assets held by the company. REITs are companies operating under a set of constraints that makes their asset holdings particularly transparent: not only are they required by the *asset test* (at least 75% of the company’s asset must be qualifying real estate) and the *income test* (at least 75% of its income must come from leases or other income generated by the qualifying real estate) to hold a relatively homogeneous portfolio of assets primarily in the real estate asset class, but real estate itself is a more transparent asset than those held by many other companies—such as, for example, intellectual property (important in industries such as pharmaceuticals), creative potential (publishing or film production), distribution efficiency (discount retailing), or credit risk modeling capability (banking). Put simply, it is relatively easy to enumerate, describe, and value the assets from whose values REIT stock prices derive.

Unlevered changes in REIT stock values, then, are driven primarily by changes in the unlevered values of the assets (properties) owned by each REIT and the weight of each asset in the portfolio of each REIT.[[8]](#footnote-8) For many purposes, however, what is of interest is not changes in the value of each individual asset but common (systematic) changes in the values of groups of similar assets. If the relevant asset groups consist, for example, of six property types common in institutional portfolios, then (following HCGP)

( 1 )

where denotes the unlevered change in stock price for REIT *i* during period *t*, denotes the share of REIT *i*’s total portfolio during period *t* that is comprised of properties of type *k* (where the subscripts refer, respectively, to the Apartment, Health Care, Hotel, Industrial, Office, and Retail property types and ), denotes the common (systematic) change in the market values for properties of type *k* during period *t*, and encompasses idiosyncratic sources of change in the unlevered stock price for REIT *i* during period *t*. Similarly, if the relevant asset groups consist of the four regions of the U.S., then

( 2 )

where the subscripts denote East, Midwest, South, and West and .[[9]](#footnote-9)

If represent the change in market values of asset groups that are held across multiple REITs during period *t*, then we can estimate them by regression using data from the entire collection of REIT constituents:

( 3 )

whereis an *N*x1 vector giving the percentage change in unlevered stock prices during period *t* for each of *i*=1,…,*N* REITs; is an *N*x*K* matrix representing the weight of each asset group *k*=1,…,*K* in the total asset portfolio held by REIT *i* during period *t*; is a *K*x1 vector giving the common (systematic) percent return on assets during period *t* for each asset group *k*; and is an Nx1 vector of unsystematic sources of return.

It is reasonable for several reasons to suppose that the relationships described in equations (1) and (2) will hold more precisely for larger than for smaller REITs: for example, larger REITs are more likely to be followed by a robust community of equity analysts, and more likely to be held by sophisticated institutional investors who may be more skilled at evaluating the values of individual properties and assigning the correct derivative values to the REIT stock prices. To reflect this source of cross-sectional heterogeneity in the variance of the error term, we estimate the common (systematic) changes in asset values using generalized least squares:

( 4 )

where is a *K*x1 vector giving the period-*t* estimated return on assets for each of *K* asset groups and is a diagonal matrix of regression weights in which the weight in any cell (*i*,*i*) is equal to the inverse of the square root of the enterprise value of REIT *i*, where enterprise value is equal to the sum of equity market capitalization and book value of total debt and the weight in every off-diagonal cell (*i*,*j*) is zero.

Note that we could have selected a different proxy for cross-sectional variance in the error term, such as equity market capitalization rather than enterprise value; more importantly, note also that the ***X*** matrix does not depend on any REIT’s capital structure. Because of this, we can substitute return on equity—that is, observed change in REIT stock prices taking into account the effects of leverage applied to property-level price changes—for return on assets in equation (4) to derive a different set of coefficients that we would interpret as the change in equity value for investments in each asset group made through each REIT’s capital structure:

( 5 )

whereis an *N*x1 vector giving the percentage return on equity during period *t* for each of *i*=1,…,*N* REITs and is a *K*x1 vector giving the period-*t* estimated return on equity for each of *K* asset groups.

For practical purposes—especially given that the illiquidity of institutional-quality commercial properties means that the matrix ***X*** changes only very slightly on most days, while transaction costs associated with debt and equity issuances mean that the same is true for enterprise value and the matrix —the most important source of day-to-day variation in and are, respectively, variation in and. Thus we compute a matrix of constituent weights that are held constant between reweighting events:[[10]](#footnote-10)

( 6 )

where ***W*** is an *n*x*k* matrix of index weights in which each row represents a set of weights for REIT *i* and each column represents weights such that .

An index of property values is simply a time-series of estimates across *t*, while an index of equity investment values is simply a time-series of estimates across *t*. Finally, note that although for expositional purposes we have discussed only using the change in REIT stock prices to infer the change in underlying property values, the same methodology can be applied to use REIT stock total returns to infer total returns of the underlying properties.

It is very important to note that, although the constituent weights sum to 100% across all REITs for any asset group *k*, the individual weights (that is, the elements of the ***W*** matrix) are not constrained to the interval [0,1]. That is, the weight for an individual REIT can be negative, or greater than 100%. In fact, negative weights are critical to the performance of the index, as they enable the effects of every other asset group on each REIT’s stock price to be eliminated when estimating the implied return to one particular asset group.

