Implied Cash Flow Growth in U.S. Commercial Real Estate Values *

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1 A Simple Present Value Model

This note develops a simple framework for assessing the relative valuation of U.S. commercial real estate values through time. It combines two pieces of information. The first one is the cap rate, which is the ratio of the current net operating income (NOI) to the current price of the real estate. The second one is a risk model that determines the appropriate expected return for commercial real estate investments. The model can be applied at any level of aggregation, from an individual building to the global real estate market portfolio. This note will focus on the U.S. commercial real estate market as a whole, but it is straightforward to aggregate up to a global level or disaggregate to individual sectors (e.g., office, retail, etc.) or geographic markets.

1.1 Using Publicly Traded Real Estate Prices and Returns

To implement the framework, we will use a publicly-listed index of commercial real estate investment trusts (REITS). Real Estate Investment Trusts (REITs) are companies that own, and in most cases operate, income-producing real estate. We focus on equity REITs, who own and operate income-producing real estate in the office, retail, industrial, apartment, hotel, health care, or self-storage sectors, and leave out mortgage REITs, who finance real estate and own mortgages and mortgage-backed securities. REITs must distribute at least 90 percent of their taxable income to shareholders in the form of dividends, though in practice they usually distribute close to 100%. Thus, REITs pass through most of the net operating income on the properties they own.[1]

There is a large academic literature that concludes that the risk-return characteristics of unlisted (or direct) commercial real estate assets are well described by those of REITS, once the type and geography of real estate assets are matched and appraisal-induced smoothing biases in unlisted real estate price indices are undone. This high correlation between returns on unlisted and listed real estate becomes especially pronounced at longer horizons. This is not surprising since REITS and (large) private investors are usually investing in the same type of class-A properties in the major cities. If there was no price convergence, there would be a lucrative investment opportunity taking private portfolios public or vice versa. More details can be found in van Nieuwerburgh, Stanton, and de Bever (2015), chapter 4.

[1]As of April 30, 2015, there were 221 publicly traded REITs with a combined market capitalization of $926 billion. Of that, $855 billion was equity REITs and the remaining $741 billion mortgage REITs. Of these, 192 REITs trade on the NYSE; their combined market capitalization is $872 billion. Average daily trading volume in April 2015 was $6.2 billion, up from $1.4 billion in April 2005. Because they are levered (equity REITs had a debt-to-asset ratio of 31% at the end of 2014), REITS' market capitalization understates the amount of real estate assets they own. REITs own approximately $1.7 trillion of commercial real estate assets.

1.2 Data and Summary Statistics

We use the NAREIT All Equity REIT index return, the industry benchmark. The NAREIT time series start in January 1972. We end our sample in December 2014. We define the modern REIT era as the period starting in January 1994, following the passage of changes to REIT rules in 1993. The 1994–2014 sample is also useful for comparison with global real estate, for which this will be the longest available sample. NAREIT also reports return indices by property type (Office, Industrial, Retail, Apartments, Hotels, Health Care, Diversified, and Self-storage). These return indices start in January 1994.

We also use the stock market index return from CRSP (the value-weighted return on all publicly listed stocks in the U.S.), the size, value and momentum return factors (abbreviated as SMB, HML, and MOM, respectively) from Ken French's web site, and the return on a constant-maturity 10-year U.S. Treasury. The risk-free rate is the one-month nominal T-bill rate from Ibbotson.

Table 1 reports annualized means and standard deviations of monthly returns for the full sample (516 months) and for the modern REIT sample (252 months). All returns are nominal log returns.

Full sample Panel A shows that average nominal log returns on U.S. equity REITs were 11.3% per annum over the full sample, with a volatility of 17.4%. The excess return over the one month T-bill, which averaged 4.9% over the full sample, was 6.4% (U.S. real estate risk premium). The Sharpe ratio for equity REITs was 0.37. For comparison, mortgage REITs returned 4.9% per annum with a volatility of 20.5% and a Sharpe ratio of 0.003. The overall stock market generated returns of 10.0% and excess returns (over the one month T-bill) of 5.1% (equity risk premium). The volatility of stock returns was 15.9% per annum and the Sharpe ratio 0.32. Finally, ten-year Treasuries returned 7.3% over the same period, a premium of 2.5% over T-bills, with a volatility of 7.7% and a Sharpe ratio of 0.32. The table also reports return skewness which is a measure of how asymmetric returns are. Equity REITs (-1.46), mortgage REITS (-0.83), and stocks (-0.82) all have negative skewness, implying that large negative returns are more frequent than large positive returns. Long-term bond returns have positive skewness. Based on these numbers, U.S. equity REITs have outperformed U.S. stocks and bonds, while U.S. mortgage REITs under-performed both. We return to a better risk-adjusted performance analysis below.

