Geographic Portfolio Allocations, Property Selection, and Performance Attribution in Public and Private Real Estate Markets

by

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Abstract:

This paper examines the effects of geographic portfolio concentration on the return performance of U.S. public REITs versus private commercial real estate over the 1996-2013 time period. We document significant cross-sectional and temporal differences in the geographic concentration of property holdings across public and private real estate markets. Adjusting private market returns for differences in geographic concentrations with public markets, we find that core private market performance falls. This performance drop arises primarily from lower geographically adjusted retail performance. In contrast, geographically adjusted industrial and office property performance rises slightly while apartment performance remains relatively unchanged. Using return performance attribution analysis, we find that the geographic allocation effect constitutes only a small portion of the total return difference between public and private market returns, whereas individual property selection within geographic locations explains, in part, the documented outperformance of public versus private real estate market returns. This result also suggests that the decision to allocate to a geographic location is relatively less important than the manager's ability to select and manage properties within that location.

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1. Introduction

The ability to transform illiquid assets into more liquid assets through the issuance of investment securities has been a major financial innovation. This innovation has played a fundamental role in the allocation of capital and resources as well as market efficiency. However, this transformation raises an important question: do investors achieve similar risk and return outcomes by investing directly in the illiquid assets versus indirectly through a more liquid security? Real estate investments provide an important, on point, case. Both direct private and stock exchange-listed REITs can provide investors with exposure to the same underlying local property markets. In each case, returns to investors are primarily a function of the income streams generated by the property portfolio and fluctuations in the appreciation component of property values. However, in evaluating the relative *ex post* investment performance of listed REIT and private commercial real estate (CRE) markets, it is critical to control for differences in the underlying characteristics of the two markets and their benchmark return indices. For example, return performance in the private commercial real estate market is often proxied by the National Council of Real Estate Investment Fiduciaries (NCREIF) Property Index (NPI). However, differences in property mix and the treatment of leverage and management fees, compared to that of listed REIT market indices, may lead to incorrect performance comparisons and inferences between private and public markets.

Several prior studies find that investments in direct private real estate, as proxied for by the NPI, produce lower average returns than comparable investments in publicly-traded real estate investment trusts (REITs), even after adjusting for differences in financial leverage, property mix, and management fees (Pagliari, Scherer, and Monopoli, 2005; Riddiough et al., 2005). More recently, Ling and Naranjo (2015) find that passive portfolios of unlevered core REITs (unconditionally) outperformed their private market benchmark by 49 basis points (annualized) from 1994 to 2012. Although Ling and Naranjo (2015) and the aforementioned studies carefully control for (firm-level) leverage, property type, and management fees in their comparisons of public and private market returns, they do not adjust for differences in the geographic composition of property portfolios across markets.

The need to adjust for Metropolitan Statistical Area (MSA) geography at the portfolio level is not well-motivated from a financial economics perspective.[1] In theory, idiosyncratic MSA risk is diversifiable.

[1] In June of 2003, the U. S. Office of Management and Budget (OBM-https://www.whitehouse.gov/omb/inforeg_statpolicy#ms) adopted new standards for Metropolitan Areas and established Core Based Statistical Areas (CBSA). These standards replace and supersede the previous standards used to define Metropolitan Statistical Areas (MSA). CBSAs are divided into two categories: Metropolitan Statistical Areas and Micropolitan Statistical Areas. A MSA is a CBSA associated with at least one urbanized area with a population of at least 50,000, based on the 2000 Census. As of June 6, 2003, the OMB has defined a total of 362 Metropolitan Statistical Areas that incorporate 1,090 counties, containing approximately 83% of the US population.

Thus, we would not expect to observe large variations in *ex ante* risk premiums across MSAs among otherwise similar properties. However, significant variation in *ex post* MSA returns suggests that relative performance differences may be driven by the timing and selection of geographic market entry and exit. As a result, an important unanswered question in the literature remains; to what extent are the measured performance differences between equity REITs and the private direct market attributable to the magnitude and timing of MSA-level property sector allocations?

Recent research suggests that certain institutional features of public REIT markets may inhibit a manager's ability to vary geographic allocations in accordance with real estate cycles. For example, Muhlhofer (2013) focuses on the so-called "dealer rule" as a trading constraint that prevents certain REITs from consistently generating appreciation returns from portfolio disposition decisions. Muhlhofer (2015) extends this analysis to examine how these disposition constraints may hinder a REITs ability to time the property market. Furthermore, Hochberg and Muhlhofer (2014) find little evidence that REIT managers have the ability to time property type and geographic market entry and exit. This line of research has two important implications. First, in the presence of trading constraints, geographic allocation differences across markets have the potential to be persistent. Second, if REIT managers are, in fact, limited in their ability to allocate to geographies in a timely manner, it is important to understand the proportion of their relative performance attributable to geographic allocation versus asset selection within a particular location.[2]

This paper contributes to the existing literature by addressing the extent to which public and private market performance differences are attributed to differences in the geographic distribution of REIT-owned properties relative to NCREIF properties. To the extent that portfolio managers actively shift geographic and property type allocations to time real estate cycles and also vary in their ability to select value-adding properties within property types and geographic regions, relative performance can differ significantly between these two markets. We also contribute to the broader geographical allocation effects literature by documenting the influence of geographic allocation effects on both the measurement and evaluation of relative return performance across public and private commercial real estate markets.

In our analysis, we employ a two-stage approach to examine the role that the geographic compositions of REIT and private market property portfolios have on relative return performance. We first examine the extent to which geographic allocations within property type vary across publicly-listed and private CRE markets. We then evaluate the impact that controlling for geography has on relative

[2] In a similar line of research that focuses on REIT security selection rather than property selection, Cici et al. (2011) find that fund managers generate significant positive alpha with their selection ability but that geographic concentration strategies do not explain the selection outperformance.

return performance. An important difference in our approach from that of many prior studies (e.g., Ling and Naranjo, 2015) is that we adjust the geographic composition of the benchmark NPI index to mirror that of our public market REIT portfolio.[3] With these careful refinements, we then compare geographically reweighted NPI returns to unlevered REIT returns and thereby assess the relative performance of "geographically identical" public and private market portfolios.

We attribute residual performance differences after geographically reweighting NPI returns to property (asset) selection and management (operational, transaction, and corporate) within MSAs. Operational management is important because properties are typically held for long periods of time and generate much of their total return from periodic cash flows as opposed to price appreciation (Geltner, 2003).[4] The management of the transaction can also add or destroy value. It is difficult in illiquid and segmented private real estate markets to determine true market value and therefore reservation prices. Moreover, the transaction process is often complex and its outcome influenced by the negotiation skills of the buyer and seller. At the corporate level, REIT managers can also affect stock prices by their management of dividend policy and capital raising decisions.

In addition to operational, transaction, and entity-level management, we recognize that residual performance differences could also be partially attributable to time-varying volatility and liquidity risk premiums. For example, it is well documented that equity REIT returns respond to movements in the general stock market, especially in the short-run. This stock market-induced volatility can cause REIT returns to be more volatile than the underlying value of REIT assets (Clayton and MacKinnon, 2003). This additional layer of volatility, if priced by the capital markets, may generate higher risk premiums and therefore higher *ex post* returns. Furthermore, publicly-traded REITs are more liquid investments than direct ownership of commercial real estate. This liquidity is valuable and therefore reduces the *ex ante* risk premium required by REIT investors. The volatility and liquidity risk premium effects are at least partially offsetting and their time-varying magnitudes are difficult to estimate. Thus, they may too account for a portion of observed *ex post* pubic versus private market performance differentials.[5]

[3] Riddiough et al. (2005) note that differences in index composition related to geographic asset allocations may be an important source of return differences across markets. However, the authors cite a lack of reliable data on asset holding locations during their sample period as a primary reason for this omission from their analysis.

[4] Operational management functions include marketing and leasing as well as the management of operating expenses and capital expenditures.

[5] In our comparison of relative performance, we also recognize that return differences may still be related to other index composition issues such as the proportion of development properties in each portfolio or differences in property subtype allocations. As of the beginning of 2013, development properties with available estimated cost data constituted approximately one percent of properties in the REIT property portfolio, thereby mitigating concern that they are a major driver of relative performance differences. To address whether differences in property subtype allocations influence our main findings, we later perform an additional robustness check within the Retail sector and find similar results.

To measure the MSA risk exposures of publicly-traded equity REITs, we first obtain time-varying property level location data from SNL's Real Estate Database. From this information, we compute the percentage allocations of equity REIT portfolios to each MSA at the beginning of each year. This allows us to compare the MSA concentrations of publicly-traded REITs, by core property type (i.e., apartments, industrial, office, and retail) and for all core properties, to the MSA concentrations of the properties in the NCREIF database over the 1996-2013 sample period. We then calculate the extent to which adjusting for these differences in MSA exposure affects the NPI returns reported by NCREIF. This is accomplished by obtaining quarterly MSA-level NCREIF NPI returns for the four core property types and then reweighting these MSA-level returns to create returns for each core property type using the same time-varying MSA weights observed in the REIT data.

We document significant differences in geographic allocations of property portfolios between listed REIT and private markets. These differences vary significantly over time and across property type classifications. We further establish the extent to which accounting for time-series and cross-sectional differences in the geographic concentrations of the properties held by core equity REITs and NCREIF investors affects performance comparisons across markets. Adjusting private markets for differences in geographic concentrations with public markets, we find that core private market performance falls. Focusing on property types, we find the biggest return difference in the retail sector. The benchmark average return for retail NPI properties is 10.6 basis points lower than the corresponding unadjusted quarterly NPI return over our sample period; thus, its use in place of the unadjusted (published) NPI retail return increases the measured outperformance of REIT investors. In contrast, the reweighted mean returns for industrial and office properties are 1.9 and 4.4 basis points, respectively, greater than the corresponding unadjusted quarterly NPI return. Thus, using reweighted returns slightly decreases the average performance of industrial and office REITs relative to the performance of NCREIF investors in these property types over the 1996-2013 sample. NPI returns for apartment properties over the full sample period remain unchanged after reweighting by geography, though significant differences emerge over shorter investment horizons.

In addition to providing an improved methodology for comparing public and private market portfolio returns, our geographically reweighted indices also enable us to use attribution analysis to isolate the extent to which measured performance differences between listed equity REITs and the NPI benchmark are attributable to MSA-level property sector allocations. While conditional return-based investment performance regression analysis can estimate risk-adjusted alphas and identify style tilts, it is limited in its ability to decompose investment returns into potential manager value-added dimensions

such as sector/MSA allocation and asset selection. However, this decomposition is important in providing a clearer understanding of investment return sources.[6]

We find that the MSA allocation effect constitutes a small portion of the total return difference across public and private commercial real estate markets. This indicates that decisions to allocate to particular MSAs are relatively less important than other determinates of return differences, including the manager's ability to select and manage properties within that MSA. This is consistent with Capozza and Seguin's (1999) positive selection effect hypothesis. This result holds across a variety of sample periods and within property type and subtype classifications.[7] However, the sign and magnitude of the pure allocation effect varies significantly over the sample period and property type being examined.

Regarding the fundamental question of whether investors achieve similar risk and return outcomes by investing in listed equity REITs versus investing directly in the private market, our results suggest that listed equity REITs are real estate. This is especially true as the length of the investment horizon increases and short-term return differences driven by stock market-induced volatility and time-varying liquidity in the listed market dissipate.

The remainder of the paper proceeds as follows. The next section provides an initial comparison of public and private market performance over the 1996-2013 sample period without adjustments for differences in geographic allocations across markets. Section 3 describes our MSA level data and discusses our methodology for adjusting benchmark returns for differences in MSA concentrations. Section 4 presents a formal attribution analysis that examines the extent to which differences in *ex post* returns between public and private markets are attributable to differences in MSA allocations. Section 5 provides the results of a number of robustness checks addressing issues of sample period dependence and property subtype analyses. We provide concluding remarks in the final section. Details of the de-

[6] The investment performance evaluation literature is voluminous, dating back to the 1960's with conditional return-based Jensen's alpha and Sharpe ratio performance measures as well as their many multifactor model extensions (e.g., Jensen (1968), Sharpe (1964), Fama and French (1992, 1993), and Carhart (1994), among many others). However, an important concern with these returns-based model approaches is that they are joint tests of the underlying benchmark model being used and the statistical and economic significance of the measured performance. More recently, research attention has turned towards developing measures of portfolio performance that allow weights to play a more central role in the formation of the benchmark against which return performance is measured. These weights are often based on portfolio holdings and the characteristics of those holdings (e.g., Grinblatt and Titman (1989), Brinson, Hood, and Beebower (1986), Brinson, Singer, and Beebower (1991), Grinblatt and Titman (1993), Grinblatt, Titman, and Wermers (1995), Zheng (1999), Daniel, Grinblatt, Titman, and Wermers (1997), Kacperczyk, Sialm and Zheng (2005, 2008), Griffin and Xu (2009), among others). Our approach is grounded in this more recent performance attribution characteristic weighting approach, where our weights are the MSA-level REIT and private market property locations. In contrast to traditional characteristic-based approaches whose focus is on decomposing the sources of fund return performance attributable to characteristic selectivity, characteristic timing, and average style exposure (or industry), our focus is on attributing the relative performance of REITs versus private market real estate returns for each property type into asset MSA allocation and property selection.