Table 1 illustrates this by showing a set of weights computed for the Apartment property type during November 2014. Thirty-four REITs have positive weights, with the largest associated with Equity Residential (+15.516%) and AvalonBay Communities (+13.442%), two large REITs with pure Apartment portfolios. The third-largest positive weight is associated with Essex Property Trust (+10.106%), a relatively large REIT that holds an almost purely Apartment portfolio but that also has small exposures to Office and Retail properties. Ninety REITs have negative weights, but they are quite small, aggregating to just 3.67% with the largest negative weight -0.146%. Illustrating the purpose served by the negative weights in “purifying” the information contained in the stock price movements of mostly-Apartment REITs such as Essex Property Trust, among the REITs with relatively large negative weights are several with purely or primarily Office portfolios (including Alexandria Real Estate Equities at -0.146%) and others with purely or primarily Retail portfolios (including Simon Property Group at -0.082%).

Table 1: Sample Constituent Weights for a PureProperty Apartment Index

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Constituent** | **Weight** |  | **Constituent** | **Weight** | | Acadia Realty Trust | -0.022% |  | Hudson Pacific Properties | -0.082% | | Agree Realty | -0.009% |  | Inland Real Estate | -0.017% | | Alexander's | -0.021% |  | Investors Real Estate Trust | 1.096% | | Alexandria Real Estate Equities | -0.146% |  | Kilroy Realty | -0.137% | | American Assets Trust | 0.278% |  | Kimco Realty | -0.029% | | American Campus Communities | 6.720% |  | Kite Realty Group Trust | -0.023% | | Am Realty Capital Healthcare Tr | -0.021% |  | LaSalle Hotel Properties | -0.008% | | Am Realty Capital Properties | -0.055% |  | Lexington Realty Trust | -0.066% | | Apt Investment & Management | 8.064% |  | Liberty Property Trust | -0.029% | | Armada Hoffler Properties | 0.286% |  | LTC Properties | -0.018% | | Ashford Hospitality Prime | -0.004% |  | Macerich | -0.046% | | Ashford Hospitality Trust | -0.006% |  | Mack-Cali Realty | 0.081% | | Associated Estates Realty | 3.547% |  | Medical Properties Trust | -0.027% | | **AvalonBay Communities** | **13.442%** |  | Mid-America Apt Communities | 7.625% | | Aviv REIT | -0.021% |  | Monmouth Real Estate Investment | 0.004% | | BioMed Realty Trust | -0.122% |  | National Health Investors | -0.023% | | Boston Properties | -0.128% |  | National Retail Properties | -0.031% | | Brandywine Realty Trust | -0.111% |  | New Senior Investment Group | -0.015% | | Brixmor Property Group | -0.042% |  | New York REIT | -0.044% | | Camden Property Trust | 7.782% |  | Omega Healthcare Investors | -0.037% | | Campus Crest Communities | 2.388% |  | One Liberty Properties | 0.055% | | CBL & Associates Properties | -0.023% |  | Parkway Properties | -0.059% | | Cedar Realty Trust | -0.013% |  | Pebblebrook Hotel Trust | -0.006% | | Chambers Street Properties | -0.047% |  | Pennsylvania | -0.022% | | Chatham Lodging Trust | -0.004% |  | Physicians Realty Trust | -0.012% | | Chesapeake Lodging Trust | -0.005% |  | Piedmont Office Realty Trust | -0.109% | | Columbia Property Trust | -0.105% |  | Post Properties | 5.301% | | Commonwealth | -0.122% |  | Prologis | 0.024% | | Corporate Office Properties Trust | -0.047% |  | PS Business Parks | -0.058% | | Cousins Properties | 0.009% |  | Ramco-Gershenson Properties Tr | -0.018% | | DCT Industrial Trust | -0.025% |  | Realty Income | -0.046% | | DDR | -0.012% |  | Regency Centers | -0.033% | | Diamondrock Hospitality | 0.306% |  | Retail Opportunity Investments | -0.018% | | Douglas Emmett | -0.034% |  | Retail Properties of America | -0.035% | | Duke Realty | 0.016% |  | Rexford Industrial Realty | 0.002% | | EastGroup Properties | 4.505% |  | RLJ Lodging Trust | 0.005% | | Education Realty Trust | -0.073% |  | Rouse | -0.019% | | Empire State Realty Trust | -0.076% |  | Ryman Hospitality Properties | -0.007% | | Equity One | 0.019% |  | Sabra Health Care REIT | -0.021% | | **Equity Residential** | **15.516%** |  | Saul Centers | 0.052% | | **Essex Property Trust** | **10.106%** |  | Senior Housing Properties Trust | -0.036% | | Excel Trust | -0.016% |  | Simon Property Group | -0.082% | | Federal Realty Investment Trust | 0.106% |  | SL Green Realty | -0.058% | | FelCor Lodging Trust | -0.006% |  | Spirit Realty Capital | -0.033% | | First Industrial Realty Trust | 0.008% |  | STAG Industrial | 0.007% | | First Potomac Realty Trust | -0.051% |  | Strategic Hotels & Resorts | -0.007% | | Franklin Street Properties | -0.071% |  | Summit Hotel Properties | -0.004% | | General Growth Properties | -0.077% |  | Sunstone Hotel Investors | -0.007% | | Getty Realty | -0.011% |  | Tanger Factory Outlet Centers | -0.026% | | Gladstone Commercial | -0.025% |  | Taubman Centers | -0.034% | | Glimcher Realty Trust | -0.024% |  | Terreno Realty | 0.004% | | Government Properties Income Tr | -0.071% |  | UDR | 8.482% | | Gramercy Property Trust | -0.038% |  | Universal Health Realty Income | -0.013% | | HCP | -0.104% |  | Urstadt Biddle Properties | -0.013% | | Health Care REIT | -0.083% |  | Ventas | -0.077% | | Healthcare Realty Trust | -0.028% |  | Vornado Realty Trust | 0.190% | | Healthcare Trust of America | -0.031% |  | W.P. Carey | -0.042% | | Hersha Hospitality Trust | -0.005% |  | Washington Prime Group | -0.027% | | Highwoods Properties | -0.112% |  | Washington REIT | 0.669% | | Home Properties | 6.377% |  | Weingarten Realty Investors | -0.032% | | Hospitality Properties Trust | -0.009% |  | Whitestone REIT | -0.013% | | Host Hotels & Resorts | -0.016% |  | Winthrop Realty Trust | 0.595% | |  |  |  | **Sum of positive weights** | **1.0367** | |  |  |  | **Sum of negative weights** | **-0.0367** | |  |

