Are Cap Rates Derived from Capital Markets Good Proxies for Space Market Cap Rates?

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Abstract

This paper uses error correction and tax adjustment methods to derive capitalization rates from capital markets to proxy for space market cap rates. Using quarterly mortgage loan data from the American Council of Life Insurers from 2000 through 2023 (96 quarters 24 years), we find that capital market cap rates are highly correlated and consistently higher than space market cap rates. The high correlation suggests that the two series may be cointegrated, allowing one series to predict the values of the other. Using cointegration tests, we find that capital market cap rates and space market cap rates are cointegrated; consequently, we use an error correction model to predict space market cap rates from capital market cap rates. We also find that the adjusting for depreciation tax deduction in the capital market cap rates accounts for most of the variation between the two cap rate series, providing another way for using capital market cap rates to proxy for space market cap rates when property level data are sparse or unavailable.

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1. Introduction

Direct capitalization is the most often used ratio model in the valuation of investment real estate; however, space[4] market prices and net operating income are often hard to come by for some property types and geographic areas, making reliable valuation difficult.[5] In contrast, capital market data from mortgage lenders are readily available, so this obstacle could be overcome if capital market data could be used to derive and predict reliable space market cap rates. The valuation literature includes many ways to derive capitalization rates from both debt and equity markets, including definitional models proposed by McLaughlin (1959), Gettel (1978), and Steele (1981), and those rooted in discounted cash-flow models proposed by Ellwood (1959), Lusht and Zerbst (1980), Fisher and Lusht (1981), and Cannaday and Colwell (1986). Other research on cap rates generally falls into two categories. The first examines the intertemporal movement of cap rates based on changes in the capital markets, e.g., interest rates. The second examines the cross-section variation in cap rates across property types and locations.[6] In this study, we examine capitalization rates through a different lens. We look at alternative methods used within the real estate industry to estimate capitalization rates, and work to explain the difference in the estimated capitalization rates. In rapidly changing market environments, it can be difficult to accurately assess current market value and future income projections, impacting cap rate calculations. In addition, in smaller or niche markets, there may be a lack of recent

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[4] In this paper, space markets are synonymous with property level markets. See Archer and Ling (1997) for a more refined discussion of space, capital, and property markets.

[5] Space market or property-level cap rates are derived by dividing Net Operating Income by Sales Price or Value and can be considered an inverse Price/Earnings ratio.

[6] Some include Nelson and Allen (1976),Albert and Pearson (1980), Lusht and Fisher (1984), Nourse (1987), Ambrose and Nourse (1993), Jud and Winkler (1995), Hendershott and Turner (1999), Sivitanides and Sivitanidou (1999), Sivitanidou, Torto, and Wheaton (2001), De Wit and Van dijk (2003), Hendershott and MacGregor (2005), Chichernea, Miller, Fisher, Sklarz, and White (2008), Chervachidze, Costello, and Wheaton (2009), Chichernea, Miller, Fisher, Sklarz, and White (2008), McDonald and Dermisi (2009), Plazzi, Torous, Valkanov (2010), Chervachidze and Wheaton (2013), Beracha, Downs, and MacKinnon. (2017), Duca, Hendershott, and Ling (2017), Chuangdumrongsomsuk and Fuerst (2017), Duca and Ling (2018), Fisher, Steiner, Titman, and Viswanathan (2022), Białkowski, Titman, and Twite (2023).

comparable sales data to use for comparison when determining a property's market value. The debt coverage ratio method is compared to space market cap rates to determine if an estimation long-run gap exists and what factors might explain the gap.

This study uses error correction and tax adjustment methods to derive capitalization rates from capital markets to proxy for space market cap rates. It extends the original work by Boykin and Hoesli (1990), who argue the merits of using the debt-coverage method, proposed by Gettel (1978), for developing cap rates because of its simplicity and known inputs. They argue that many alternative methods for deriving a cap rate, especially those from a DCF perspective, require many unverifiable assumptions, potentially leading to unreliable valuation results. Using quarterly ACLI mortgage data over 20 years from 1969 through 1988, they show that cap rates derived using the debt-coverage ratio overstate the actual property capitalization rate but conclude that the magnitude is “fairly small.”

Our paper seeks to close this gap. Using quarterly mortgage loan data from the American Council of Life Insurers from 2000 through 2023 (96 quarters 24 years), we find that capital market cap rates are highly correlated and consistently higher than space market cap rates. The high correlation suggests that the two series may be cointegrated, allowing one series to predict the values of the other. Using cointegration tests, we find that capital market cap rates and space market cap rates are cointegrated; consequently, we use an error correction model to predict space market cap rates from capital market cap rates.

Although error correction techniques provide a mechanism for adjusting capital market cap rates to proxy for space market cap rates, a fundamental question remains: Why are capital market cap rates derived from the Gettel (1978) method consistently higher than actual space market cap rates?

By extending the work by Duca, Hendershott, and Ling (2017), who show how taxes influence real estate valuations, we find that tax depreciation accounts for most of the variation between the two cap rate series; therefore, we conclude that a tax-adjusted Gettel model is another way for deriving reliable capital market cap rates to proxy for space market cap rates when data are sparse or unavailable.

This article proceeds as follows: the second section outlines the relevant theory, while the third section summarizes the data. The fourth section summarizes the empirical results, while the fifth section concludes the study.

2. Appraisal Foundations

Income valuation models are divided into two basic categories: ratio models, like direct capitalization, and discounted cash flow models. There is also a well-established line of literature connecting these approaches by deriving capitalization rates from the discounted cash flow model (for example, see Cannaday and Colwell (1979)).

The discounted cash flow model is based on the concept (theory) that value is determined as the sum of the present value of the expected net cash flows. In a discrete-time setting, equilibrium value can be expressed as:

$$V_0 = \sum_{t=1}^{HP} \frac{NOI_t}{(1+r_t)^t} + \frac{NSP_{HP}}{(1+r_{HP})^{HP}} \tag{1}$$

where NOI_t is the expected net operating income (income after expenses) at time t, NSP_{HP} is the expected net selling price at the end of the holding period, r is the overall discount rate.

In a discrete-time setting with a finite holding period, where NOI and NSP grow at a constant rate g and r is time-invariant, the equilibrium value can be expressed as:

$$V_0 = \frac{NOI_1}{r-g} \tag{2}$$

The cap rate (R_0) in equation (2) is r- g. The cap rate (R_0) can also be written as:

$$R_0 = \frac{NOI_1}{V_0}. \qquad (3)$$

This equation represents the property level (space market) capitalization rate. Appraisers derive this rate from comparable sales (similar use, location, and rental characteristics) by dividing NOI by the sale price of comparable properties that sold recently. When property markets are active, this valuation method is commonly relied on. When property markets are thin, other methods, which utilize inputs from other markets, are used to derive cap rates.

Band of Investment

One category of alternative cap rate models, mortgage-equity models, recognizes that when debt is used, lenders and equity investors are due a return on and of their investments. One such mortgage-equity model, the band-of-investment method, derives a cap rate by calculating the weighted average of expected first-year cash returns to the lender and equity investor as of the valuation date. In other words, the capitalization rate (R_o) is defined as the weighted average of the mortgage capitalization rate (R_m) and the equity capitalization rate (R_e).[7] The band-of-investment formula is as follows:

$$R_o = LTV(R_m) + (1 - LTV)R_e \qquad (4)$$

where LTV is the loan-to-value ratio, (1 – LTV) is the equity-to-value ratio, R_m is the mortgage capitalization rate (or mortgage constant), and R_e is the equity capitalization rate (also referred to as the equity dividend rate or the before-tax cash-on-cash return). Based on a generalization of cap rate in equation (2), the mortgage cap rate can be written as:

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[7] The analysis assumes that the mortgage capitalization rate and the equity capitalization rate relate to similar or comparable properties as the subject property.

$$R_{mtg} = r_{mtg} - g_{mtg} = \frac{r_{mtg}}{1 - \frac{1}{\left(1 + r_{mtg}\right)^{n}}} \quad (5)$$

where, in the case of a fixed rate fully amortizing mortgage, g_{mtg} represents the annualized change in the mortgage principal over the loan term and *n* represents the loan term. Thinking of the NOI as the cashflow return to the investment of debt and equity, if we subtract the annual debt service (DS) from NOI, the result is before tax equity cashflow (BTCF). So, the equity cap rate (R_e) can be derived by dividing the before-tax cash flow (NOI-DS) by the equity investment; a variant of eq (3).

