What Drives REIT Prices? The Time-Varying Informational Content of Dividend Yields

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Abstract

In this study, I investigate the informational content in the dividend yields of equity real estate investment trusts (REITs). The findings show that during the vintage REIT era, 1980–1992, expected aggregate REIT dividend growth is forecastable from aggregate REIT dividend yields at both short and long horizons. This empirical predictive relation is *negative*, which is consistent with the usual prediction of the dividend pricing model. In contrast, over the new REIT era, 1993–2011, there is a positive predictive relation from dividend yields to aggregate REIT returns. Meanwhile, REIT dividend yield cedes its role in predicting aggregate REIT dividend growth.

An essential task of studying asset prices is to understand the price behavior of assets. In this study, I address the following research questions: What drives real estate investment trust (REIT) prices? Can REIT price movements be attributed to new information about future cash flows and/or to new information about future expected returns/discount rates? The inquiries focus on whether the linkages between REIT prices and the two sources of information evolve over time.

REITs, like other assets, are commonly thought to arrive at their value estimates and prices through a discounting process; that is, asset prices should equal the present values of expected future cash flows discounted by expected returns. If this rational valuation model provides reasonable description of asset prices, one would expect that asset prices reflect the growth potential of cash flows and/or the time variation in expected returns. In this way, fundamentals can be grouped into two categories: one relating to cash flows (e.g., rent rate, occupancy rate, and operating expenses), and the other relating to expected returns (e.g., interest rate, risk tolerance, and other discount factors). This dichotomous grouping of fundamentals has also helped shape a debate in the financial economics literature about the behavior of common stock prices in which stock prices are normalized by dividends.[1] That is, do high prices relative to dividends (i.e., low dividend yields and high price-dividend ratios) today reflect optimistic expectations of future dividends? Or, do high prices relative to dividends today imply lower returns in the future? This ongoing debate of price behavior is important because many of the applications of financial economics involve valuing assets. For these applications, it is often useful to understand the informational content of normalized prices so that values/prices can be calculated based on dividend estimates. In addition, this simple dichotomy is useful in understanding REIT pricing and may help practitioners direct their research efforts in a more focused and effective way. For example, if current REIT price movements are shown to relate to the subsequent growth of cash flows, practitioners would have incentives to devote more resources than otherwise would be to improve the quality of their pro forma analyses.

An important reason for studying the sources of REIT price movements *over time* is that there is good evidence suggesting that the relative importance of these sources may evolve as the real estate industry grows and matures. Linneman (1997) outlines the forces that forever change the real estate industry beginning in 1993. These forces include the industry's collapse in the early 1990s, changes in the banking and securitized real estate regulations, and the increasing role of capital markets in real estate investing and financing. Crain, Cudd, and Brown (2000), Glascock, Lu, and So (2000), Ooi, Webb, and Zhou (2007), Chiang (2010), and many others document a structural change in REIT pricing in the early 1990s. It is now almost a standard practice in the REIT pricing literature that REIT return datasets are partitioned into the vintage and new REIT eras, using the Revenue Reconciliation Act of 1993 as the defining event.[2] In this study, I follow this convention and investigate whether the informational content of REIT dividend yields exhibits a shift around 1993.

The results indicate a fundamental shift in the informational content of REIT dividend yields beginning in 1993. During the vintage REIT era, 1980–1992, REIT aggregate dividend growth is predictable from REIT aggregate dividend yields at both short and long predictive horizons, and that the predictability is increasing in time horizons. For example, at a three-year horizon, around 43% of the variation in dividend growth is forecastable from dividend yields. In addition, many of the dividend yield coefficients are negative and statistically significant. These negative relations are also robust over various REIT property types. To the best of my knowledge, this is the first study to document a strong, intuitively *negative* relation between aggregate dividend yields and expected aggregate dividend growth.

Over the new REIT era, 1993–2011, a positive predictive relation from dividend yields to REIT returns emerges. Consistent with the financial economics literature, this emerging return predictability is more apparent for long predictive horizons. For example, at a three-year horizon, around 33% of the variation in aggregate REIT returns is forecastable from dividend yields. Meanwhile, the ability of dividend yields in forecasting REIT dividend growth disappears in the new REIT era. Overall, the results are in line with Linneman's (1997) argument that the REIT industry has changed forever. The results also support the notion that there is a fundamental shift in the REIT pricing structure beginning in 1993 (Crain, Cudd, and Brown, 2000; Glascock, Lu, and So, 2000; Chiang, 2010).

Literature Review

Peaking in the 1970s, the traditional view of asset pricing was that stock market returns were close to unpredictable, and that high stock market prices contained optimistic expectation of future aggregate dividends. In the 1980s, this conventional view was revised when Campbell and Shiller (1988a, b), Fama and French (1988, 1989), and many others showed that aggregate dividend yields are predictive of aggregate stock returns, but not aggregate dividends. Today, many financial economists believe that the time variability in expected returns is the dominant component of market price variability.

Dividend growth predictability has been critically re-examined by Bansal and Yaron (2004), Menzly, Santos, and Veronesi (2004), Lettau and Ludvigson (2005), Ang and Bekaert (2007), and Ang and Liu (2007). Thus far, these efforts have shown that aggregate dividend growth is predictable, but have failed to present evidence of a desirable *negative* relation between aggregate dividend yields and expected aggregate dividend growth.