Problem One: Constituent Weights May Trigger Market Liquidity Problems

Note from equations (4)-(6) that the size of each constituent REIT plays only a small role in determining constituent weights, through the elements of the regression weight matrix used to correct for heteroskedasticity. In practice, a REIT with a portfolio that is concentrated in a particular asset group may attain a constituent weight that is large relative to the liquidity of its shares. For example, as Table 1 shows, the HCGP methodology assigns a constituent weight of +2.388% to Campus Crest Communities, one of just 13 REITs with a pure or nearly pure Apartment portfolios. This means that the constituent weight for Campus Crest Communities is more than 15% as large as the weight for Equity Residential although the market capitalization of Campus Crest is less than 2% as large as for Equity Residential. Given the size of the Campus Crest’s constituent weight relative to its market cap, an investor wishing to invest a substantial amount of capital while replicating the index might well “move the market” or encounter other liquidity problems.[[11]](#footnote-11) This is especially true for companies with negative constituent weights, which in an investment context would imply short positions in the stock of those companies.

To address this investability problem, we modify the constituent weights shown in equation (6) to impose minimum and maximum weight constraints that are themselves functions of the liquidity of each constituent’s common stock:

( 7 )

subject to

where and are “hard” lower and upper limits on constituent weights (set, on the basis of empirical testing, at -0.1 and +0.1 respectively), is the average daily trading volume for REIT *i*, and are proportions of average daily trading volume (set at -0.2 and +0.2 respectively) used in setting liquidity-based “soft” constraints, V is a notional index size (set at $500 million), and the subscript *t* is suppressed for notational simplicity.

The first constraint shown in equation (7) says that the constituent weight associated with any given REIT *i* in any index *k* will in no case call for a long or short investment in that company of more than 10% of the capital to be invested; furthermore (and more importantly), however, the weight will in no case call for an investment that, assuming a capital investment totaling $500 million, would call for transactions exceeding 20% of the average daily trading volume for that company. While these values are set exogenously, they are based on discussions with investment bankers and investment managers active in trading and particularly in establishing derivative positions to replicate indices. It should be noted that data regarding liquidity in short positions—that is, the number of shares available to be borrowed for short sales—is particularly difficult to obtain; for this reason the notional value ($500 million) is set at a value much larger than the value commonly quoted by traders ($100 million), thereby making it unlikely that a negative weight will exceed the share-borrowing capacity of a particular stock.[[12]](#footnote-12)

For an illustration of the effect of the liquidity-based constraints, Table 2 shows weights computed for the East region index based on data from November 2012, using both the HCGP methodology and the revised (liquidity-based optimization) methodology. Seven entries shown in bold identify companies with pure East region portfolios: in all seven cases the HCGP methodology generated positive weights, based on their concentrated portfolios, that were large relative to the companies’ average daily trading volume. Seven other entries shaded in grey identify companies with substantial but (except for Boston Properties) not majority holdings in the East region, and that had adequate trading volume to support larger weights under the revised methodology.

