INTERNATIONAL REAL ESTATE REVIEW

2023 Vol. 26 No. 1: pp. 43 – 71

Anomalies in U.S. REIT Returns: Evidence for and against the Q-theory

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Among the well-known asset pricing anomalies in U.S. common stocks (i.e. size, value, momentum, investment, and profitability), only investment and momentum premiums are significant in the REIT industry. According to the q-theory, the investment effect turns significant because REIT firms tend to expand (extract) their assets when discount rates are low (high), thereby investment has statistical power to explain for REIT returns. Even though the insignificant effect of probability in REITs challenges the explanation of the q-theory, we provide evidence that profitability, in fact, controls the momentum. Our results indicate market inefficiency as investors who have a better understanding of the significant investment and momentum premiums perform better than others.

Keywords

Asset Pricing, Q-Theory of Investment, REITs, Cross Section of Expected Returns, Market Efficiency

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1. Introduction

The cross-section of expected return predictability, anomalous premiums, and factor models have been examined extensively in the asset pricing literature, especially on the returns of U.S. common stocks. Recently, the *q*-theory of investment (e.g. Xing 2008, Liu et al., 2009, Hou et al. 2015, and Zhang 2017) suggests an investment-based approach for a new capital asset pricing model. Using the *q*-theory of Tobin (1969) and Cochrane (1991), the first order condition for the maximization of firm value yields

$$r_{i_0} \propto \frac{\pi_{i_1}}{\lambda_i\left(I_{i_0} / K_{i_0}\right)} \tag{1}$$

where for firm i at time 0, Ii0/Ki0 (proxied by investment-to-asset, I/A) is investment scaled by capital. Therefore, the q-theory predicts that for a given expected profitability πi1 (proxied by return on equity (ROE)) and investment cost parameter λi, the expected return, ri1, is negatively related to scaled investments, and holding scaled investments constant, the expected return is positively related to profitability. 1 The mechanisms behind the q-theory of investment is the concept of capital budgeting. Investment explains for expected returns because, given the expected profitability, the high (low) costs of capital imply the low (high) net present value of new capital so firms have low (high) investment. Profitability explains for expected returns because, fixation for a low (high) level of investment, high (low) expected profitability drives high (low) discount rates. If the discount rates are not sufficiently high (low), firms would otherwise have high (low) net present values of new capital and thereby invest more (less). Zhang (2017) discusses the q-theory in detail with comprehensive evidence and concludes that most anomalies in U.S. common stocks turn out to be different manifestations of investment and profitability premiums. In terms of factor models, the *q*-theory suggests a new class of factor model with factors that capture investment and profitability. The *q*-theory factors are consistent with those in Fama and French (2006, 2008, 2015, 2017, and 2018), in which investment and profitability are naturally

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[1] The behavioral-asset pricing literature argues that the investment and profitability effects are due to mispricing. Cooper et al. (2008) suggest that extrapolative investors overreact to corporate asset expansion and hence overvalue high investment firms. Extrapolative investors also overreact to corporate asset contraction and hence undervalue low investment firms. As the mispricing is subsequently resolved, the future stock returns on high investment firms are low and vice versa. This mechanism produces the investment effect. Wang and Yu (2013) suggest that conservative investors underreact to implicit good news associated with high profitability; hence they undervalue high profitability firms. Conservative investors also underreact to implicit bad news associated with low profitability; hence they overvalue low profitability firms. As the mispricing is subsequently corrected, future stock returns on high profitability firms are high and vice versa. This mechanism produces the profitability effect.

embedded in stock returns via the general form of a discount cash-flow valuation model.