This study contributes to this vast literature by focusing on the informational content in the dividend yields of REITs. These real estate securities ordinarily adopt a stable dividend policy and distribute almost all of their cash flows from operations as dividends (Kallberg, Liu, and Srinivasan, 2003). During the 1980–2000 period, REITs distributed on average 110% of taxable income (Chan, Erickson, and Wang, 2003, Table 8.1, p. 130).[3] This unique policy removes much of managerial discretion over dividend payout, thus making the uncovering of the true relation between aggregate dividend yields and expected aggregate dividend growth more plausible.

In the real estate literature, this study is related to Kallberg, Liu, and Srinivasan (2003) and Muhlhofer and Ukhov (2012). Kallberg, Liu, and Srinivasan (2003) use the variance bounds test of Shiller (1981) and West (1988) to investigate whether REIT price volatility can be justified by subsequent changes in REIT dividends. Their results suggest that REIT prices are not excessively volatile. The recent work of Muhlhofer and Ukhov (2012) extends Kallberg, Liu, and Srinivasan's (2003) results by employing out-of-sample estimation and by augmenting their VAR system to include cash flow information from the commercial property market. Muhlhofer and Ukhov's (2012) results are consistent with Kallberg, Liu, and Srinivasan's (2003), demonstrating that REIT prices do not move too much relative to REIT (and underlying property) cash flows.

Although related, the current study differentiates itself from Kallberg, Liu, and Srinivasan (2003) and Muhlhofer and Ukhov (2012) in three ways. First, I address the relative importance of dividend growth and discount rate in explaining REIT dividend yields, whereas Kallberg, Liu, and Srinivasan (2003) and Muhlhofer and Ukhov (2012) investigate how to resolve the excess volatility puzzle. Second, I employ long-run regression procedures in an attempt to understand REIT price behavior because REIT prices are influenced by expectations of returns and dividend growth into the distant future. Third, predictive regressions are used to provide perspectives for those practitioners who adopt long-term market timing strategies, such as contrarian strategies.[4]

Predictive Regression Specifications

The different views of asset prices can be better understood via a dynamic version of the Gordon (1962) dividend pricing model. The original Gordon model, $P_t = D_{t+1}/(R - g)$, relates asset price measured at time t, P_t, to the discounted value of all future dividends, $\{D_{t+1\to\infty}\}$, under the assumptions of a constant discount rate (expected return), R, and a constant dividend growth rate, g. Campbell and Shiller (1988b) relaxed the constant assumptions and showed that, in a log-linear setting, current log dividend yield, $\delta_t \equiv \log(D_t) - \log(P_t) \equiv d_t - p_t$, is a positive function of the difference between the discounted value of all future log returns and the discounted value of all future log dividend growth rates. They showed that current log dividend yield can be approximated as follows:

$$\begin{aligned}\delta_t &= \text{constant} + E_t \sum_{j=0}^{\infty} \rho^j (r_{t+1+j} - \Delta d_{t+1+j}) \\ &= \text{constant} + E_t \sum_{j=0}^{\infty} \rho^j r_{t+1+j} - E_t \sum_{j=0}^{\infty} \rho^j \Delta d_{t+1+j},\end{aligned} \tag{1}$$

where $r_t \equiv \log(1 + R_t)$, and $\Delta d_t \equiv \log(D_t/D_{t-1})$. Intuitively, Equation (1) demonstrates that if dividend yields are high, then either expected returns are high, or the growth rates of dividends are expected to be low, or a combination of both.

Equation (1) has been extensively examined by running the following two predictive OLS regressions:

$$\Delta d_{t+1\to t+T} = \alpha + \beta_d \delta_t + \varepsilon_{t+1\to t+T} \tag{2}$$

and

$$r_{t+1\to t+T} = \alpha + \beta_r \delta_t + \varepsilon_{t+1\to t+T,} \tag{3}$$

where T-period accumulated log dividend growth rate is $\Delta d_{t+1\to t+T} \equiv \Sigma_{l=1}^{T} \Delta d_{t+l}$ and T-period accumulated log return is $r_{t+1\to t+T} \equiv \Sigma_{l=1}^{T} r_{t+l}$. In these two specifications, current dividend yield is specified as the predictor to reveal the informational content of dividend yield.[5] As a result, the statistical properties of dividend yield coefficients, β_d and β_r, reveal whether dividend growth and return are predictable, respectively.

Based on Equation (3) or a similar specification, Campbell, Lo, and MacKinlay (1997), Fama and French (1988), Hodrick (1992), Cochrane (2001, 2008), Lettau and Ludvigson (2001), and many others documented return predictability, particularly in the long run. For example, at a two- to four-year horizon, Fama and French (1988) documented that monthly predictive regressions based on dividend yields can be used to explain approximately 25% of the variances of subsequent accumulated returns. In contrast, empirical tests based on Equation (2) yielded no evidence of dividend growth predictability.