Table 2: Comparison of Constituent Weights from HCGP and Revised Methodologies

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| |  |  |  |  | | --- | --- | --- | --- | | Constituent | HCGP | Revised | Change | | Vornado Realty Trust | 11.932% | 9.714% | -2.218% | | Boston Properties | 10.622% | 10.962% | 0.340% | | **SL Green Realty** | **9.334%** | **6.774%** | **-2.561%** | | Federal Realty Investment Trust | 5.792% | 3.711% | -2.081% | | Home Properties | 5.696% | 3.604% | -2.092% | | **Mack-Cali Realty** | **5.350%** | **2.700%** | **-2.650%** | | AvalonBay Communities | 4.936% | 5.220% | 0.284% | | **Alexanders** | **4.924%** | **0.153%** | **-4.771%** | | Brandywine Realty Trust | 4.755% | 1.826% | -2.929% | | **Washington** | **4.504%** | **1.384%** | **-3.120%** | | Corporate Office Properties Trust | 4.397% | 2.369% | -2.028% | | Pennsylvania | 3.720% | 0.567% | -3.153% | | Liberty Property Trust | 3.288% | 2.393% | -0.895% | | Alexandria Real Estate Equities | 3.252% | 3.299% | 0.047% | | **First Potomac Realty Trust** | **3.185%** | **0.379%** | **-2.806%** | | Hersha Hospitality Trust | 3.060% | 0.980% | -2.080% | | Health Care REIT | 2.769% | 2.881% | 0.111% | | Saul Centers | 2.729% | 0.270% | -2.459% | | BioMed Realty Trust | 2.701% | 2.817% | 0.116% | | **Cedar Shopping Centers** | **2.679%** | **0.217%** | **-2.462%** | | **Urstadt Biddle Properties** | **2.213%** | **0.243%** | **-1.970%** | | Highwoods Properties | 2.198% | 2.912% | 0.713% | | Acadia Realty Trust | 2.088% | 1.061% | -1.027% | | Getty Realty | 2.063% | 0.131% | -1.933% | | LaSalle Hotel Properties | 1.937% | 2.123% | 0.185% | | Tanger Factory Outlet Centers | 1.807% | 1.887% | 0.080% | | Sabra Healthcare | 1.284% | 0.559% | -0.726% | | CBL & Associates Properties | 1.284% | 1.325% | 0.042% | | Apartment Investment & Management | 1.156% | 1.236% | 0.080% | | DDR | 1.145% | 1.177% | 0.032% | | Senior Housing Properties Trust | 1.141% | 1.204% | 0.062% | | Equity Residential | 1.141% | 1.919% | 0.778% | | CommonWealth | 1.139% | 1.362% | 0.223% | | UDR | 1.000% | 1.536% | 0.536% | | DiamondRock Hospitality | 0.966% | 1.110% | 0.144% | | Kimco Realty | 0.894% | 0.942% | 0.048% | | Host Hotels & Resorts | 0.854% | 0.852% | -0.002% | | PS Business Parks | 0.768% | 0.699% | -0.069% | | Colonial Properties Trust | 0.700% | 1.180% | 0.480% | | PiedmontOfficeRealtyTrust | 0.687% | 1.552% | 0.865% | | Simon Property Group | 0.658% | 0.452% | -0.206% | | American Realty Capital Trust | 0.612% | 0.812% | 0.200% | | Retail Properties of America | 0.594% | 0.871% | 0.277% | | Taubman Centers | 0.537% | -0.615% | -1.152% | | ChathamLodgingTrust | 0.509% | 0.057% | -0.452% | | Government Properties Income Trust | 0.495% | 1.195% | 0.700% | | Pebblebrook Hotel Trust | 0.443% | 0.550% | 0.108% | | Hospitality Properties Trust | 0.402% | 0.604% | 0.202% | | Sunstone Hotel Investors | 0.390% | 0.885% | 0.495% | | OneLibertyProperties | 0.357% | 0.028% | -0.329% | | Healthcare Trust of America | 0.355% | 0.073% | -0.282% | | STAG Industrial | 0.343% | 0.616% | 0.273% | | Ventas | 0.313% | 0.241% | -0.072% | | FelCor Lodging Trust | 0.291% | 0.404% | 0.113% | | TerrenoRealty | 0.290% | 0.056% | -0.234% | | Ashford Hospitality Trust | 0.268% | 0.272% | 0.004% | | CapLease | 0.243% | 0.086% | -0.157% | | ChesapeakeLodgingTrust | 0.213% | -0.045% | -0.258% | | Lexington Realty Trust | 0.152% | 1.020% | 0.867% | |  |  |  |  |  |  |  |  |

This reallocation of constituent weighting from companies with pure or near-pure portfolios in a given asset group, but relatively little liquidity, to companies with greater liquidity but a greater share of holdings outside that asset group will introduce a discrepancy between the indices estimated using the two methodologies, and is likely to attenuate the differences across asset groups. Graph 2, for example, compares sample index histories computed for the East and West regions under the HCGP and revised methodologies. The index computed under the revised methodology did not reveal as much strength in East-region property returns (Graph 2A) during the 2009-2011 market recovery as did the index computed using the HCGP methodology; instead, the revised methodology attributed some of that relative strength to the West region (Graph 2B).

While the HCGP methodology is certainly likely to provide a superior benchmark for purely informational purposes, the fact that the revised methodology avoids or ameliorates market liquidity issues is equally likely to prove beneficial for portfolio risk management purposes.

Graph 2: Sample PureProperty Histories Under HCGP and Revised Methodologies

The HCGP Delevering Methodology

As noted, the constituent weights computed under the HCGP methodology (as well as under the revised methodology) can be post-multiplied either by a vector of delevered returns on assets () to generate the estimated change in market values for each group of assets () or by a vector of returns on equity ()—that is, actual stock price changes—to generate the estimated change in equity investment values for each group of assets () after the effects of leverage employed in the capital structure of each REIT. Return on assets, of course, can be recovered from return on equity using the weighted average cost of capital (WACC) accounting identity:

( 8 )

To produce an asset-return index, then, HCGP collected information from each REIT on the proportions of equity and debt in its capital structure and estimated the average cost of debt during each period (with periods defined by reweighting triggers as mentioned above) to derive return on assets for each REIT.

While this approach is satisfactory for producing a benchmark or other information product, it is wholly unsatisfactory for an investment product designed to enable investors to replicate the returns of unlevered commercial property investments on the basis of the levered returns of REITs.

The use of leverage by a REIT, of course, entails (1) borrowing capital to increase the aggregate value of assets that can be purchased and (2) making periodic debt payments on that borrowed capital, while (3) the market value of the debt held as liabilities on the REIT’s balance sheet will be affected by changes in the cost of that debt. For an investor to eliminate the effects of leverage, then, requires reversing them by (1) lending capital equal in value to the borrowed capital and (2) receiving debt payments on that lent capital, while (3) the market value of the loans held as assets on the investor’s balance sheet will be affected by the same changes in the cost of debt.