[7] Pavlov and Wachter (2011) suggest that the selection ability of REIT managers relative to their private market counterparts should be less prominent during periods of economic growth but valued significantly during periods of economic stagnation. However, our results suggest that the selection effect is equally important in boom, bust, and recovery periods.

levering process used to create the unlevered return series for core REITs, a breakdown of our sample construction by geographic concentration measure, and a simplified example of how our methodology can provide REIT managers with an additional tool for analyzing firm-level performance are provided in Appendices A, B, and C, respectively.

2. Public vs. Private Market Returns: 1996-2013

It is well known that significant differences in financial leverage and property type mix complicates performance comparisons across public and private markets (Pagliari et al., 2005, Riddiough et al., 2005; Ling and Naranjo, 2015). To render total returns on equity REIT portfolios comparable to unlevered private market returns, it is necessary to adjust the composition and risk characteristics of publicly-traded REIT portfolios to match as closely as possible the composition and characteristics of their benchmark private market portfolios. Following the methodology of Ling and Naranjo (2015), we (1) remove the effects of financial leverage from firm-level REIT returns, (2) exclude from the final analysis those equity REITs that do not invest in core property types, and (3) construct unlevered total return series for each of the four core property classifications.[8] No explicit adjustments are made to reflect the exposure of publicly-traded REITs to stock market-induced volatility or the liquidity advantage that publicly-traded REITs enjoy relative to private market investments.

Our initial list of publicly-traded U.S. equity REITs is obtained from the CRSP-Ziman database. We collect the following data for each REIT at the beginning of each quarter: REIT identification number, property type and sub-property type focus, and equity market capitalization. We also obtain levered monthly total returns for each REIT in our sample from CRSP-Ziman, which we then compound to produce the levered total return on equity for each REIT in a particular quarter.

We obtain the balance sheet and income statement information necessary to unlever quarterly returns at the firm level by merging our initial REIT sample with data collected from the quarterly CRSP/Compustat database. A detailed explanation of the delevering process and property type adjustments used to create the unlevered return series for core REITs is available in Appendix A.

Our primary source of return data in the private CRE market is the National Council of Real Estate Investment Fiduciaries (NCREIF). Established in 1982, NCREIF is a not-for-profit industry

[8] A REIT is included in our retail index if it is classified by CRSP-Ziman as having a property type focus of 9 (retail) and a sub-property type focus of 5 (freestanding), 14 (outlet), 15 (regional), 17 (shopping center), or 18 (strip center). Our industrial index includes REITs classified by CRSP-Ziman as having a property type focus of 4 (industrial/office) and a sub-property type focus of 8 (industrial). Our quarterly office sample includes REITs with a property type focus of 4 (industrial/office) and a sub-property type focus of 13 (office). Finally, a REIT is included in our apartment index in a given quarter if it is assigned by CRSP-Ziman a property type focus of 8 (residential) and a sub-property type focus of 2 (apartments).

association that collects, processes, validates, and disseminates information on the risk/return characteristics of commercial real estate assets owned by institutional (primarily pension and endowment fund) investors (see www.ncreif.org). NCREIF's flagship index, the NCREIF Property Index (NPI), tracks property-level quarterly returns on a large pool of properties acquired in the private market for investment purposes only. The property composition of the NPI changes quarterly as data contributing NCREIF members buy and sell properties. However, all historical property-level data remain in the database and index.

Any analysis of the relative return performance between public and private real estate returns must address the well-known smoothing and stale appraisal problems associated with the NCREIF NPI.[9] Our solution is to compare public and private market returns over time horizons of at least six years. Such an approach largely mitigates the problems associated with smoothing and stale appraisals.[10]

Since firm-level REIT returns are net of all firm-level management fees, we must also adjust downward our quarterly NPI returns because they are reported gross of management fees. According to industry sources, investment management fees as a proportion of assets under management range between 50 and 120 basis points per year in the direct private market (see, for example, Riddiough et al., 2005; Ling and Naranjo, 2015). We conservatively estimate total advisor/management fees to be 80 basis points per year (20 bps per quarter) in our formal analysis.

Table 1 reports quarterly geometric means of our unlevered equity REIT returns (Panel A), unlevered raw NPI returns (Panel B), and the difference in geometric means across property types (Panel C) for the following periods: 1996-2001, 2002-2007, 2008-2013, and 1996-2013. "Raw" NPI returns are those reported by NCREIF. The aggregate, core properties return in each panel is constructed by value-weighting the four core property type returns in each quarter using the market value property type weights of the NPI. We find that value-weighted portfolios of unlevered core REITs (unconditionally) outperform their private market benchmark by three basis points per quarter (12 basis points annually) from 1996-2013. However, comparisons of public and private market return performance are sensitive

[9] Unless a constituent property happens to sell during the quarter, the reported quarterly capital gain on an individual property within the NCREIF NPI is based on the change in the property's appraised value. Appraisal-based indices are thought to suffer from two major problems. First, estimated price changes lag changes in "true" (but unobservable) market values; this smoothing of past returns understates return volatility. Second, formal appraisals of constituent properties in the NCREIF Index by third party appraisers are usually conducted annually; the property's asset manager is responsible for updating the appraisal internally in the intervening quarters. This leads to what is commonly called the "stale" appraisal problem.

[10] In addition to the NPI, NCREIF also produces a suite of Transaction Based Indices (TBIs). An advantage of the TBI indices is that the capital gain component of the TBI in each quarter is based only on the constituent properties in the NCREIF database that were sold that quarter. The TBI indices are available from NCREIF at the national level back to 1994Q1 for multifamily, office, industrial, and retail properties. However, these core TBI indices are not available at the MSA level, which precludes their use in this research.

to the time period selected for the analysis and the property type being examined. Focusing on the comparison of our core return series, the relative outperformance of equity REITs is concentrated in the most recent recovery period (2008-2013) as REITs outperformed their private market benchmark by 60 (240) basis points quarterly (annually). However, during the 1996-2001 and 2002-2007 time periods, core REITs underperformed their private market benchmark by 11 and 41 basis points quarterly, respectively. Apartment, office, and retail REITs all outperformed the raw NPI series in the recent recovery period (2008-2013). However, in earlier sub-periods, only retail REITs (from 1996-2001) and industrial REITs (from 2002-2007) outperformed their private market benchmarks. These return comparisons further underscore the importance of controlling for the mix of property types and carefully considering the appropriate investment horizon when comparing the relative performance of REIT and private market return series.[11]

3. Differences in MSA Allocations

The return differences reported in Panel C of Table 1 control for differences in leverage, property type, and management fees. However, these return differences do not account for time-series and cross-sectional differences in the geographic concentrations of the properties held by core equity REITs and the data contributing members of NCREIF (primarily pension and endowment funds). Thus, from this comparison we are unable to determine the portion of public-private performance differences attributable to MSA allocations.

If idiosyncratic MSA risk is diversifiable, we would not expect to observe large variations in *ex ante* risk premiums across MSAs among otherwise similar properties. This expectation is borne out in a variety of survey data. For example, the *Real Estate Investment Survey*, the results of which are published quarterly in the *Real Estate Report* by the Real Estate Research Corporation (RERC), summarizes information on current investment criteria, such as acquisition cap rates, required rates of return on equity, and expected rental growth rates.[12] In 2014Q1, RERC reported required unlevered rates of return for nine property types across 48 of the most important MSAs. We focus our example on the major "gateway" MSAs, most frequently defined as Boston, Chicago, Los Angeles, New York, San

[11] Some REITs that primarily invest in one of the four "core" property types, and are therefore included in our sample, nevertheless own assets that would not be considered 'class A" properties. In contrast, the NCREIF properties used to construct the NPI are largely, if not exclusively, class A properties. To the extent REIT portfolios contain less then class A properties which, on average, are risker, we would expect mean REIT returns to be higher, all else equal.

[12] The survey respondents are a sample of CRE investors, lenders, fee appraisers, and managers in the U.S. The survey focuses on "institutional grade" assets that are owned and financed by pension and endowment funds, life insurance companies, private equity funds, investment banks, and real estate investment trusts. A distinct advantage of the RERC data is the ability to abstract required unlevered rates of return by property type and major MSA. For more details, see http://store.rerc.com/collections/real-estate-repor.

Francisco, and Washington, D.C. It is important to note that the gateway MSAs are widely thought to be less risky markets than the majority of MSAs. One reason often cited for the lower perceived risk profile of these markets is that the ability for developers to add new supply, which could reduce rents and prices, are severely constrained. In addition, these major markets are thought to be more liquid, which would in theory drive down risk premiums.

As displayed in panel A of Table 2, the mean required rate of return for apartment properties in the first quarter of 2014 was 7.28 percent; the standard deviation of required returns across these six MSAs was just 0.13 percent. For CBD office properties (panel B of Table 2), the mean required return was 7.97 percent and the standard deviation was 0.27 percent. Thus, despite differences in the expected prospects for these gateway MSAs, there is remarkably little variation in required returns in early 2104. This strongly suggests investors are unable to detect large variations in systematic risk across these major MSAs.

However, an examination of ex post MSA returns suggests something much different. For the six gateway MSAs, we obtained unlevered realized returns for the most recent six-year period (2008-2013) as well as realized returns over the full sample. The mean realized return for apartment properties in the gateway markets was 4.69 percent during 2008-2013 with a standard deviation of 3.26 percent. The mean realized return over the 18-year study period was 7.68 percent during with a standard deviation of 3.22 percent. Thus, despite significant variation in realized returns across these six markets prior to the 2014Q1 survey, market participants were not able to detect *ex ante* differences in systematic risk for these gateway markets. We observe similar relations using data for CBD office properties in panel B of Table 2. This apparent disconnect between expected returns and realized MSA returns suggests that relative performance differences may still be driven by the timing and selection of geographic market entry and exit.

To examine the importance of time-varying geographic concentrations, we collect the following data from SNL's Real Estate Database on an annual basis for each property held by an equity REIT during the period 1996 to 2013: the property owner (institution name), property type, geographic location (MSA), acquisition date, sold date, book value, initial cost, and historic cost. Our analysis begins in 1996 (end of 1995) because this is the first period for which SNL provides historic cost and book value information at the property level. Although the property composition of the aggregate REIT portfolio changes as properties are bought and sold, all historical property-level data remain in the SNL database.

Over our 1996-2013 sample, we have 517,131 property-year observations in our REIT dataset. At the beginning of 1996, equity REITs held 15,752 properties with a reported book value of over $34 billion. The corresponding property counts and book values for core equity REITs are 9,420 and $25 billion,

respectively. By the beginning of 2013, equity REITs owned 32,707 properties with a reported book value of over $419 billion. Core REITs held 15,510 properties with a reported book value of $242 billion. After excluding non-core REITs, 291,894 property-year observations remain in the sample.

To construct our time-varying measures of geographic allocations, we first sort equity REITs by their CRSP-Ziman property type and property subtype classifications. We then sort each core REIT's properties into MSA categories that mirror those tracked by the NCREIF NPI within a particular year. We compute the percentage of the REIT portfolio held in an MSA by REITs of property type f at the beginning of year T as follows:

$$GEO_{f,m,T}^{REIT} = \frac{\sum_{i=1}^{N_{m,T}}(ADLCOST_{i,m,T})}{\sum_{m=1}^{N_T}\left(\sum_{i=1}^{N_{m,T}}(ADJCOST_{i,m,T})\right)} \quad , \tag{1}$$

where $ADJCOST_{i,m,T}$ is the "adjusted cost" of property i in Metropolitan Statistical Area m at the beginning of year T. *ADJCOST* is defined by SNL as the maximum of (1) the reported book value, (2) the initial cost of the property, and (3) the historic cost of the property including capital expenditures and tax depreciation.[13] Of our 291,894 property-year observations for core REITs, 197,387 (68 percent) contain adjusted cost information.[14] The total number of properties of type f in a particular MSA at the beginning of year T is denoted as $N_{m,T}$. The total number of NCREIF MSA classifications as of the beginning of year T is denoted as N_T.