Many researchers have expressed concern that the OLS results of return predictability based on Equation (3) may be spurious because the regressor (i.e., dividend yield) is highly persistent. Mankiw and Shapiro (1986), Nelson and Kim (1993), Stambaugh (1999), and many others demonstrated that a highly persistent regressor leads to upward-biased estimates if innovations of the regressor are correlated with returns. To deal with these inference difficulties, I used the re-sampling method to generate the empirical distributions of test statistics under the null hypothesis of *no* return predictability or the null hypothesis of *no* dividend growth predictability. Specifically, when return predictability is examined using Equation (3), I run a regression of one-period returns on lagged dividend yields and an autoregression of dividend yields on lagged dividend yields. The return residuals and dividend yield residuals are stored and jointly bootstrapped (i.e., re-sampled with replacement).[6] The re-sampled dividend yield residuals and the autoregression coefficient are used to create artificial dividend yields. Artificial returns are created by using re-sampled return residuals under the null of no predictability. Artificial returns are then accumulated over T periods and regressed on artificial dividend yields. This re-sampling and subsequent regression is repeated 5,000 times to generate the empirical distribution of the dividend yield coefficient under the null of no predictability. The bias-adjusted dividend yield coefficient is defined here to be the difference between the biased OLS dividend yield coefficient and the average value of the dividend yield coefficients from the 5,000 experiments. Statistical inference can be conducted in the usual fashion, based on the standard error of the bootstrapped distribution of the dividend yield coefficient (Plazzi, Torous, and Valkanov, 2010).

Data Analysis

The definitions of variables and their constructions closely follow those in Fama and French (1988). Monthly dividend yields, $\{D_t/P_t\}$, are retrieved from the Center for Research in Security Prices (CRSP)/Ziman Real Estate Database for five REIT portfolios: the all equity REIT value-weighted portfolio and four REIT value-weighted property-type sub-portfolios. The property-type sub-portfolios include diversified REITs, office/industrial REITs, residential REITs, and retail

REITs. The data are from January 1980 to December 2011 because the CRSP/Ziman data starts in January 1980. The baseline analysis is conducted at the monthly frequency because of the relative short period of the REIT sample. To mitigate the seasonality in dividends, I accumulate monthly dividend yields backward into rolling annual dividend yields; that is, $\delta_t \equiv \Sigma_{l=0}^{11} \log(D_{t-l}/P_{t-l})$, where t is set at the monthly frequency.[7] Thus, the first annualized dividend yield observation starts in December 1980.

The monthly returns of the five REIT portfolios are retrieved from the CRSP/Ziman Real Estate Database. I rely on log excess returns, $r \equiv \log(1 + R) - \log(1 + R_f)$, for the measurements of returns in the predictive regressions. The reason for this focus is that total returns can be partially driven by risk-free rates, instead of expected returns or expected dividend growth. I use the return on T-bills as a proxy for the risk-free rate, R_f. The T-bill monthly return series is collected from the *2012 Stocks, Bonds, Bills, and Inflation* (*SBBI*) *Yearbook*.

The monthly price series of the REIT portfolios, $\{P_t\}$, are also retrieved from the CRSP/Ziman Real Estate Database. The calculation of log dividend growth rates is based on annualized dividend yields and is given by the following identity:

$$\begin{aligned} \Delta d_t &\equiv \log(D_t/D_{t-1}) \\ &= \log([(D_t/P_t)/(D_{t-1}/P_{t-1})] \times (P_t/P_{t-1})). \end{aligned} \tag{4}$$

Thus, the first log dividend growth rate observation starts in January 1981. For this reason, although the data runs from January 1980 to December 2011, the sample/test period is from January 1981 to December 2011.

Exhibit 1 reports summary statistics. It is evident that REITs exhibit a rather diverse return and dividend growth pattern. During the sample period, 1981–2011, office/industrial REITs have a negative average dividend growth rate, −0.03%. Residential REITs have the highest average dividend growth rate, 0.68%. Office/industrial REITs have the lowest average return, 10.10%, whereas retail REITs have the highest average return, 14.35%. These differences in summary statistics are consistent with the notion that different REIT property types are influenced by different sets of macroeconomic factors (Gyourko and Nelling, 1996; Gallo, Lockwood, and Rutherford, 2000). Given the rather diverse patterns in returns and dividend growth rates, it is interesting to note that the average dividend yields of the five REIT portfolios are similar. Specifically, average dividend yields range from 6.36% to 7.16%.

The autocorrelation structure in Panel B of Exhibit 1 shows that REIT log dividend yields are highly persistent. The one-month autocorrelation coefficients range from 0.94 to 0.99. The six-month autocorrelation coefficients range from 0.73 to 0.87.

Exhibit 1 | Summary Statistics for Equity REITs and Equity REIT Sub-Portfolios

	D/P	R	ΔD
Panel A: Summary statistics			
Mean (%)			
Equity REITs	6.76	12.37	0.25
Diversified	6.36	12.28	0.43
Office/Industrial	6.76	10.10	−0.03
Residential	7.16	14.20	0.58
Retail	6.56	14.35	0.38
Std (%)			
Equity REITs	1.20	17.93	5.83
Diversified	1.00	20.20	8.05
Office/Industrial	1.59	22.83	7.88
Residential	2.19	19.79	7.44
Retail	1.37	19.88	6.20
Panel B: Autocorrelation			
	δ	r	Δd
θ_1; θ_6; θ_{12}			
Equity REITs	0.98; 0.82; 0.65	0.13; −0.20; 0.13	0.03; −0.17; −0.09
Diversified	0.94; 0.73; 0.36	0.14; −0.17; 0.12	−0.09; −0.06; −0.15
Office/Industrial	0.97; 0.86; 0.61	0.09; −0.16; 0.16	−0.03; −0.07; 0.08
Residential	0.98; 0.87; 0.61	0.06; −0.12; 0.07	−0.09; 0.06; −0.07
Retail	0.99; 0.87; 0.65	0.13; −0.18; 0.12	0.04; −0.23; 0.02
Panel C: Unit root			
t-Statistic	δ	r	Δd
Equity REITs	−1.95	−16.87*	−18.76*
Diversified	−3.55**	−16.69*	−21.25*
Office/Industrial	−2.51	−17.48*	−20.89*
Residential	−4.41*	−18.07*	−21.33*
Retail	−1.49	−16.95*	−18.52*

Notes: In Panel A, D/P is backward annualized dividend yield, R is annual return, and ΔD is dividend growth rate. The variables in Panels B and C are measured monthly. δ is log backward annualized dividend yield, r is log excess return, and Δd is log dividend growth rate. θi is the ith monthly autocorrelation coefficient. The Dickey-Fuller unit root test includes a constant. The data set is from January 1980 to December 2011. The first year's data is used for lags so that the sample period is from January 1981 to December 2011.

