SOME THOUGHTS ON REAL ESTATE PRICING

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This article focuses on two aspects of commercial real estate pricing: First, the spread between interest rates and commercial real estate pricing is dissected into its fundamental components. While this spread is often cited as supporting an argument about how investors might consider tilting their portfolio allocations as between bonds and commercial real estate, it is ultimately a comparison of two very different types of securities: the former represents a nominal-yield fixed-rate security while the latter represents a real-yield (provided real estate markets are operating at or near equilibrium) variable-rate security. The observed spread represents the market’s consensus view on the future growth of real estate’s (unlevered) cash flow less the differential in return premia (i.e., real estate’s expected real return less the fixed-income security’s expected real return). Second, real estate pricing itself is examined. In the absence of shifting capitalization rates, real estate’s (unlevered) cash-flow yield ought to equal the real estate market’s real-return requirement grossed up for inflationary effects plus the uncompensated portion of inflationary growth in future cash flows (i.e., the extent to which the expected growth of real estate’s (unlevered) cash flow lags the expected inflation rate).

The balance of this paper addresses these concerns from a theoretical approach, leavened with empirical data to provide context for those theoretical assertions.

I. Misconceptions in Relative Pricing

It is common practice to see a comparison of Treasury rates\(^1\) to real estate’s capitalization rates – similar to that shown in Exhibit 1 in which the interest rate on the five-year U.S. Treasury bond is compared to the capitalization rate on the NCREIF Index. (For our purposes, the NCREIF capitalization rate (or “cap rate”) is defined as the trailing four quarters of net operating income divided by the end-of-period market value.) While this difference (or spread) is sometimes referred to as the “(real estate) equity premium,” it is not – as subsequent analysis will show.

\(^1\) It is elsewhere argued that a better comparison is made when investment-grade corporate bonds – as opposed to Treasury bonds – are used for this purpose. As subsequently shown, the spread partly reflects differences in required real rates of return on real estate \(v.\) fixed-income bonds. Whether those bonds are Treasury- or corporate-backed matters little to the conceptual analysis. However, the default-free and non-prepayable nature of the Treasury-backed bonds makes for an analytically “cleaner” comparison; the use of (fixed-rate) corporate-backed bonds, which are subject to default (where the credit cycle for the corporate assets underlying these debentures may differ from the real estate cycle) and often subject to prepayment, makes for a more complicated comparison.
A comparison such as Exhibit 1 can give the misguided impression that interest rates and capitalization rates are inexorably linked.\(^2\) There are two substantive problems with this perspective. First, this inexorable link is not necessarily the case; consider a longer perspective which – among other factors – incorporates a period of higher inflation rates (and higher volatility about the average anticipated inflation rate), as shown in Exhibit 2. When this longer perspective is consider, it is readily apparent that the market’s consensus anticipation of future inflation rates can have a substantial effect on the observed spread between Treasury interest rates and real estate’s capitalization rates.

\(^2\)A step in the right direction is Zisler and Zisler (2016).
Given this longer perspective, it is apparent that there was an inflection point in the late 1980s/early 1990s with regard to long-term U.S. Treasury interest rates. With the benefit of hindsight, this inflection point seems to reflect the efforts of the Reagan administration and its central bankers which were said to have “broken the back” of inflation\(^3\) (i.e., previous administrations had witnessed double-digit inflation rates). Consider Exhibit 3, which illustrates the annual inflation rate \(\rho\)^4 realized over the history of the NCREIF Index:

\(^3\) For example, see: Poole (2005).

\(^4\) For notational convenience, the realized inflation rate will be shown as \(\bar{\rho}\) and the expected (or anticipated) inflation rate as \(E[\rho]\). When the two versions can be used interchangeably, then \(\rho\) will suffice. A similar convention will be utilized for other variables of interest.
Unsurprisingly, the bond market required persistent evidence of lower realized inflation rates before lower expected inflation rates were embedded in the bond market’s consensus required return. Consequently, the shorter-term perspective (e.g., that shown in Exhibit 1) on the spread between interest rates and capitalization rates is characteristic of a stable-, low-inflation environment. Whether this is an accurate characterization of future market conditions, of course, remains to be seen. History, on the other hand, indicates a more-volatile inflationary environment than that experienced since the mid-1980s – consider Exhibit 4 which displays realized inflation rates over the last century or so. The likely range of the pre-Reagan era (illustrated by the red bars) is about five

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5 This initial skepticism on the part of the bond market can be observed by comparing forward Treasury rates to realized Treasury rates. For example, see: Klein (2015).

6 While it is perhaps unsurprising to suggest that the typical investor’s view of future inflation is conditioned upon his/her experience with earlier inflation periods (notwithstanding a much longer data series), it is interesting that the Federal Reserve Board governors also have views shaped by their life experiences (e.g., the Federal Open Market Committee voting records of older governors generally display more concern about future rates of inflation than younger governors); see Melamendier, et al. (2016).
times the size of the post-Reagan era (illustrated by the blue bars). The point to be made here is simply that the low inflation rates and the low volatility of those rates as witnessed over the last 30 or so years is not in evidence in the preceding years.

Consequently, a robust analysis of the spread between bonds’ interest rates and real estate’s capitalization rates must consider the broader implications of anticipated future rates of inflation and the possibility that the economy may revert to higher levels of (realized and/or anticipated) inflation (along with greater uncertainty about the future rate of inflation). Given the (near) zero-interest-rate policy of the central banks in many developed countries, much concern about the role of monetary

7 For illustrative purposes, the “likely range” is taken to mean the realized inflation rate \( \bar{\rho} \) plus or minus the standard deviation of the inflation rate \( \sigma_\rho \) over the period(s) chosen. Here, the pre-Reagan era denotes the years before 1983 and, accordingly, post-Reagan era denotes the years thereafter.
policy in the macro economy has been voiced (e.g., see: Cochrane (2016), Dierks (2017), Ferguson (2008), Gilder (2016) and Hall (2016)).