Moreover, Li and Zhang (2010) differentiate the absolute value of the slope of investment-to-asset to discount rate with respect to the investment cost parameter. The outcome of their study shows that investment is less sensitive to discount rate with higher investment cost. Holding profitability constant, a given reduction in discount rate is associated with a smaller increase in investment when investment costs are higher. In other words, the negative relation between investment and expected return is stronger when investment costs are higher. In the q-theory, firms with higher investment costs face more investment frictions than firms with lower investment costs. The investment frictions are identified by using firm-level financial constraints. It is logically proxied that firms with a small asset size are financially constrained than those with a large asset size.[2] The former are usually less mature and unfamiliar to investors as opposed to the latter. Li and Zhang (2010) empirically show that the Fama-MacBeth slopes of investment-to-assets are larger in size in the more constrained subsample of firms with a small asset size than in the less constrained subsample of firms with a large asset size. Zhang (2017) also explains that the q-theory can be related to price (i.e. return) momentum anomaly via a profitability channel. The logic is driven by earnings momentum. That is, stocks that have recently experienced positive (negative) shocks to profitability are likely to be more (less) profitable. Earnings momentum drives price momentum in two ways, through: (1) the profitability effect (i.e. profitability explaining for expected returns) and (2) shocks to earnings that are positively correlated with stock returns contemporaneously (i.e. profitability explaining for current returns). Both cause earnings momentum winners to earn higher expected returns than earnings momentum losers. Therefore, profitability provides a rational explanation for price momentum.

Real estate investment trusts (REITs) are an important alternative investment class that provides investors with a convenient, liquid, and diversified way to invest in real property (Ling et al., 2018). The total U.S. real estate value in 2011 was US$25 trillion (Ghysels et al., 2012). However, the large number of studies in the literature on asset pricing have excluded the REIT and other financial industries. In general, asset pricing studies investigate and identify the variables that could induce returns on financial assets. The financial assets could be common stocks and previous work shows that variables such as size, book-to-market, and momentum empirically drive stock returns. Therefore,

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[2] Since studies on REITs have a fewer number of firm-level observations than those in common stocks, we instrument asset size as a proxy for investment frictions since asset size is a predominant variable in terms of the number of observations.

researchers have come up with the factors, which are return premiums, generated by these variables. Papers that specifically analyze stock returns use factors created for general stocks (i.e., ordinary common equity with security type 10 or 11 as per the Center for Research in Security Prices (CRSP) and this approach is consistent with Fama and French (1992). More importantly, REITs and financial firms are not part of the sample because of the different structure of their financial statements. This leads to the niche and contribution of our paper. Our paper investigates and identifies the specific variables under a REIT sample that could drive REIT returns. Then, we come up with REIT-specific factors, which might not be the same as factors constructed from the variables that drive common stock returns. It is worth noting that the process of using a REIT sample to construct REIT-specific factors based on common methods has been done in well-known studies such as Chui et al. (2003a, 2003b), Hartzell et al. (2010), and Cici et al. (2011).

In this study, we examine the cross-sectional return predictability within the contexts of the q-theory of investment for REITs. We follow the spirit of Fama and French (2018) by focusing on five major factors of their six-factor model. Namely, other than the market risk premium factor, the premiums of size, value, momentum, investment, and profitability are shortlisted as potential factors in asset pricing models. Size and value are unanimously well-known factors originally used in Fama and French (1993). Momentum is also a well-documented factor used in the models in Carhart (1997) on top of size and value. In the real estate literature, Ro and Ziobrowski (2011) apply four of these factors in their study on REITs. Fama (2014) concluded that momentum is the most prominent anomaly and the biggest challenge to market efficiency in his view. Moreover, many studies including Chui et al. (2003a, 2003b), Hung and Glascock (2008), Derwall et al. (2009), Hung and Glascock (2010), Goebel et al. (2013) and Feng et al. (2014) show that momentum is prevalent in a REIT sample. The last two factors, investment and profitability, are augmented into the Fama and French (1993) (FF) three-factor model to become the five-factor model in Fama and French (2015). The five-factor model has been tested internationally in Fama and French (2017). Investment and profitability effects have also been investigated separately by many studies. Papers that are related to the investment effect include Titman et al. (2004), Polk and Sapienza (2009), Cooper and Priestley (2011), Allen et al. (2013), Titman et al. (2013), Mao and Wei (2016), etc. Papers that are related to the profitability effect include Novy-Marx (2013) and Ball et al. (2015).