Modern REIT period Panel B shows results for the 1994–2015 period. The performance of equity REITs in this period was stronger than in the first half of the sample. Average returns were 10% per year, or 7.4% above the risk-free T-bill rate. While excess returns were higher than in the full sample period, the volatility was also higher at 20.3%, arguably because the financial crisis is a more influential observation in the shorter sample. The Sharpe ratio of equity REITs is 0.37, just as in the full sample. Skewness is more negative at −1.65, again because of the financial crisis. Mortgage REITs had return of 5.5%, a volatility of 21.9%, and a Sharpe ratio of 0.13, all substantially higher than in the first half of the sample. Mortgage REITs became more dominated by Agency REITs, which performed better than non-agency REITs, which dominated the previous period. The stock market as a whole had a Sharpe ratio of 0.41 and the bond market one of 0.43 over this period. Both bonds and stocks were marginally less volatile over this period than over the full sample. Over this 1994–2015 period, then, listed real estate was substantially more volatile than stocks. This should not come as a surprise given that real estate was at the heart of the Great Recession and the financial crisis. The Sharpe ratio on equity REITs is in line with that of stocks and long-term bonds, and much higher than that of mortgage REITs.

Table 1: **Return Summary Statistics REITs — Monthly Horizon**

Means, standard deviations, and Sharpe ratios are annualized. Skewness is the skewness of monthly returns. Data are monthly from January 1972 until June 2015 in Panel A and from January 1994 until

	Equity REITs	Mortgage REITs	Stocks	T-Bond	T-bill
		Panel A: 1972–2015			
Mean	11.27	4.92	9.99	7.32	4.86
Standard Deviation	17.42	20.46	15.86	7.72	0.97
Sharpe Ratio	0.37	0.00	0.32	0.32	0.00
Skewness	−1.46	−0.83	−0.82	0.22	0.53
		Correlations			
Equity REITs	1.00	0.54	0.60	0.10	
Mortgage REITs	0.54	1.00	0.48	0.23	
Stocks	0.60	0.48	1.00	0.10	
Bonds	0.10	0.23	0.10	1.00	
		Panel B: 1994–2015			
Mean	10.02	5.52	8.94	5.61	2.61
Standard Deviation	20.26	21.87	15.46	6.93	0.64
Sharpe Ratio	0.37	0.13	0.41	0.43	0.00
Skewness	−1.65	−1.49	−0.93	−0.09	0.08
		Correlations			
Equity REITs	1.00	0.46	0.57	−0.01	
Mortgage REITs	0.46	1.00	0.39	0.14	
Stocks	0.57	0.39	1.00	−0.17	
Bonds	−0.01	0.14	−0.17	1.00	

Correlations Next we turn to the correlation analysis on monthly returns. Over the full sample, we see that equity REITs have a 60% correlation with stock returns at the monthly frequency. While this is obviously a non-trivial positive correlation, it leaves open the possibility of substantial gains from diversification. Equity REITs have a 54% correlation with mortgage REITs due to the fact that both have assets whose cash flows ultimately derive from the performance of real-estate-linked assets. Equity REITs have only a 10% correlation with bond returns, similar to the 10% correlation of all stocks with bonds. Listed real estate is therefore not bond-like, contrary to some "folk wisdom." Mortgage REITs, which are akin to long-short bond portfolios, nevertheless only have a 23% correlation with Treasury bond returns. This is due to credit risk in non-agency REITs and prepayment risk embedded in Agency REITs. Mortgage REITs actually have a higher correlation (48%) with the stock market despite being bond-like plays.

Panel B shows that, over the 1994–2015 period, the correlation of equity REITs with stocks was marginally lower (57%) and the correlation with bond returns was substantially lower (−1%). This reflects a broader and bigger shift in the correlation between stocks and bonds, which was −17% over this period. Economists have documented this change in the sign of the correlation between stocks and bonds from the pre-1994 to the post-1994 period (see Campbell, Pflueger, and Viceira, 2014; David and Veronesi, 2013; Hasseltoft, 2009; Song, 2014). They have ascribed it to a different monetary-policy regime, in which investors changed their perception about positive inflation shocks from being harbingers of bad news to being good news. Rather than being inflation bets, stocks became deflation hedges. Over this 21 year period, equity REITs displayed essentially no interest-rate risk. We return to this in the factor analysis below.

2 Risk Model for Commercial Real Estate

Next, we investigate the performance of publicly traded commercial real estate in the U.S. using a state-of-the-art asset pricing model. The analysis serves to advance the univariate correlation analysis of the previous section. In addition to understanding what risks commercial real estate is exposed to, we can investigate whether equity REITs have displayed abnormal performance (alpha) relative to the factors considered.

2.1 Full-sample Analysis

We present the full-sample analysis for the January 1972–June 2015 sample of monthly returns (522 months). Table 2 shows the results, reporting both point estimates and Newey-

West t-statistics. In the first column, we assume that real estate is exposed to broad stock market risk. In the second column, we assume that real estate is also exposed to broad bond market risk, as reflected in its covariance with long-term Treasury bond returns. Columns 3 adds two well-known asset pricing factors from the equity literature: the size (smb) and value factor (hml). The last column also adds a momentum factor. The resulting five-factor model in the last column is our favorite risk-return model for commercial real estate returns.