*Significant at the 1% level.

**Significant at the 5% level.

The Dickey-Fuller unit root tests in Panel C of Exhibit 1 show that the null hypotheses of a unit root are often not rejected for log dividend yields. In contrast, the autocorrelation coefficients of REIT log excess returns and log dividend growth rates are not far from zero. The Dickey-Fuller unit root tests show that the null hypotheses of a unit root are all rejected at the 1% level for REIT log excess returns and log dividend growth.

Empirical Results

Exhibit 2 reports predictive OLS regression results for log dividend growth rates based on Equation (2).[8] The tests are performed for the entire sample period, 1981–2011, and two sub-periods: the vintage REIT era, 1981–1992, and the new REIT era, 1993–2011. The year 1993 is widely regarded as the point at which the REIT market experienced a structural change (Glascock, Lu, and So, 2000). This structural change has been shown to have implications on REIT risk, return predictability, and return behavior (e.g., Chiang, Lee, and Wisen, 2005; Ott, Riddiough, and Yi, 2005; Lee, Lee, and Chiang, 2008; Chiang, Jiang, and Lee, 2010). Because of the emphasis on the structural change in the literature, the discussion below focuses on the two sub-period results. The results over the entire sample period are omitted for brevity.

The OLS predictive regression results in Exhibit 2 show that REIT dividend yields are predictive of REIT dividend growth during the vintage REIT era, 1981–1992. For the all equity REIT portfolio, the OLS dividend yield coefficients are all negative; they are −0.01, −0.06, −0.24, −0.82, −1.54, and −1.58 for one-month, three-month, six-month, 12-month, 24-month, and 36-month predictive horizons, respectively. These negative signs are consistent with the mainstream present value logic that high prices relative to dividends (i.e., low dividend yields and high price-dividend ratios) today reflect optimistic expectations of future dividends. In addition, the *t*-statistics grow fast as the predictive horizon becomes longer: −7.41, −13.98, and −10.03 at the one-year, two-year, and three-year horizons, respectively. At the two-year and three-year horizons, the R^2 values are 59.88% and 43.43%, respectively. To the best of my knowledge, this is the first study to document such a strong *negative* relation between aggregate dividend yields and expected aggregate dividend growth.

For the four REIT sub-portfolios, the evidence of dividend growth predictability during the vintage REIT era is even stronger. The dividend yield coefficients of the four REIT sub-portfolios are negative and statistically significant at all predictive time horizons. Residential REITs have the highest R^2 value of 66.55% at the three-year horizon.

Given the strong dividend growth predictability over the vintage REIT era, it is interesting to note that there is virtually no evidence of dividend growth predictability during the new REIT era, 1993–2011. Exhibit 2 shows that five and 25 of the 30 dividend yield coefficients during this later sub-period are negative

Exhibit 2 | Monthly Predictive Regressions of Log Accumulated Dividend Growth Rates

	1981–1992			1993–2011			1981–2011		
T	β_d	*t*-Stat.	R^2 (%)	β_d	*t*-Stat.	R^2 (%)	β_d	*t*-Stat.	R^2 (%)
Equity REITs									
1	−0.01	−0.48	0.18	0.03	1.14	0.54	0.02	1.11	0.33
3	−0.06	−0.82	0.52	0.08	1.96**	1.59	0.05	1.82	0.89
6	−0.24	−2.45†	4.38	0.12	2.01**	1.69	0.07	1.51	0.62
12	−0.82	−7.41*	29.54	0.17	2.64*	2.96	0.02	0.50	0.07
24	−1.54	−13.98*	59.88	0.39	5.17*	10.97	0.07	1.16	0.38
36	−1.58	−10.03*	43.43	0.47	6.50*	17.11	0.09	1.31	0.51
Diversified									
1	−0.13	−2.83*	5.75	0.01	0.14	0.01	−0.02	−0.76	0.16
3	−0.27	−3.57*	8.87	0.10	2.00**	1.66	0.03	0.068	0.12
6	−0.51	−4.89*	15.41	0.13	1.62	1.11	−0.01	−0.10	0.01
12	−0.98	−7.28*	28.82	−0.01	−0.08	0.02	−0.24	−2.68*	1.95
24	−1.43	−7.31*	28.96	0.34	1.88	1.62	−0.25	−1.88	1.00
36	−1.41	−5.40*	18.20	0.12	0.54	0.14	−0.46	−2.77*	2.23
Office / Industrial									
1	−0.14	−3.44*	8.29	0.01	0.61	0.16	−0.03	−1.91	0.98
3	−0.21	−3.73*	9.59	0.07	1.73	1.24	−0.04	−1.39	0.52
6	−0.35	−4.71*	14.49	0.09	1.40	0.82	−0.09	−2.25**	1.37
12	−0.76	−8.03*	32.97	0.11	1.43	0.88	−0.28	−5.17*	6.91
24	−1.17	−8.02*	32.91	0.40	3.48*	5.30	−0.51	−5.77*	8.73
36	−0.90	−4.70*	14.42	1.65	4.84*	10.24	−0.49	−4.40*	5.45
Residential									
1	−0.07	−3.19*	7.19	0.00	0.01	0.00	−0.02	−1.45	0.57
3	−0.17	−5.19*	17.05	0.01	0.28	0.01	−0.04	−2.05**	1.12
6	−0.31	−6.63*	25.11	−0.13	−0.80	0.27	−0.09	−3.36*	2.99
12	−0.57	−8.94*	37.87	−0.17	−4.17*	7.06	−0.25	−6.73*	11.18
24	−1.08	−15.04*	63.32	−0.36	−6.70*	17.15	−0.57	−11.33*	26.94
36	−1.14	−16.14*	66.55	−0.14	−2.40**	2.73	−0.53	−10.21*	23.68
Retail									
1	−0.10	−2.43**	4.30	0.02	1.52	0.95	0.01	0.76	0.16
3	−0.28	−3.90*	10.41	0.07	2.61*	2.78	0.03	1.22	0.40
6	−0.62	−6.51*	24.42	0.12	3.05*	3.81	0.03	0.95	0.25
12	−1.04	−11.22*	49.01	0.20	4.79*	9.09	0.06	1.42	0.55
24	−1.28	−13.90*	59.63	0.50	8.96*	26.99	0.28	4.80*	6.20
36	−1.26	−8.44*	35.24	0.74	12.79*	44.38	0.50	7.23*	13.47