As a robustness check, we create additional time-varying geographic concentration measures for each of the four property types. First, we replace the adjusted cost of each property by its book value.[15] Of our 291,894 property-year observations, 197,387 (65 percent) contain book value information.[16] It is important to note that the use of adjusted cost or book value in place of true market values may understate the (value-weighted) percentage of the REIT portfolio that is invested in MSAs that have recently experienced a relatively high rate of price appreciation. Conversely, the use of adjusted cost or book value may overstate the percentage of the REIT portfolio in MSAs that have experienced relatively large price declines.

[13] SNL's initial cost variable (SNL Key Field: 221778) is defined as the historic cost currently reported on the financial statements, which may be different than the cost reported at time of purchase. SNL's historic cost variable (SNL Key Field: 221782) is defined as the book value of the property before depreciation.

[14] For more information on the extent to which the adjusted cost field is populated by year by property type, see Appendix B.

[15] SNL's net book value variable (SNL Key Field: 221784) is defined as the historical cost of the property and improvements, net of accumulated depreciation.

[16] See Appendix B for more detailed information.

We also consider two additional geographic allocation approaches: a simple property count measure and the square footage of properties held within an MSA. However, each of these approaches has its own limitations relative to using book value or adjusted cost. While property count allows us to maximize our sample size without any loss of observations, it does not capture relative value differences of properties within and between MSAs. Thus, to the extent that valuations differ in the geographical cross-section of property portfolios, the use of property count weights can yield significantly different inferences about relative performance.

Similar to Hochberg and Muhlhofer (2014), we also use square footage of properties held by equity REITs as an additional geographic allocation weight. However, this measure suffers from the same limitation as our simple property count variable because valuations per square foot vary significantly across MSAs. In addition, square footage data is only available for approximately 60 percent of core property-year observations in the SNL database over our sample period.[17] Although our aggregate results are qualitatively similar using these alternate measures of geographic exposure, we use adjusted cost and book value as our primary measures of geographic concentrations to mitigate the aforementioned concerns.

To compare the geographic exposure of the NCREIF portfolio with that of our sample of equity REITs, we calculate geographic concentrations for each of the four core property NCREIF NPI portfolios as follows:

$$GEO_{f,m,T}^{NPI} = \frac{\sum_{i=1}^{N_{m,T}}\left(MV_{i,m,T}\right)}{\sum_{m=1}^{N_T}\left(\sum_{i=1}^{N_{m,T}}\left(MV_{i,m,T}\right)\right)} \quad , \tag{2}$$

where $MV_{i,m,T}$ is the market (appraised) value of property i in Metropolitan Statistical Area m at the beginning of year T.[18] The total number of properties of type f in a particular MSA at the beginning of year T is denoted as $N_{m,T}$. The total number of MSA classifications as of the beginning of year T is again denoted as N_T.

The NCREIF NPI at the beginning of 1996 was composed of 2,379 core properties with an estimated market value of $50 billion. NCREIF does not report a quarterly return for property type f in MSA m unless there are at least four properties available for the return calculation. This is done to protect the identity of the individual properties and owners. We classify the MSA location of properties

[17] See Appendix B for more details on sample construction descriptive statistics.

[18] The lagged and smoothed nature of the NPI will cause the calculated percentage of the NCREIF portfolio invested in MSAs experiencing rapid price appreciation to be understated. Conversely, the use of appraisal values will overstate the percentage of the NPI portfolio in MSAs experiencing rapid price declines.

held outside of the NCREIF MSAs with reported returns as "Other." By the beginning of 1996, the NPI contained four or more apartment, industrial, office, or retail properties in 58 MSAs, with its greatest concentration in Washington, D.C. (7.1 percent). In comparison, equity REITs held 6.7 percent of their core portfolio (based on adjusted cost) in the D.C. area. By the beginning of 2013, the NPI index contained 6,968 core properties with an estimated market value of $366 billion. The NPI database contained four or more of one of the core properties in 106 MSAs, with its greatest concentration in New York (10.4 percent). Equity REITs held 13.1 percent of their core assets in New York in 2013.

3.1. Allocations to Gateway MSAs

Much has been written by industry professionals about the desirability of investing in major gateway MSAs. These MSAs are thought to have significant investment advantages over the remaining 300-plus MSAs, including increased liquidity, due to the size and depth of these markets. In addition, constraints on the production of new supply in these MSAs put upward pressure on rental rates. Therefore, the degree to which public and private market investors allocate investment capital to these markets, as well as the timing of these investments, may be an important determinant of their portfolio's performance. This important question has not been addressed in the academic literature.

In Figure 1, we present the concentrations of equity REIT and NCREIF core properties located in gateway MSAs. On average, NCREIF investors held approximately 34 percent of their portfolio in gateway MSAs over our 1996 to 2013 sample period; equity REITs held approximately 31 percent of their core assets in these six metropolitan areas. However, we observe larger differences in allocations over time and by property type. For example, REITs held a slightly larger portion of their core portfolio in gateway MSAs from 2001 to 2006. However, as the recent credit crisis unfolded, NCREIF investors held a significantly higher proportion of their portfolio in these six cities. In fact, in 2008 NCREIF investors increased their concentrations in gateway MSAs to constitute nearly 40 percent of their core portfolio.

In Panel A of Figure 2, we present allocations to gateway MSAs for apartment properties. Panels B-D of Figure 2 display geographic concentrations in these six markets for industrial, office, and retail properties, respectively. There are several key takeaways from these comparisons. First, within a particular year there are often significant differences between the proportion of properties held by NCREIF data contributing members and those held by equity REITs in gateway markets. For example, in 2003 equity REITs held approximately 50 percent of their industrial assets in gateway cities (Figure 2, Panel B). During the same year, NCREIF investors held just 21 percent of their industrial property portfolio in these six major markets.

Second, the relative weighting of REIT property portfolios toward gateway cities is persistent. During most of our sample period, equity REITs hold larger portions of their apartment, industrial, and office properties in gateway cities. Since 2003, however, NCREIF investors have been significantly more exposed to gateway retail than equity REITs.

Third, we observe significant variation in the time-series distribution of these portfolio concentrations. For example, from 2000-2013 equity REITs increased the concentration of their apartment portfolios in gateway markets from approximately 10 percent to nearly 50 percent. This represents a massive reallocation of REIT apartment portfolios to gateway markets. In contrast, REIT allocations to gateway cities within the industrial property type have been more cyclical. For example, from 1996-2003 equity REITs increased their holdings of industrial properties in gateway cities by approximately 20 percent. However, from 2004-2008 equity REITs shifted their industrial portfolio away from gateway cities, decreasing their holdings from 50 percent of their portfolio to approximately 33 percent.

In both the apartment and office property type, changes in portfolio holdings in gateway markets appear to be positively correlated across investor types for much of our sample period. From 2000-2013, both equity REITs and NCREIF investors increased their exposure to gateway apartment properties by 40 and 20 percent, respectively. During this same period, both equity REITs and NCREIF investors also significantly increased their office holdings in gateway cities by 20 percent and 10 percent, respectively.

For industrial properties, on the other hand, we observe a significant negative correlation between changes in gateway allocations by equity REITs and NCREIF investors. While equity REITs shifted their industrial portfolio away from gateway cities from 2004-2008, NCREIF investors increased the proportion of industrial properties owned in these markets from 19 percent to 28 percent of their portfolio. In the retail sector, however, there is less correlation between changes in concentration across investor groups. Since 2005, equity REITs have maintained a fairly consistent allocation to gateway markets in their retail portfolios, ranging from 18 percent to 20 percent. In contrast, NCREIF investors have reduced their allocations to gateway retail from 30 percent to 20 percent during the same period. In comparing public and private market gateway concentrations across property types, it is evident that differences exist within a particular year and across time.

As we narrow our focus to portfolio concentrations in specific gateway cities, the points observed previously at the aggregate level become more evident. In Figure 3, we present the concentrations of equity REIT and NCREIF apartment properties located in Chicago.[19] As observed in the aggregate data,

[19] The corresponding figures for the remaining five gateway MSAs are available from the authors upon request.

there are significant differences between the proportion of properties held by NCREIF data contributing members and those held by listed equity REITs, persistence in REIT weighting toward gateway cities, significant variation in the time-series distribution of these portfolio concentrations, and notable differences across property types when comparing listed REIT and private market geographic concentrations within a gateway MSA. For example, in 2013 NCREIF investors held approximately 7.0 percent of their apartment assets in Chicago. During the same year, equity REITs held approximately 1.0 percent of their apartment assets in Chicago. Looking more broadly over the full sample period, NCREIF investors consistently held a significantly larger portion of their apartment portfolio in Chicago than equity REITs. From 2006 to 2013, NCREIF investors substantially increased the concentration of their apartment portfolios in Chicago, while equity REITs were decreasing their exposure to apartment properties in Chicago during this period. These are strikingly different "bets" on the attractiveness of the Chicago apartment market. In sharp contrast, since at least 2006 public and private market investors have allocated similar proportions of their capital to Chicago industrial and office properties. Finally, in recent years NCREIF investors have been significantly more exposed to Chicago retail properties than retail REITs.

There are also noticeable differences in how NCREIF investors and equity REITs allocate their portfolios to specific gateway markets within property types. For example, apartment REITs hold a relatively larger proportion of their apartment assets in Los Angeles, Washington, D.C., Boston, and San Francisco; in contrast, NCREIF investors tend to dedicate greater concentrations of their apartment portfolio to Chicago than equity REITs. The two groups of investors hold similar proportions of their apartment portfolio in New York. Overall, it is clear that the MSA composition of NCREIF and REIT apartment, industrial, office, and retail portfolios often varies significantly across gateway markets at a particular point in time; moreover, these relative allocations can also vary significantly over time. It is therefore important to understand the extent to which these differences in MSA allocations affect the return performance of public and private market investors, both in the short- and long-run.

3.2. Have Gateway MSAs Outperformed?

To determine how these differences in gateway allocations may impact portfolio returns it is important to first establish that there are in fact significant performance differences between gateway and non-gateway markets. To conduct this analysis, we begin with quarterly NCREIF NPI returns disaggregated by property type and MSA. We then create a value-weighted gateway return series for each property type, as well as an aggregate core property series, in which the weights are the market (appraised) values of properties held by NCREIF within each of the six gateway cities as of the beginning

of the year. Similarly, we construct value-weighted non-gateway return series in which the weights are the market (appraisal) values of properties held by NCREIF in each of the remaining non-gateway cities.[20]

Table 3 reports quarterly geometric means of our gateway NPI returns (Panel A), non-gateway NPI returns (Panel B), and the difference in means between gateway and non-gateway returns (Panel C) for the following periods: 1996-2001, 2002-2007, 2008-2013, and 1996-2013. We report mean returns for each of the four core property types, as well as an aggregate value-weighted core property type series. Over the full sample, gateway markets outperform non-gateway markets for all property type classifications, including the aggregate core series. In fact, the only indication of underperformance in gateway markets appears in the recovery period for apartment and industrial properties. In the aggregate, gateway markets outperformed non-gateway markets by 26 (106) basis points quarterly (annually) over the 1996-2013 sample period. The most significant difference in performance between gateway and non-gateway markets at the property type level is in the office sector, which outperformed non-gateway office investments by 44 basis points quarterly. During the period of rapid expansion in commercial real estate markets (2002-2007), this return difference was even larger as gateway office markets outperformed non-gateway markets by 96 basis points quarterly.

To further establish differences in performance across MSAs, we also calculate quarterly geometric means of NPI returns for each of the six gateway cities by core property type. Although not separately tabulated, we find significant variation in returns within each property type across the six gateway markets. In addition, relative performance varies significantly across our three sub-sample periods.

3.3. Adjusting Private Market Returns for Differences in MSA Concentrations

The observed differences in the MSA concentrations of core property investments and performance differences across gateway MSAs highlights the importance of controlling for MSA exposure, particularly if both public and private investment managers have at least some discretion over the MSAs in which they are able to invest. We therefore reweight NPI MSA-level returns using the time-varying MSA weights of the corresponding REIT portfolio, as detailed in equation (1). In particular, for each core property type *f*, the total MSA-reweighted NPI return in quarter *t* is defined as:

$$ADJRET_{f,t}^{NPI} = (w_{t,m=1}^{REIT} r_{t,m=1}^{NPI} + w_{t,m=2}^{REIT} r_{t,m=2}^{NPI} + w_{t,m=3}^{REIT} r_{t,m=3}^{NPI} + \ldots + w_{t,m=n}^{REIT} r_{t,m=n}^{NPI}), \quad (3)$$

[20] Though not separately tabulated, we obtain similar results when using equally-weighted portfolios.

where $r_{t,m=n}^{NPI}$ is the NPI total return for property type *f* in Metropolitan Statistical Area *n* in quarter *t* and $w_{t,m=n}^{REIT}$ is the (adjusted cost) weight of the REIT property portfolio concentrated in Metropolitan Statistical Area *n* and property type *f* as of the beginning of year *t*. This weighting and aggregation process is repeated each quarter to produce a time series of reweighted NPI returns for each of the four core property types from 1996Q1 to 2013Q4. Note that we hold our MSA weights, $w_{t,m=n}^{REIT}$, constant across quarters within a calendar year. However, the reweighted return ($ADJRET_{f,t}^{NPI}$) varies quarterly because the MSA-level NPI return ($r_{t,m=n}^{NPI}$) varies quarterly.