Debt Coverage Method

Another definitional method, first proposed by Gettel (1978), uses the lender's perspective to calculate a capitalization rate using basic mortgage terms. The cap rate is derived using the debt coverage ratio (NOI/DS), mortgage constant (DS/Loan Amount), and loan-to-value ratio (Loan Amount/Value). This approach is commonly referred to at the debt-coverage or lender's method and can be written as:

$$R_o = \text{DCR x } R_m \text{ x LTV.} \quad (6)$$

If we substitute the definition of each righthand side term into equation (6), we see the cap rate is equivalent to the base cap rate. For example:

$$R_o = \frac{\text{Net Operating Income}}{\text{Debt Service}} \text{ x } \frac{\text{Debt Service}}{\text{Loan Amount}} \text{ x } \frac{\text{Loan Amount}}{\text{Value}} = \frac{\text{Net Operating Income}}{\text{Value}} \quad (7)$$

This equation requires no explicit assumption of the equity dividend rate and all the variables (DCR, R_m, and LTV) are readily available from mortgage lenders. Because of this, one might argue that the debt coverage method ignores equity investor criteria, expectations, and requirements, making it inferior for deriving reliable cap rates for valuation. However, we argue that in equilibrium, the debt coverage or lender's method implicitly captures the optimal arrangement for both lenders (debt position) and borrowers (equity position).

Equity investors will not pursue mortgage financing unless the proposed terms lead to positive leverage. In this case, when the equity dividend rate (EDR) or R_e is higher than the mortgage constant or R_m. In addition, a borrower will shop among lenders and only accept the terms that optimize the return on equity. We know that in a competitive market, debt and equity participants naturally arrive at an equilibrium in which the quantity supplied equals the quantity demanded (the market naturally migrates to Pareto optimality in a competitive market); therefore, the lender's method for deriving a cap rate implicitly accounts for the required rates of return to the equity investor when transactions are occurring.

One of the primary benefits of the debt coverage method is its simplicity and known inputs. Boykin and Hoesli (1990) convincingly argue this point.

3. Data

The data used in this study comes from the American Council of Life Insurers and includes information about commercial mortgage commitments collected from member firms in the United States from the first quarter of 2000 through 2023, comprising 96 quarters or 24 years.[8] ACLI collects data on floating-rate loans; however, since these types are uncommon, this study only investigates fixed-rate loans.[9] Table 1 provides summary statistics of the data by property

[8] Boykin and Hoesli (1990) used this data source to examine cap rates from 1969 through 1988.

[9] The survey includes long-term (over one year) mortgage commitments on commercial properties in the United States and its possessions, including maturing balloon mortgages that have been refinanced for more than one year at current market terms. It excludes construction loans without permanent mortgage financing, standby loans, loans secured by land only, social responsibility loans, tax-exempt loans, purchases of existing mortgages, and acquisitions of mortgage-backed securities. Source: ACLI

type. Note that the data includes information on apartments, office buildings, retail centers, and industrial facilities.[10]

The first three columns of table 1 provide a perspective of the magnitude of debt capital from life insurance companies. The data show that retail had the highest average number of loans per quarter, at 187, followed by industrial properties at 150. Offices had the fewest, at 119. Based on the average total committed loan amount per quarter, column (2), apartments were the most preferred property type for the deployment of debt capital, with an average of $2.44 billion. Office buildings were second at $2.37 billion, and industrial properties were last at $1.79 billion. Office properties had the highest average loan amount at $20,959,705, with retail centers the lowest at $9,880,772 (see column (3)).

According to ACLI, the average space market or property-level cap rate is “derived for each loan by dividing net stabilized earnings by the property value.”[11] Only properties with stabilized earnings (NOI) are included in the study. There is no reason to believe that the average cap rate reported by ACLI is a derivative of the loan terms provided for each property. If this were the case, then a feedback process may exist, undermining the results of this study. Table 1 column 4 shows apartments had the lowest average cap rate of 6.19%, followed by office buildings at 6.86%.

Mortgage-related data are presented in columns (5) – (8) of Table 1. The average contract interest rate shows that apartments enjoyed the lowest average rate of 4.97%, followed by

[10] ACLI began collecting loan data in the third quarter of 1965; however, prior to the first quarter of 2000, ACLI aggregated the data irrespective of property type. Beginning in the first quarter of 2000, ACLI disaggregated the data for five property types, including apartments, office, retail, industrial, and hotels. Periodically, ACLI has collected mortgage commitment data on other property types; however, because of the inconsistency in the data collection and the paucity of hotel information, only data on apartments, office, retail, and industrial properties are included in this study.

[11] Average Cap Rate: Derived for each loan by dividing net stabilized earnings by the property value. Since net stabilized earnings are not relevant for certain property types, such as eleemosynary institutions, the capitalization rate is the average of the individual rates for which this information is available. Source: ACLI

industrial buildings at 5.06%. The average debt coverage ratio[12] is lowest for apartment properties at 1.78, followed by retail properties at 1.84. The average loan-to-value ratio shows that industrial properties experienced the highest LTV of 63.95%, followed closely by apartments at 62.98%. The narrow band of LTV ratios over the entire study period indicates that this variable is the most stable of all variables used.

The average mortgage constant,[13] The cap rate on a mortgage is a derivative of the interest rate and term of the mortgage. Apartments had the lowest average mortgage constant, at 6.34%, followed by office properties, at 6.56%. Overall, apartments enjoyed the most favorable mortgage terms over the study period.

4. Empirical Analysis

The primary objective of this study is to determine if cap rates derived from the capital markets are a good proxy for space market cap rates. ACLI provides the space market cap rates and the inputs necessary to derive cap rates from the capital market. Using the lender's method shown in Equation 6, the average capital market cap rates are calculated for each quarter for each property type. Table 2 compares the space market cap rates with each property type's capital market cap rates.

The table shows that average capital market cap rates are consistently higher than average space market cap rates. In fact, on average, capital market cap rates are 10.44% higher than space

[12] Debt Coverage Ratio: Derived on a loan-by-loan basis by dividing net stabilized earnings by the annual debt service (as calculated for each loan from the percent constant). This ratio is available only for those loans where net stabilized earnings is available and for which the percent constant could be estimated. Source: ACLI

[13] Average Mortgage Constant: The annual fixed percentage of the original loan amount required to service the debt over the amortization period for partially amortizing loans or over the term to maturity for fully amortizing loans or interest-only loans. The annual constant is estimated by the ACLI, assuming an annual payment and using supplemental information reported on the amortization period applicable to partially amortizing loans. The mortgage constant is not calculated for partially amortizing loans having an interest-only period. Source: ACLI

market cap rates, which amounts to an average difference of 71 basis points. Figure 1 illustrates the intertemporal difference between the two cap rates for all property types.

Figure 1 shows a positive correlation between the two cap rates but does not measure the correlation's strength. A bivariate Pearson Correlation Coefficient provides a definitive measure of the strength and direction of the linear relation between the two cap rate series. In this case, the correlation coefficient for all property types is 95.72%, a very high positive correlation.

The high correlation coefficients suggest a strong positive relation between the two alternative cap rates, but neither provides insight into cointegration and causation. Cointegration (or co-movement) occurs when two or more time series have a common stochastic trend, and the two time series drift together at roughly the same rate (Granger and Weiss, 1983). Put another way; cointegration occurs when the two cap rate series tend to move together in the long run, even when experiencing short-run deviations. If the two cap rate series are cointegrated, an Error Correction Model can be used to predict the movement of one series based on the movement of the other. So, if capital market cap rates are cointegrated with the space market cap rates then adjusted capital market cap rates can be used to proxy for space market cap rates.

Cointegration Analysis

There are typically two approaches for determining if two variables are cointegrated. The first involves plotting the difference or spread between the two variables and examining the trend. If the spread or difference hovers around zero, then the two variables would appear to be cointegrated. Figure 1 also provides a plot of the two cap rate series for all property types and the absolute percent difference between the two.