Note: The dependent variable is log dividend growth rate accumulated over month $t+1$ to month $t+T$, where T is 1, 3, 6, 12, 24, or 36. The independent variable is log dividend yield in month t. β_d is OLS dividend yield coefficient. The sample period is from January 1981 to December 2011.

*Significant at the 1% level.

**Significant at the 5% level.

and positive, respectively. In addition, many of these regression coefficients have a value that is virtually zero, yielding very low R^2 values. For example, the R^2 values for diversified REITs range from 0.01% to 1.66%. This lack of dividend growth predictability during the new REIT era is consistent with the evidence that the time variability in expected returns is the dominant component of stock market price variability (Cochrane, 2008). The result is also consistent with Linneman's (1997) argument that the real estate industry changed forever beginning in 1993. In terms of REIT price movements, new information about aggregate dividend growth cedes to move aggregate REIT prices.

The predictive regression results reported in Exhibit 2 are intuitive and straightforward, but plagued by inference issues. The predictor (i.e., dividend yield) is highly persistent, and this statistical property has implications on small sample inferences. Stambaugh (1999), Lewellen (2004), Torous, Valkanov, and Yan (2005), and Campbell and Yogo (2006), among many others, demonstrated that a highly persistent predictive valuation variable leads to upward-biased estimates for a one-period prediction. I use the bootstrap method to generate the distribution of the dividend yield coefficient under the null of no dividend growth predictability.

The bootstrap test results are reported in Exhibit 3. This table includes the biased OLS dividend yield coefficients that were duplicated from Exhibit 2, the bias-adjusted dividend yield coefficients, and the bootstrapped-adjusted *t*-statistics. During the vintage REIT ear, 1981–1992, the relation between dividend yields and dividend growth is negative. Consequently, the downward bootstrap adjustments generally make the bootstrap results in Exhibit 3 stronger than the OLS results in Exhibit 2. For example, the all equity REIT portfolio has statistically significant dividend yield coefficients at the 1% level starting at the six-month horizon. During the same sub-period, 28 of the 30 dividend yield coefficients in Exhibit 3 are statistically significant at the 1% level, whereas 26 of the 30 dividend yield coefficients in Exhibit 2 are statistically significant at the 1% level. Overall, the dividend growth predictability during the vintage REIT era, 1981–1992, is shown to be robust under an alternative method.

For the new REIT sub-period, 1993–2011, the bootstrap adjustments do not have material impacts on dividend growth predictive results either. The main reason for this is that the OLS log dividend yield coefficients are small in the first place. As a result, Exhibit 3 shows that 8 and 22 of the 30 dividend yield coefficients during this later sub-period are negative and positive, respectively. Most of them are not statistically different from zero. Overall, the results are very similar to those reported in Exhibit 2.

Exhibit 4 reports monthly OLS predictive regression results of log accumulated REIT excess returns. The results show that REIT dividend yields are not predictive of REIT returns during the vintage REIT era, 1981–1992. For the all equity REIT portfolio, the OLS dividend yield coefficients are all small and do not have mixed signs; they are 0.04, 0.12, 0.16, 0.05, −0.34, and −0.02 for one-month, three-

Exhibit 3 | Monthly Predictive Regressions of Log Accumulated Dividend Growth Rates with Bootstrapped Adjusted *t*-Statistics