We also construct an adjusted aggregate core property NPI total return series using NCREIF market value property type weights. We first calculate quarterly property type weights using the market value of all properties held by the NPI for each of the four core property type classifications. More specifically, the core portfolio weight assigned to property type *f* in quarter *t* is:

$$w_{f,t}^{NPI} = \frac{MV_{f,t}}{\sum_{f=1}^{4}(MV_{f,t})} , \tag{4}$$

where *f* = 1…4 for multifamily (apartment), office, industrial and retail properties, respectively, and $MV_{f,t}$ is the total market value of properties held by the NCREIF portfolio within property type *f* as of the beginning of quarter *t*. Thus, the total return in quarter *t* on our core-properties reweighted NPI index is defined as:

$$R_t^{NPI} = \sum_{f=1}^{4} w_{f,t}^{NPI}\, ADJRET_{f,t}^{NPI} , \tag{5}$$

where $ADJRET_{f,t}^{NPI}$ is the total return on our reweighted NPI index for property type *f* in quarter *t* as detailed in equation (3). This aggregation of property type NPI returns is repeated each quarter to produce a time series of aggregate core reweighted NPI returns.

Table 4 provides summary statistics for the quarterly differences between our raw NPI and reweighted NPI return series, by core property type and by reweighting methodology. The reweighted mean NPI apartment return using adjusted cost weights (Panel A) is equal to the unadjusted NPI apartment return over the full sample. The median return, standard deviation, and serial correlation of the reweighted NPI apartment returns are also very similar in magnitude to the corresponding summary statistics for the unadjusted NPI apartment returns.

The reweighted mean returns for industrial and office properties, using adjusted cost weights, are 1.9 and 4.4 basis points, respectively, greater than the corresponding unadjusted quarterly NPI

return. Thus, using reweighted returns slightly increases the average performance of industrial and office NCREIF investors relative to the performance of REIT investors in these property types over the 1996-2013 sample. In contrast, the reweighted mean return for retail NPI properties is 10.6 basis points lower than the corresponding unadjusted NPI return; thus, its use in place of the unadjusted NPI retail return decreases the measured relative performance of NCREIF investors. The reweighted quarterly mean return for core NPI properties is 1.4 basis points lower than the corresponding unadjusted NPI return; thus, core private market performance falls slightly after adjusting private market returns for differences in geographic concentrations with public markets. Overall, the small magnitude of the differences in NPI returns that results from reweighting are striking.

The differences in geographically reweighted NPI returns and unadjusted NPI returns are very similar when MSA weights are based on the time-varying book value of REIT properties (Table 4, Panel B). In untabulated results using REIT weights based on property count and square footage, we continue to find that the reweighted mean return for core NPI properties is less than the corresponding unadjusted NPI return. These additional findings further suggest that our core property adjusted return results are robust to alternate measures of geographic concentrations.[21]

The geographic reweighting of apartment, industrial, and office properties using REIT allocations does not produce notable differences in mean or median private market returns over the full sample. However, these sample means and medians mask significant differences over time as shown by the large minimum and maximum differences in Table 4. To better display this time-series variation in return differences, we plot quarterly differences between reweighted and unadjusted NPI returns for apartment properties in Panel A of Figure 4. The dashed red line plots differences using MSA weights based on the adjusted cost of the underlying REIT properties. The solid (blue) line captures quarterly differences in returns assuming MSA weights are based on the book value of the underlying REIT properties. A point on any curve greater than zero percent indicates the reweighted NPI return for apartments in that quarter is greater than the unadjusted NPI return; that is, the unadjusted NPI return understates the performance of the NPI for the purpose of comparing private market performance to returns on equity REITs.

Although the mean return difference for apartment properties is clearly centered around zero, there are significant quarterly differences over the 1996 to 2013 sample period. For example, in the

[21] At the property type level, the results show more variability because the use of square footage significantly reduces the number of property-year observations within property types and simple property count weights do not capture relative value differences between MSAs.

second quarter of 2005, the reweighted NPI return (using adjusted cost) is less than the unadjusted return by 0.94 percentage points (94 basis points), or 376 basis points annually. In contrast, the reweighted NPI return is greater than the unadjusted NPI return in the first quarter of 2007 by 77 basis points, or 308 basis points annually. These are large and economically meaningful differences that could significantly distort short-run comparisons between public and private real estate markets.

In Panels B-D of Figure 4, we plot quarterly differences in reweighted and unadjusted NPI total returns for industrial, office and retail properties, respectively. Similar to apartment properties, reweighting MSA-level NPI returns produces large changes in many quarters. For example, in the fourth quarter of 2008, reweighted NPI office returns are less than unadjusted office returns (adjusted cost value geographic concentrations) by 137 basis points (548 basis points annually). Similarly large differences in quarterly returns are observable in the industrial and retail property returns. In addition, the return differences can remain positive, or negative, for sustained periods of time. The serial correlations of the return differences (last column in Table 3), especially for industrial and office properties, also indicate statistically significant persistence in return differences. Given that many investment management contracts have durations of three-to-five years, these persistent differences could significantly affect the measured performance of a manager.

4. Attribution Analysis

A primary objective of the current research is to better understand the extent to which the return differences in public and private CRE markets reported in Table 1 are attributable to differences in MSA allocations. It is generally impossible to define unique, break-downs of total returns that correspond to clear investment management functions. Nevertheless, useful insights can be obtained from performance attribution.

Assume that both REIT and NCREIF managers do not have discretion over the core property type in which they invest. Assume also that the effects of leverage have been removed from the underlying REIT returns in the REIT portfolio. Then, for property type *f* in quarter *t*, the difference in REIT and NCREIF NPI total returns, $R_{f,t}^{REIT}$ - $R_{f,t}^{NPI}$, is equal to:

$$R_{f,t}^{REIT} - R_{f,t}^{NPI} = allocation + selection + interaction, \quad (6)$$

where *allocation* is the portion of the return differential due to MSA allocations. *Selection* is defined as the portion due to property/asset picking and operational management; although, as discussed above, the performance difference not explained by MSA allocations could be partially attributable to the combined effects of time-varying stock market-induced volatility and liquidity risk premiums on REIT

returns, in addition to the relative property selection and management skills of REIT managers. From here forward we refer to the sum of these decisions/effects as the "selection" component of the return differential. Finally, *interaction* is the portion of the return differential that results from the synergy between allocation and selection decisions. The interaction effect is positive when a REIT manager over-weights MSAs in which she has positive property selection and management ability and underweights MSAs in which she does not.

Using the total unlevered return earned by NCREIF managers on property type *f* in quarter *t* as the benchmark, we can attribute the differential performance of REIT managers to allocation, $A_{f,t}^{REIT} - A_{f,t}^{NPI}$, and selection, $S_{f,t}^{REIT} - S_{f,t}^{NPI}$. The pure effect of REIT managers' asset allocation, relative to the benchmark return of NCREIF NPI mangers, is quantified as the sum across all MSAs of the difference between REIT allocation and NCREIF allocation to an MSA, multiplied by the NCREIF NPI return in that MSA. More formally, the return differential for property type *f* in quarter *t* attributable purely to differences in MSA allocations is

$$A_{f,t}^{REIT} - A_{f,t}^{NPI} = r_{m=1}^{NPI}(w_{m=1}^{REIT} - w_{m=1}^{NPI}) + r_{m=2}^{NPI}(w_{m=2}^{REIT} - w_{m=2}^{NPI}) + r_{m=3}^{NPI}(w_{m=3}^{REIT} - w_{m=3}^{NPI}) + \cdots + r_{m=n}^{NPI}(w_{m=n}^{REIT} - w_{m=n}^{NPI}), \quad (7)$$

where $r_{m=n}^{NPI}$ is the NPI return in MSA *n* in quarter *t*, $w_{m=n}^{REIT}$ is the percentage of the REIT portfolio invested in MSA *n* in quarter *t,* and $w_{m=n}^{NPI}$ is the percentage of the NCREIF portfolio invested in MSA *n* in quarter *t*.

The pure effect of REIT managers' asset selection in quarter *t*, relative to the benchmark NCREIF NPI return, is quantified as the sum across all MSAs of the difference between the REIT portfolio's return and the NPI return in an MSA, weighted by the allocation of the NCREIF NPI portfolio in that MSA. More formally, the return differential attributable to differences in property/asset selection is

$$S_{f,t}^{REIT} - S_{f,t}^{NPI} = w_{m=1}^{NPI}(r_{m=1}^{REIT} - r_{m=1}^{NPI}) + w_{m=2}^{NPI}(r_{m=2}^{REIT} - r_{m=2}^{NPI}) + w_{m=3}^{NPI}(r_{m=3}^{REIT} - r_{m=3}^{NPI}) + \cdots + w_{m=n}^{NPI}(r_{m=n}^{REIT} - r_{m=n}^{NPI}), \quad (8)$$

where $r_{m=n}^{REIT}$ is the return on the REIT portfolio in MSA *n*.

As detailed in equation (6), the sum of the pure allocation and selection effects do not equal the total differential between REIT and NCREIF NPI returns. The remaining differential is due to the combined effect of REIT managers' allocation and selection performances interacting together. Unfortunately, there is no meaningful way to disentangle this interaction effect and allocate it to either one of the two pure effects. Typically, if the allocation of capital across MSAs is the primary decision facing REIT and NCREIF managers, the interaction effect is added to the selection effect to keep the allocation effect pure. This would be appropriate, in this application, if REIT mangers generally pursued

a top-down investment strategy (MSA selection then property selection). In contrast, if REIT managers generally follow a bottom-up investment strategy—finding the best properties without a primary concern for MSA allocations—it would be appropriate to add the interaction effect to the allocation effect to keep the selection effect pure. However, our primary objective is to quantify the importance of MSA allocation decisions in explaining differences in public and private market return performance. Moreover, data on REIT returns by property type at the MSA level ($r_{m=n}^{REIT}$ in equation (8) above) are not available. We are therefore unable to calculate a pure selection effect (using the private market return series as our benchmark) and thus must lump together the pure selection and interaction effects.[22]

Performing attribution analysis for one quarter, as depicted in equation (7), is relatively straight-forward if the MSA-level NPI returns ($r_{m=n}^{NPI}$), as well as NPI and REIT MSA weights ($w_{m=n}^{NPI}$ and $w_{m=n}^{REIT}$), are known. However, NPI and REIT portfolio allocations change over time and these changes must be accounted for when explaining relative performance over the duration of a typical asset management contract, or longer.

To facilitate a multi-year attribution analysis, we start with equation (7). Using the distributive property and regrouping terms, equation (7) can be rewritten as

$$A_{f,t}^{REIT} - A_{f,t}^{NPI} = (w_{m=1}^{REIT} r_{m=1}^{NPI} + w_{m=2}^{REIT} r_{m=2}^{NPI} + w_{m=3}^{REIT} r_{m=3}^{NPI} \ldots + w_{m=n}^{REIT} r_{m=n}^{NPI}) - (w_{m=1}^{NPI} r_{m=1}^{NPI} + w_{m=2}^{NPI} r_{m=2}^{NPI} + w_{m=3}^{NPI} r_{m=3}^{NPI} \ldots + w_{m=n}^{NPI} r_{m=n}^{NPI}). \quad (9)$$

Note that the top term in parentheses is the return on the reweighted NPI for property type *f* in quarter *t* (i.e., $ADJRET_{f,t}^{NPI}$ from equation (3)), using REIT allocations for the reweighting. The bottom term in parentheses is simply the "raw" NPI return for property type *f* in quarter *t*. Thus, by subtracting the raw NPI return for a particular property type from the re-weighted NPI, we are left with the pure allocation effect in quarter *t* using NPI as the benchmark.

For a *T* quarter analysis period, equation (9) can be rewritten as follows to produce the geometric average return differences over T quarters:

$$A_{f,T}^{REIT} - A_{f,T}^{NPI} = (\sqrt[T]{\prod_1^T (1 + ADJRET_{f,t}^{NPI})} - 1) - (\sqrt[T]{\prod_1^T (1 + r_{f,t}^{NPI})} - 1). \quad (10)$$

[22] An argument can be made for using REIT returns and MSA weights as the benchmark in equations (7) and (8), respectively. This allows us to calculate a pure selection effect; however, the interaction effect must then be included with the allocation effect due to the lack of available MSA-level REIT return data. In untabulated results, the use of REIT MSA weights and returns in place of NPI weights and returns does not alter the relative magnitudes of the allocation and selection effects reported in Table 5.