The chart shows that the two series follow a similar trend; however, the capital market cap rate is consistently higher than the space market rate, especially following the great recession of 2008 and 2009. Notice that the two cap rates have been converging more recently. This has been a period of rapidly increasing nominal interest rates. Overall, the absolute mean difference between the two series is 71 basis points, and although it is greater than zero, it is consistently greater, suggesting that the two series may be cointegrated.[14]

The second approach for investigating cointegration involves formal statistical tests. The first step in statistical testing for cointegration involves verifying the order of integration for each variable by performing unit root tests.[15] The Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979) and the Phillips-Perron (PP) test (Phillips and Perron, 1988) are common methods for performing unit root tests. The null hypothesis in both tests is that the series has a unit root and is non-stationary (nonpredictable). So, if the null hypothesis is rejected, the time series does not have a unit root and is stationary. Table 3 provides the unit root tests for the two cap rate time series in levels.

Panel A shows that the Dickey-Fuller and the Phillips-Perron tests fail to reject the null hypothesis that the space market cap rate series has a unit root and is nonstationary in all cases. The results for the capital market cap rates are mixed. The tests fail to reject the null hypothesis for all properties and industrial properties, but the null is rejected for apartments, office, and retail. Overall, the results from these tests suggest that the two series may have a unit root and are nonstationary.

Because of the mixed results, common with time series in levels, the first differences are

[14] Although not included in the paper for brevity, similar plots for apartment, office, retail, and industrial properties were also constructed and show similar trends; however, these do not provide conclusive evidence of cointegration.
[15] At a basic level, a time series can be written as a series of monomials or expressions with a single term. Each monomial corresponds to a root. If one of these roots is equal to 1, then that's a unit root, and we conclude that the series is nonstationary (a systematic pattern that is unpredictable). This is sometimes called a random walk with drift. Often, the series can be made stationary by differencing.

calculated, and the statistical tests are reapplied. Panel B, the variables in first differences, provides a much clearer signal. The null hypothesis of non-stationarity is rejected in all cases with both the Dickey-Fuller and Phillip-Perron tests, suggesting that the two series in first differences are stationary. Therefore, we found that the two series in levels are nonstationary, but in first differences are stationary. Both conditions are necessary for cointegration which occurs when a linear combination of non-stationary variables is stationary, meaning there is a long-term relationship between the series, even though they are individually nonstationary.

Now that the necessary conditions have been met, we can test for cointegration in two steps. First, we regress the capital market cap rate series on the space market cap rate series in levels and save the residuals. Second, we regress the first differenced capital market cap rates on the first differenced property level cap rates and the first differenced residuals from the previous regression. Engle and Granger (1987) provide the test statistic on the residuals. The null hypothesis is that the residuals have a unit root, are nonstationary, and are not cointegrated. Rejecting the null hypothesis results in the series being stationary, or cointegrated. Table 4 provides the results of this test for each property type.

In all cases, the null hypothesis of no cointegration is rejected; therefore, there is ample evidence that a long-run relation exists between space market cap rates and capital market cap rates, allowing the values in one series to predict the values in the other.

Granger Causality Analysis

Granger (1986, 1988) and Engle and Granger (1987) posit that cointegration in two-time series requires a causal relation in at least one direction. Granger (1969) posits that a variable P Granger-causes Q if the prediction of Q is improved by including past values of P. If P Granger-causes Q, a unidirectional relationship exists; however, if P Granger-causes Q and Q Granger-causes P, a bi-directional or joint causality exists between the two variables. Table 5 shows the results from the Granger causality Wald tests.

The null hypothesis of no causal relation is rejected in both directions for all properties, apartments, and office properties, suggesting a bidirectional or joint causality between the two cap rate series. A unidirectional relation exists between the cap rate series for retail and industrial properties. Specifically, capital market cap rates have a causal effect on space market cap rates.

Error Correction Analysis

Because space market and capital market cap rates are cointegrated, an Error Correction Model can be used to predict the movement of one cap rate series based on the movement of the other. The error correction model is specified in two steps. First, the long-run model, as shown in Equation 8, is estimated, and the residuals are saved.

$$\mathrm{CMCR}_t = \beta_o + \beta_1 \mathrm{SMCR}_t + \varepsilon_t \quad (8)$$

CMCR is the capital market cap rate, and SMCR is the space market cap rate. Second, the saved error terms are differenced and inserted into Equation 9.

$$\Delta\mathrm{CMCR}_t = \beta_o + \beta_1 \Delta\mathrm{SMCR}_t + \beta_2 \epsilon_{t-1} + v_t \quad (9)$$

Where $\Delta\mathrm{CMCR}_t$ and $\Delta\mathrm{SMCR}_t$ are the differenced values of the capital market cap rates and the space market cap rates, respectively. The parameter β_2 determines the speed of the adjustment toward long-run equilibrium. Table 6 provides the results from the error correction regressions.

In all cases, the coefficients on the space market cap rate variable and the residuals are significant at the 5% level. Next, we use the parameter estimates to fit or construct the error-corrected capital market cap rate series for each property type. Figure 2 compares the newly constructed error-corrected capital market cap rates with the original cap rate series for all property types and shows the new error-corrected capital market cap rate series experiences a material downward adjustment that more closely approximates the space market or property level cap rate series. In addition, the error-corrected series exhibits less volatility than the original capital market series. Similar results were found for each of the four property types (see Appendix figures A1-A4).

Overall, the illustrations provide ample evidence that the error-corrected capital market cap rate series can be used as a proxy for space market cap rates. This is great news for practitioners because there are numerous occasions when space market cap rates are hard to come by, making it difficult to estimate value reliably. On the other hand, capital market inputs, such as mortgage interest rates, debt coverage ratios, and loan-to-value ratios, are readily available in just about all situations, allowing for the construction of capital market cap rates.

The Spread between Rates

The previous analysis showed that capital market cap rates are consistently higher than space market cap rates, and for the most part, the spread is consistent across property types and geographic areas. Why might this finding be so consistent? In their paper on how taxes and required rates of return drive commercial real estate valuations, Duca and Ling (2015) and Duca, Hendershott, and Ling (2017) posit that accounting for the present value of tax depreciation helps explain cap rates. Using the Gordon Growth model as a basis, they provide the following:

$$P_o = \frac{NOI_1}{r-g} + (taxdep)P_o - taxgain \quad (10)$$

where P_o equals price or value, NOI_1 equals Net Operating Income in period one, r equals the required rate of return or discount rate, g equals the expected constant growth rate of NOI, and

$taxdep$ equals the net present value of depreciation deductions per dollar of acquisition price over an N-year holding period, more formally defined as:

$$taxdep = \frac{\left(\sum_{t=1}^{n}\frac{(SLDEP_t)\tau_{MTR}}{(1+k)^t} - \frac{\sum_{t=1}^{N} SLDEP_t \tau_{RTR}}{(1+k)^t}\right)}{P_o} \quad (11)$$

where SLDEP equals straight-line depreciation, k equals the appropriate after-tax discount rate, τ_{MTR} equals the marginal tax rate, and τ_{RTR} is the recapture tax rate. The $taxgain$ equals the present value of expected capital gains taxes. The $taxgain$ may be dropped because its movement is already accounted for in r because the rate of return rises when the tax rate on income or capital gains rises.[16] This results in the following definition of cap rate:

$$R_o = (r - g)[(1 - taxdep)]^{17} \quad (12)$$

Notice that this equation does not include a term for the mortgage interest tax deduction because, at the optimal LTV, the after-tax cost of debt equals the cost of equity. Substituting $(r - g)$ with DCR x R_m x LTV (see equation 6) results in a tax-adjusted capital markets cap rate as follows:

$$DCR\ x\ R_{\ m}\ x\ LTV\ x\ (1 - taxdep) \quad (13)$$

To calculate $taxdep$, we use the highest annual marginal personal tax rate for τ_{MTR}, 25% for the recapture tax rate τ_{RTR} , an after-tax rate on Baa Corporate bonds for (k), and a straight-line depreciation (SLDEP) of 27.5 years for residential properties and 39 years for commercial. Using ACLI mortgage data and the above assumptions, we calculate the tax-adjusted capital markets cap rates and compare these to the space market cap rates.