Table 2: **Analyzing equity REIT Performance**

The dependent variable is the excess return on the equity REIT index. The independent variables are listed in the main text. The first row reports the intercept α, it is multiplied by 12 to express it as an annual number. The other rows report risk factor exposures β. The t-statistics are computed using Newey-West standard errors with one lag. The last but one row reports the R^2 of the regression. The last row reports the expected return according to the regression model. It includes the current month's risk-free rate and excludes the alpha. The data are monthly from January 1972– June 2015.

	(1)	(2)	(3)	(4)
α	3.01	2.83	−0.97	−0.26
t-stat	1.35	1.27	−0.48	−0.13
β^s	0.66	0.66	0.71	0.69
t-stat	9.12	8.91	10.48	10.68
β^b	−−	0.08	0.17	0.19
t-stat	−−	0.79	2.03	2.32
β^{smb}	−−	−−	0.44	0.44
t-stat	−−	−−	8.29	8.50
β^{hml}	−−	−−	0.68	0.65
t-stat	−−	−−	7.69	7.78
β^{mom}	−−	−−	−−	−0.08
t-stat	−−	−−	−−	−1.53
R^2	36.5	36.6	54.4	54.9
Exp. ret.	8.26	8.44	12.24	11.54

We have the following findings:

CAPM The first column shows the standard CAPM. Equity REIT excess returns have a stock market beta of $\beta^s = 0.66$, which is estimated very precisely with a t-stat of 9.1. The monthly outperformance of equity REITs relative to the CAPM is 3% per year. However, it is not statistically distinguishable from zero. Covariation with the stock market alone explains 36% of the variation in equity REIT returns. Based on stock market risk exposure alone as well as compensation for time value of money (the nominal risk-free interest rate), the expected return on real estate is 8.26% (last row).

Two-factor model with stocks and bonds Column (2) adds a 10-year Treasury bond excess return as the second factor. Equity REITs have essentially zero exposure to the bond market, consistent with the correlation analysis. The resulting 2-factor α is 2.8% per year. The two factor model explains 36.5% of monthly return variation in equity REITs, with the bond factor adding only marginally to the R^2. In other words, 2/3 of the variation in publicly listed commercial real estate index returns in the U.S. is unaccounted for by a stock and a bond index. The expected return on real estate, given its stock and bond exposure, is 8.44% per year.

Fama-French with bonds Column (3) reports results on the standard three-factor Fama-French model plus a bond market factor. It shows that equity REITs are exposed to the risk inherent in small firms and in value firms (high-minus-low book-to-market) factors. Both loadings are measured precisely. In other words, equity REITs behave like small-value stocks. The R^2 of the three-factor model increases to 54%, a substantial jump compared to the 2-factor model in column (2). Also of note is that, once we control for size and value risk exposure, the bond market beta increases substantially to 0.17 and becomes statistically significant. The expected return on commercial real estate increases to 12.2% once the size and value risk are taken into account.

Adding Momentum In Column (4), we add one more equity risk factor which has become standard in the asset pricing literature: the momentum factor. Equity REITs have a small negative exposure to the momentum factor, but the exposure is not statistically different from zero. Because real estate is a momentum hedge and the momentum risk premium is large, the expected return on real estate falls to 11.54% per year. This is our headline risk premium estimate. The model in Column (4) explains 55% of the return variation. While this is substantially higher than the 36% of the two-factor model, there remains a large component of equity REIT returns, "a real estate factor," that is not captured by standard stock and bond portfolios. However, there does not seem to be any compensation for exposure to this risk factor given that the five-factor alpha is zero. There is no indication that equity REITs as an asset class have outperformed a portfolio of stocks and bonds, once a size, value, and momentum risk factors are included in the analysis.

2.2 Time-variation in factor risk exposure

To investigate how the risk exposure of REITs to the various risk factors has changed over time, we estimate the five-factor risk model over rolling 60-month windows. Figure 1 plots the resulting multivariate risk factor exposures. The first panel displays the monthly alpha from the five-factor model. The next panel displays the stock market beta. The left panel in the second row displays the bond market beta of commercial real estate in the U.S. They are the multivariate counterparts to the univariate correlations between real estate and stock and bond returns discussed earlier. The remaining panels show the dynamic size, value, and momentum exposures of real estate. Several interesting patterns emerge:

1. Equity REITs have seen a strongly increasing stock market beta in the last ten years, from around 0.5 in the five-year period ending in 2005 to 1 in the five-year period ending in 2015. This increasing beta is the combination of a rise in the correlation between the two return series and a rise in the relative volatility of equity REITs relative to stocks. The two-factor model somewhat overstates the stock market beta compared to our preferred five-factor model.
2. The bond market beta of equity REITs stayed between -0.5 and +0.5 until 2005. Since then, we have seen a strongly increasing bond beta, which reaches all-time high values of around 1.2 at the end of the sample.
3. The exposure of equity REITs to the small stock factor is relatively stable over time around 0.5 until the end of the sample. The size beta of real estate has declined precipitously at the end of the sample. Since the size premium is modest, this is a minor factor.
4. In contrast, the value premium is larger and so the value beta of real estate matters more for its expected return. The exposure to value stocks has increased substantially in the 1990s and 2000s, but has gone back down in the last five years of the sample.
5. The exposure to momentum oscillates between negative and positive and is more modest in magnitude. However, the momentum premium is very large. At the end of the sample, real estate had a positive exposure to momentum.
6. The corresponding five-factor alpha is shown in the top left panel of Figure **??**. It fluctuate between -12.5% and $+10.3\%$ per year. The last reading for the five-year period ending in June 2015 is -7.6% per year. This is a dramatic reversal from the high positive alphas found just prior to the start of the crisis. We caution that estimating alphas over short horizons (60 months) is difficult, so these results are to be interpreted with caution. The two-factor model substantially overstates the alpha compared to our preferred five-factor model.
7. The five-factor model explains a strongly fluctuating fraction of equity REIT return variation: between 30% and 80% with an average of 60%. The latest reading for the ten-year period is 53%, down sharply from the 80% maximum estimated over the period mid-2008 to mid-2013 which includes the financial crisis and the recovery. The lowest explanatory power occurs in the period 2000–2005 when the stock market was

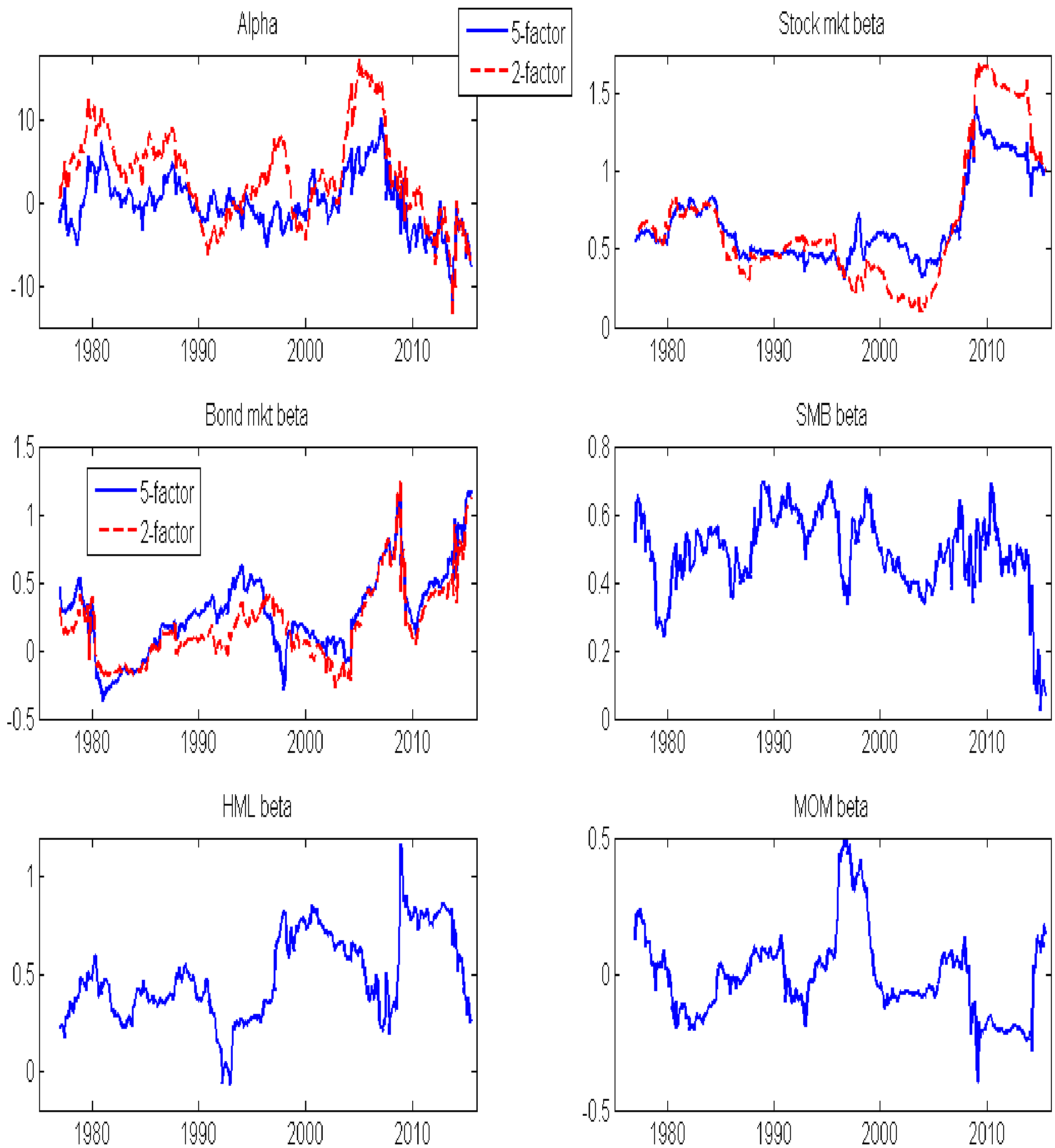

Figure 1: Time-Varying Betas for equity REITs

The figure plots the exposures (betas) of equity REITs to five risk factors: the stock market, the 10-year bond market return, the size (SMB) factor, the value (HML) factor, and the momentum (MOM) factor. Each set of risk-factor exposures is estimated via a multivariate regression using the most recent 60 months of data. The sample period is January 1972–June 2015.