Second, the exhibits above also suffer from using real estate’s capitalization rate rather than its cash-flow yield. In other words, a fair-minded comparison of interest rates to real estate’s pricing ought to compare the cash-flow yield of the former to the cash-flow yield of the latter. As is seen in Exhibit 5, real estate’s (unlevered) cash flow can be significantly less than its net operating income; the difference is attributable to capital expenditures (“cap ex”) for leasing commissions, tenant improvements and other capital improvements.

**Exhibit 5: Comparison of 5-year US Treasury Rates to NCREIF Cap Rates & Cash-Flow Yields for the Quarterly Periods 1979-2016**

Notice that the cash-flow yield averages approximately two-thirds of the capitalization rate over the history of the NCREIF Index and across the “core” property types that comprise the Index. Exhibit 6 provides another direct comparison of the fixed-income security’s coupon yield to the real estate’s cash flow yield over the history of the NCREIF Index:
The vertical bars of Exhibit 6 measure the quarterly spread between the five-year Treasury rates and the NCREIF-implied cash-flow yields. The interpretation of these differences is to be explored in the next section. However, it is apparent from Exhibit 6 that no precise relationship exists as between interest rates and capitalization rates (and/or cash-flow yields). That is, we can observe instances of interest rates rising and capitalization rates rising and falling and, similarly, we can observe instances of interest rates falling and capitalization rates falling and rising. This indeterminate relationship is also observed in the market for listed real estate investment trusts (REITs); see Giliberto and Schulman (2017).

Before moving on, a cautionary note is appropriate: Unlike the securitized market, reported market values in the securitized market – for indices such as NCREIF – are largely estimates, prepared by

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8 It is worthwhile to note that univariate regressions of either capitalization rates or cash-flow yields against the five-year Treasury interest rates produce predicted values with significant residual variance – as exemplified by $R^2$ values ranging from $\approx 5\%$ to $20\%$. (These results worsened when the changes in dependent and independent variables were examined.) While the point of this article is not an econometric quest, it is interesting to note that a multivariate regression of capitalizations rates against the one-, five- and ten-year Treasury rate as well as the spread in ten- $\times$ one-year rates produces an only slightly improved (adjusted) $R^2$ value ($\approx 22\%$).
appraisers, of “true” prices. These appraised values are thought to: a) contain “noise” (or error), b) lag the spot market (as appraisers, in part, examine past transactions of comparable properties to formulate an estimate of current market values) and c) “smooth” the changes in estimated values over time (as appraisers ideally use a Bayesian weighted average of contemporaneous information and historical appraised values to estimate current values). While the first issue is generally believed to diversify in large samples (such as the NPI), the second two are believed to be persistent problems. And, in turn, these lagging appraised values also affect our estimates of the real estate’s market capitalization rate. For an overview of the vast literature relating to appraisal lag (or smoothing), see Geltner, MacGregor and Schwann (2003). For purposes of this paper, we will assume that that appraisal noise is essentially eliminated in large samples and will ignore the appraisal lag and smoothing, as we are more concerned with a theoretical treatment of pricing issues.

II. A Conceptual Examination of the Spread
So, how can theory help shape our understanding of the spread identified in Exhibit 6? As noted earlier, these comparisons of bond yields and real estate’s cash-flow yields contrast a riskless, nominal-yielding security (i.e., the long-term Treasury) with a risky, (essentially) real-yielding security (i.e., the dividend yield on the real estate investment).9

Given certain simplifying assumptions, the nominal return \( k \) on an investment is given by a restatement of Gordon’s dividend discount model (DDM):10

\[
k = \frac{CF_1}{P_0} + g
\]

where: \( CF_1 \) = the first period’s cash flow, \( P_0 \) = the beginning-of-period price, and \( g \) = the periodic growth in cash flow.11 These simplifying assumptions include: the absence of transaction costs, constant cash-flow growth rates, a growth rate which is less than the return on investment, and an infinite investment horizon or, alternatively, constant pricing multiples.12 It is also well known that the relationship between the nominal \( k \) and the real \( r \) rates of return can be expressed as follows:

\[
k = (1 + r)(1 + \rho) - 1
\]

So, let’s examine the nature of return-generating process for real estate \( k_{RE} \) by setting these first

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9 This observation about the nature of these securities has been made earlier, with regard to Treasuries and common stocks; see, for example, Asness (2000) and Sorenson and Arnott (1998).

10 More typically, the DDM is written as: \( P_0 = \frac{CF_0 (1 + g)}{k - g} \); this expression is equivalent to Equation (1).

11 For our purposes, a period will be taken to equal one year.

12 In our case, constant pricing multiples equates to constant capitalization rates. This assumption is subsequently revisited – see §III.
two equations equal to one another:

\[ k_{RE} = \frac{CF_1}{P_0} + g = (1 + r_{RE})(1 + \rho) - 1 \]  

(3)

Let’s also consider long-term bond returns \( k_{Bds} \) with constant interest rates \(^{13}\) (as a special case of the DDM where the growth rate \( g \) equals zero):

\[ k_{Bds} = \frac{i}{P_0} = (1 + r_{Bds})(1 + \rho) - 1 \]  

(4)

Now, let’s utilize Equations (3) and (4) to theoretically examine the spread between the two observable measures: \( \frac{i}{P_o} - \frac{CF_1}{P_0} \). \(^{14}\) Note that, given our simplifying assumptions, the observed Treasury yield equals its total return and the observed real estate cash-flow yield is equal to its total return less the anticipated growth of future cash flows:

\[
\frac{i}{P_o} - \frac{CF_1}{P_0} = k_{Bds} - [k_{RE} - g]
\]

\[
= \left[ (1 + r_{Bds})(1 + \rho) - 1 \right] - \left[ (1 + r_{RE})(1 + \rho) - 1 - g \right]
\]

\[
= \left[ r_{Bds} + \rho + r_{Bds}(\rho) \right] - \left[ r_{RE} + \rho + r_{RE}(\rho) - g \right]
\]

\[
\approx \left[ r_{Bds} + \rho \right] - \left[ r_{RE} + \rho - g \right]
\]

\[
= g - (r_{RE} - r_{Bds})
\]

(5)

As is clear from above, the spread between Treasuries and real estate yields reflects expected growth

\(^{13}\) To simplify the discussion, it is assumed that the fixed-income security is bought at par and held to maturity (or, equivalently, sold at par) – such that the coupon yield equals the total return.