Figure 3 illustrates this comparison and shows that the capital market cap rates adjust downward after accounting for the tax adjustment. The average spread between the space market

[16] Duca, Hendershott, and Ling (2017), Page 571.
[17] Duca, Hendershott, and Ling (2017), Page 571, footnote 31

cap rates and the tax-adjusted capital market cap rates has been reduced by 29 basis points (0.7118% less 0.4227%); however, a sizable gap of 42 basis points remains on average. What might be the cause of the remaining spread? There is anecdotal evidence that many commercial property investors use a 1031 tax-deferred exchange to defer recapture taxes when selling a property that has enjoyed tax depreciation benefits.[18] This mechanism allows investors to defer capital gains and recapture taxes almost into perpetuity if used strategically. If this is the case, we could assume that the recapture tax rate is effectively zero, thereby eliminating the right-hand side of the numerator in the $taxdep$ equation (see Equation 11).

Figure 4 compares the space market cap rate series and the tax-adjusted capital market cap rate, assuming no recapture taxes. In this case, the average spread between the space market cap rates and the tax-adjusted capital market cap rates has been reduced by 0.6801% (0.7118%-0.0316%), leaving a remaining spread of about three basis points on average. Of course, more research and analysis need to be conducted to investigate this issue thoroughly, but the initial calculations suggest that market participants may be adjusting for the benefit of depreciation but are not expecting a significant recapture tax expense at the time of exit.

It should be noted that although small, a difference in the space market cap rate series and the tax-adjusted capital market cap rate, assuming no recapture taxes, still exists even after this adjustment. When we look at the difference charted across time, at the bottom of Figure 4, we notice that the space market rate, which fell consistently below the capital market cap rate, now only occurs after mid-2010. This is consistent with the overall pattern of the difference in Figure 1; the average spread between the two cap rates is lower from 2000 through 2010 than from 2010 through 2023. Duca and Ling (2020) note that capital availability significantly affect property

[18] See IRS Publication 544 (Sales and Other Dispositions of Assets), and IRS Section 1031.

prices. It is possible that the capital market cap rate lacks the mechanism to capture this effect. Thus, a future pursuit is to examine if changes in the availability of debt capital caused by structural changes in the macro economy impacts the differences between capital and space market cap rates.

Deeper Dive into Geographic Areas

Because the previous analysis used national data we wondered if the finding would hold over alternative geographic markets. We were able to obtain ACLI data at the division and MSA level, as well as for three metro markets. The disaggregated data runs from the first quarter of 2014 through the fourth quarter of 2023 or ten years of quarterly data. We conducted the same unit root tests at both the division, MSA, and metro levels and found that, for the most part, the time series were nonstationary; however, when we reapplied these tests to the first differences, the null hypotheses of non-stationarity were rejected in all cases (a necessary condition for cointegration). Next, we applied the Engle-Granger test for cointegration across geographic divisions, MSAs, and three major metro markets, and with rare exception, the analysis found strong evidence of cointegration between capital market cap rates and space market cap rates (See Appendix Table A1 Panels A, B, and C). When the Granger Causality Wald tests were applied to the smaller geographic areas (divisions, MSAs, and cities), only a handful showed a unidirectional relation, and in these cases, capital market cap rates had a causal effect on space market cap rates (See Appendix Table A2 Panels A, B, and C). Next, we constructed error-corrected capital market cap rates and compared these to the space market cap rates (See Appendix Figures A1, A2, A3, and A4). Similar to the national perspective, the error-corrected cap rate series dropped considerably, approximating the space market cap rates closely.

6. Summary and Conclusion

Direct capitalization is the most often used ratio model in the valuation of investment real estate; however, space market cap rates are often hard to come by for some property types and geographic areas, making reliable valuation difficult. On the other hand, capital market data (mortgage terms) from mortgage lenders is readily available, so if these data could be used to derive and predict reliable space market cap rates, then this obstacle could be overcome. In addition, the ability to predict cap rates from capital market data could also provide important pricing guidance for investors.

Using quarterly data from the American Council of Life Insurers from the first quarter of 2000 through the second quarter of 2023 (96 quarters or 24 years), space market cap rates and capital market cap rates were examined to determine if cap rates derived from the capital markets are a good proxy for cap rates derived in the space market.

The analysis found that capital market cap rates and space market cap rates were highly correlated and that capital market cap rates were consistently higher. This consistency suggested that the two series may be cointegrated. Cointegration occurs when two time series move together in the long run, even when experiencing short-run deviations. When two time series are cointegrated, an Error Correction Model can be used to predict the movement of one series based on the movement of the other. The analysis found that space and capital market cap rates are cointegrated, allowing the values in one series to predict the values in the other.

Because space market and capital market cap rates were found to be cointegrated, an Error Correction Model was used to predict the movement of space market cap rates based on the movement of capital market cap rates. Although the error correction method provides an effective adjustment for capital market cap rates, it does not explain the cause of the spread between them. Duca and Ling (2015) and Duca, Hendershott, and Ling (2017) propose that tax depreciation helps explain cap rates, and so we set out to determine if this may explain the spread, which on average, amounts to 71 basis points. Our investigation found compelling evidence that this may be the case, but with a twist. Duca et al. propose that accounting for depreciation includes the present value of the periodic depreciation minus the present value of the recapture taxes. When we applied this methodology to the data, the spread was reduced by 29 basis points, leaving a 42-basis point gap. Anecdotal evidence suggests that investors may use tax-deferred exchange options to defer recapture taxes into perpetuity. When we remove the recapture tax component from the calculation of the capital market cap rate, the spread declines to three basis points on average. Of course, more investigation into this potential cause is warranted; however, these initial results suggest this path is worth pursuing.

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Figure 1 – Cap Rate Comparison with Absolute Difference (All Property Types)

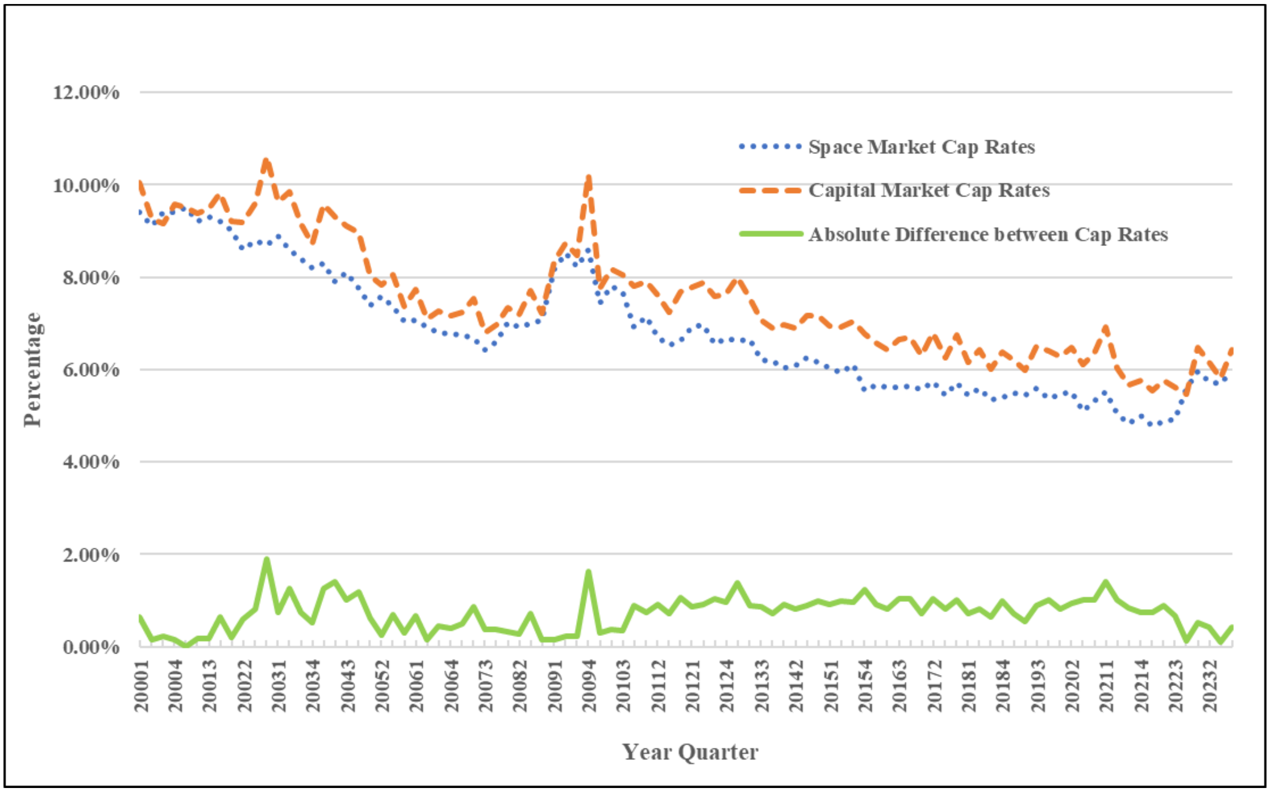


Figure 2 - Error Corrected Capital Market Cap Rates (All Property Types)