somewhat disconnected from commercial real estate price dynamics.

Cost of capital The time-varying beta model can be applied to calculate the fair expected return on equity REITs. Figure 2 plots that cost of capital over time. To make the figure, we hold the average risk premium on each of the five risk factors constant at its full-sample average and only allow the betas to fluctuate over time (as estimated from the 60-month rolling windows). Since estimating betas is much easier in a statistical sense than estimating mean factor premia, we use the maximum amount of data to estimate the latter. The approach avoids misinterpreting negative realized returns on factors as periods with low risk premia.

Several interesting findings stand out.

1. The nominal risk-free interest falls nearly continuously since the early 1980s. This reduces the expected return of real estate as can be seen in the dark blue area, which reports the contribution of the time value of money component to the expected return.
2. The stock market risk has increased as indicated before, and the increased compensation for equity risk nearly fully compensates for the decline in the risk-free interest rate.
3. The overall (nominal) expected return on real estate fluctuates substantially between 5% in the early 2000s and 22% in the late 1970s-early 1980s.
4. Over the last five years, the expected return has increased from 9.5% to 10.2%. Since nominal risk-free rates were constant at zero, this is the result of a 70 basis points rise in the risk premium. The stock market risk compensation fell from 6.2% to 5.2%, the bond market risk compensation rose from 0.6% to 2.9%, the size risk compensation fell from 1.1% to 0.1%, the value risk compensation fell from 2.8% to 1.0%, and the momentum risk compensation changed from -1.3% to +1.0%. One way to summarize these changes is that the compensation for the four sources of equity risk fell by 140 bps over the past five years, while the compensation for interest rate risk rose by 210 basis points. So it is the increased interest rate risk of real estate that has dominated the expected return dynamics recently.

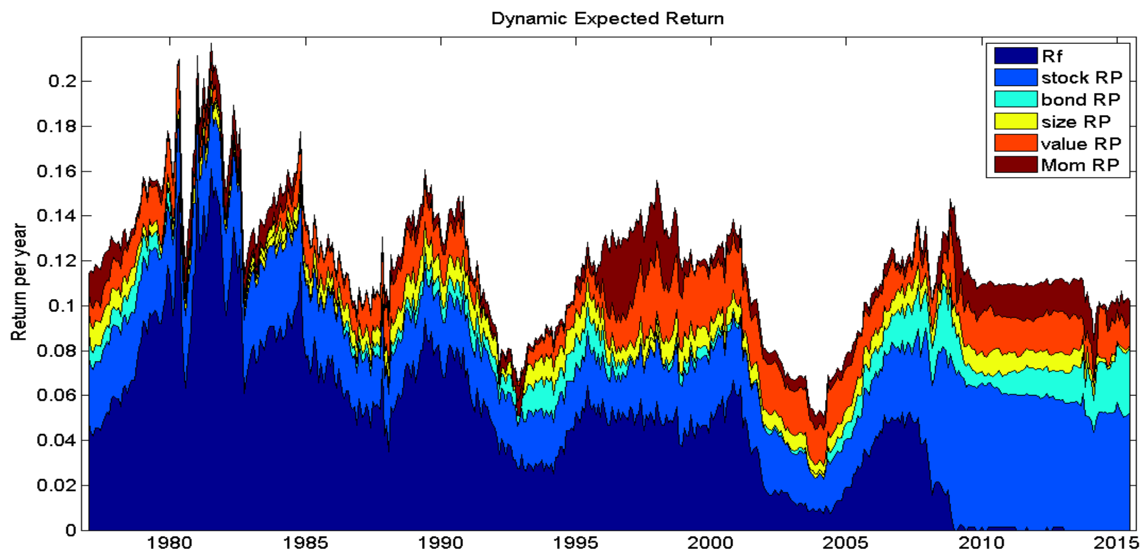

Figure 2: Risk Premium Decomposition for equity REITs

The figure plots the expected return on equity REITs as implied by the five-factor model. The risk factors are: the stock market, the 10-year bond market return, the size (SMB) factor, the value (HML) factor, the momentum (MOM) factor. The betas on the factors are estimated on 60-month rolling windows. To calculate the risk premium, we multiply each beta with the average return on each factor, where the averages are computed over the full January 1972– June 2015 sample. We add to this risk premium the current nominal one-month T-bill rate to arrive at the expected return.