\(^{14}\) Because these two left-hand variables are easily observed, practitioners naturally gravitate towards their use. However, this necessarily omits what’s unobservable \((e.g., E[k_{RE}], E[g])\).
(g) in real estate’s cash flow less the differences in their real return requirements \( r_{RE} - r_{Bds} \).\(^{15, 16}\) In and of itself, this spread represents neither a signal about whether investors ought to tilt their investments toward real estate (and away from bonds) nor *vice versa*. (Note: There are other reasons (e.g., diversification benefits, liquidity, inflation-hedging characteristics, investor utility (or risk aversion), “downside” protection, etc.) as to why investors would continue to hold a portion of their portfolios in bonds and/or real estate irrespective of the considerations provided in Equation (5).) Instead and because the \( r_{Bds} \) is observable via the TIPS (Treasury Inflation-Protected Securities) market,\(^{17}\) investors must formulate estimates of real estate’s expected growth (g) and real return requirements \( r_{RE} \) in order to make a judgment about tilting their portfolios one way or the other.\(^{18}\)

Given the observable market conditions \( \left( \frac{i}{P_0}, \frac{CF_1}{P_0}, r_{Bds} \right) \), these considerations are illustrated in Exhibit 7:

\(^{15}\)Note, that from Equation (1), \( CF_1/P_0 = k - g \). Additionally, we assume – for expository purposes – that \( r_{Bds} (\rho) - r_{RE} (\rho) \) is sufficiently close to zero so as to be safely ignored.

\(^{16}\)Some practitioners prefer to invert the spread \( \left( \frac{i}{P_0} - \frac{CF_1}{P_0}, r_{Bds} \right) \), as means of identifying the “carry” (of course, the carry would be more precisely estimated if commercial mortgage rates – sized for the borrower’s leverage ratio – were used). In such instances, the (inverted) spread then represents \( (r_{RE} - r_{Bds}) - g \).

\(^{17}\)Another attractive aspect of using the TIPS instrument is the absence of a meaningful risk premium due to the uncertainty of future inflation rates. As pointed out in Ang, Bekaert and Wei (2008), the real-return requirement in (nominal-yielding) Treasury bonds contains a component of deferred consumption (i.e., the real return) plus another component for the variability of future inflation rates. (This latter component is not needed when investing in TIPS.) Presently, the risk premium for future inflation-rate variability is thought to be fairly small and, therefore, is ignored here (perhaps perilously so).

\(^{18}\)For purposes of creating this exhibit, the following parameters were chosen: \( \frac{i}{P_0} = 2.0\% \), \( \frac{CF_1}{P_0} = 3.0\% \) and \( r_{Bds} = 0.5\% \) – roughly in keeping with market values available at the time of this writing.
Merely as an illustration, the solid blue line of Exhibit 7 represents the combinations of real estate's expected growth ($g$) and excess real-return requirement ($\phi_{RE} \equiv r_{RE} - r_{Bds}$) for which investors ought to be indifferent – given the observable market conditions – as to tilting their portfolios towards or away from real estate. However, investors ought to tilt their portfolio allocations toward real estate and away from bonds if their beliefs about future market conditions result in a combination (of $g$ and $\phi_{RE}$) that lies above the solid blue line; conversely, investors ought to tilt their portfolio allocations toward bonds and away from real estate if their beliefs about future market conditions result in a combination that lies below this solid line. Continuing the illustration, the red and green icons in Exhibit 7 both represent instances in which investors require a real return on real estate which exceeds the real return on Treasury bonds by 2.5%.19 The green icon represents instances in

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19 However, this difference substantially exceeds the historical difference, which is essentially zero – see Exhibit 14.
which investors anticipate that real estate’s future cash-flow growth will be 2%, while the red icon represents instances in which investors anticipate real estate’s future cash-flow growth will be 1%.\(^{20}\) In the former instance, investors ought to tilt their portfolio allocations toward real estate and away from bonds; in the latter instance, investors ought to tilt their portfolio allocations toward bonds and away from real estate.\(^{21}\)

Finally, investors can use the current yield curve to derive expectations about future interest rates, inflation rates and/or real-return requirements. In this view – often referred to as the “expectations theory” (e.g., see Ang, et al. (2008) and Fama (1976, 1984 and 1990)) – current long-term (nominal) interest rates can be viewed as the market’s expectation about the future evolution of the short-term interest rate over time.\(^{22}\) These “forward rates” can be used to inform investors’ judgments about how they might calibrate forecasts of the components relating to the tradeoffs between today’s observed difference between bond yields and real estate’s cash-flow yields.

III. A Digression: Changing Capitalization Rates and Other Violations of the DDM

The previous section made a number of simplifying assumptions regarding real estate’s return-generating process. This section addresses these potential oversimplifications. To begin with, let’s expand Equation (1) to incorporate potential violations of the DDM (see Pagliari (1991)):

\[
k = \frac{NOI_1}{P_0} \overline{b} + \lambda \rho + \Delta + \varepsilon
\]  

(6)

where: \(NOI_1\) = the first period’s net operating income, \(\overline{b}\) = the “dividend payout ratio” (i.e., the conversion rate from net income to cash flow),\(^{23}\) \(\lambda\) = the inflation pass-through rate (i.e., the ability

\(^{20}\) For those property markets operating in equilibrium (e.g., low vacancy rates), the growth rate (\(g\)) is often approximately equal to the inflation rate (\(\rho\)). More to be said about this subsequently – see §III.