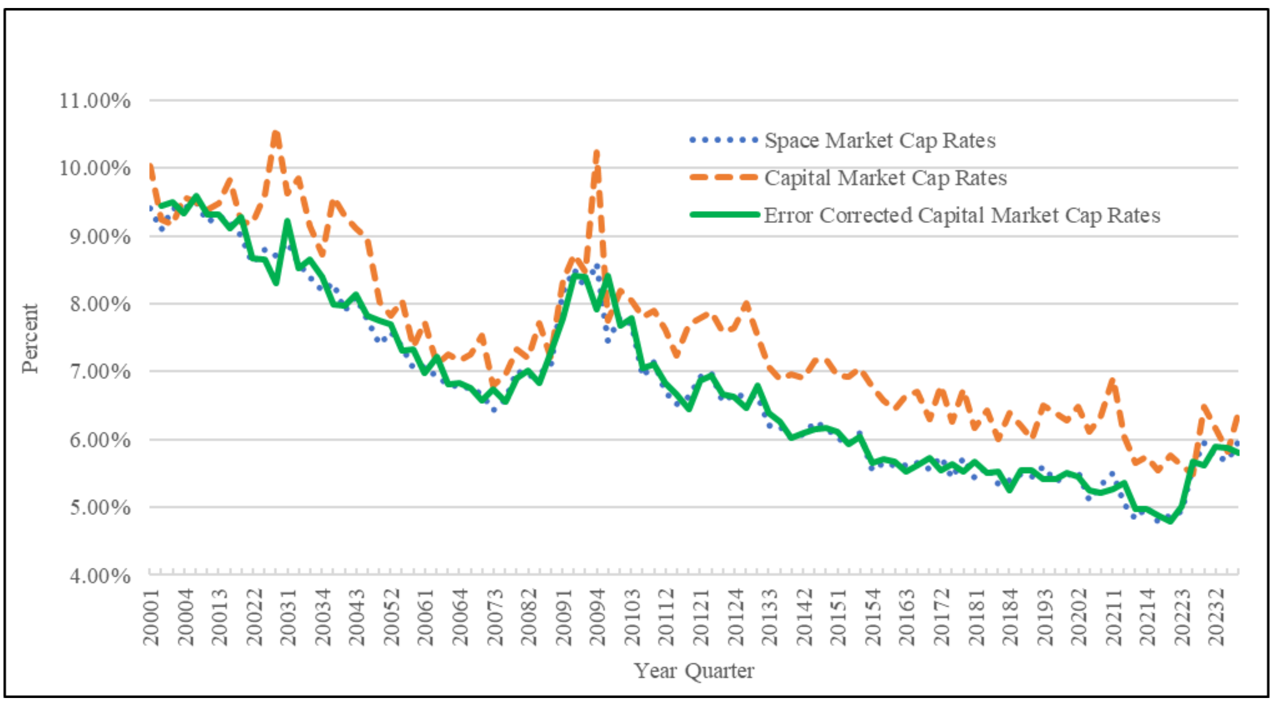


Figure 3 – Tax Adjusted Cap Rate Comparison (All Property Types)

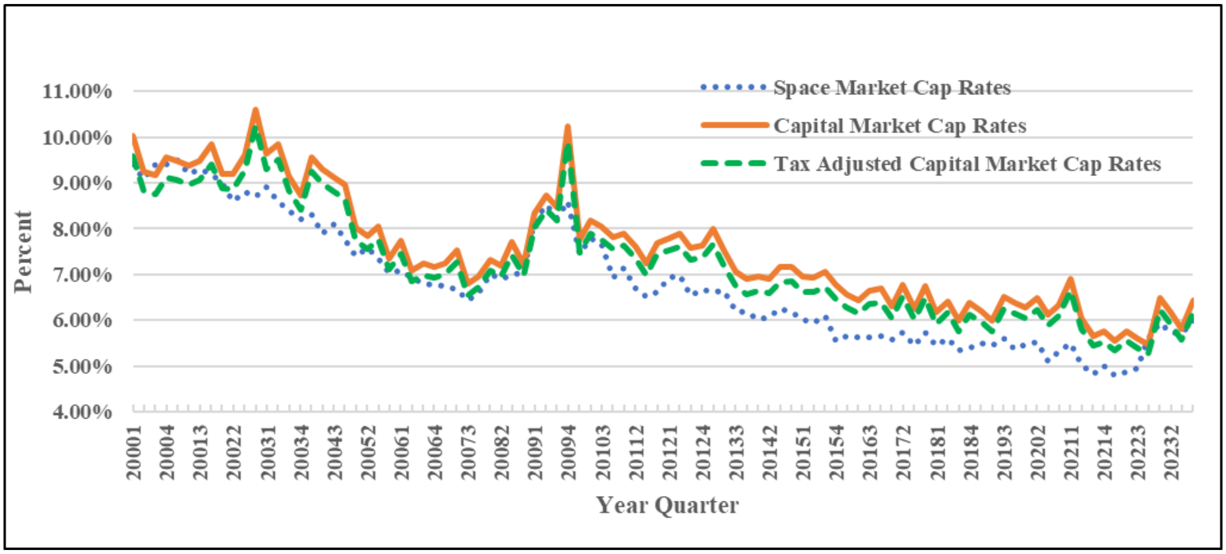


Figure 4 – Tax Adjusted Cap Rate Comparison with Absolute Difference (All Property Types)

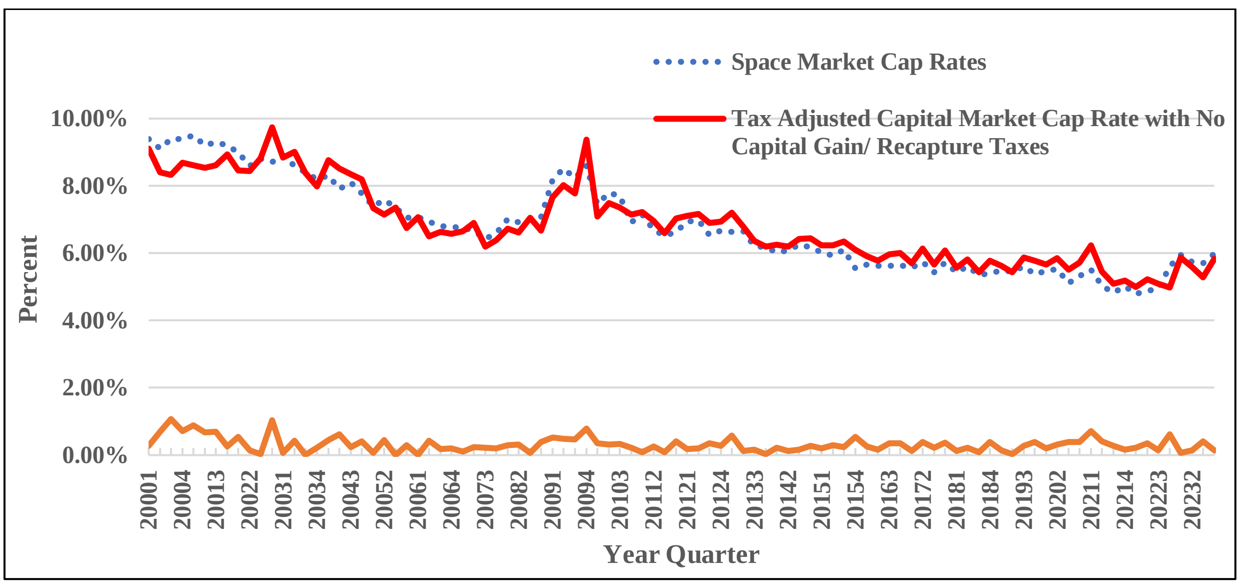


Table 1
Summary Statistics by Property Type (Quarterly)
National Perspective
1st Qtr. 2000 - 4th Qtr. 2023 (Twenty-four Years)