Table 5 displays results from our attribution analysis using adjusted cost weights and NPI returns as the benchmark for each of the four core property types, as well as the aggregate core property type series. We report in each panel the quarterly difference in geometric means between our unlevered REIT returns and the raw NPI returns, the geometric mean of the pure allocation effect, and the geometric mean of the selection plus interaction effects.

In each of the core property types and for all reported return horizons, the pure allocation effect constitutes a small portion of the total return difference relative to the selection plus interaction effects. This indicates that the decision to allocate to a particular MSA is relatively less important than the manager's ability to select and mange properties within that MSA. However, the sign and magnitude of the allocation effect varies significantly over time and across property types. For example, retail REITs outperformed their NPI benchmark by 16.9 basis points quarterly over the full sample. The pure allocation decisions of REIT managers actually resulted in a 10.5 basis point quarterly underperformance relative to the private market benchmark. However, the asset selection (plus interaction) of REIT managers produced an outperformance of 27.3 basis points. In this case, the allocation of REIT properties across MSAs reduced the positive outperformance of equity REIT's generated by superior asset selection and management. In each of the three sub-periods, the MSA allocation of the REIT retail portfolio also reduced the relative outperformance of retail REITs. In all sub-periods, the allocation effect is smaller in magnitude that the selection and interaction effect.

In contrast to retail REITs, industrial REITs (panel B) underperformed their NPI benchmark over the full sample and in two of the three sub-periods. However, the pure allocation effect is negative only in the 1996-2001 subperiod. Thus, the underperformance of industrial REITs is driven by selection (and interaction) effects, except during the 2002-2007 subperiod. Nevertheless, the pure allocation effects in the industrial sector are small in magnitude relative to the selection and interaction effects. For core portfolios (panel E), the magnitudes of the allocation effects are also small relative to the selection/interaction effect. Overall, the variation in allocation and selection effects both across time and across property types is noteworthy. However, the relatively small role that MSA allocations have on relative performance is striking.

To ensure that our results are not being driven by our choice of geographic concentration measure, we report results of our attribution analysis using book value in place of adjusted cost weights in Table 6. These results are very similar to those reported in Table 5. This is not surprising given that differences in reweighted NPI returns produced by the two weighting methodologies are minimal (see Figure 4). Though untabulated, using property count and square footage weights for our core portfolio analysis, we continue to find that the magnitude of the allocation effect is small relative to the selection effect. These

additional findings further suggest that our core property results are not sensitive to alternate measures of geographic concentrations.

4.1. Economic Significance

To more formally address the economic significance of the allocation decision we examine the extent to which the variability in equity REIT returns across time is explained by MSA allocation decisions. We follow a framework similar to Ibbotson and Kaplan (2000) and report R-squared estimates from a portfolio regression approach. To first understand the proportion of REIT return variability explained by its private market benchmark, we regress quarterly unlevered REIT returns on unadjusted NPI returns. These results are reported in panel A of Table 7. Over the full sample period, raw NPI returns explain 11.7 percent, 10.6 percent, 4.4 percent, and 6.1 percent of the variation in unlevered REIT returns for apartment, industrial, office, and retail property types, respectively. Using the aggregate core series, NPI returns explain 7.8 percent of the variation in unlevered core REIT returns over the full sample.

The previous regression setup does not allow us to isolate the proportion of return variability explained by MSA allocation decisions. However, by holding geographic allocations constant between our two return series, we are better able to isolate the relative importance of REIT geographic allocation strategy. We regress quarterly unlevered REIT returns against reweighted NPI returns. These results are reported in panel B of Table 7. If MSA allocations matter, using NPI returns that have the same MSA weightings as the equity REIT portfolio should improve the explanatory power of the regressions, despite the smoothing and lagging problems associated with the use of NPI returns in quarterly regressions. For some property types and time periods, the R-squared improves slightly, while in several cases the explanatory power of the REIT total return model decreases when using reweighted NPI returns as the explanatory variable. However, in no case is the difference in R-squareds statistically significant. The inability of reweighted NPI returns to improve our ability to explain unlevered REIT returns is consistent with our finding that MSA allocation policies account for a relatively small proportion of the difference in REIT and NPI returns. Taken together, our results also suggest that using unadjusted NPI returns tends to overstate the proportion of equity REIT return variation that is explained by its private market benchmark.

5. Further Robustness Checks: Sample Period Dependence and Property Subtype Analysis

Since geometric means simulate a buy-and-hold strategy, inferences drawn from their use may be dependent on the assumed investment holding period. The results reported in Tables 5 and 6 assume

non-overlapping six-year investment horizons as well as an eighteen-year holding period. In Table 8, we report results based on six non-overlapping three-year holding periods. With the exception of one window for industrial properties (2008-2010), we again find that MSA allocation strategies account for a relatively small portion of the difference in REIT and NPI returns. In fact, this result is generally stronger with the shorter three-year windows.

To further examine the sensitivity of our results to holding period assumptions, we performed the analysis using rolling six-year windows starting in the first quarter of 1996. We then averaged (arithmetically) across these overlapping six-year windows. These results are reported by property type in panel A of Table 9. The mean quarterly return differential between unlevered REIT returns and raw NPI is 4.8 basis points for retail properties. The mean MSA allocation effect is -13.3 basis points; that is, retail REIT managers underperformed the private market retail benchmark with respect to MSA allocations. However, the asset selection (plus interaction) of retail REIT managers produced a mean outperformance of 18.0 basis points, somewhat larger in absolute magnitude than the negative allocation effect. For industrial properties, the average allocation effect is positive, indicating REIT managers outperformed the data contributing members of NCREIF in selecting and timing MSA allocations. However, the positive allocation effect of 8.4 basis points was nearly offset, on average, by inferior selection and management. For apartment, office, and core REITs, the mean allocation effect is small in absolute magnitude relative to the selection and interaction effect. Thus, our primary result does not appear to be driven purely by the chosen six-year windows reported earlier in Tables 5 and 6.

To ensure our results are not being driven by a particular sample year, we also performed the analysis for the 1996-2013 period 18 times, each time dropping a different year from the sample. We then averaged (arithmetically) across these 18 samples.[23] These results are reported by property type in panel B of Table 9. For all property types, including core REITs, the mean allocation effect is small in absolute magnitude relative to the selection and interaction effect.

If the selection plus interaction component of our original analysis is also capturing required allocations to property subtypes rather than pure property selection within a particular MSA, we would expect the selection plus interaction effect to be relatively less important at the property subtype level. To address whether differences in property subtype allocations reduce the relative importance of the selection plus interaction effect, we conduct an additional attribution analysis within the retail property type classification. In particular, we focus on the shopping center subtype.[24] We follow the methodology

[23] We thank Andrey Pavlov for this suggestion.

[24] Since the NCREIF and CRSP-Ziman property subtype classifications are not a one-to-one match, we group together REITs classified as Shopping Center (property subtype 17) and Strip Center (property subtype 18) REITs as "shopping centers."

described previously to construct an unlevered REIT return series and a geographically reweighted NPI return series for shopping centers.

Table 10 reports results from our shopping center attribution analysis using NPI returns as the benchmark. In all but one sub-period (2002-2007) we observe similar results to those reported for the retail property type in Table 5. The selection effect remains a significant portion of the return difference between private and public market portfolios. Due to data limitations, we are unable to conduct this analysis for other property subtypes within the retail or other core property type classifications. Thus, to the extent that property subtypes can be evaluated, our primary findings are robust.

The discussion to this point has centered on controlling for differences in geographic concentrations between public and private market investors in an attempt to provide a better benchmark for return comparisons as well as insights on the relative importance of allocation and selection in return performance at the portfolio level. However, our methodology can also be applied on a firm level basis. For example, REIT managers and investors can utilize our reweighting procedure to generate a private benchmark return series that is "geographically identical" to their particular portfolio. They also can utilize the attribution framework to better understand how allocation and selection decisions impact firm return performance relative to a chosen benchmark. An example of a firm level application is provided in Appendix C.

6. Conclusion

While direct private and public REIT investments can provide investors with exposure to the same underlying local property markets, they often exhibit substantially different risk-return characteristics. Thus, when evaluating relative investment performance the construction of a similar-risk benchmark index is of utmost importance. This study identifies the importance and respective influences of geographic allocation and selection effects on both the measurement and evaluation of relative return performance across public and private commercial real estate markets. By adjusting returns for differences in financial leverage, property type focus, management fees, and geographic concentrations we are able to more accurately assess the relative performance of "geographically identical" public and private market portfolios. Furthermore, through formal attribution analysis, we are able to disentangle whether the relative return performance is attributable to differences in MSA allocations or individual property selection and management within MSAs.

Properties classified by NCREIF as Community, Neighborhood, or Power Centers are used to construct our NCREIF shopping center returns.

To the extent that portfolio managers actively shift geographic allocations to time real estate cycles and vary in their ability to select value-adding properties within property types and geographic regions, relative performance can differ significantly across investment markets. In comparing the MSA concentrations of publicly-traded REITs, by core property type, to the MSA concentrations of the properties in the NCREIF database, we document material differences in geographic allocations of property portfolios between public and private market investors. Since these differences vary substantially over time and across property type classifications, we find that accounting for time-series and cross-sectional differences in the geographic concentrations of the properties held by core equity REITs and NCREIF investors has an economically meaningful impact on performance comparisons across markets.

Controlling for the geographic composition of property portfolios in these two markets, we continue to find that public market real estate returns exceed comparable private market returns. Through our attribution analysis, we also find that MSA allocations explain a relatively small portion of the total return difference relative to selection effects. However, the direction and magnitude of this effect can vary across investment periods and property types. Overall, this result indicates that the decision to allocate to a particular MSA is relatively less important than the manager's ability to select properties within that MSA. Taken together, our results suggest that additional follow-on research examining geographic allocation and selection effects is important to understanding return performance and effective investment strategies in both public and private commercial real estate markets. In this regard, our research reveals an important open question on what factors contribute to explaining the superior REIT selection effects that we document.

Appendix A: Calculating Unlevered REIT Returns

To create our unlevered REIT return series, we follow the methodology outlined in Ling and Naranjo (2015). The first step in delevering REIT returns at the firm level is to calculate the firm's unlevered return on assets (weighted average cost of capital) in each quarter. We estimate the unlevered return on total assets for REIT *i* in quarter *t*, $r_{i,t}^{TA}$, as:

$$r_{i,t}^{TA} = \left(r_{i,t}^{e}\theta_{i,t}^{e}\right) + \left(r_{i,t}^{d}\theta_{i,t}^{d}\right) + \left(r_{i,t}^{p}\theta_{i,t}^{p}\right), \tag{A1}$$

where $r_{i,t}^{e}$ is the levered total return on equity, $r_{i,t}^{d}$ is the total return earned by the firm's long-term and short-term debt holders in quarter *t*, and $r_{i,t}^{p}$ is the return earned by preferred shareholders. The time-varying quarterly weights corresponding to equity, debt, and preferred shares in the firm's capital structure are denoted as $\theta_{i,t}^{e}$, $\theta_{i,t}^{d}$, and $\theta_{i,t}^{p}$, respectively.

The returns on debt obligations and preferred shares, respectively, are calculated as:

$$r_{i,t}^{d} = \frac{int_{i,t}^{d}}{bval_{i,t-1}^{d}} \ , \tag{A2}$$

$$r_{i,t}^{p} = \frac{pdiv_{i,t}^{p}}{lval_{i,t-1}^{p}} \ , \tag{A3}$$

where $int_{i,t}^{d}$is total interest paid to debt holders in quarter *t*, $pdiv_{i,t}^{p}$ is total preferred dividends, $bval_{i,t-1}^{d}$ is the total book value of short- and long-term debt, and $lval_{i,t-1}^{p}$ is the estimated liquidation value of outstanding preferred shares for REIT*i* at the end of quarter *t-1*. $r_{i,t}^{e}$ is constructed by chain-linking monthly returns obtained from CRSP-Ziman.