3 Valuation levels of real estate

3.1 Valuation ratios U.S. commercial real estate

A low cap rate or high price-to-NOI ratio must reflect the market's expectation of (i) lower future returns on real estate (i.e., future price declines), (ii) higher future NOI growth, or (iii) a combination of the two. The simple Gordon growth model relates average cap rates to average expected returns and average expected dividend growth rates:

$$\overline{DP} = \bar{R} - \bar{G}$$

The term on the left is the long-term mean dividend yield or cap rate; $\bar{R}$ and $\bar{G}$ are the long-term mean return and mean dividend growth rates, respectively.

This relationship holds also dynamically, that is, for deviations of cap rates from its long-term average. Using the present-value relationship pioneered by Campbell and Shiller (1988), the cap rate dp is the difference between the expected discounted sum of future returns r and the expected discounted sum of future dividend (NOI) growth Δd, with each variable in deviation from its long-term average:

$$dp_t - \overline{dp} = E_t\left[\sum_{j=1}^{+\infty} \rho^{j-1}\left(r_{t+j} - \bar{r}\right)\right] - E_t\left[\sum_{j=1}^{+\infty} \rho^{j-1}\left(\Delta d_{t+j} - \bar{g}\right)\right], \quad (1)$$

All variables measured in logs.[2] Using the present value relationship, we can ask how much of the observed variation in cap rates reflects fluctuations in discount rates (the first term) versus fluctuations in future cash flow growth rates (the second term).

A large finance literature has found that stock price movements largely reflect movements in future prices (first term), rather than in future cash flows (second term). When the dp ratio is low, stock prices tend to fall to restore the dp ratio back to its long-run mean. Put differently, a low dp ratio predicts price declines rather than high dividend growth rates going forward (see Koijen and van Nieuwerburgh, 2011). We now revisit this evidence for U.S. equity REITs. Since REITs pay out essentially all of their NOI, and to the extent that they hold a representative portfolio of institutional-grade buildings, the dividend yield on REITs should be a good measure of the underlying cap rate on commercial real estate.[3]

[2]This follows from log-linearizing the definition of a return $R_{t+1} = \frac{P_{t+1}+D_{t+1}}{P_t}$, to obtain $r_{t+1} = k + \Delta d_{t+1} + \rho\, pd_{t+1} - pd_t$, where $dp_t = d_t - p_t = -pd_t$ and all lowercase letters denote natural logarithms. The constants k and ρ are related to the long-term average log dividend-price ratio: $\rho = (1 + \exp(\overline{dp}))^{-1}$. By iterating forward on the return equation, adding an expectation operator on each side, and imposing a transversality condition (i.e., ruling out rational bubbles), we obtain the equation in the main text.

[3]More precisely, since REITs are levered (about 40% for U.S. REITs), the dividend yield reflects the

The left panel of Figure 3 plots the price-dividend ratio on U.S. equity REITs from 1972–June 2015. Each data point refers to the dividends paid out over the course of the year divided by the price at the end of the year.[4,5] The graph shows that over the past 5 years real estate stocks have reached valuations not seen since at least 1972. Valuation ratios have roughly doubled since the end of 2000. The average price-dividend ratio was 13.1 from December 1972–December 2000. It was 28.8 from June 2010–June 2015. As of June 2015, the price-dividend ratio is 26.4, down from a peak of 31.3 in January 2015. We note that the dividend-price ratio is persistent, with annual autocorrelation of 0.74. However, this is not nearly as persistent as for stocks, which historically have had autocorrelations of 0.95 at annual frequency.[6]

Also of interest are the dividend growth rates, which reflect largely the growth rate in net operating income. The right panel of Figure 3 plots annual dividend growth rates in real terms (in excess of CPI inflation). Mean nominal dividend growth is 3.9% per year. Subtracting an annual inflation of 4.2% results in a slightly negative real dividend growth of -0.3% per year. In other words, cash flow growth on U.S. REITs barely kept up with inflation over the past 43.5 years. Of the 11.5% annual nominal log return, only 3.2% came from nominal log dividend growth. Further, the graph clearly shows a strong comovement between the price-dividend ratio in the left panel and annual dividend growth in the right panel. This suggests that movements in the *pd* ratio may be informative of future cash-flow growth, not just returns. We return to this below. Finally, dividend growth is volatile, with a volatility of 12% compared to a volatility of returns of 17%. Thus the "excess volatility puzzle" is not as deep for REITs.

cap rates of the underlying real estate portfolio minus the yield on the corporate debt minus management expenses. Strictly speaking then, this analysis investigates the variation in dividend yields on REITs rather than commercial real estate cap rates. This seems like a trade-off worth making given that REIT prices are higher-quality and timelier measures of real estate prices than the appraisal- and transaction-based price series typically used when valuing commercial real estate buildings.

[4]We assume that all dividends are reinvested at the 1-month T-bill rate. Koijen and van Nieuwerburgh (2011) argue why this is the most appropriate assumption to make.