Mean	(1) Average No. of Loans in a Quarter	(2) Average Committed Loan Amount per Quarter	(3) Average Loan Amount	(4) Average Space Market Cap Rate	(5) Average Contract Interest Rate	(6) Average Debt Coverage Ratio	(7) Average Loan to Value Ratio	(8) Average Mortgage Constant
Apartments	108	$2,448,935,444	$20,540,931	6.19%	4.97%	1.78	62.98%	6.34%
Office	119	$2,367,298,909	$20,959,705	6.86%	5.15%	1.95	60.13%	6.56%
Retail	187	$1,834,268,646	$9,880,772	7.15%	5.26%	1.84	61.93%	6.99%
Industrial	150	$1,793,463,326	$12,041,874	7.12%	5.06%	1.86	63.95%	6.73%
All Properties	619	$9,376,402,329	$15,239,881	6.80%	5.12%	1.87	61.82%	6.62%
Std. Dev.								
Apartments	50	$1,722,465,543	$7,759,703	1.22%	1.34%	0.27	4.32%	1.26%
Office	48	$1,002,337,309	$7,340,667	1.37%	1.37%	0.31	4.90%	1.39%
Retail	57	$804,205,417	$3,094,732	1.12%	1.34%	0.27	4.16%	1.22%
Industrial	42	$1,026,842,303	$6,071,288	1.36%	1.41%	0.29	4.31%	1.46%
All Properties	165	$3,479,390,562	$4,233,716	1.33%	1.38%	0.25	3.81%	1.35%
Min								
Apartments	7	$54,025,000	$3,933,351	4.29%	2.83%	1.32	52.31%	3.99%
Office	25	$413,173,000	$7,007,142	4.68%	2.98%	1.39	48.89%	4.24%
Retail	58	$518,119,000	$5,234,000	4.52%	3.39%	1.35	52.25%	5.19%
Industrial	41	$395,664,500	$4,690,000	4.36%	2.77%	1.31	53.71%	3.66%
All Properties	188	$2,416,642,780	$8,953,000	4.79%	2.94%	1.4	55.68%	4.17%
Max								
Apartments	256	$7,975,679,000	$37,955,000	8.70%	8.47%	2.33	72.60%	9.70%
Office	231	$6,059,591,000	$46,256,420	9.70%	8.40%	2.97	70.10%	9.80%
Retail	330	$4,687,034,000	$21,800,158	10.00%	8.54%	3.06	70.90%	10.20%
Industrial	248	$5,287,899,000	$30,621,000	9.50%	8.39%	2.66	71.90%	10.10%
All Properties	958	$16,522,810,000	$24,094,000	9.50%	8.49%	2.44	69.40%	9.90%

Note: The data begins in the first quarter of 2000 and ends in the fourth quarter of 2023 (96 quarters or twenty-four years). All ratios are dollar-weighted except for average loan size, which is based on a simple average. Source: American Council of Life Insurers

Table 2
Comparison of Cap Rates
By Property Type - National Perspective
(1st Qtr. 2000 - 4th Qtr. 2023 or 24 Years)

Mean	Average Space Market Cap Rate	Average Capital Market Cap Rate
Apartments	6.19%	6.99%
Office	6.86%	7.55%
Retail	7.15%	7.83%
Industrial	7.12%	7.84%
All Properties	6.80%	7.51%
Std. Dev.		
Apartments	1.22%	1.23%
Office	1.37%	1.46%
Retail	1.12%	1.04%
Industrial	1.36%	1.41%
All Properties	1.33%	1.27%
Min		
Apartments	4.29%	5.14%
Office	4.68%	4.64%
Retail	4.52%	5.98%
Industrial	4.36%	4.46%
All Properties	4.79%	5.48%
Max		
Apartments	8.70%	9.81%
Office	9.70%	12.88%
Retail	10.00%	10.48%
Industrial	9.50%	10.36%
All Properties	9.50%	10.61%

Table 3
Results of Unit Root Tests
National Perspective
1st Qtr. 2000 - 4th Qtr. 2023 (24 Years)

Panel A -- Variables in Level		ADF Test	PP Test
All Properties	Space Market Cap Rate	-1.913	-1.902
	Capital Market Cap Rate	-2.467	-2.194
Apartments	Space Market Cap Rate	-2.217	-2.096
	Capital Market Cap Rate	-3.295*	-2.990*
Office	Space Market Cap Rate	-2.573	-2.305
	Capital Market Cap Rate	-4.285*	-4.015*
Retail	Space Market Cap Rate	-2.762	-2.306
	Capital Market Cap Rate	-3.741*	-3.469*
Industrial	Space Market Cap Rate	-1.510	-1.266
	Capital Market Cap Rate	-2.086	-1.536
Panel B – Variables in First Differences			
All Properties	Space Market Cap Rate	-11.684*	-11.583*
	Capital Market Cap Rate	-15.281*	-15.978*
Apartments	Space Market Cap Rate	-13.980*	-14.166*
	Capital Market Cap Rate	-13.929*	-15.675*
Office	Space Market Cap Rate	-14.229*	-15.271*
	Capital Market Cap Rate	-17.090*	-20.457*
Retail	Space Market Cap Rate	-15.699*	-17.449*
	Capital Market Cap Rate	-15.831*	-17.524*
Industrial	Space Market Cap Rate	-14.730*	-14.522*
	Capital Market Cap Rate	-13.161*	-14.967*

Notes: * Indicates that the result is significant at the 5% significance level. The Stata functions dfuller and pperon were used in default form without time trend. The critical value of the ADF and the PP t-statistic at the 5% level is -2.896.

Table 4
Engle-Granger Test for Cointegration by Property Type
National Perspective
1st Qtr. 2000 - 4th Qtr. 2023 (24 Years)

Property Types	Test Statistic
All Properties	-6.259*
Apartments	-8.163*
Office	-9.125*
Retail	-7.810*
Industrial	-6.697*

Notes: * Indicates that the result is significant at the 5% significance level.
The critical value at the 5% level is -3.403.

Table 5
Results of the Granger Causality Wald Tests by Property Type
National Perspective
1st Qtr. 2000 - 4th Qtr. 2023 (24 Years)

Null Hypothesis	Chi2-Statistic	P-Value
All Properties		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	16.498*	0.000
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	32.538*	0.000
Apartments		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	12.532*	0.002
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	17.143*	0.000
Office		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	21.817*	0.000
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	44.633*	0.000
Retail		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	2.4302	0.297
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	14.186*	0.001
Industrial		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	2.4971	0.287
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	24.364*	0.000

Notes: * Significant at the 5% level of significance. The null is no causal relation between the two series.

Table 6
Results of the Error Correction Regressions by Property Type
National Perspective
1st Qtr. 2000 - 4th Qtr. 2023 (24 Years)

Property Type	Variable	Coefficient	t-Stat
All Properties	Space Market Cap Rate	0.9154607	7.21*
	Residuals	-0.5924083	-5.82*
	Constant	-0.0000297	-0.08
Apartments	Space Market Cap Rate	0.5595188	3.63*
	Residuals	-0.7665976	-7.36*
	Constant	-0.0001843	-.033
Office	Space Market Cap Rate	0.953062	7.59*
	Residuals	-0.942445	-8.41*
	Constant	0.000013	0.02
Retail	Space Market Cap Rate	0.511183	6.10*
	Residuals	-0.7221595	-7.83*
	Constant	-0.0001863	-0.40
Industrial	Space Market Cap Rate	0.7618927	6.47*
	Residuals	-0.6430366	-6.72*
	Constant	-0.0000627	-0.14

*Significant at the 5% level.