In effect, then, investors hoping to use the PureProperty index series to replicate unlevered property investments would (under the HCGP methodology) be given information regarding (1) the aggregate borrowed capital to be matched by lent capital, along with instructions regarding (2) the periodic debt payments that they should aim to receive on the lent capital and (3) the interest rate sensitivity (duration) that they should aim to match. Given the difficulty of matching the credit quality and other attributes of REIT borrowers—not to mention the illiquidity of the bond market—it would be practically impossible for investors to achieve a return pattern replicating unlevered returns on commercial property assets without considerable tracking error.

To address this second investability problem, we think of a delevered investment portfolio as a blended portfolio of investments in stocks (of companies that borrow some capital) and bonds (representing the lending that will reverse the effects of that borrowed capital). We transform the relative REIT constituent weights into absolute weights taking into account the aggregate debt used by REIT constituents:

**( 9 )**

where is the weight of REIT *i* in index *k* computed from the optimization shown in equation (7) where , is the delevered weight for REIT *i* in index *k* where assuming that aggregate REIT leverage is positive, and represents the effective leverage in index *k* where = debt used by REIT *i* and = market cap of REIT *i*. The excess aggregate weight, , then, represents the share of total capital that will be invested in bonds to reverse the effects of leverage.

The problem is to specify investments for the bond share of the “blended portfolio” that will simultaneously reverse the effects of REIT leverage while minimizing tracking error on the part of investors seeking to replicate the property-level (unlevered) index. To accomplish this, we first compute the effective cost of debt for each PureProperty index:

**( 10 )**

We next perform a time-series regression of this effective weighted average cost of debt on the yields of bond portfolios:

**( 11 )**

where  is a *T*x1 vector of time-series observations on the effective weighted average cost of debt associated with index *k*, ***Y*** is a *T*x*J* matrix of bond portfolio yields in which each row *t=1,…,T* represents a time period and each column *j*=1,…,*J* is a bond portfolio represented either directly by an investable product (such as a bond mutual fund or bond ETF) or indirectly by an index tracked closely by an investable product,[[13]](#footnote-13) is a vector of disturbance terms, and is a Jx1 vector of relative bond portfolio weights where we impose the constraints and .

Finally, the absolute bond portfolio weights are

**( 12 )**

such that .

Preliminary empirical analysis shows that the best regression fit for REIT weighted average cost of debt, given the constraints imposed on the regression, produces a relative weight of about 80% on U.S. government bond portfolios with 10+ year maturities, with the remaining 20% on U.S. high-yield corporate bond portfolios. Graph 3 shows an example of the fitted WACD along with the two bond portfolio proxies and the underlying observations on WACD for individual REITs. Unfortunately the fit is not as close as we would prefer: government bond yields seem to be a good proxy for time-series variation in REIT WACD but not to its average level, while high-yield debt serves the function of increasing the average fitted WACD but degrades the time-series fit because REIT WACD showed significantly less variability than high-yield corporate debt especially during the 2008-09 liquidity crisis. We continue to refine the analysis.

Graph 3: REIT WACD, Proxy Bond Yields, and Fitted WACD, 2002Q4-2014Q1

The availability of a series of indices of unlevered commercial property returns, targeted by property type, region, or other asset group, each of which can be replicated without significant tracking error through fully liquid stock and bond investments, also makes it possible to achieve the same property exposures with any targeted amount of leverage. In particular, measures the effective leverage of REIT constituents in any asset group *k*. To achieve an exposure to asset group *k* with, for example, 20% targeted leverage, the investor would simply allocate to replicating the property (unlevered) index and to replicating the equity (levered) index.

Risk Management Using the PureProperty Index Methodology

The revised PureProperty index methodology gives investors a fully-investable means of replicating the total returns to commercial property investments while addressing several of the concerns outlined above:

* Returns are measured accurately, eliminating uncertainty regarding true returns, volatilities, and correlations with other portfolio assets.
* Positions are fully liquid and fully granular (scalable), as they derive from individual stock positions that are themselves fully liquid and fully granular.
* Exposures can be targeted by property type, region, and type/region combination.[[14]](#footnote-14)
* Effective leverage can be targeted easily.
* Short-sales, options, futures, and other risk management tools are entirely straightforward.

In this section we consider the remaining, and perhaps most important, objection to REIT-based real estate investing, and also note several potential applications of the PureProperty index series in real estate portfolio management.

*Is REIT-Based Investing More Volatile than Illiquid Real Estate Investing?*

As noted, the volatility of returns on illiquid commercial property investments is reported to be extraordinarily low (4.33% per year according to the NCREIF Property Index), implying exceptionally strong risk-adjusted returns (Sharpe ratio 1.05 for the NPI on the basis of gross returns, 0.81 using estimated net returns). In contrast, the volatility of returns on exchange-traded equity REITs is much higher (17.83% per year over the same period according to the FTSE NAREIT All Equity REITs Index), implying much weaker risk-adjusted returns (Sharpe ratio 0.51 using gross returns, 0.48 using estimated net returns). In fact, the risk-adjusted returns reported for illiquid real estate are so extraordinary that they have given rise to the “real estate risk premium puzzle” investigated by Lin & Vandell [2007], among others.

Of course, part of the difference in measured volatilities between the NPI and the FTSE NAREIT All Equity REITs Index is attributable to the fact that the NPI measures property-level (unlevered) returns even if leverage was used, whereas the FTSE NAREIT All Equity REITs Index measures equity-level (levered) returns. To eliminate this definitional difference, Graph 4 compares the NPI total return and capital appreciation indices with the PureProperty return-on-asset indices (while including the PureProperty equity indices for comparison).