The capital structure weights for each REIT in each quarter are based on the claims of equity, debt, and preferred shares outstanding at the end of quarter t-1, relative to total assets outstanding, or

$$\theta_{i,t}^{e} = \frac{\left(mcap_{i,t-1}^{e}\right)}{TA_{i,t-1}}, \tag{A4}$$

$$\theta_{i,t}^{d} = \frac{\left(bval_{i,t-1}^{d}\right)}{TA_{i,t-1}} \ , \tag{A5}$$

$$\theta_{i,t}^{p} = \frac{\left(lval_{i,t-1}^{p}\right)}{TA_{i,t-1}} \quad , \tag{A6}$$

where $mcap_{i,t-1}^{e}$is the market capitalization of the firm's common shares at the end of quarter *t-1* and $TA_{i,t-1}$ is the total asset value for REIT *i* at the end of quarter *t-1*. Total asset value for REIT *i* at the end of quarter *t*, $TA_{i,t}$, is set equal to

$$TA_{i,t} = mcap_{i,t}^{e} + bval_{i,t}^{d} + lval_{i,t}^{p} \ , \tag{A7}$$

An index of unlevered returns on total assets for equity REITs in quarter *t*, R_t^{REIT}, is constructed by summing over the weighted unlevered returns earned by each constituent REIT; that is,

$$R_t^{REIT} = \sum_{i=1}^{N_t} w_{i,t}^{TA} r_{i,t}^{TA} \ , \tag{A8}$$

where $r_{i,t}^{TA}$ is REIT *i*'s unlevered (total) return on assets [equation (A1)] and

$$w_{i,t}^{TA} = \frac{\left(TA_{i,t-1}\right)}{\sum_{i=1}^{N_t} TA_{i,t-1}} \ , \tag{A9}$$

When constructing an index of returns on office REITs, for example, $N_t$equals the number of office REITs in the sample. Unlevered quarterly returns are compounded to obtain an index of cumulative returns for our four core property type indices, as well as our aggregate core property type series.

Appendix B: Sample Construction

Although our aggregate results are qualitatively similar using alternate measures of geographic exposure, we focus our main analysis on our measure of adjusted cost. One reason is that it mitigates the loss of observations that results from using book value or square footage measures. The table provided in this appendix (Appendix B Table 1) provides the yearly distribution of property observations in the SNL Real Estate Database for the four core property types across our four concentration measures. In three out of the four core property types, a significant loss of observations occurs when using square footage in place of either adjusted cost or book value, with the office property type being the exception. We also identify that this issue becomes increasingly prominent in the post-2000 sample period. On average, from 2000-2013, the use of adjusted cost in place of square footage allows for a 10 percent increase in observations. This potential selection issue reaches an extreme in 2013, during which the use of adjusted cost in place of square footage allows for a 20 percent increase in overall sample size.

Appendix B: Table 1

This table reports yearly distributions of property observations in the SNL database using adjusted cost, book value, square footage and number of properties over the 1996-2013 sample period for each of the four core property types.

Panel A: Apartment

Year	Adjusted Cost	Book Value	Square Footage	# of Properties
1996	837	825	805	1807
1997	1057	1052	1146	2038
1998	1500	1495	1572	2654
1999	2111	1996	2395	3840
2000	2635	2464	2174	4386
2001	2722	2606	2020	4354
2002	2758	2622	1999	3710
2003	2935	2805	2067	3887
2004	3222	3117	2360	4198
2005	3624	3515	2662	4517
2006	3725	3592	2582	4712
2007	3374	3242	2509	4664
2008	3278	3138	2361	4009
2009	2100	1998	1263	3749
2010	1958	1883	1255	2412
2011	1956	1898	1238	2336
2012	1902	1843	1270	2308
2013	1813	1765	1202	2204
Total	43507	41856	32880	61785

Panel B: Industrial

Year	Adjusted Cost	Book Value	Square Footage	# of Properties
1996	469	232	486	2144
1997	623	623	642	2323
1998	1218	1217	1244	2733
1999	1778	1761	1921	3369
2000	1809	1793	2005	3607
2001	1963	1939	2019	3574
2002	1564	1554	1805	3449
2003	1550	1546	1924	2928
2004	1565	1558	1945	2865
2005	1706	1694	2027	2958
2006	1654	1648	1522	3161
2007	1571	1539	1415	2801
2008	1581	1547	1434	2455
2009	1717	1708	1269	2316
2010	1728	1722	1264	2072
2011	1768	1765	1302	2109
2012	1870	1865	1460	2278
2013	2022	2018	1554	2162
Total	28156	27729	27238	49304

Panel C: Office

Year	Adjusted Cost	Book Value	Square Footage	# of Properties
1996	398	394	401	1460
1997	687	686	772	1731
1998	1423	1408	1460	2504
1999	2096	2085	2118	3122
2000	2201	2180	2223	3227
2001	2139	2115	2270	3122
2002	2318	2275	2443	3199
2003	2302	2253	2419	3098
2004	2290	2242	2409	3039
2005	2213	2166	2341	3034
2006	2270	2201	2377	3197
2007	1890	1549	2056	3107
2008	1567	1495	1635	2600
2009	1603	1531	1658	1967
2010	1631	1537	1695	1896
2011	1660	1567	1716	1912
2012	1662	1564	1711	1930
2013	1565	1512	1642	1960
Total	31915	30760	33346	46105

Panel D: Retail

Year	Adjusted Cost	Book Value	Square Footage	# of Properties
1996	1308	1282	1525	4009
1997	2392	2297	2554	4438
1998	3000	2917	3135	5024
1999	4004	3913	3790	5897
2000	4567	4502	4404	6400
2001	4467	4371	4384	6721
2002	4601	4507	4639	6743
2003	4743	4649	4809	6841
2004	5209	5075	5056	7249
2005	5739	5015	5446	7736
2006	7329	7038	5792	9669
2007	5828	5536	5633	10229
2008	6098	5856	5577	10738
2009	6550	6315	5524	8407
2010	6494	6278	5368	8270
2011	6802	6598	5284	8435
2012	7142	6961	5167	8710
2013	7536	7373	4976	9184
Total	93809	90483	83063	134700

Panel E: Core Properties

Year	Adjusted Cost	Book Value	Square Footage	# of Properties
1996	3012	2733	3217	9420
1997	4759	4658	5114	10530
1998	7141	7037	7411	12915
1999	9989	9755	10224	16228
2000	11212	10939	10806	17620
2001	11291	11031	10693	17771
2002	11241	10958	10886	17101
2003	11530	11253	11219	16754
2004	12286	11992	11770	17351
2005	13282	12390	12476	18245
2006	14978	14479	12273	20739
2007	12663	11866	11613	20801
2008	12524	12036	11007	19802
2009	11970	11552	9714	16439
2010	11811	11420	9582	14650
2011	12186	11828	9540	14792
2012	12576	12233	9608	15226
2013	12936	12668	9374	15510
Total	197387	190828	176527	291894

Appendix C: Sample Apartment REIT

We consider the case of a large apartment REIT to implement our framework on a firm level basis. In particular, we construct unlevered REIT returns for the firm on a quarterly basis following the methodology of Ling and Naranjo (2015). For our initial comparison to a private market benchmark, we utilize quarterly raw NPI returns for the apartment property type. We then create a reweighted NPI return series using NPI MSA-level returns and the time-varying MSA weights of the firm's property portfolio, as detailed in equation (3). In particular, the total firm weighted NPI return in quarter t is defined as:

$$ADJRET_{EQR,t}^{NPI} = (w_{t,m=1}^{EQR} r_{t,m=1}^{NPI} + w_{t,m=2}^{EQR} r_{t,m=2}^{NPI} + w_{t,m=3}^{EQR} r_{t,m=3}^{NPI} + \ldots + w_{t,m=n}^{EQR} r_{t,m=n}^{NPI}), \quad \text{(C1)}$$

where $r_{t,m=n}^{NPI}$ is the NPI total return in Metropolitan Statistical Area n in quarter t and $w_{t,m=n}^{EQR}$ is the (book value) weight of EQR's property portfolio concentrated in Metropolitan Statistical Area n as of the beginning of year t.

Panel A of Appendix C Table 1 reports the geometric means for the firm's unlevered REIT returns, the raw NPI apartment returns, and the reweighted NPI return series using the firm's geographic concentrations as weights. Over each return horizon, the raw NPI series overstates benchmark returns, although the differences are relatively small in magnitude. For example, over the full sample period there is a 2.5 (10) basis point quarterly (annually) difference between the raw NPI and the reweighted NPI that makes use of the firm's geographic composition. Therefore, the use of the raw NPI series leads to an overstatement in the relative underperformance of the firm to its private market benchmark. During the period of generally rising real estate prices (2002-2007), the magnitude of this effect is a bit larger. The raw NPI overstates the benchmark performance by 5.5 (22) basis points quarterly (annually) over this horizon. While these differences are relatively small, we expect there to be significant cross-sectional variation across equity REITs. In particular, we expect this reweighting procedure to matter most for firms whose geographic concentration differs significantly from that of the benchmark property type NPI series.

Panel B of Appendix C Table 1 reports results from our firm-level attribution analysis. Consistent with our earlier results at the portfolio level, we find that the pure allocation effect constitutes a small portion of the total return difference, relative to the selection plus interaction effects. For example, over our full sample period the allocation effect constituted 2.5 (10) basis points of the 21 (84) basis point quarterly (annual) difference between the firm's unlevered returns and the NPI benchmark apartment series.

Appendix C: Table 1

This table reports quarterly geometric means of the unlevered REIT return for a large apartment REIT, the raw NPI apartment return series, the reweighted NPI index using the firm's geographic allocations, and firm level attribution analysis using the NCREIF NPI as the benchmark over the following periods: 1996-2001, 2002-2007, 2008-2013, 1996-2013. Returns are reported in percentage form.

Panel A: Return Series

	1996-2001	2002-2007	2008-2013	1996-2013
Unlevered REIT Return (firm)	2.177	2.619	1.581	2.125
Raw NPI Returns - Apartment	2.696	2.879	0.840	2.134
Reweighted NPI Returns (using the firm's weights)	2.696	2.818	0.839	2.113

Panel B: Attribution Analysis

	1996-2001	2002-2007	2008-2013	1996-2013
Unlevered REIT return (firm) minus raw NPI – Apartment	-0.519	-0.261	0.741	-0.010
Pure allocation effect	-0.001	-0.062	-0.001	-0.021
Selection effect plus interaction	-0.518	-0.199	0.742	0.011

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Figure 1: Gateway City Concentrations of Core Properties – NCREIF vs. REITs

This figure plots the geographic concentrations of private (NCREIF) and public (equity REIT) commercial real estate portfolios in gateway cities for all core property types over the 1996-2013 sample period. Gateway cities are defined as Boston, Chicago, Los Angeles, New York, San Francisco, and Washington, D.C. Private market concentrations are calculating using market (appraised) value of each core property held by the NCREIF NPI in gateway cities. Public market concentrations are calculated using reported adjusted cost of each core property held by equity REITs in gateway cities.

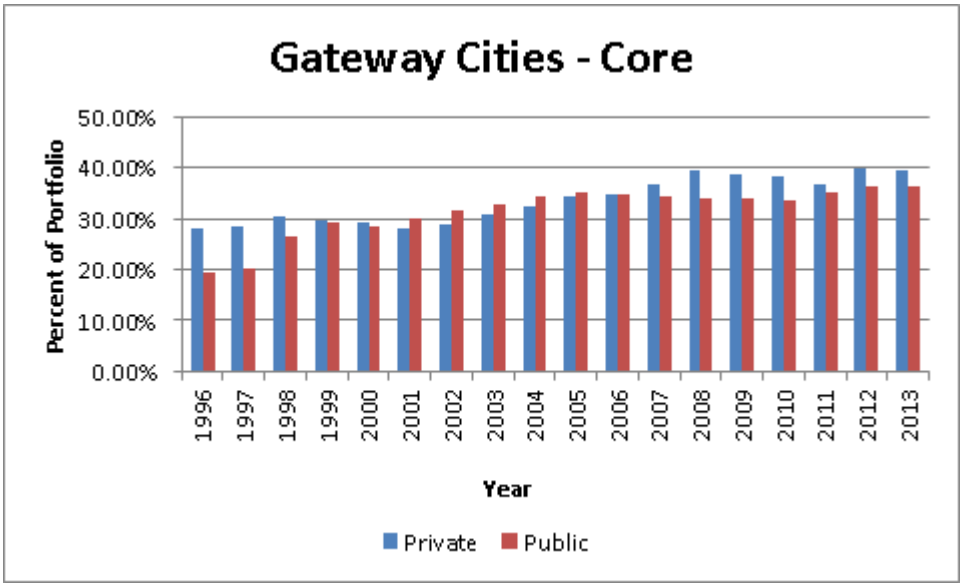
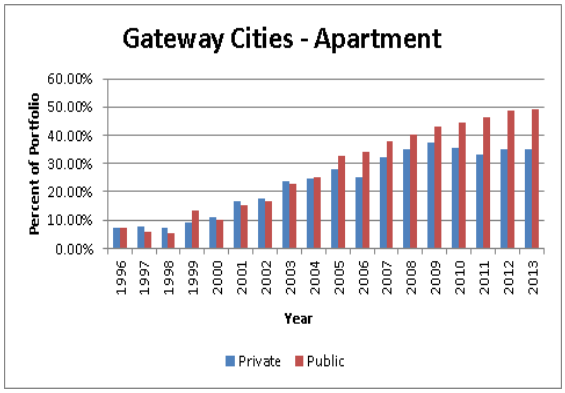


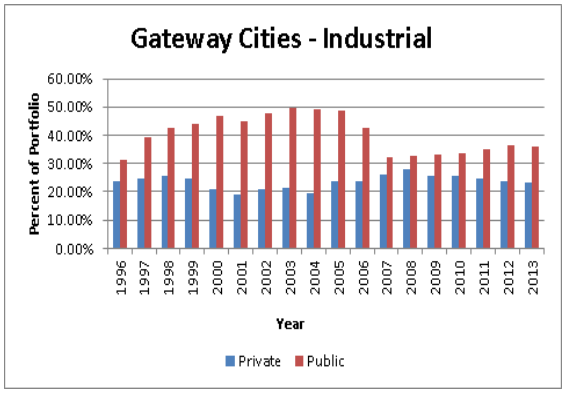
Figure 2: Gateway City Concentrations by Core Property Type – NCREIF vs. REITs

This figure plots the geographic concentrations of private (NCREIF) and public (equity REIT) commercial real estate portfolios in Gateway cities for each of the four core property types over the 1996-2013 sample period. Gateway cities are defined as Boston, Chicago, Los Angeles, New York, San Francisco, and Washington, D.C. Private market concentrations are calculating using market (appraised) value of each core property held by the NCREIF NPI in gateway cities. Public market concentrations are calculated using reported adjusted cost of each core property held by equity REITs in gateway cities.