Appendix

Figure A1 - Error Corrected Capital Market Cap Rates (Apartments)

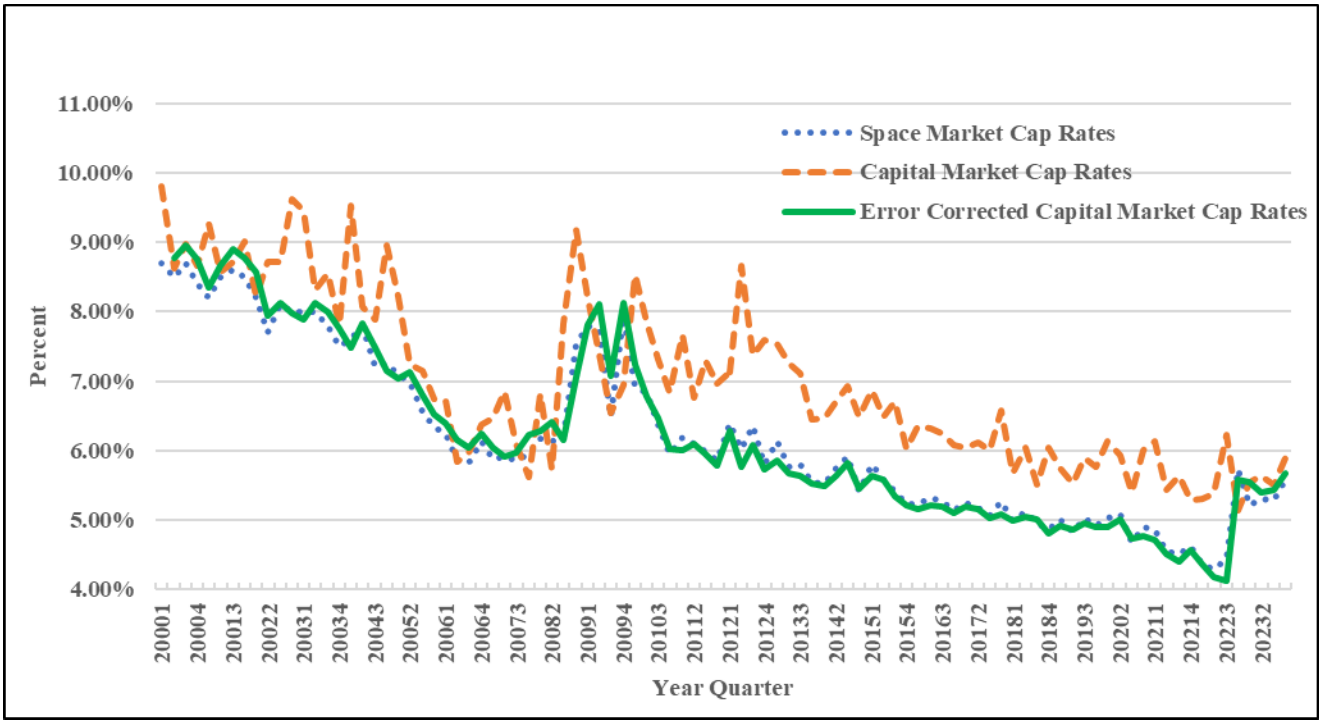


Figure A2 - Error Corrected Capital Market Cap Rates (Office)

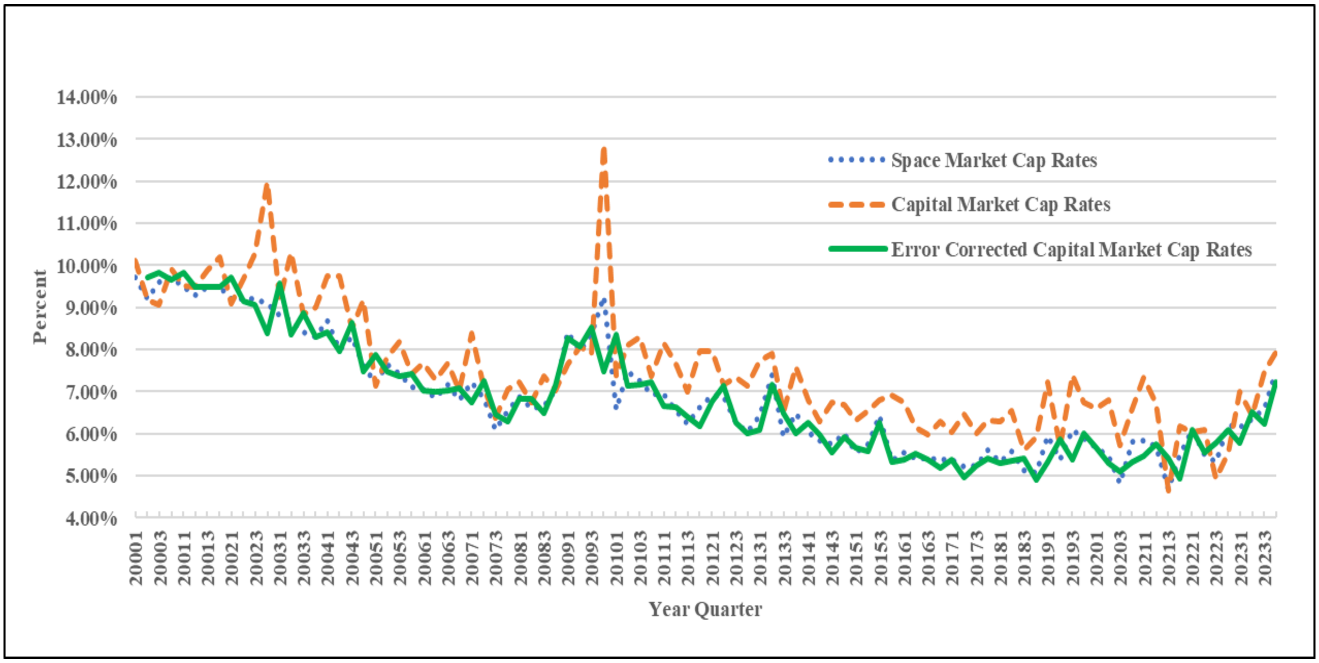
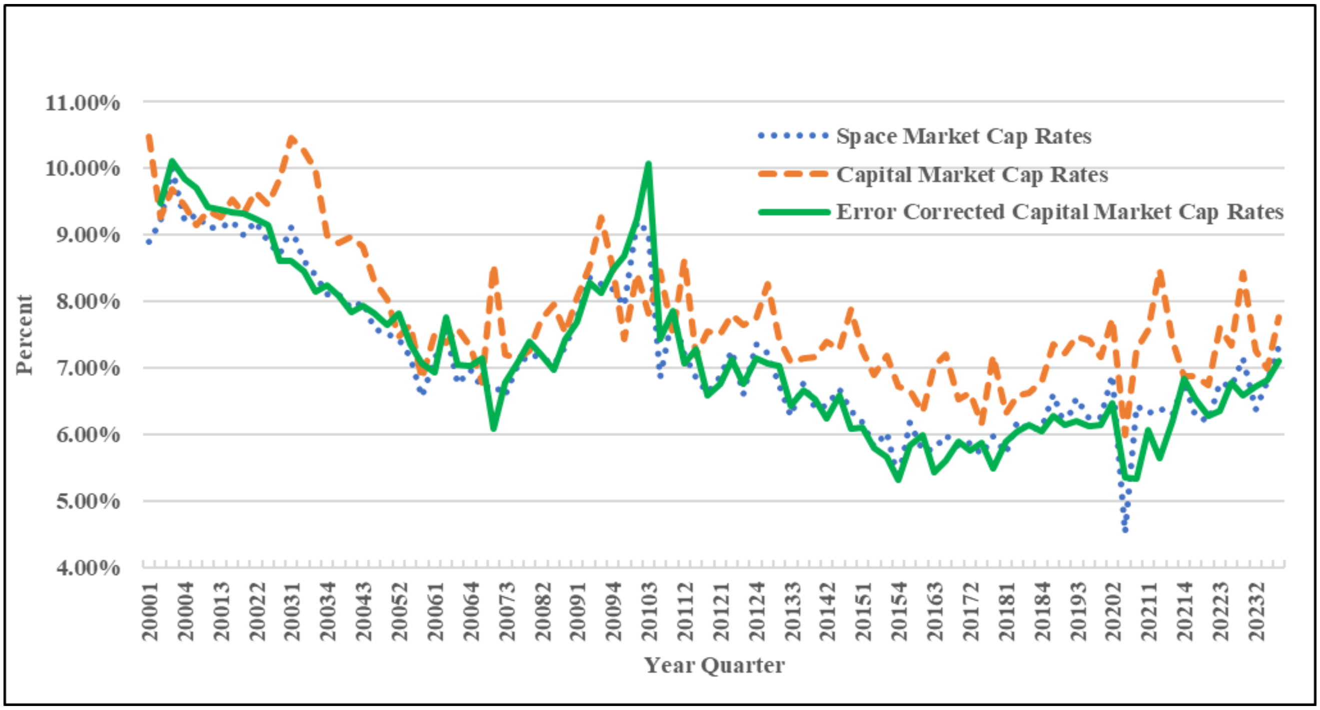