\(^{21}\) In principle, the same sort of analysis can be extended to a comparison of the dividend yields of common stocks to commercial real estate:

\[
\left( \frac{CF_1}{P_0} \right)_{RE} - \left( \frac{CF_1}{P_0} \right)_{CS} = (g_{CS} - g_{RE}) - (r_{CS} - r_{RE})
\]; see the Appendix for details.

\(^{22}\) Similarly, current long-term (real) interest rates (e.g., TIPS) can be viewed as the market’s expectation about the future evolution of the short-term real-return requirements over time and the spread between the current long-term (nominal) bond yield and the current long-term real yield can be viewed as the market’s expectation about the future evolution of inflation rates over time.

\(^{23}\) The notation \(\overline{b}\) is used, rather than simply \(b\), to indicate that the long-run average payout ratio is being used and that, by inference, the volatility of the annual payout ratio can be quite large. In this manner, the average payout ratio can also be thought of as deposits to either a sinking fund or a replacement reserve.
of NOI to keep pace with inflation), $\Delta = \text{the impact on return when the end-of-period capitalization rate differs from beginning-of-period capitalization rate, and } \varepsilon = \text{a “catch-all” error term.}$

Notice that the first two elements of the right-hand side of Equation (6) are merely restatements of the right-hand side of Equation (1): $\frac{CF_{i}}{P_{0}} = \frac{NOI_{i} \left( \bar{b} \right)}{P_{0}}$ and $g = \lambda \rho$. However, the last two elements of the right-hand side of Equation (6) represent violations of the DDM. The last element, $\varepsilon$, represents an error term, which captures a variety of violations of the DDM’s underlying assumptions (i.e., certain non-linearities, non-constant dividend pay-out ratios, non-constant growth rates, etc.). However, it is generally the violation of constant capitalization rates – as captured by $\Delta$ – which represents the largest impact on short-run returns. More specifically, the magnitude of $\Delta$ is an increasing function of $\nabla = \text{the capitalization rate shift (i.e., the ratio of the ending capitalization rate to the beginning capitalization rate)}$ and a decreasing function of $N = \text{the length of the holding period – as illustrated in Exhibit 8:}$

\[ \frac{CF_{0}}{CF_{0}} = \left( \frac{k - g}{k} \right) \left( \frac{1}{1 + g} \right) \left[ \frac{(1 + k)^{N} - 1}{(1 + k)^{N} - (1 + g)^{N}} \right]. \]

As the holding period substantially lengthens, this ratio approached: $\frac{CF_{0}}{CF_{0}} = \frac{k - g}{k(1 + g)}$.

24 For example, $(x)^{N} + (y)^{N} \neq (x + y)^{N}$, for $N > 1$.

25 The notion of constant cash-flow growth is generally best suited to property types characterized by short-term leases (e.g., apartments and hotels) and/or to portfolios of properties – including aggregate indices like NCREIF – where the lease turnover rate is constant. However, when these characteristics are not met, it is a fairly simple matter to arithmetically convert a long-term, fixed lease payment $\left( CF_{0} \right)$ to an annual, growing lease payment $\left( CF_{0} \right)$; consider their ratio: $\frac{CF_{0}}{CF_{0}} = \left( \frac{k - g}{k} \right) \left( \frac{1}{1 + g} \right) \left[ \frac{(1 + k)^{N} - 1}{(1 + k)^{N} - (1 + g)^{N}} \right]$. As the holding period substantially lengthens, this ratio approached: $\frac{CF_{0}}{CF_{0}} = \frac{k - g}{k(1 + g)}$.

26 For example, if the ending capitalization rate equals 6.6% and the beginning rate equals 6.0%, then $\nabla = 1.10.$
Exhibit 8 illustrates (unlevered) asset returns as a function of the capitalization rate shift and the holding period. As indicated earlier (see Equation (1)), when capitalization rates remain constant (i.e., when $\nabla = 1.0 \Rightarrow \Delta = 0$) the assumed asset-level return (10%) – provided the other simplifying assumptions of the DDM are also met – equals the sum of the assumed initial cash-flow yield (7%) and the assumed growth rate (3%) – as indicated by the blue line – irrespective of the holding period. However, a fall in capitalization rates – often described as “cap rate compression” – increases the return over what would have otherwise had been the case (i.e., when $\nabla < 1.0 \Rightarrow \Delta > 0$), as indicated by the green lines. Conversely, a rise in capitalization rates – often described as “cap rate expansion” – decreases the return (i.e., when $\nabla > 1.0 \Rightarrow \Delta < 0$), as indicated by the red lines.

The impact of rising or falling capitalization rates is clearly a function of the holding period: fairly short holding periods (say, less than five years) may produce significant effects, while fairly long
holding periods (say, more than ten years) produce largely muted effects. An approximation of the impact of shifting capitalization rates is given by:

\[ \Delta \approx \left( \frac{1}{V} - 1 \right) \quad (7) \]

Exhibit 9 identifies the realized return-generating process for the NCREIF Property Index and several of its property subtypes over nearly four decades of the Index (see Pagliari, et al. (2001)):

![Exhibit 9: Annualized Components of Return by NPI Property Type for the Period 1978 through 2016](image)

The approximation tends to overstate the absolute value of the exact effect when the holding period is quite long (say greater than twenty years) and when the magnitude of the shift is exceedingly large.