[5]We believe there to be three data errors in the NAREIT ex-dividend equity REIT return series. In May 1980, the income return is 12.26%, in September 1984 it is 3.42%, and in June 1990 it is 5.45%. These data points are extreme outliers since the average monthly income return is 0.61% and the 99th percentile 1.53%. Further, using these data results in a dividend yield series that does not correspond to the one provided by NAREIT. We assume that these three observations are typos and should be an order of magnitude smaller. We adjust the ex-dividend returns accordingly, while leaving the cum-dividend returns as is. The resulting dividend yield series has a correlation with that reported by NAREIT of 97% instead of 76% pre-correction.

[6]The lower autocorrelation mitigates statistical problems with the return predictability regressions we present below.

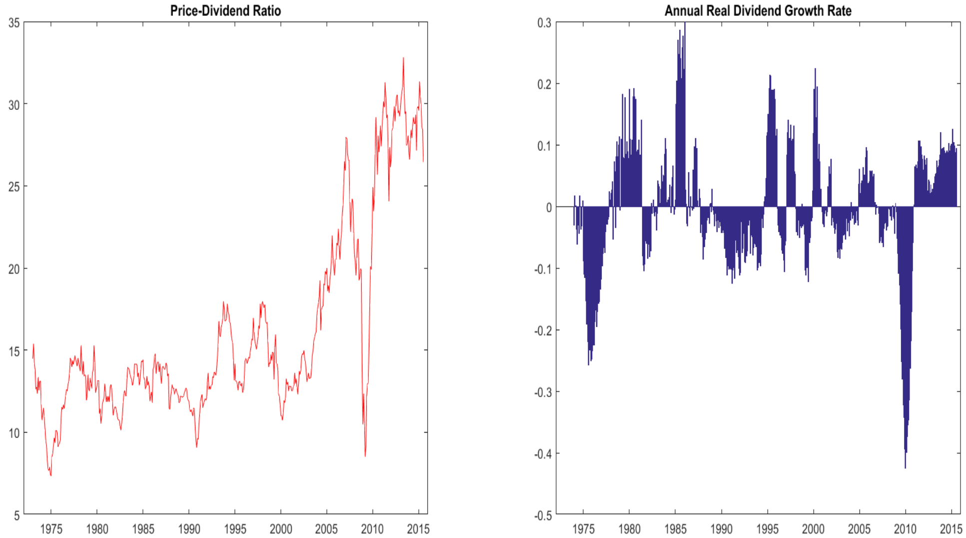

Figure 3: Price-Dividend ratio and Dividend Growth on U.S. equity REITs
The left panel plots the price-dividend ratio on the U.S. All Equity REIT index from NAREIT. Data are monthly from December 1972–June 2015. The right panel plots dividend growth on the All equity NAREIT index. Dividends are invested within the year at the T-bill rate.

3.2 Implied dividend growth rates

How to reconcile the expected return implied by the factor risk models discussed above with the current price-dividend ratios on US commercial real estate stocks? The low dividend yields (or equivalently the cap rates) and the high expected returns (high risk levels) must then imply that investors *expect strong future dividend growth*. Rewriting equation (1), we get:

$$E_t\left[\sum_{j=1}^{+\infty}\rho^{j-1}\left(\Delta d_{t+j}-\bar{d}\right)\right]=E_t\left[\sum_{j=1}^{+\infty}\rho^{j-1}\left(r_{t+j}-\bar{r}\right)\right]+\left(pd_t-\overline{pd}\right). \tag{2}$$

The expected return term (first term on right-hand side) is obtained as follows. The current value for the expected return comes from the five-factor risk model, which contains a stock, bond, size, value, and momentum factor. We assume that this expected return reverts back linearly to its long-run mean $\bar{r}$ over the following 10 years. The higher the risk (and therefore the higher the expected return) relative to the long-run mean, the higher the implied dividend growth rate must be to justify a given valuation ratio.

The second term on the right-hand side of equation (2) is difference between the current price-dividend ratio and its long-term average. The higher the price-dividend ratio relative to its long-term mean, the higher the implied dividend growth rate must be all else equal.

For simplicity, we assume that the expected dividend growth rate on the left-hand side is constant for the first ten years, and that expected growth reverts back to its long-term mean from year 11 onwards. Call the expected dividend growth in years one through ten d^{impl}. It is an annual number. We solve for this implied dividend growth rate as:

$$g^{impl} = \bar{g} + \frac{1-\rho}{1-\rho^{10}} \left\{ E_t \left[\sum_{j=1}^{10} \rho^{j-1} \left(r_{t+j} - \bar{r} \right) \right] + \left(pd_t - \overline{pd} \right) \right\}. \tag{3}$$