Our original motivation for this paper is based on the belief that the REIT industry needs its own asset pricing factors that are constructed by using REIT-only samples, see Hartzell et al. (2010) and Cici et al. (2011) and Zhang and Hansz (2022). One of the unique characteristics of the REIT industry is that it has a relatively low growth-opportunity and high asset-in-place components. Namely, the REIT industry has few intangible assets. If researchers use Fama-French factors, which are constructed from broader samples including, for example, tech companies, the factors should not be generalized for use in REIT analyses among REIT firms, especially when it comes to risk analyses where the required rates of return or costs of capital are determined by these factors. Moreover, those who use these factors to identify the characteristics of REIT firms within the REIT industry, for example, growth or value characteristics, might be misled by the regression coefficients that are from inappropriate regressors. Another unique characteristic of the REIT industry is that its asset expansion (i.e. investment) logically depends on interest rates. Therefore, the REIT industry is a perfect candidate for capital asset pricing tests in general and the q-theory in particular.

The findings from this research work contribute to the related literature in that even though we have five major anomaly variables (i.e. size, book-to-market, momentum, investment, and profitability) in general asset pricing, researchers now have empirical results in supporting them to focus more on the significant variables and pay less attention to the insignificant ones. Understanding the significant variables will improve the accuracy of REIT return forecasts and pricing REITs (Aguilar et al., 2018). Likewise, from the standpoint of a practitioner, financial analysts for the REIT industry have fewer variables for their screener, and fund managers could come up with more appropriate long/short strategies to form their portfolios. Moreover, they have appropriate discount rates for their financial modelling that come from the REIT sample.

Among the well-known common stock-based anomalies in asset pricing (i.e. size, value, momentum, investment, and profitability), we find that only investment and momentum premiums are statistically significant. In addition, we find that the momentum (investment) premium is strong in the value- (equally-) weighted approach. Both momentum and investment premiums outperform the FF 3-factor model that was created from a REIT sample with statistically significant positive alphas. In the cross-sectional regressions in Fama and Macbeth (1973), the proxy variables of prior-year return and investment-to-assets do not subsume each other in predicting returns. We also find that the investment effect is not statistically sensitive to the change in investment friction of the asset size proxy. Even though the profitability effect is not significant after we conduct an extensive investigation, we find that the momentum effect is linked to profitability. Specifically, when we include the product between the prior return and ROE dummy, the product is essentially the momentum that is conditioned at the levels of the ROE, and subsumes the unconditioned momentum. Furthermore, in the time series regression of momentum on the ROE factor, the factor coefficient is significant, with more than 14 to 18 standard errors from zero, in explaining the momentum under value- and equally-weighted measures, respectively.

The paper closest to ours is Bond and Xue (2017) who investigate in general, the presence of investment and profitability effects in the REIT sector. Ours is different in that we additionally focus on the mechanics of how the statistically significant anomalies in REITs work under the q-theory rational explanation, namely, how increase in assets (i.e. investments in the REIT industry) is sensitive to interest rates, and how the momentum can be logically linked to ROE under the q-theory. This requires Fama-MacBeth cross-sectional regressions in order to investigate how REIT returns, at the firm-level, are driven since the rational q-theory is, in fact, derived under a firm-level setting as shown in Equation (1). This approach is important since portfolio analyses can only show the results at the aggregate level but not the interaction of two variables at the firm level. Moreover, as opposed to using quintile portfolios to construct factor premiums as seen in Bond and Xue (2017), we incorporate the critique in Fama and French (2015) that the traditional definition of constructing premiums with the use of percentiles such as the 30th and 70th percentiles eliminates 40% of the useable sample so using median breakpoint constructs better diversifies portfolios and consequently provides more observations in each portfolio. Using medians is more appropriate for such a study like this paper because its sample is naturally smaller in size than the U.S. common stock sample. Using the median means that some early-year data can be larger so it allows us to have a longer time span of data to the earliest year of 1973. Additionally, while Bond and Xue (2017) use the latest data in 2013, ours is a more recent study which takes the latest year to 2017.