	1981–1992			1993–2011			1981–2011		
T	β_d	Adj. β_d	*t*-Stat.	β_d	Adj. β_d	*t*-Stat.	β_d	Adj. β_d	*t*-Stat.
Equity REITs									
1	−0.01	−0.07	−1.51	0.03	0.01	0.50	0.02	0.00	0.16
3	−0.06	−0.10	−1.43	0.08	0.05	1.48	0.05	0.03	0.94
6	−0.24	−0.32	−2.97*	0.12	0.11	1.62	0.07	0.04	0.68
12	−0.82	−0.92	−6.53*	0.17	0.15	2.06**	0.02	0.00	0.15
24	−1.54	−1.58	−9.05*	0.39	0.33	2.61*	0.07	0.02	0.20
36	−1.58	−1.63	−8.06*	0.47	0.45	3.39*	0.09	0.05	0.48
Diversified									
1	−0.13	−0.24	−5.61*	0.01	−0.05	−1.43	−0.02	−0.12	−4.81*
3	−0.27	−0.32	−4.62*	0.10	0.03	0.51	0.03	0.02	0.35
6	−0.51	−0.56	−5.73*	0.13	0.04	0.54	−0.01	−0.09	−1.52
12	−0.98	−1.01	−7.86*	−0.01	−0.13	−1.24	−0.24	−0.33	−4.41*
24	−1.43	−1.44	−7.97*	0.34	0.25	1.76	−0.25	−0.32	−2.96*
36	−1.41	−1.41	−6.64*	0.12	0.03	0.17	−0.46	−0.52	−3.84*
Office / Industrial									
1	−0.14	−0.20	−6.64*	0.01	0.00	0.02	−0.03	−0.07	−4.84*
3	−0.21	−0.25	−5.26*	0.07	0.03	0.47	−0.04	−0.07	−2.50**
6	−0.35	−0.38	−6.27*	0.09	0.03	0.40	−0.09	−0.13	−3.07*
12	−0.76	−0.79	−10.26*	0.11	0.06	0.53	−0.28	−0.32	−6.28*
24	−1.17	−1.17	−10.64*	0.40	0.35	2.03**	−0.51	−0.51	−6.32*
36	−0.90	−0.91	−6.10*	1.65	0.59	2.80*	−0.49	−0.49	−4.76*
Residential									
1	−0.07	−0.09	−6.14*	0.00	−0.01	−1.01	−0.02	−0.04	−3.89*
3	−0.17	−0.18	−7.43*	0.01	−0.01	−0.43	−0.04	−0.05	−3.15*
6	−0.31	−0.33	−8.99*	−0.13	−0.04	−1.30	−0.09	−0.12	−4.54*
12	−0.57	−0.59	−11.78*	−0.17	−0.20	−5.09*	−0.25	−0.28	−8.57*
24	−1.08	−1.09	−19.20*	−0.36	−0.38	−6.00*	−0.57	−0.59	−13.55*
36	−1.14	−1.14	−20.99*	−0.14	−0.14	−1.53	−0.53	−0.54	−11.62*
Retail									
1	−0.10	−0.15	−3.90*	0.02	0.02	0.77	0.01	−0.00	−0.08
3	−0.28	−0.32	−4.54*	0.07	0.06	1.34	0.03	0.02	0.66
6	−0.62	−0.68	−7.03*	0.12	0.10	1.59	0.03	0.01	0.35
12	−1.04	−1.11	−9.59*	0.20	0.18	2.48**	0.06	0.03	0.78
24	−1.28	−1.31	−10.85*	0.50	0.45	3.91*	0.28	0.26	4.10*
36	−1.26	−1.29	−8.80*	0.74	0.71	5.74*	0.50	0.49	6.37*

Notes: The dependent variable is log dividend growth rate accumulated over month $t+1$ to month $t+T$, where T is 1, 3, 6, 12, 24, or 36. The independent variable is log dividend yield in month t. β_d is OLS dividend yield coefficient. Adj. β_d is bias-adjusted bootstrapped dividend yield coefficient. The *t*-statistics are obtained from bootstraps. The sample period is from January 1981 to December 2011.

*Significant at the 1% level.

**Significant at the 5% level.

Exhibit 4 | Monthly Predictive Regressions of Log Accumulated Excess Returns

	1981–1992			1993–2011			1981–2011		
T	β_r	t-Stat.	R^2 (%)	β_r	t-Stat.	R^2 (%)	β_r	t-Stat.	R^2 (%)
Equity REITs									
1	0.04	1.29	1.25	0.04	2.06†	1.74	0.03	1.71	0.78
3	0.12	1.96**	2.85	0.12	3.27*	4.30	0.07	2.72*	1.96
6	0.16	1.85	2.54	0.29	4.91*	9.30	0.16	3.82*	3.82
12	0.05	0.46	0.16	0.58	7.55*	19.94	0.30	5.15*	6.85
24	−0.34	−2.24**	3.69	1.12	10.77*	34.83	0.56	6.77*	11.63
36	−0.02	−0.09	0.00	1.11	10.12*	33.32	0.57	6.51*	11.19
Diversified									
1	−0.02	−0.61	0.29	0.06	2.64*	2.82	0.03	1.80	0.86
3	−0.00	−0.03	0.00	0.17	4.04*	6.42	0.09	2.77*	2.04
6	0.09	0.85	0.54	0.34	4.81*	8.96	0.20	3.54*	3.30
12	0.16	1.02	0.79	0.59	5.42*	11.36	0.31	3.59*	3.46
24	−0.14	−0.64	0.31	1.33	8.07*	23.10	0.57	4.27*	4.96
36	0.43	1.57	1.84	1.09	5.78*	14.03	0.54	3.47*	3.46
Office / Industrial									
1	−0.02	−0.80	0.48	0.04	1.73	1.24	0.00	0.01	0.00
3	−0.04	−0.83	0.53	0.11	2.85*	3.31	0.00	0.10	0.00
6	−0.05	−0.80	0.48	0.23	3.81*	5.81	0.01	0.35	0.01
12	−0.04	−0.45	0.15	0.58	6.96*	17.46	0.08	1.27	0.45
24	0.32	2.04†	3.07	1.37	12.55*	42.04	0.35	3.58*	3.55
36	0.70	3.70*	9.44	1.34	11.06*	37.35	0.31	2.68*	2.69
Residential									
1	0.01	0.58	0.26	0.02	1.18	0.57	0.01	0.74	0.15
3	0.03	1.26	1.20	0.06	2.65*	2.87	0.03	1.91	0.98
6	0.05	1.31	1.29	0.17	4.59*	8.21	0.07	3.05*	2.48
12	0.02	0.46	0.16	0.47	9.61*	28.76	0.18	4.99*	6.47
24	−0.10	−1.51	1.71	0.93	15.46*	52.42	0.30	5.95*	9.23
36	0.07	0.85	0.55	0.62	8.53*	26.18	0.21	3.99*	4.53
Retail									
1	0.00	0.04	0.00	0.03	1.64	1.10	0.02	1.60	0.68
3	0.01	0.16	0.01	0.09	2.89*	3.38	0.07	2.87*	2.19
6	−0.04	−0.58	0.25	0.20	4.32*	7.36	0.16	4.16*	4.51
12	−0.14	−1.37	1.41	0.48	7.39*	19.27	0.37	7.00*	11.97
24	−0.13	−1.00	0.76	1.04	11.23*	36.74	0.84	11.01*	25.84
36	−0.04	−0.28	0.04	1.14	10.98*	37.02	0.95	11.09*	26.78