27 The exact effect – as was utilized in Exhibit 8 – is identified by \( \Delta = k_C - k_S \) where: \( k_C \) = the total return assuming constant capitalization rates and \( k_S \) = the total return assuming shifting capitalization rates. These rates of returns are found, respectively, by solving the following equations:

\[
P_0 = \sum_{s=1}^{N} \frac{CF_s}{1 + k_C^s} \quad \text{and} \quad P_0 = \sum_{s=1}^{N} \frac{CF_s}{1 + k_S^s}. \]

The approximation tends to overstate the absolute value of the exact effect when the holding period is quite long (say greater than twenty years) and when the magnitude of the shift is exceedingly large.
The long-term history of the NCREIF Property Index displays important information, including: the dividend payout ratio has averaged approximately two-thirds \((i.e., \text{for every three dollars of NOI, approximately two dollars is available as (pre-leverage) cash flow})\) and earnings (and/or cash flow) growth has averaged approximately 70% of the realized inflation rate. However, there is considerable variation among the property subtypes. Moreover, the long-term nature of Exhibit 9 masks much of the short-term volatility in these return components – perhaps nowhere more pronounced than with regard to the impact on returns due to shifting capitalization rates.

Finally, more complexity can be added to Exhibit 7 by including the effects of a potential shift in the current capitalization rate, as shown in Exhibit 10:

If capitalization rates are expected to rise over the holding period, then investors must accept a lower excess real-return requirement \(\phi_{RE}\) and/or forecast a higher growth rate \(g\) than would otherwise be the case in order to tilt their portfolios towards real estate (and away from bonds). The magnitude of these potential changes is illustrated by the two blue-dashed lines above the solid blue.
line. Merely as an illustration, the upper most of these two lines represents the impact of capitalization rates increasing by 20% over a five-year holding period; the second of these two lines represents the impact of capitalization rates increasing by 10% (also over five years). Conversely, if capitalization rates are expected to fall over the investor’s holding period, then investors can accept a higher excess real-return requirement \( \phi_{RE} \) and/or forecast a lower growth rate \( g \) than would otherwise be the case in order to tilt their portfolios towards real estate and away from bonds. The magnitude of these potential changes is represented by the blue-dashed line below the solid blue line, which illustrates the impact of capitalization rates decreasing by 10% over a five-year holding period. There is, of course, a limitless set of potential combinations of \( \nabla \) and \( N \).

IV. How Should Capitalization Rates Be Determined?
If the spread between Treasuries and real estate yields reflects real estate’s expected growth in cash flow \( g \) less the differences in their real return requirements \( \phi_{RE} \), this then begs the question: How should real estate be priced? As MacKinnon (2016) expressed, there is no such thing as a “normal” capitalization rate \( \text{(i.e., there is no number to which they naturally revert)} \); instead, such rates are a product of the then-current capital-market forces. Moreover, Cochrane (2011) has argued that, whereas the older research suggested that the bulk of variation in capital-asset prices was primarily due to time-varying differences in the expected cash flows, the current research suggests that the variation is primarily due to the time-varying differences in the discount rates used to price capital assets. If accurate and because prices vary more than incomes \( \text{(e.g., see Exhibit 11)} \), the unobserved variation in discount rates is reflected in the observable variation in capitalization rates (and/or cash-flow yields).

Again, let’s begin by taking a simple \( \text{(e.g., } \nabla = 1.0) \) but theoretically sound approach, setting (expanded versions of) Equations (2) and (3) equal to one another and solving for the (forward) cash-flow yield \( (CF_1/P_0) \):

\[
(1 + r_{RE})(1 + \rho)^{-1} = \frac{CF_1}{P_0} + \lambda \rho
\]

\[
(8)
\]

\[
\frac{CF_1}{P_0} = r_{RE} (1 + \rho) + \rho (1 - \lambda)
\]

The left-hand side of the first line of Equation (8) can be thought of what we want our real estate investments to return, while the right-hand side can be thought of how that return will be generated. The initial yield that satisfies both of these want and how aspects has two components: \( a) \) the real-
return requirement grossed up for inflation \(28\) \( [i.e., \, r_{RE} (1 + \rho)] \) and \( b) \) the uncompensated portion \(29\) of inflation \( [i.e., \, \rho (1 - \lambda)] \).

In the special case of the real estate markets operating in equilibrium such that operating cash flows grow at the rate of inflation \( (i.e., \, \lambda = 1 \Rightarrow g = \rho) \), then Equation (8) simplifies to:

\[
\frac{CF_0}{P_0} = r_{RE}
\]  

(9)

Equation (9) tells us that, when the markets operate in equilibrium, the trailing cash-flow yield equals real estate's real return – regardless of the inflation rate \(30\) (and, again, making our earlier simplifying

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28 Recall: \( r_{RE} (1 + \rho) = \left[ (1 + r_{RE}) (1 + \rho) - 1 \right] - \rho \). Here too, it may be helpful to consider real estate's real-return requirement in relationship to the (observable) real-return requirement on Treasury bonds.

29 While it is possible, at least in the short run, that real estate markets operate at \( \lambda > 1 \), this is unrepresentative of the long-run history of the NCREIF Property Index – see Exhibit 9.

30 While it is also true that Equation (9) will result from Equation (8) when the inflation rate equals zero, this may be misleading given the multiplicative relationship presumed here as between \( g \) and \( \rho \) \( (i.e., \, g = \lambda \rho) \). Consider, instead, an additive relationship: \( e.g., \, g = \gamma + \rho \), which is better behaved when inflation rates approach zero. [Ultimately, the choice of a multiplicative or additive relationship is an empirical one \( (i.e., \, which approach better suits the data?) \). Given the high rates of inflation experienced in the early years of the NCREIF Property Index and the low rates realized more recently, a plausible argument can be made for either approach.] If an additive approach is taken, then Equation (9) will only result from Equation (8) when \( \gamma \), the additive inflation pass-through rate, equals zero.
assumptions). Additionally, this definition of the equilibrium ($\lambda = 1$) does not comport with the historical average ($\lambda \approx .7$); moreover, it can also be argued that capital assets are generally subject to aging/obsolescence (e.g., see Hoteling (1925) and Bokhari and Geltner (2017)).