Graph 4: Comparison of NPI and PureProperty Indices

Total Return and Capital Appreciation, 12/31/1999 – 12/4/2014

It is clear that the PureProperty index series reveals much greater volatility, even when returns have been corrected for the effects of leverage. On the other hand, the fact that the PureProperty indices are computed daily, while the NPI is measured only quarterly, may introduce a false “optic” difference. Graph 5 dispels this possibility by restricting the comparison to quarterly observations: clearly the REIT-based indices measure substantially greater volatility even after correcting for leverage and focusing only on quarterly returns.

Graph 5: Comparison of NPI and PureProperty Indices

Quarterly Total Return and Capital Appreciation, 1999Q4 – 2014Q3

The answer, of course, is that any index of returns for illiquid assets, including the NPI, fails to measure fully the volatility of returns for those assets. In fact, volatilities measured by return indices for illiquid assets suffer from three main sources of bias:

* First, valuing non-traded assets such as commercial properties is an expensive and time-consuming process and so is typically done infrequently: annual “full” appraisals are common in the commercial real estate industry (and triannual was the norm until recently), with simple extrapolations common between appraisals. The reliance on “stale” appraisals for computing quarterly returns introduces what may be termed “non-appraisal smoothing.” In contrast, market values of liquid assets such as REIT stocks are revealed near-continuously through frequent arms-length transactions.
* Second, even when “full” appraisals are performed, appraisers themselves are subject to anchoring and similar behavioral biases (Hansz [2004]): in particular, appraisers appear to attach substantial weight to known prior appraised values relative to *de novo* estimates of current market values. These behavioral biases introduce what may be termed “appraisal smoothing.”
* Finally, even when market values are revealed by transactions, for illiquid assets such as commercial properties there are not enough transactions to estimate a daily return index: rather, transactions occurring over a broader time period must be aggregated to produce, for example, a monthly or quarterly index (Geltner [1993]). In effect (although not in mathematical fact), the index value for a particular month or quarter reflects an average of all assets transacting during that month or quarter, introducing what may be termed “illiquidity smoothing.” In contrast, for liquid assets such as REIT stocks daily, monthly, or quarterly returns are computed “end-to-end”—that is, on the basis of only the last transaction observed for that day, month, or quarter.

To eliminate the effects of appraisal smoothing and non-appraisal smoothing, the volatility of commercial property returns can be estimated using indices based only on observed property transactions. One such index is the NCREIF Transaction Based Index (NTBI), which measures quarterly total return and capital appreciation based on the subsample of transacting properties from the data set used to compute the NPI. Because the NTBI index series measures property-level (unlevered) returns, Table 3 compares annualized volatilities of quarterly NTBI returns and quarterly returns measured by the corresponding PureProperty (unlevered) indices over the period 2000Q1-2014Q3 for which both index series are available. In each comparison, the index showing the smaller volatility is shaded. The comparisons reveal that the volatility of unlevered commercial property investments measured on the basis of transaction values rather than appraisals is essentially identical to the volatility of unlevered commercial property investments measured on the basis of REIT stock price movements.

Table 3: Volatility Comparison of PureProperty and NTBI Index Returns

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Capital Appreciation | | Total Return | |
| PureProperty | NTBI | PureProperty | NTBI |
| Apartment | 10.45% | 10.67% | 10.53% | 10.74% |
| Industrial | 12.50% | 10.48% | 12.61% | 10.61% |
| Office | 10.43% | 10.62% | 10.53% | 10.62% |
| Retail | 11.18% | 10.91% | 11.28% | 11.07% |
| East Region | 11.28%\* | 10.91% | 11.39%\* | 10.04% |
| Midwest Region | 9.92%\* | 9.99% | 9.97%\* | 10.06% |
| South Region | 10.68%\* | 10.27% | 10.77%\* | 10.36% |
| West Region | 11.60%\* | 10.68% | 11.68%\* | 10.73% |
| **Aggregate** | **10.48%**\* | **10.54%** | **10.58%**\* | **10.62%** |

\*Includes health care and hotel properties, which are slightly more volatile.

It is important to note that the returns measured by the NTBI and summarized in Table 3 suffer from the “illiquidity smoothing” described above as a product of temporal aggregation of infrequent transactions, whereas the PureProperty indices are measured end-to-end and suffer from no such smoothing. It is possible to replicate the effect of temporal smoothing using indices based on frequent transactions by, for example, averaging index values over the same time periods. Applying such artificial illiquidity smoothing to the PureProperty indices reduces their measured volatilities considerably: for example, the volatility of total returns for the “temporally aggregated” aggregate PureProperty index is 8.81%, more than one-tenth less than the “non-temporally-aggregated” PureProperty volatility of 10.58%.

Is it believable that the returns of commercial property investments based on exchange-traded REIT stock price movements are actually *less* volatile than the returns of non-traded commercial real estate assets, even though REIT stock price movements may be affected by “spill-over” from non-REIT companies in the stock market (Ambrose, Lee & Peek [2007])? In fact, I argue that it is to be expected. Volatility reveals uncertainty in asset values. During a market crisis, for example, volatility typically surges because investors become much more uncertain regarding the future stream of earnings likely to be produced by a given asset as well as the future stream of discount rates. A market in which frequent, transparent, arms-length transactions of homogeneous assets reveal greater information to investors and prospective investors regarding asset values and their underlying drivers should be less volatile than a market that is rendered informationally inefficient by the scarcity and opacity of transactions of heterogenous assets.