Figure A3 - Error Corrected Capital Market Cap Rates (Retail)



A4 – Error Corrected Capital Market Cap Rates (Industrial)

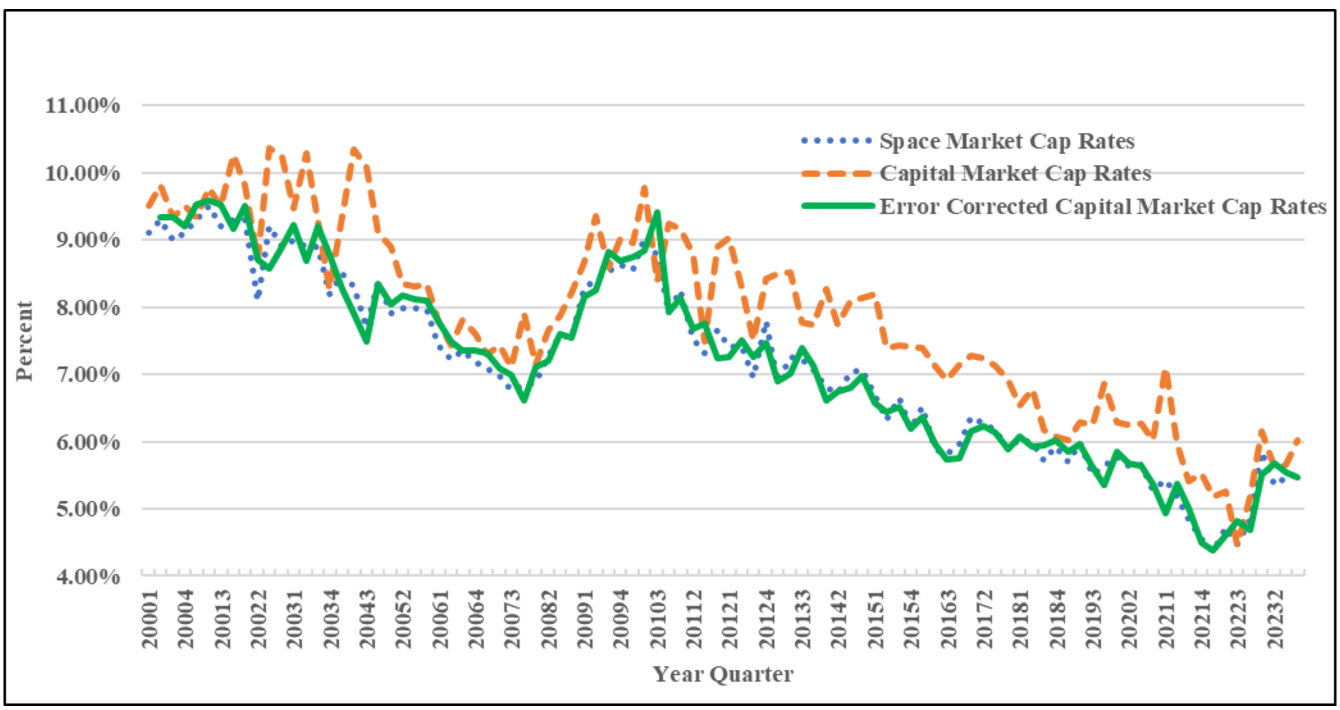


Table A1
Engle-Granger Test for Cointegration
By Divisions – All Property Types
1st Qtr. 2014 - 4th Qtr. 2023 (10 Years)

Panel A
By Division – All Property Types

Division	Test Statistic
East North Central	-4.333*
East South Central	-4.794*
Mid-Atlantic	-3.059
Mountain	-4.439*
New England	-4.333*
Pacific	-4.355*
South Atlantic	-4.033*
West North Central	-6.457*
West South Central	-3.511*

Panel B
By MSA – All Property Types

MSA	Test Statistic
Atlanta	-5.690*
Baltimore	-6.732
Chicago	-3.554*
Dallas	-5.015*
Denver	-5.500*
Houston	-5.935*
Los Angeles	-6.180*
New York	-5.926*
Orange County	-4.283*
Phoenix	-5.441*
Portland	-5.600*
Riverside	-6.252*
San Diego	-6.346*
Seattle	-6.321*
Washington DC	-5.089*

Panel C
By Cities – All Property Types

Cities	Test Statistic
Chicago	-4.431*
Los Angeles	-5.515*
New York City	-6.277*

Notes: * Indicates that the result is significant at the 5% significance level. The critical value at the 5% level is -3.403.

Table 2A
Results of the Granger Causality Wald Tests
By Divisions – All Property Types
1st Qtr. 2014 - 4th Qtr. 2023 (10 Years)

Panel A
Divisions – All Property Types

Null Hypothesis	Chi2-Statistic	P-Value
East North Central		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	1.1257	0.570
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	0.3209	0.852
East South Central		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	4.0226	0.134
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	1.6768	0.432
Mid-Atlantic		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	0.4911	0.782
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	5.5334	0.063
Mountain		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	2.0393	0.361
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	1.2671	0.531
New England		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	1.1592	0.560
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	7.5483*	0.0023
Pacific		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	14.878*	0.001
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	4.6057	0.100
South Atlantic		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	10.911*	0.004
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	5.4095	0.067
West North Central		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	3.275	0.194
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	1.835	0.400
West South Central		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	7.3676*	0.025
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	0.18037	0.914

Panel B
By MSA – All Property Types

Null Hypothesis	Chi2-Statistic	P-Value
Atlanta		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	1.9717	0.373
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	1.0122	0.603

Baltimore		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	1.4694	0.480
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	3.7009	0.157
Chicago		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	6.491*	0.039
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	0.3117	0.856
Dallas		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	3.4618	0.177
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	2.5394	0.281
Denver		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	2.9864	0.255
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	0.8964	0.639
Houston		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	11.579*	0.003
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	0.10843	0.947
Los Angeles		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	5.0636	0.080
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	2.4695	0.291
New York City		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	1.6275	0.443
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	0.2932	0.864
Orange County		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	3.765	0.152
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	2.331	0.312
Phoenix		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	1.1939	0.550
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	0.9963	0.608
Portland		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	1.1875	0.552
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	1.2262	0.542
Riverside		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	0.2250	0.894
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	1.6803	0.432
San Diego		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	2.7608	0.251
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	1.6115	0.447
Seattle		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	15.416*	0.000
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	2.4526	0.293
Washington DC		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	0.5423	0.762
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	0.2484	0.883

Panel C
By Cities – All Property Types

Null Hypothesis	Chi2-Statistic	P-Value
Chicago		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	1.6193	0.445
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	0.0989	0.952
Los Angeles		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	4.9857	0.083
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	0.2179	0.897
New York City		
Space Market Cap Rate does not Granger cause Capital Market Cap Rate	1.4323	0.489
Capital Market Cap Rate does not Granger cause Space Market Cap Rate	0.7836	0.676