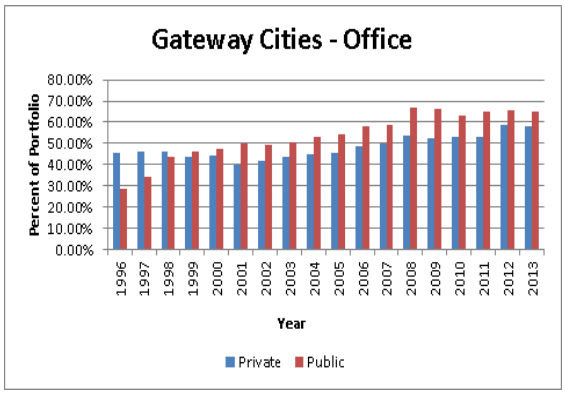
Panel A: Apartment



Panel B: Industrial



Panel C: Office



Panel D: Retail

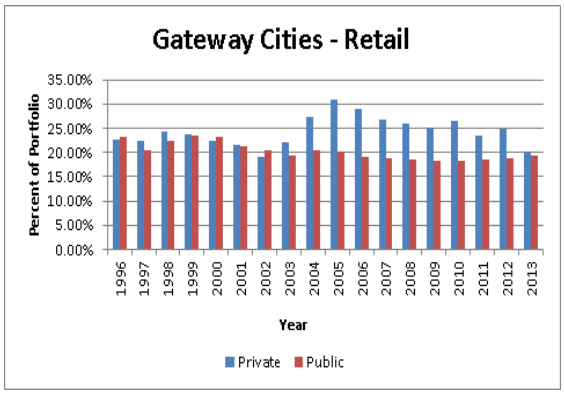
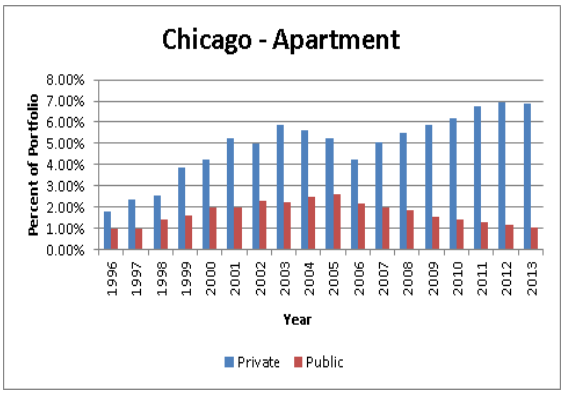


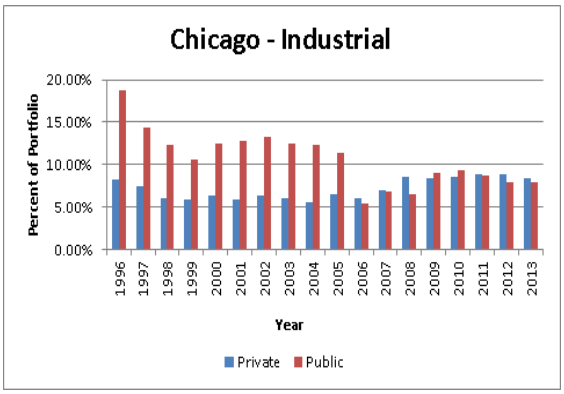
Figure 3: Geographic Concentrations – NCREIF vs. REITs (Chicago)

This figure plots the geographic concentrations of private (NCREIF) and public (equity REIT) commercial real estate portfolios in Chicago for each of the four core property types over the 1996-2013 sample period. Private market concentrations are calculating using market (appraised) value of each core property held by the NCREIF NPI in gateway cities. Public market concentrations are calculated using reported adjusted cost of each core property held by equity REITs in gateway cities.

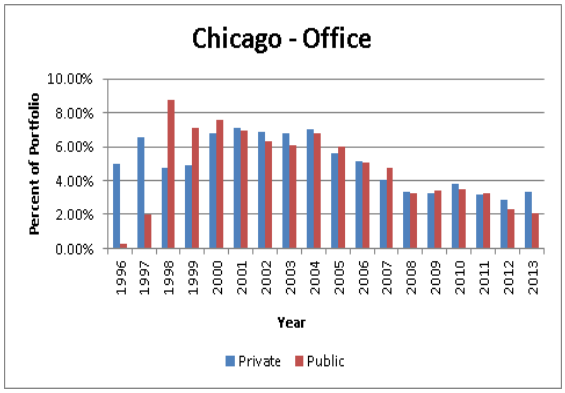
Panel A: Apartment



Panel B: Industrial



Panel C: Office



Panel D: Retail

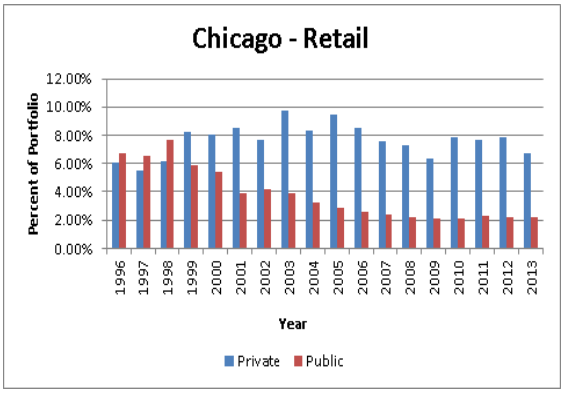
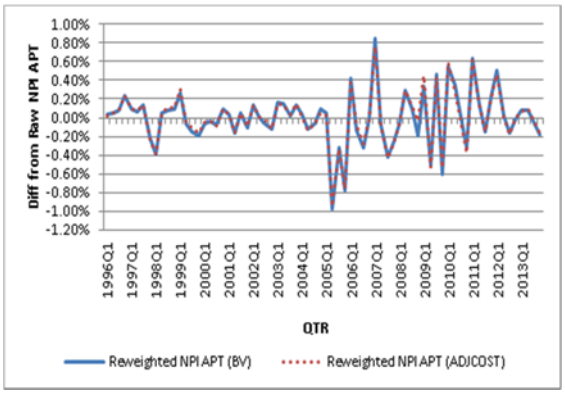


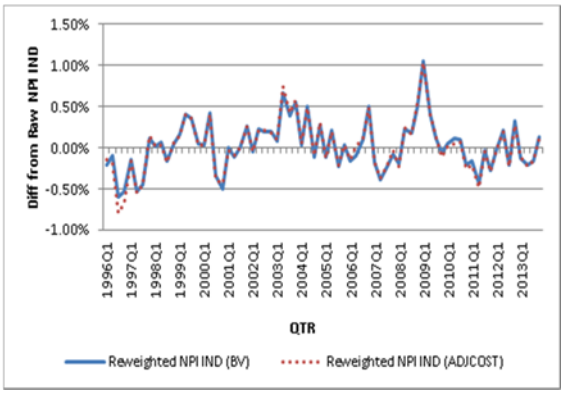
Figure 4: Differences in Reweighted NPI Returns and Raw NPI Returns

This figure plots quarterly differences between the reweighted and unadjusted NPI return series for each of the four core property types. The dashed line plots differences using MSA weights based on the adjusted cost of the underlying REIT properties. The solid line captures quarterly differences in returns assuming MSA weights are based on the book value of the underlying REIT properties.

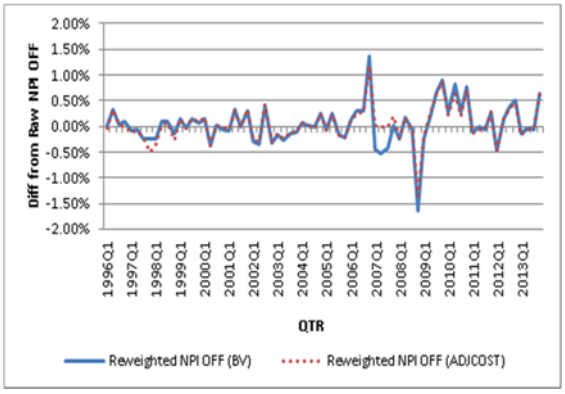
Panel A: Apartment



Panel B: Industrial



Panel C: Office



Panel D: Retail

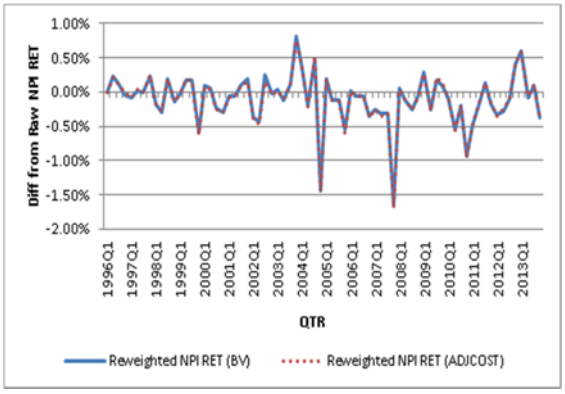


Table 1: Average Return Comparison: Public and Private Real Estate Markets

This table reports quarterly geometric means of our unlevered equity REIT returns, unlevered raw NPI returns, and the difference between the two series over the following periods: 1996-2001, 2002-2007, 2008-2013, 1996-2013. Returns are reported in percentage form.

Panel A: Unlevered Equity REIT Returns

	1996-2001	2002-2007	2008-2013	1996-2013
Apartment	2.584	2.022	1.728	2.111
Industrial	2.560	3.439	0.133	2.034
Office	2.734	2.346	1.205	2.093
Retail	2.333	3.184	1.692	2.401
Aggregate: Core Properties	2.529	2.659	1.295	2.159

Panel B: Unlevered Raw NPI Returns

	1996-2001	2002-2007	2008-2013	1996-2013
Apartment	2.696	2.879	0.840	2.134
Industrial	2.986	2.926	0.585	2.159
Office	3.095	2.913	0.372	2.119
Retail	1.828	3.742	1.146	2.233
Aggregate: Core Properties	2.637	3.066	0.700	2.129

Panel C: Unlevered REIT Returns minus Unlevered Raw NPI Returns

	1996-2001	2002-2007	2008-2013	1996-2013
Apartment	-0.113	-0.857	0.888	-0.024
Industrial	-0.426	0.513	-0.452	-0.125
Office	-0.361	-0.567	0.833	-0.026
Retail	0.505	-0.558	0.546	0.169
Aggregate: Core Properties	-0.108	-0.407	0.595	0.030

Table 2: Average Return Comparison: Individual Gateway Markets

This table reports a comparison of expected returns and realized returns for individual gateway markets for the apartment and office property type classifications. Return series are value-weighted based on the market (appraised) value of the properties held by the NCREIF NPI. Gateway cities are defined as Boston, Chicago, Los Angeles, New York, San Francisco, and Washington, D.C. Returns are reported in percentage form.