In short, perhaps the most influential reason why many institutional investors have concentrated their real estate portfolios in illiquid assets (properties, as well as private equity real estate fund shares) rather than liquid assets (exchange-traded REIT stocks) appears to be a basic falsehood: the supposition that illiquid real estate is less volatile than liquid real estate. In contrast, the PureProperty index methodology makes it possible for investors to measure accurately the actual volatility of real estate positions, including property-level (unlevered) exposures as well as equity-level exposures with varying degrees of leverage.

*Portfolio and Risk Management Applications of the PureProperty Index Series*

I close by briefly noting several potential uses of indices based on the PureProperty methodology to real estate portfolio management and real estate portfolio risk management.

*Strategic Portfolio Allocation.* The most straightforward application is simply to use the PureProperty index series as a way to make strategic real estate investments while taking advantage of the liquidity and granularity (scalability) of REIT-based property investing. The liquidity of PureProperty investments means that transaction costs should be a small fraction of those associated with property transactions, and that exposures can be rebalanced at any desired frequency. Moreover, there is ample evidence that REIT-based returns have outpaced the returns on otherwise similar institutional real estate investments: for example, the average total return measured by the aggregate (unlevered) PureProperty index over the available period 2000Q1-2014Q3 exceeded the compound average total return measured by the NTBI by 56 basis points per year (9.39% *vs* 8.83%) even before taking into account a difference in investment costs of approximately 50 basis points per year.[[15]](#footnote-15)

*Tactical Portfolio Allocation.* Tactical allocation is virtually impossible with illiquid assets except over very long deployment periods. In contrast, the liquidity and small transaction costs of investments through the PureProperty index series, as well as the ability to target exposures by property type, region, or type/region combination, offer the potential for very rapid—even daily—tactical moves to take advantage of temporary mis-pricings or emerging information regarding real estate operating fundamentals.

*Portfolio Completion*. Many institutional real estate portfolios are partially diversified by property type and/or location, but lack holdings in a particular segment of the real estate market. Completion of such portfolios through illiquid investments would be hindered by the lengthy transaction process, large transaction costs, and non-granularity of the direct property market; in contrast, the PureProperty methodology enables real estate exposure to be targeted by property type, region, type/region combination, or potentially other ways of segmenting the market.

*Portable Alpha.* Some private equity real estate investment managers may have exceptional skill in identifying assets with *ex ante* idiosyncratic outperformance, but only in certain segments of the real estate market. The opportunities for targeting real estate exposures through the PureProperty index series make it possible for investors to take advantage of such narrow alpha-generating capabilities while recovering real estate market beta from the remaining segments of the market.

*Synthetic Leveraging/Deleveraging.* As noted, the combination of property-level (unlevered) and equity-level (levered) indices enables investors or investment managers to target a preferred amount of leverage in real estate investments. Investors or investment managers may be able to make use of these capabilities for tactical shifts between low and high amounts of leverage in real estate. Alternatively, they can invest in assets with leverage either lower or higher than the preferred level and then adjust the leverage with exposure to the same segment of the real estate market through either the property- or the equity-level PureProperty index for that market segment.

*Short Selling.* The fact that properties cannot be sold short means that investors have no practical way of acting on predictions of poor real estate returns going forward; moreover, portfolio managers have no way of hedging their real estate exposures. The PureProperty indices make explicit use of short positions in REIT stocks—not for tactical or hedging purposes, but rather to “purify” exposures to a given segment of the real estate market.[[16]](#footnote-16) Given that they derive from REIT stocks that themselves can be sold short, it would be at least conceptually straightforward to take a short position in a segment of the real estate market through the relevant PureProperty index.

*Swaps and Similar Derivatives.* A nascent market in swaps based on the NPI disappeared shortly after its attempted launch (as did a similar market in the U.K.) primarily because of multiple product design problems that suppressed liquidity in the market:

* The underlying NPI is appraisal-based and therefore subject to both random and systematic error (averaging 12% and 5% respectively, according to Cannon & Cole [2011]) in reporting asset values.
* The investment managers most likely to take positions in swaps indexed to the NPI are also those most able to influence index values through their decisions regarding the number, timing, and selection of properties to be appraised.
* The NPI is reported quarterly, implying very large margin requirements to protect against adverse intra-quarterly changes in the values of derivative positions.
* Reported movements in the NPI lag behind movements in underlying asset values by approximately four quarters on average, making it possible for all potential counterparties to predict index movements.
* The underlying asset portfolio is not investable, making it impossible for market participants to hedge their positions and requiring counterparties to be identified for all transactions.

The PureProperty index series resolves each of these market shortcomings: the index is based on actual transactions that cannot realistically be affected by the data reporting activities of potential counterparties; there is no measurement or reporting lag, and margin requirements would be a small fraction because of daily index recomputation; and the underlying index is explicitly investable, so it would be straightforward for prospective counterparties to hedge their positions.

*Backward-Forward Trading Contract.* Finally, in connection with the development of the PureProperty Index Series the inventors also developed the “backward-forward trading contract,” which makes it possible for investors to generally replicate the lag and smoothing characteristic of an appraisal-based index such as the NPI through a derivative contract tied to the PureProperty index. In particular, counterparties can enter into a forward contract, the value of which is determined at a specified future date according to a (backward-looking) lagged moving average of a given PureProperty index. Because the underlying is investable, the selling party can hedge the exposure; moreover, because REIT-based returns have consistently outpaced returns on non-REIT property investments, the spread between the two segments of the real estate market can potentially compensate both parties for the risks associated with such lag and smoothing.