Because the real estate market generally talks of pricing in terms of capitalization rates, it is helpful to convert the stabilized cash-flow yield of Equation (8) into the more-conventional pricing metric (and recalling that $CF_t = (\bar{b})NOI_t$):

$$\frac{NOI_t(\bar{b})}{P_0} = r_{RE}(1 + \rho) + \rho(1 - \lambda)$$

(10)

$$\frac{NOI_1}{P_0} = \frac{r_{RE}(1 + \rho) + \rho(1 - \lambda)}{(\bar{b})}$$

31 Taking the partial derivative of the pricing equation

$$P_0 = \frac{CF_0(1 + \lambda \rho)}{(1 + r_{RE})(1 + \rho) - 1 - \lambda \rho}$$

with respect to each of its elements provides the price sensitivity of each factor (when operating under equilibrium (i.e., $\lambda = 1$) and when not (i.e., $\lambda \neq 1$)):

**When $\lambda = 1$**

$$\frac{\partial P_0}{\partial \rho} = 0$$

$$\frac{\partial P_0}{\partial r_{RE}} = -\frac{CF_0}{r_{RE}^2}$$

$$\frac{\partial P_0}{\partial \lambda} = \text{N.A.}$$

**When $\lambda \neq 1$**

$$\frac{\partial P_0}{\partial \rho} = -\frac{CF_0 (1 + r_{RE})(1 - \lambda)}{[(1 + r_{RE})(1 + \rho) - 1 - \lambda \rho]^2}$$

$$\frac{\partial P_0}{\partial r_{RE}} = -\frac{CF_0 (1 + \rho)(1 + \lambda \rho)}{[(1 + r_{RE})(1 + \rho) - 1 - \lambda \rho]^2}$$

$$\frac{\partial P_0}{\partial \lambda} = \frac{CF_0 (1 + r_{RE})(1 + \rho) \rho}{[(1 + r_{RE})(1 + \rho) - 1 - \lambda \rho]^2}$$

32 However, there is little unanimity with regard to the market’s usage of the term “capitalization rates” (e.g., there are differences as between trailing v. forward earnings, before v. after replacement reserves, projected v. stabilized earnings, etc.). To consider just one aspect of this variation, approximately 75-80% of the respondents to the Situs RERC (2016) survey of institutional investors indicated that they define capitalization rates based on after-reserves forecasts for residential property types (i.e., apartments, hotels and student housing), while approximately 75-80% of those same respondents indicate that they define capitalization rates based on before-reserves forecasts for non-residential property types (i.e., industrial, office and retail).
If real estate investors have had perfect foresight, then consensus capitalization rates would have perfectly incorporated these elements. Exhibit 11 identifies the historical path of (one-year trailing-earnings) capitalization rates for the NCREIF Property Index:

Exhibit 11: NCREIF Index - Market Values, Rescaled NOI and Capitalization Rates Based on a $100 Investment for the Period 1978 through 2016

To help orient the reader: The blue line indicates the growth in unlevered, core property values – assuming an initial $100 investment in the NCREIF Property Index in 1978 – over the period ending in 2016. Similarly, the red line indicates the growth in (restated) net operating income assuming a $100 of income in 1978 over the same period (both property values and incomes are indexed to the left-hand vertical axis). Given a time series of property values and income levels, a time series of capitalization rates is constructed; these rates are shown by the top line of the green-shaded region (and are indexed to the right-hand vertical axis). The green dashed line indicates that capitalization rates have averaged approximately 7.0% over this period. (The standard deviation of which was approximately 1.1%.) In general, the time-series path of capitalization rates has been downward sloping. Possible explanations include: a generally declining path of interest rates (as

33 While a $100 property investment does not produce $100 of income, both indices are initially set to $100 so as to improve the visual comparison of changes in property values to changes in income levels. Without restating the income levels, it would be difficult to visually discern the differences in changing income levels.
indicated in Exhibits 5 and 6) and growing acceptance of commercial real estate as an institutional asset class. Whatever the reasons, capitalization rates cannot endlessly decline – there has to be some bottom (if not a rebound). Greenspan (2010) indicated as much when describing what he thought the signs of a “bubble” to be:

"... I define a bubble as a protracted period of falling risk aversion that translates into falling capitalization rates that decline measurably below their long-term, trendless averages. Falling capitalization rates propel one or more asset prices to unsustainable levels. All bubbles burst when risk aversion reaches its irreducible minimum, i.e., credit spreads approach zero, though analysts' ability to time the onset of deflation has proved illusive." {emphasis added}

Another way to contemplate the time-series path of capitalization rates is to remove the then-current average capitalization rate from the then-current capitalization rate. These “de-meaned” capitalization rates\(^{34}\) – as shown in Exhibit 12 – provide another perspective on the level of capitalization rates relative to historical observations:

\(^{34}\)To be more precise, let \(y_t\) = the capitalization rate (or income yield) in period \(t\); the de-meaned capitalization rate is then \(\hat{y}_t = y_t - \overline{y}_{T-j}\), where: \(\overline{y}_{T-j} = \frac{1}{T-j} \sum_{i=1}^{T-j} y_i\) and \(j = \) the number of (annual) periods prior to the last observation (i.e., \(T = 39 = 2016 - 1978 +1\)). The then-current standard deviation of capitalization rates is determined in an analogous manner. And assuming that the underlying population of (de-meaned) capitalization rates is normally distributed, Exhibit 12 then illustrates the 90\(^{th}\) and 10\(^{th}\) percentiles.
To help orient the reader: The green-shaded regions indicate the differences between the then-current capitalization rates and the then-current average capitalization rate. The green dashed lines represent the 90th and 10th percentiles about the de-meaned average. It is readily apparent that, for much of the past decade, capitalization rates lie significantly below the lower bound of the 10th percentile.