The rest of this study is organized as follows. In the next section, we discuss the variable definitions, sample selection procedures, and methodologies. In Section 3, we report the REIT return premiums and their relation. Section 4 shows the cross-sectional Fama-MacBeth regression results, the results of isolated investment and momentum premiums, and a discussion on how investment and momentum premiums explain for each other. Section 5 investigates whether the investment effect is governed by investment frictions. Section 6 shows how momentum premium can be explained at the level of the profitability proxy. Section 7 discusses and concludes the outcomes of the study.

2. Variable Definitions, Sample Selection Procedures, and Methodologies

The dataset used in this study involves REIT firms traded on the New York Stock Exchange (NYSE), American Stock Exchange (AMEX), and NASDAQ. We obtain the REIT price, shares outstanding, and return data from the monthly master files maintained by the CRSP and quarterly and annual financial statement data from the North American Compustat files. [3] We eliminate survival bias by requiring firms to have two years of CRSP data. Proper adjustments for delisted firms are used as suggested by Shumway (1997). To ensure that accounting information is known sufficiently in advance of returns,

[3] Risk-free rates are the one-month Treasury bill rates from Kenneth French's website.

we follow Fama and French (1992) by matching returns for the period between July of year *t* to June of year *t*+1 to the annual accounting data of a firm for the fiscal year ending in calendar year *t*-1. All characteristic (i.e. explanatory) variables in this study are updated annually except prior year returns and returns on equity which are updated monthly and quarterly, respectively. After merging, the CRSP and Compustat data in this study span from July 1973 to December 2017.[4]

Table 1 reports the summary statistics and correlations of the underlying variables: investment-to-assets (*I/A*), prior-year return (*PRYR*), firm size (*SZ*), book-to-market equity (*BM*), and return on equity (*ROE*). Investment-to-assets (*I/A*) is percentage of change in total assets at the end of fiscal year $t - 1$ relative to the total assets at the end of fiscal year $t - 2$. *PRYR* is the continuous cumulative and compounded REIT return from month *t*-12 to month *t*-2, where *t* is the month of the forecasted return. *SZ* is market capitalization (price times shares outstanding, in millions) at the end of June. *BM* is the ratio of the book-to-market equity which is the ratio of the book equity for the fiscal year ending in $t-1$ to market equity at the end of December in $t-1$. *ROE* is the ROE from month *t*-4, and calculated from quarterly earnings divided by one-quarter-lagged assets. *I/A*, *SZ*, and *BM* are calculated annually. *PRYR* and *ROE* are calculated monthly and quarterly, respectively.

We construct premiums (i.e. factors) by using medians as the breakpoints. We follow the same procedure as commonly found in the traditional asset pricing literature with the use of non-univariate sorting. However, the REIT sample size does not allow us to complete the procedure since we find that some portfolios do not contain sufficient observations. Fama and French (2015) suggest that the traditional definition of constructing premiums using the 30th and 70th percentiles eliminates 40% of the useable sample, so using median breakpoints as in our paper constructs better diversified portfolios. Using medians is more appropriate for REIT samples that are naturally smaller in size than U.S. common stock datasets. Investment premium, denoted as L-H I/A, uses two portfolios sorted by investment-to-assets. In June of each year *t*, we sort the REITs based on the median into two groups by *I/A* for the fiscal year ending in calendar year *t*-1. L-H I/A is the monthly difference between the returns on the low- and high- *I/A* portfolios. We measure *I/A* (e.g. Hou et al. 2015) as a change in percentage of total assets (COMPUSTAT item AT) at the end of fiscal year *t*-1 relative to the total assets at the end of fiscal year *t*-2. Similarly, the ROE premium, H-L ROE, uses two portfolios sorted by the ROE. ROE is income before extraordinary items (COMPUSTAT item IBQ) divided by 1-quarter-lagged book equity (e.g. Hou et al. 2015). Quarterly book equity is the equity of the shareholders, plus balance sheet deferred taxes and investment tax credit (item TXDITCQ) if available, minus the book value of preferred stock (item

[4] July 1973 is the earliest observation in this study due to the analyses that need a sufficient sample size in each particular portfolio over the entire time period.