Panel A: Apartment

	RERC Required unlevered return: 2014Q1	NPI Realized returns: 2008-2013	NPI Realized returns: 1996-2013
Chicago	7.50	6.29	9.75
Los Angeles	7.20	3.19	8.60
New York	7.20	-1.16	4.80
Washington, D.C.	7.20	5.50	12.33
Boston	7.40	6.37	3.66
San Francisco	7.20	7.94	6.96
Mean	7.28	4.69	7.68
Standard deviation	0.13	3.26	3.22

Panel B: Office

	RERC Required unlevered return: 2014Q1	NPI Realized returns: 2008-2013	NPI Realized returns: 1996-2013
Chicago	8.20	0.91	7.44
Los Angeles	8.10	2.13	10.27
New York	7.90	3.14	11.75
Washington, D.C.	7.50	3.80	10.14
Boston	8.20	-0.32	10.20
San Francisco	7.90	3.36	11.03
Mean	7.97	2.17	10.14
Standard deviation	0.27	1.60	1.46

Table 3: Average NPI Return Comparison: Gateway and Non-Gateway Markets

This table reports quarterly geometric means of unlevered raw NPI returns for gateway and non-gateway markets, and the difference between the two series for each of the four core property types, and all core properties, over the following periods: 1996-2001, 2002-2007, 2008-2013, 1996-2013. Return series are value-weighted based on the market (appraised) value of the properties held by the NCREIF NPI. Gateway cities are defined as Boston, Chicago, Los Angeles, New York, San Francisco, and Washington, D.C. Returns are reported in percentage form.

Panel A: Gateway NPI Returns

	1996-2001	2002-2007	2008-2013	1996-2013
Apartment	3.507	3.376	0.612	2.490
Industrial	3.345	3.437	0.761	2.507
Office	3.388	3.618	0.673	2.551
Retail	2.239	4.308	1.457	2.661
Aggregate: Core Properties	3.114	3.627	0.781	2.500

Panel B: Non-Gateway NPI Returns

	1996-2001	2002-2007	2008-2013	1996-2013
Apartment	2.832	2.979	1.278	2.360
Industrial	3.139	3.045	0.789	2.319
Office	3.237	2.664	0.457	2.112
Retail	1.962	3.813	1.321	2.360
Aggregate: Core Properties	2.690	3.063	0.970	2.237

Panel C: Gateway NPI Returns minus Non-Gateway NPI Returns

	1996-2001	2002-2007	2008-2013	1996-2013
Apartment	0.675	0.397	-0.666	0.129
Industrial	0.206	0.392	-0.028	0.188
Office	0.151	0.955	0.217	0.439
Retail	0.277	0.496	0.136	0.302
Aggregate: Core Properties	0.424	0.564	-0.189	0.263

Table 4: Reweighted NPI Returns minus Unadjusted NPI Returns

This table reports summary statistics of the quarterly differences between our reweighted NPI returns and the raw NPI returns for each of the core property types, and all core properties, over the 1996-2013 sample period. Returns are reported in percentage form.

Panel A: Using Adjusted Cost (*ADJCOST*) Reweighting of NCREIF MSA Returns

	Mean	Median	Std Dev	Min	Max	Serial Correlation
Apartment	0.000	0.012	0.284	-0.941	0.765	-0.07
Industrial	0.019	0.017	0.318	-0.787	1.042	0.45
Office	0.044	0.008	0.348	-1.369	1.175	0.19
Retail	-0.106	-0.071	0.378	-1.696	0.763	0.02
Aggregate: Core Properties	-0.014	-0.021	0.175	-0.498	0.477	0.19

Panel B: Using Book Value (*BV*) Reweighting of NCREIF MSA Returns

	Mean	Median	Std Dev	Min	Max	Serial Correlation
Apartment	-0.002	0.021	0.290	-0.973	0.842	-0.08
Industrial	0.025	0.021	0.303	-0.593	1.050	0.40
Office	0.038	0.006	0.393	-1.649	1.371	0.18
Retail	-0.100	-0.065	0.374	-1.662	0.818	0.02
Aggregate: Core Properties	-0.016	-0.020	0.191	-0.647	0.557	0.20

Table 5: Attribution Analysis Using NPI as Benchmark and Adjusted Cost Weights

This table reports quarterly geometric means of our attribution analysis using NPI as the benchmark for each of the four core property types over the following periods: 1996-2001, 2002-2007, 2008-2013, 1996-2013. Returns are reported in percentage form.

Panel A: Apartment

	1996-2001	2002-2007	2008-2013	1996-2013
Unlevered REIT return minus raw NPI	-0.113	-0.857	0.888	-0.024
Pure allocation effect	0.002	-0.069	0.068	0.001
Selection effect plus interaction	-0.115	-0.788	0.821	-0.024

Panel B: Industrial

	1996-2001	2002-2007	2008-2013	1996-2013
Unlevered REIT return minus raw NPI	-0.426	0.513	-0.452	-0.125
Pure allocation effect	-0.091	0.115	0.044	0.023
Selection effect plus interaction	-0.334	0.398	-0.496	-0.148

Panel C: Office

	1996-2001	2002-2007	2008-2013	1996-2013
Unlevered REIT return minus raw NPI	-0.361	-0.567	0.833	-0.026
Pure allocation effect	-0.017	0.034	0.107	0.042
Selection effect plus interaction	-0.344	-0.601	0.725	-0.068

Panel D: Retail

	1996-2001	2002-2007	2008-2013	1996-2013
Unlevered REIT return minus raw NPI	0.505	-0.558	0.546	0.169
Pure allocation effect	-0.023	-0.189	-0.103	-0.105
Selection effect plus interaction	0.529	-0.369	0.649	0.273

Panel E: Core Properties (Aggregate)

	1996-2001	2002-2007	2008-2013	1996-2013
Unlevered REIT return minus raw NPI	-0.108	-0.407	0.595	0.030
Pure allocation effect	-0.047	-0.026	0.031	-0.014
Selection effect plus interaction	-0.061	-0.381	0.564	0.044

Table 6: Attribution Analysis Using NPI as Benchmark and Book Value Weights

This table reports quarterly geometric means of our attribution analysis using NPI as the benchmark for each of the four core property types over the following periods: 1996-2001, 2002-2007, 2008-2013, 1996-2013. Returns are reported in percentage form.

Panel A: Apartment

	1996-2001	2002-2007	2008-2013	1996-2013
Unlevered REIT return minus raw NPI	-0.113	-0.857	0.888	-0.024
Pure allocation effect	-0.004	-0.065	0.062	-0.002
Selection effect plus interaction	-0.109	-0.792	0.826	-0.022

Panel B: Industrial

	1996-2001	2002-2007	2008-2013	1996-2013
Unlevered REIT return minus raw NPI	-0.426	0.513	-0.452	-0.125
Pure allocation effect	-0.073	0.096	0.060	0.028
Selection effect plus interaction	-0.353	0.417	-0.512	-0.153

Panel C: Office

	1996-2001	2002-2007	2008-2013	1996-2013
Unlevered REIT return minus raw NPI	-0.361	-0.567	0.833	-0.026
Pure allocation effect	0.009	-0.020	0.113	0.035
Selection effect plus interaction	-0.370	-0.547	0.720	-0.061

Panel D: Retail

	1996-2001	2002-2007	2008-2013	1996-2013
Unlevered REIT return minus raw NPI	0.505	-0.558	0.546	0.169
Pure allocation effect	-0.020	-0.172	-0.105	-0.099
Selection effect plus interaction	0.525	-0.386	0.651	0.267

Panel E: Core Properties (Aggregate)

	1996-2001	2002-2007	2008-2013	1996-2013
Unlevered REIT return minus raw NPI	-0.108	-0.407	0.595	0.030
Pure allocation effect	-0.036	-0.046	0.033	-0.016
Selection effect plus interaction	-0.072	-0.362	0.562	0.046

Table 7: Time Series Regression Analysis

This table reports R-squared estimates obtained from regressing unlevered REIT return on our reweighted NPI index. We report results for the following periods: 1996-2001, 2002-2007, 2008-2013, 1996-2013. R-squared statistics are reported in percentage form.

Panel A: Using Raw NPI

	1996-2001	2002-2007	2008-2013	1996-2013
Apartment	0.0	9.6	17.3	11.7
Industrial	3.2	0.1	11.5	10.6
Office	0.0	0.0	7.0	4.4
Retail	24.2	0.3	13.2	6.1
Aggregate: Core	2.0	1.2	12.3	7.8

Panel B: Using Reweighted NPI

	1996-2001	2002-2007	2008-2013	1996-2013
Apartment	0.0	12.5	17.6	12.3
Industrial	0.0	0.0	10.3	9.9
Office	0.0	0.1	10.0	5.9
Retail	20.9	2.3	12.4	6.9
Aggregate: Core	3.8	2.5	13.8	8.8

Table 8: Robustness Checks – 3 Year Estimation Periods

This table reports average quarterly geometric means of our attribution analysis using NPI as the benchmark for each of the four core property types. We report results for the following periods: 1996-1998, 1999-2001, 2002-2004, 2005-2007, 2008-2010, and 2011-2013. Returns are reported in percentage form.

Panel A: Apartment

	1996-1998	1999-2001	2002-2004	2005-2007	2008-2010	2011-2013
Unlevered REIT return minus raw NPI	-0.557	0.332	0.357	-2.072	3.340	-1.595
Pure allocation effect	0.029	-0.025	0.028	-0.167	0.049	0.087
Selection effect plus interaction	-0.586	0.357	0.329	-1.905	3.290	-1.682

Panel B: Industrial

	1996-1998	1999-2001	2002-2004	2005-2007	2008-2010	2011-2013
Unlevered REIT return minus raw NPI	-0.673	-0.180	2.163	-1.141	0.373	-1.306
Pure allocation effect	-0.242	0.058	0.263	-0.036	0.183	-0.100
Selection effect plus interaction	-0.431	-0.239	1.900	-1.106	0.190	-1.206

Panel C: Office

	1996-1998	1999-2001	2002-2004	2005-2007	2008-2010	2011-2013
Unlevered REIT return minus raw NPI	-0.704	-0.021	1.107	-2.262	2.540	-0.915
Pure allocation effect	-0.094	0.059	-0.067	0.138	0.140	0.073
Selection effect plus interaction	-0.611	-0.080	1.174	-2.399	2.400	-0.989

Panel D: Retail

	1996-1998	1999-2001	2002-2004	2005-2007	2008-2010	2011-2013
Unlevered REIT return minus raw NPI	0.753	0.259	0.646	-1.743	1.579	-0.511
Pure allocation effect	0.009	-0.055	-0.060	-0.317	-0.150	-0.055
Selection effect plus interaction	0.744	0.314	0.706	-1.426	1.729	-0.456

Panel E: Core

	1996-1998	1999-2001	2002-2004	2005-2007	2008-2010	2011-2013
Unlevered REIT return minus raw NPI	-0.279	0.063	1.073	-1.889	2.202	-1.048
Pure allocation effect	-0.105	0.011	0.002	-0.055	0.041	0.021
Selection effect plus interaction	-0.174	0.052	1.070	-1.834	2.161	-1.069

Table 9: Robustness Checks – Sample Period Dependence

This table reports average quarterly geometric means of our attribution analysis using NPI as the benchmark for each of the four core property types. Returns are reported in percentage form.

Panel A: Rolling 6 Year Windows

	Apartment	Industrial	Office	Retail	Core
Unlevered REIT return minus raw NPI	0.093	0.004	-0.065	0.048	0.043
Pure allocation effect	-0.017	0.084	0.035	-0.133	-0.013
Selection effect plus interaction	0.110	-0.079	-0.100	0.180	0.056

Panel B: Removing One Sample Year from Estimation

	Apartment	Industrial	Office	Retail	Core
Unlevered REIT return minus raw NPI	-0.022	-0.118	-0.025	0.159	0.027
Pure allocation effect	0.001	0.022	0.040	-0.099	-0.013
Selection effect plus interaction	-0.023	-0.139	-0.065	0.258	0.040

Table 10: Attribution Analysis Using Property Subtypes – Retail Centers

This table reports quarterly geometric means of our attribution analysis using NPI as the benchmark for the retail center subtype over the following periods: 1996-2001, 2002-2007, 2008-2013, 1996-2013. REITS classified as Shopping Center (property subtype 17) and Strip Centers (property subtype 18) and NCREIF properties classified as Community, Neighborhood and Power Centers constitute our definition of the retail center property subtype. Returns are reported in percentage form.

	1996-2001	2002-2007	2008-2013	1996-2013
Unlevered REIT return minus raw NPI	0.358	-0.154	0.320	0.177
Pure allocation effect	-0.013	-0.150	0.027	-0.045
Selection effect plus interaction	0.372	-0.004	0.293	0.221