Both Exhibits 11 and 12 indicate that current (trailing-earnings) capitalization rates (≈ 4.6%) are at or near the lowest levels observed in the NCREIF Property Index. So, what are we to make of this? Let’s restate Equation (10) and solve for real estate’s implied real return based on estimates of the observable capitalization rate:

\[
    r_{RE} = \frac{\frac{\text{NOI}}{P_0} \left( \bar{\delta} \right) - \rho (1 - \lambda)}{1 + \rho} 
\]

(11)
To the extent that $b$ and $\lambda$ are less than one and the $\rho$ is greater than zero (again, see Exhibit 9 for a historical perspective on these parameters), the inescapable conclusion is that the anticipated real return is significantly lower than the historical average ($\approx 5.8\%$). How much lower? According to Exhibit 11, the current capitalization rate is $\approx 4.6\%$. So, if one ignores future shifts in capitalization rates (i.e., $E(\nabla) = 1$), assumes the market’s anticipated inflation rate [$E(\lambda)$] is 1–2% per annum and uses the historical NCREIF-implied dividend payout ratio [$E(b) \approx 67\%$] and inflation pass-through rate [$E(\lambda) \approx 70\%$], then the market’s anticipated real estate’s real return [$E(r_{RE})$] is $\approx 2.5\%$. (This figure is, however, more consistent with the recent history – see Exhibit 14.)

Naturally, the anticipated real return on commercial real estate should be viewed in the context of the broader capital markets. One readily observable measure of the market’s sentiment is the TIPS market – as illustrated in Exhibit 13:

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35 Taking the derivative of Equation (11) with respect to the (forward-looking) capitalization rate provides the price sensitivity of this factor: 

$$
\frac{\partial r_{RE}}{\partial \left(\frac{NOI}{P_0}\right)} = \frac{b}{(1 + \rho)}
$$

36 In contrast, Van Nieuwerburgh (2017), using a version of the Campbell and Shiller (1989) log-linearization of the dividend discount model and focusing on the long-term dividend-price ratio of real estate investment trusts (REITs), suggests that the current increase in values relative to cash flow is a product of the market’s expectation of future cash-flow growth “…that is far above the growth rates seen in the data.”
Because the TIPS market for five-year maturities was re-introduced in 2003, there is not a great deal of empirical evidence (which would typically be used as the basis for framing future expectations) on real estate’s excess real return ($\phi_{RE}$). Moreover, a portion of that 14-year period has been significantly and perhaps unrepresentatively epitomized by the great financial crisis of 2007-08. Nevertheless, we can say that the historical average 5-year TIPS yield has been approximately 0.6% and is currently close to zero. In this light, the anticipated real return on commercial real estate – as implied by Equation (11) – may look more compelling than it does relative to its long-term average. In other words, real estate’s expected excess real return [$E(\phi_{RE})$] would currently seem to be approximately 2.6% (i.e., $E(\phi_{RE}) \approx 2.6\% - 0\%$).

37 The first Treasury inflation-protected security (TIPS) auction was held in January of 1997; the security was a 10-year note. The 5-year note was introduced in June of 1997, only to be discontinued the next year – and then reintroduced in 2003. Since its inception, the TIPS market has undergone a noteworthy evolution; see: https://www.treasurydirect.gov/indiv/research/history/histmkt/histmkt_tips.htm.
From yet another perspective, the excess realized real return on the NCREIF Property Index has varied considerably over time; consider the summary statistics provided in Exhibit 14:

**Exhibit 14: A Comparison of Realized Real Returns on U.S. Treasury and the NCREIF Property Index for Various Time Periods**

<table>
<thead>
<tr>
<th></th>
<th>1978-2016 (Entire History)</th>
<th>1987-2006 (Low Inflation &amp; Pre-Crisis)</th>
<th>2003-2016 (TIPS History)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCREIF Property Index</td>
<td>5.79%</td>
<td>5.37%</td>
<td>7.36%</td>
</tr>
<tr>
<td>U.S. Treasury Bonds</td>
<td>5.70%</td>
<td>5.86%</td>
<td>4.53%</td>
</tr>
<tr>
<td>Mean Difference ($\phi_{RE}$)</td>
<td>0.09%</td>
<td>-0.49%</td>
<td>2.83%</td>
</tr>
<tr>
<td>Volatility of Difference</td>
<td>14.70%</td>
<td>12.85%</td>
<td>14.08%</td>
</tr>
</tbody>
</table>

The near-zero excess real-return differential for real estate ($\phi_{RE}$) observed over the entire 1978-2016 time period would partly seem to be an artifact of the high rates of inflation experienced during the late 1970s/early 1980s (see Exhibit 3), as investors demanded a substantial premium related to the uncertainty of future inflation rates, and is therefore not necessarily representative of the market’s current *ex ante* beliefs. However, a look at 1987-2006 (a period of low inflation and before the financial crisis of 2007-08) indicates that a negative excess real-return differential for real estate was realized. Interestingly, the excess return for the more-recent, 2003-2016 time period (beginning with the reintroduction of the 5-year TIPS instrument) seems more in keeping with current *ex ante* beliefs. In any case, it would seem that the historical evidence is, at best, mixed.

These observations bring us full circle. Given today’s historically low interest rates, a commonly asked question is: What happens to capitalization rates if interest rates rise? To answer the question, recall that interest rate has two components: a) the expected inflation rate and b) the real-return requirement. We have already seen – Equation (9) – that when the markets operate in equilibrium (i.e., $\lambda = 1$) changes in expected inflation rates have no impact on real estate prices; however, when the markets operate outside of equilibrium (i.e., $\lambda \neq 1$), then the initial cash-flow

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38 Said another way, the long-term U.S. Treasury bond is default-free, but not risk-free – in the sense that that the future inflation rate is unknowable (as is, therefore, the future real return) – and, in periods of high inflation and large uncertainty (about the future rate of inflation), the *ex ante* real return on commercial real estate may – given its perceived inflation-hedging characteristics – seem a compelling alternative to fixed-income securities. In any case, each of the three sets of differences (i.e., $\phi_{RE}$ for 1978-2016, 1987-2006 and 2003-2016) is indistinguishable from zero at conventional statistical confidence levels.