The five-factor model for real estate returns, discussed above, implied an average expected return of 11.5% per year (in logs). At the end of the sample, in June 2015, the expected return was 10.3% as a reflection of the higher risk premium but also the very low risk-free interest rate at that point. Despite the high expected return, we observed a high price-dividend ratio of 26.4 on U.S. real estate in June 2015. We ask what assumptions on future dividend growth rates are necessary to reconcile the observed price-dividend ratio with the five-factor estimate of the expected return. In our calculation, we assume that the expected return gradually reverts back to the full sample mean, over a 10-year period. We also assume that dividend growth is constant for the first ten years and returns to its long-term mean of 3.18% per year (in logs) after 10 years. We compute the annual dividend growth rate (over the first 10 years) that investors must be expecting to justify the current valuation ratio. Figure **??** reports this number for each month starting in December 1976, always using the corresponding price-dividend ratio and expected return for each month (thick line). The thin straight line shows the observed average annual dividend growth rate, as a point of comparison. When the thick line is above the thin line, the market expects dividend growth rates to be above average. To the extent that positive deviations appear excessive, one could interpret these findings as support for a "bubble."

How can current valuation ratios be justified? The pd ratio was 26.4 in June 2015. We use the expected return given by the 5-factor model. Given an expected return of 10.28% in June 2015, investors must believe that dividend growth will be 9.89% each year for the next ten years before reverting back to the long-term average of 3.18%. Put differently, investors must believe that (discounted) NOI growth will be 51% over the next ten years rather than the 24% implied by the historical average growth rate. Despite the strong cash flow growth observed in 2014 and 2015, we do not deem these implied growth rates particularly plausible. If dividend growth turns out to be only average over the next 10-years, then the price-dividend ratio ought to be 12.1 as opposed to the observed 26.4. That is, REITs would be overvalued by a factor of 2.19 (119%).

We repeat this exercise for every month from December 1976 to June 2015. Figure 4 plots the resulting time-series of the implied dividend growth rate (thick line). The thin straight line shows the observed average annual dividend growth rate, as a point of comparison. When the thick line is above the thin line, the market expects dividend growth rates to be above average. To the extent that positive deviations appear excessive, one could interpret these findings as support for a "bubble." The graph shows that real estate was more expensive in January 2015 when the market expected dividend growth of 12% per year over the next 10 years. In 2011, the measure peaked at 12.73%. For comparison, the implied expected dividend growth number on the eve of the financial crisis in February 2007 was 10.1%. In February 2009, the measure bottomed out at a -3.4% value, suggesting that real estate was cheap.

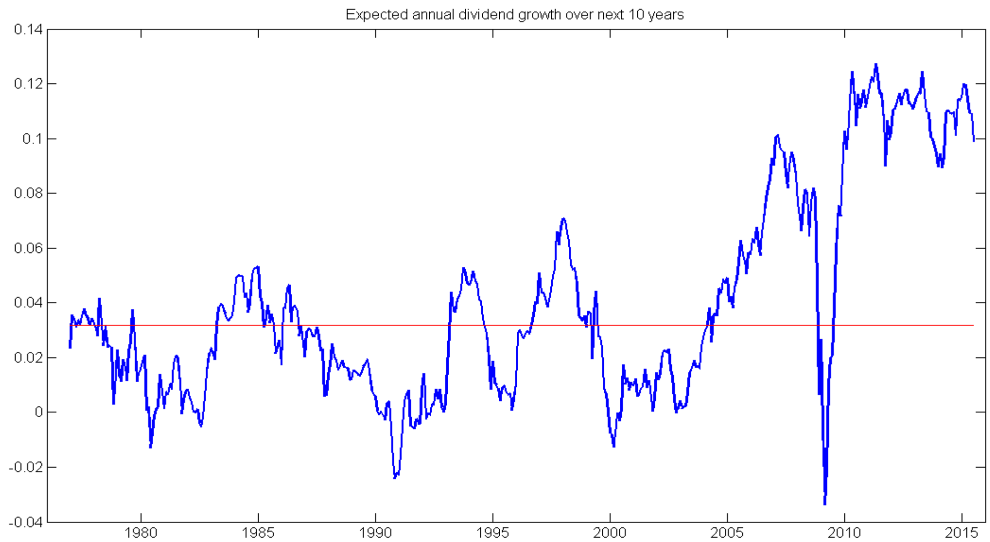

Figure 4: Expected Dividend Growth Implied in US REITS Valuation
In each month, the graph plots the expected dividend growth over the next 10 years, expressed as a per year quantity, that is implied by the price-dividend ratio in that month and the expected return on global real estate in that same month according to the 5-factor model (estimated over a 60-month window ending that month).

Conclusion In conclusion, U.S. commercial real estate looks expensive in absolute terms, relative to earnings, and when taking into account an appropriate and well-fitting risk model. Current prices can only be justified under aggressive, arguably implausible, assumptions on long-term NOI growth (even when taking account of strong near-term NOI growth). Yields on commercial property have increased relative to Treasury yields, but this comparison is misleading since the spread is not a good measure of the risk premium and since the spread may still be too low compared to what is warranted by the risk of commercial real estate.

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