PSTKQ). Depending on availability, we use stockholder equity (item SEQQ), or common equity (item CEQQ) plus the book value of preferred stock, or total assets (item ATQ) minus total liabilities (item LTQ) in that order as shareholder equity. Negative quarterly book equity values are dropped. At the beginning of each month *t*, we categorize all REITs into two groups based on the median breakpoints of the quarterly ROE for the fiscal quarter ending at least four months ago. Subsequently, we calculate the portfolio returns for month *t* and rebalance the portfolios in month *t*+1. H-L ROE is the monthly difference between the returns on the high-ROE and low-ROE portfolios. For the SZ premium, we sort all REITs at the end of June of each year *t* into two groups of market equity based on the median size. For BM premiums, we sort REITs into two groups by book-to-market equity for the last fiscal year ending in calendar year *t*-1. We calculate the returns on the portfolios from July of year *t* to June of *t*+1, and rebalance the portfolios in June of *t*+1. The BM premium, H-L BM, is the monthly difference between the returns on the high-BM and low-BM portfolios. We create the SZ premium, S-B SZ, as the return difference between small and large portfolios. Annual book equity is the difference between assets (COMPUSTAT item AT) and liabilities (item LT), plus balance sheet deferred taxes (item TXDB if available) and investment tax credits (item ITCI if available), minus the book value of preferred stock if available. Depending on data availability, we use liquidation (item PSTKL), redemption (item PSTKRV), or preferred stock at carrying value (item UPSTK), in this order, to represent the book value of preferred stock. Negative annual book equity values are dropped. Book-to-market equity is the ratio of book equity for fiscal year *t*-1 to market equity at the end of December year *t*-1. For firms with more than one share class, we merge the market equity for all share classes before calculating the BM.

The last premium is momentum, denoted as H-L PRYR. At the beginning of each month *t*, we categorize all REITs into two groups based on prior returns for months *t* -12 to *t* -2 and calculate the portfolio returns for month *t*. We rebalance the portfolios in month *t*+1. H-L PRYR is the monthly difference between the returns on the high and low prior returns. In each month, we calculate the value-weighted portfolio returns for any premiums by using firm size from the previous month as the proportions while equally-weighted portfolio returns use the same proportion as the weights.[5]

Table 1 reports the summary statistics and characteristics of the explanatory variables used in this study. Panel A of Table 1 shows the variation in the explanatory variables. Panel B shows that the pairwise correlations are quite small, which range from -0.119 (*BM* vs. *SZ*) to 0.065 (*BM* vs. *I/A*). Panel C shows, through both the means and medians, that a low *I/A* portfolio has a higher *BM* and lower *ROE* than a high *I/A* portfolio. Panel D indicates through

[5] We calculate market risk premium for the Fama-French (1993) 3-factor model regression by using excess REIT market returns calculated based on all of the observations of the REIT firms in this study.

both the means and medians, that a high *PRYR* portfolio has a higher *SZ*, higher *BM*, and higher *ROE* than a low *PRYR* portfolio.

Table 1 Descriptive Statistics

This table reports the characteristics of explanatory variables that are merged with REIT returns. The merged data are from July 1973 to December 2017. Investment-to-assets (I/A) is the rate of growth of total assets for the fiscal year ending in calendar year t−1 relative to the fiscal year ending in calendar year t−2. Prior return (PRYR) is the compounded monthly raw return, b the latest month, over the previous year. Other variables include the market value of equity (SZ) (×103), book-to-market equity (BM), and return on equity (ROE). Panel A presents the mean, standard deviation, minimum and maximum values. Panel B reports the pair-wise correlation coefficients. The numbers in parentheses are the p-values. Panel C (D) presents the means and medians of the characteristics for I/A (PRYR) sorted (i.e. lower (Low) and higher (High) than median) quantile portfolios. For each portfolio and in each month, the mean and median are calculated across REITs. The mean and median shown below are the time-series averages calculated over all months.