39 Of course, in another economic environment the question might well be: What happens if interest rates fall? The answer would mirror that which follows.
yield must reflect the real-return requirement grossed up for inflation and the uncompensated portion of inflation – see Equation (10). But while changes in in expected inflation rates may or may not be benign, it is unambiguous that changes in the real required rate of return directly and inversely effect real estate prices (as well as the prices of most asset classes – including fixed-income securities and, often, common stocks). For the world’s leading economies, the real return requirement on sovereign debt reflects the marginal productivity of capital (i.e., when economic prospects are highly uncertain, real return requirements on sovereign debt are relatively low and vice versa – see Hartzmark (2016)) – as is loosely illustrated in Exhibit 13 (e.g., consider TIPS’ yields before and after the 2007-08 financial crisis). So, if the real-return requirements on Treasury bonds were to increase and if, therefore, real-return requirements on real estate were to increase, real estate prices may fall – presuming that the forecasted increase in real estate’s cash-flow growth \((g = \lambda \rho)\) is insufficient to offset the increase in real estate’s real-return requirement. Here too, the impacts of anticipated capitalization-rate shifts – see Equation (7) – can be incorporated into the analysis.

V. Concluding Remarks
Utilizing a number of simplifying assumptions, two key aspects of commercial real estate pricing have been the focus of this article. First, the spread between interest rates and commercial real estate pricing, which is often cited as supporting an argument about how investors might consider tilting their portfolio allocations as between bonds and commercial real estate, is ultimately a comparison of two very different types of securities: the former represents a nominal-yield fixed-rate security while the latter represents a real-yield (provided real estate markets are operating at or near equilibrium) variable-rate security. The observed spread represents the market’s consensus view on the future growth of real estate’s (unlevered) cash flow less the differential in return premia (i.e., real estate’s expected real return less the fixed-income security’s expected real return). Second, real estate pricing itself is examined. Real estate’s (unlevered) cash-flow yield ought to equal the real return requirement grossed up for inflationary effects plus the uncompensated portion of inflationary growth in future cash flows (i.e., the extent to which the expected growth of real estate’s (unlevered)

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40 While the empirical aspects of this article have focused on the U.S. (largely because it is the world’s largest/deepest real estate market and has extensive data sets), the theoretical aspects may be applied to most any country. That said, applications to other countries may include considerations not raised herein. One example: the real return requirements in less-developed countries may include a premium for sovereign default (the Greek debt crisis in the aftermath of the 2007-08 recession is but one example). Another example: transaction costs (which, for purposes of this paper, are embedded in the real-return requirements) can vary substantially from one country to the next.

41 For a given initial cash-flow yield \(\left(\frac{CF_0}{P_0}\right)\) and inflation environment \((\rho)\), the pricing equation can be inverted to solve for \(r_{RE}\); see Equation (11) or equivalently: \(r_{RE} = \left(1 + \frac{CF_0}{P_0}\right)\left(1 + \frac{\lambda \rho}{1 + \rho}\right) - 1\).
cash flow lags the expected inflation rate). Accordingly, a change in interest rates may or may not effect capitalization rates. If the change in interest rates is due to a change in the expected inflation rate, then real estate pricing – provided the real estate markets are operating at or near equilibrium – will not be effected. If the change in interest rates is due to a change in the real-return requirement, then real estate pricing – even when the real estate markets are operating at or near equilibrium – will be directly effected. In both instances, the presence of shifting capitalization rates will effect these results; the magnitude of the effect is an increasing function of the capitalization rate shift itself and a decreasing function of the length of the holding period.
VI. References


VII. Appendix

As before and given our earlier simplifying assumptions, let’s examine the nature of the return-generating process for common stocks ($k_{CS}$):

$$k_{CS} = \left( \frac{CF_1}{P_{0,CS}} \right) + g_{CS} = (1 + r_{CS})(1 + \rho) - 1 \quad (A1)$$

Now, let’s utilize Equations (3) and (4) to theoretically examine the spread between two observable measures: one for common stocks and the other for real estate. Note that, given our simplifying assumptions, the observed dividend yield is the total return less the anticipated growth of future dividends and the observed real estate cash-flow yield is the total return less the anticipated growth of future cash flows:

$$\left( \frac{CF_1}{P_{0,RE}} \right) - \left( \frac{CF_1}{P_{0,CS}} \right) = [k_{RE} - g_{RE}] - [k_{CS} - g_{CS}]$$

$$= \left[ (1 + r_{RE})(1 + \rho) - 1 - g_{RE} \right] - \left[ (1 + r_{CS})(1 + \rho) - 1 - g_{CS} \right]$$

$$= [r_{RE} + \rho + r_{RE}(\rho) - g_{RE}] - [r_{CS} + \rho + r_{CS}(\rho) - g_{CS}] \quad (A2)$$

$$\approx [r_{RE} + \rho - g_{RE}] - [r_{CS} + \rho - g_{CS}]$$

$$= (g_{CS} - g_{RE}) - (r_{CS} - r_{RE})$$

As is clear from above, the spread between real estate and common stock dividend yields reflects the differences in their expected growth rates ($\delta \equiv g_{CS} - g_{RE}$) less the differences in their real return requirements ($\phi \equiv r_{CS} - r_{RE}$). In and of itself, this spread does not represent a signal about whether investors ought to tilt their investments toward real estate (and away from common stocks) or vice versa. Instead, here too investors must formulate estimates of real estate’s expected growth-rate differential ($\delta$) and excess real-return requirement ($\phi$) in order to make a judgment about tilting their portfolios one way or the other – given observable market conditions $\left[ \left( \frac{CF_1}{P_{0,RE}} \right), \left( \frac{CF_1}{P_{0,CS}} \right) \right]$.

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42 Again, for our expository purposes, we assume that $r_{RE}(\rho) - r_{CS}(\rho)$ is sufficiently close to zero.