Notes: The dependent variable is log excess return accumulated over month $t + 1$ to month $t + T$, where T is 1, 3, 6, 12, 24, or 36. The independent variable is log dividend yield in month t. β_r is OLS dividend yield coefficient. The sample period is from January 1981 to December 2011.

*Significant at the 1% level.

**Significant at the 5% level.

month, six-month, 12-month, 24-month, and 36-month predictive horizons, respectively. The *t*-statistics are rather small; none of them is statistically significant at the 1% level. The highest R^2 occurs at the two-year horizon, but has a value of only 3.69%. For the four REIT property-type sub-portfolios, two of the 24 dividend yield coefficients are positively, statistically significant at the 1% level or the 5% level. Overall, the well-documented positive predictive relation from log dividend yields to log excess returns in the financial economics literature is absent for the sample of equity REITs during the vintage 1981–1992 period.

On the other hand, over the new REIT era, 1993–2011, Exhibit 4 shows that a strong, positive predictive relation from dividend yields to REIT returns emerges. The slope coefficients for all equity REITs are 0.04, 0.12, 0.29, 0.58, 1.12, and 1.11 for one-month, three-month, six-month, 12-month, 24-month, and 36-month predictive horizons, respectively. Most of these positive coefficients are statistically significant at the 1% level. In addition, the R^2 value reaches 34.83% at the two-year horizon. Similarly, during the new REIT era, the positive predictive relation from log dividend yields to log excess returns is documented at long horizons for all property type sub-portfolios. Specifically, for the four REIT property type sub-portfolios, 21 of the 24 dividend yield coefficients are positively, statistically significant at the 1% level. Overall, the test results over the new REIT era, 1993–2011, are in line with those documented in the financial economics literature that focuses on stock prices. That is, new information about future expected returns/discount rates appears to move aggregate prices during the new REIT era. The results also support Linneman's (1997) argument that capital markets, whose integration drives discount rates in various markets, play an increasingly important role in real estate investing.

As mentioned earlier, the predictive OLS regressions have a persistent regressor. Again, the bootstrap method is used to address the difficulty of small sample inferences. The bootstrap results are reported in Exhibit 5. In general, the bootstrap results in Exhibit 5 are qualitatively similar to those reported in Exhibit 4. Specifically, some coefficients become smaller, but not by much. As a result, their statistical significances mostly remain at the same level.

Further Check

The existing predictive evidence from dividend yields is mostly obtained using monthly regressions. For completeness, I repeat earlier analyses for bi-annual and annual horizons. For brevity, I do not report the results as they are qualitatively similar.

In addition to the usual OLS regression specifications in Equations (2) and (3), the dynamic Gordon model in Equation (1) has also been extensively examined in a VAR framework.[9] I adopt the classical three-variable VAR specification of Campbell (1991). The VAR results are largely in line with the baseline results reported earlier. For brevity, the VAR results are not reported; they are available upon request.

Exhibit 5 | Monthly Predictive Regressions of Log Accumulated Excess Returns with Bootstrapped Adjusted *t*-Statistics