Summary

While the original version of the PureProperty index developed by Horrigan, Case, Geltner & Pollakowski (HCGP) represented an important step forward in the measurement of returns from real estate investments targeted by property type, location, and preferred leverage, two main shortcomings of the HCGP methodology prevented its adoption for investment purposes. In this paper I describe important revisions—use of explicit liquidity-based optimization in computing index constituent weights, and use of investable bond portfolio indices in the deleveraging methodology—that transform the HCGP methodology into one that is fully liquid and fully investable without significant tracking error. With these important methodological improvements, I believe that the PureProperty index series constitutes an important improvement in the set of tools available to real estate portfolio managers for strategic and tactical investment and risk management purposes—an improvement that could potentially bring about a marked increase in allocations to the real estate asset class by large institutional investors.

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1. Author’s estimate based on Florance, Miller, Peng & Spivey [2010], adjusted using Moody’s/RCA CPPI, CoStar CRSI, and FTSE NAREIT PureProperty Index. [↑](#footnote-ref-1)
2. Securities Industry and Financial Management Association (SIFMA). [↑](#footnote-ref-2)
3. World Federation of Exchanges (WFE). [↑](#footnote-ref-3)
4. Fees and other investment costs are typically much higher for real estate than for U.S. stocks or bonds. Estimating total returns assuming investment costs equal to the averages provided by Beath [2014] implies Sharpe ratios of 0.81 for institutionally owned core properties compared to 0.48 for large-cap stocks and 0.45 for bonds. Graph 1 is based on estimated net total returns. [↑](#footnote-ref-4)
5. Beath [2014] reports that listed equity REITs generated higher average net total returns than any other asset class, averaging 11.31% per year over the period 1998-2011 after deducting investment costs averaging 51.6 basis points per year. [↑](#footnote-ref-5)
6. These figures imply that listed equity REITs account for about 15% of the average institutional real estate allocation, which is approximately the same as the share of aggregate institutional-quality properties owned by listed equity REITs in the U.S.—that is, institutional investors may be weighting by market cap. [↑](#footnote-ref-6)
7. HCGP built on the earlier work of Geltner & Kluger [1995, 1998], who developed a regression-based approach [1995] and an optimization approach [1998]; HCGP showed that the two approaches are mathematically identical under conventional assumptions. [↑](#footnote-ref-7)
8. For expositional simplicity we will ignore dividend distributions and focus only on stock price appreciation, returning later to note that the methodology applies to total returns as well. [↑](#footnote-ref-8)
9. It should be evident that the set of *K* asset groups must encompass all those held (to any significant degree) by any of the *N* REITs; for this reason, in practice the constituents of the PureProperty index series are limited to those REITs whose assets are primarily of the six property types listed and located in the four U.S. regions listed. [↑](#footnote-ref-9)
10. This is not strictly true: the weights are allowed to “drift” daily as a result of relative out- or under-performance by individual constituents. Note that the weights for market capitalization-weighted indexes also drift daily (or intra-daily) as stock price returns change market capitalizations; the difference is that such drift is the only source of change in weights for market-cap indices whereas it is a minor source of change for PureProperty indices. Market-cap-based weight adjustments are very straightforward in practice, but the same is not true for indexes that are not strictly market cap-weighted, including free-float adjustments to market cap weightings as well as index weights based on fundamental measures such as sales or earnings, for which, as in this application, the relevant data typically do not change on most days and are not observable on a daily basis. [↑](#footnote-ref-10)
11. This problem is especially severe for REITs whose portfolios are concentrated in asset groups that are not well represented in the portfolios of other REITs. For example, as of November 2014, Apartment properties located in the Midwest region accounted for just 1.1% of listed equity REIT portfolios on average, but about one-fourth of the portfolio for Campus Crest Communities. Because of this, Campus Crest Communities would receive a weight of 35% in the Midwest Apartment index under the HCGP methodology. [↑](#footnote-ref-11)
12. For the purpose of computing the index back-history, the pre-2006 notional value was reduced by the average growth rate of ADTV, about 11% per year. [↑](#footnote-ref-12)
13. In practice, for regulatory reasons we use bond indices rather than investable products. [↑](#footnote-ref-13)
14. The FTSE NAREIT PureProperty Index Series currently includes indices for East Region Apartment, Midwest Region Apartment, South Region Apartment, West Region Apartment, East Region Office, Midwest Region Office, South Region Office, West Region Office, East Region Retail, Midwest Region Retail, and South Region Retail, in addition to the six property types and four regions identified. Elonen [2013] explored the feasibility of applying the PureProperty methodology to European portfolios and concluded “that the currently available data on European REITs and other real estate investment companies may well enable the construction of a number of sector, country, as well as country-specific sector indices for the key European real estate markets.” [↑](#footnote-ref-14)
15. Also see Riddiough, Moriarty & Yeatman [2005], Paglari, Scherer & Monopoli [2005], Tsai [2007], and Ling & Naranjo [2014], each of which compared listed equity REIT returns to unlevered property returns as measured by the NCREIF Property Index after controlling for differences in leverage and property mix. [↑](#footnote-ref-15)
16. The aggregate (nationwide, all property) PureProperty indices, however, include no short positions. [↑](#footnote-ref-16)