	1981–1992			1993–2011			1981–2011		
T	β_r	Adj. β_r	*t*-Stat.	β_r	Adj. β_r	*t*-Stat.	β_r	Adj. β_r	*t*-Stat.
Equity REITs									
1	0.04	0.03	1.04	0.04	0.04	2.05**	0.03	0.03	1.59
3	0.12	0.11	1.63	0.12	0.11	3.33*	0.07	0.07	2.57*
6	0.16	0.14	1.47	0.29	0.29	4.39*	0.16	0.16	3.17*
12	0.05	0.00	0.01	0.58	0.58	6.49*	0.30	0.30	4.15*
24	−0.34	−0.37	−2.20**	1.12	1.06	5.87*	0.56	0.52	4.32*
36	−0.02	−0.04	−0.24	1.11	1.04	5.16*	0.57	0.53	3.69*
Diversified									
1	−0.02	−0.03	−0.87	0.06	0.06	2.46**	0.03	0.03	1.62
3	−0.00	−0.00	−0.02	0.17	0.15	3.69*	0.09	0.09	2.52**
6	0.09	0.09	1.11	0.34	0.30	4.63*	0.20	0.18	3.41*
12	0.16	0.15	1.12	0.59	0.54	5.87*	0.31	0.28	3.84*
24	−0.14	−0.14	−0.70	1.33	1.23	9.17*	0.57	0.51	4.78*
36	0.43	0.43	2.05**	1.09	0.98	6.64*	0.54	0.47	3.89*
Office / Industrial									
1	−0.02	−0.02	−1.07	0.04	0.04	1.62	0.00	0.00	0.11
3	−0.04	−0.04	−0.98	0.11	0.10	1.93	0.00	0.00	0.17
6	−0.05	−0.05	−1.00	0.23	0.23	2.73*	0.01	0.01	0.46
12	−0.04	−0.04	−0.47	0.58	0.57	5.35*	0.08	0.08	1.58
24	0.32	0.32	3.12*	1.37	1.31	7.31*	0.35	0.34	3.83*
36	0.70	0.69	5.21*	1.34	1.24	6.46*	0.31	0.31	2.86*
Residential									
1	0.01	0.01	0.58	0.02	0.01	0.14	0.01	0.01	0.67
3	0.03	0.03	1.55	0.06	0.06	2.77*	0.03	0.03	2.11**
6	0.05	0.04	1.52	0.17	0.17	4.53*	0.07	0.07	3.21*
12	0.02	0.02	0.50	0.47	0.46	8.92*	0.18	0.18	5.55*
24	−0.10	−0.09	−1.80	0.93	0.90	10.72*	0.30	0.29	6.53*
36	0.07	0.07	1.13	0.62	0.57	6.44*	0.21	0.20	4.21*
Retail									
1	0.00	−0.00	−0.13	0.03	0.03	1.14	0.02	0.02	1.54
3	0.01	0.00	0.01	0.09	0.09	2.00†	0.07	0.07	2.89*
6	−0.04	−0.06	−0.83	0.20	0.20	3.01*	0.16	0.16	4.11*
12	−0.14	−0.16	−1.71	0.48	0.47	4.54*	0.37	0.37	6.88*
24	−0.13	−0.16	−1.46	1.04	0.97	5.12*	0.84	0.81	9.48*
36	−0.04	−0.08	−0.61	1.14	1.08	4.93*	0.95	0.92	9.57*

Note: The dependent variable is log excess return accumulated over month $t + 1$ to month $t + T$, where T is 1, 3, 6, 12, 24, or 36. The independent variable is log dividend yield in month t. β_r is OLS dividend yield coefficient. Adj. β_r is bias-adjusted bootstrapped dividend yield coefficient. The reported *t*-statistics are obtained from bootstraps. The sample period is from January 1981 to December 2011.

*Significant at the 1% level.

**Significant at the 5% level.

Conclusion

What moves REIT prices? Employing dividend pricing models, researchers suggest that REIT prices move in response to the revisions in expectations about subsequent real estate price movements and/or the revisions in expectations about subsequent cash flows. Today, there is sufficient evidence to suggest that the real estate industry has grown and matured substantially since early 1990s. Does this industrial evolution have any impact on REIT price behavior? I find that the relative importance of new information about dividend growth rates and discount rates in explaining current aggregate REIT prices evolves over time as capital markets infuse progressively more impact on the real estate industry. Specifically, the findings show that REIT dividend yields reflect new information about REIT dividend growth during the vintage REIT era, 1980–1992. This predictability, nevertheless, disappears during the new REIT era, 1993–2011. Meanwhile, although there does not seem to be a relation between current REIT prices and future REIT returns over the vintage REIT era, a positive predictive relation from dividend yields to REIT returns emerges after 1993.

Endnotes

[1] See Cochrane (2008) for a review of the debate.

[2] The concepts of vintage and new REIT eras are discussed in Downs and Patterson (2005). Before 1992, REITs were mostly small cap because of limited participation by institutional investors. After 1993, the rapid growth of the REIT industry has been characterized by continuous infusion of institutional capital.

[3] Cash flows are often higher than taxable incomes because the depreciation of real properties is a non-cash item.

[4] Cabrera, Wang, and Yang (2011) provide a literature review on securitized real estate return predictability.

[5] A similar regression design can be found in Tidwell, Ziobrowski, Gallimore, and Ro (2013). The authors use credit rating changes as the regressor to demonstrate the informational content of credit ratings on subsequent REIT returns.

[6] Welch and Goyal (2008) used bootstrap estimators, whereas Nelson and Kim (1993) and Plazzi, Torous, and Valkanov (2010) used randomization estimators. The difference between randomization and bootstrap is that the former re-samples the data without replacement, whereas the latter re-samples the data with replacement. This study also experiments with the randomization method. The unreported results are qualitatively similar.

[7] I also experiment with an alternative definition of annual dividend yields, $\delta_t \equiv \Sigma_{l=0}^{11} \log(D_{t-l})/P_t$. The unreported results are qualitatively similar.

[8] I also experiment with deflating log dividend growth rates by the CPI from the *2012 SBBI*. The unreported results are generally slightly stronger than the reported results.

[9] The VAR approach has its own limitations. The VAR assumes stationarity of the regressor, but dividend yields are known to be highly persistent (Fama and French, 1988;

Campbell and Shiller, 1988b; Hodrick, 1992; and many others). The VAR approach also often fails to model news about cash flows and treats the news as the residual (Chen and Zhao, 2009).

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