Panel A: Summary Statistics				
	Mean	Std Dev	Min	Max
I/A	0.280	3.169	-0.943	152.234
PRYR	0.109	0.359	-0.991	6.744
SZ	1,253.3	3,476.1	0.1	67,100.0
BM	1.206	2.031	0.002	67.719
ROE	0.950	142.741	-7.594	21884.000

Panel B: Correlation				
	I/A	*PRYR*	*SZ*	*BM*
PRYR	-0.034			
	(0.000)			
SZ	0.004	0.011		
	(0.348)	(0.002)		
BM	0.065	0.005	-0.119	
	(0.000)	(0.206)	(0.000)	
ROE	0.003	0.053	0.009	-0.054
	(0.512)	(0.000)	(0.024)	(0.000)

Panel C: Characteristics of *I/A* portfolios					
	I/A	*PRYR*	*SZ*	*BM*	*ROE*
Mean:					
Low *I/A*	-0.053	0.111	1,111.2	1.550	0.006
High *I/A*	0.523	0.102	1,086.8	1.164	0.023
Median:					
Low *I/A*	-0.021	0.092	513.3	1.163	0.013
High *I/A*	0.221	0.094	559.1	0.939	0.020

Panel D: Characteristics of *PRYR* portfolios					
	I/A	*PRYR*	*SZ*	*BM*	*ROE*
Mean:					
High *PRYR*	0.197	0.307	1,127.9	1.229	0.027
Low *PRYR*	0.252	-0.088	933.0	1.467	0.005
Median:					
High *PRYR*	0.068	0.241	558.8	0.983	0.021
Low *PRYR*	0.068	-0.049	451.4	1.167	0.010

3. Premiums and Their Relation

Panel A of Table 2 presents insignificant return premiums (i.e. factors) of all explanatory variables. Size premium (S-B SZ), value premium (H-L BM), and profitability premium (H-L ROE) are not statistically different from zero regardless whether the value- or equally-weighted approach is used. An insignificant S-B SZ is consistent with the findings for the U.S. common stocks such as in Fama and French (1996) and Vassalou and Xing (2004). We will discuss about the insignificant H-L ROE, which seems inconsistent with the q-theory results for U.S. common stocks, in Section 8. Panel B reports significant return premiums which are investment (L-H I/A) and momentum (H-L PRYR) premiums. L-H I/A is 0.208% (0.294%) per month with a t-stat of 2.06 (2.37) under the value- (equally-) weighted approach. Higher premiums in the equally-weighted approach than in the value-weighted approach mean small REITs play an important role in the premiums. This is consistent with the investment effect in the common stock-based asset pricing literature that document that the investment effect is pronounced in small stocks (see for e.g. Cooper et al., 2008). H-L PRYR is 0.623% (0.393%) for each month with a t-stat of 3.39 (2.14) under the value- (equally-) weighted approach. A higher premium in the value-weighted approach than in the equally-weighted approach means that the momentum effect is more pronounced in large REITs. This finding is consistent with those in Chui et al. (2003a and 2003b) who find evidence of a momentum effect in their REIT sample. Both L-H I/A and H-L PRYR also have significant abnormal returns under the Fama-French (1993) 3-factor model. Specifically, L-H I/A has an alpha of 0.231% (0.226%) for each month with a t-stat of 2.32 (2.06) under the value- (equally-) weighted approach. H-L PRYR has an alpha of 0.796% (0.655%) for each month with a t-stat of 5.13 (5.07) under the value- (equally-) weighted approach. Panel B also shows that momentum is exaggerated by the FF 3-factor model. Specifically, momentum loads negatively on market risk premium and value factor at a large magnitude. This is the case for both the value- and equally-weighted approaches. The negative loading on market risk premium and value factor lowers the expected return for momentum, which, in turn, increases the intercept estimate.

Panel C reports the correlation coefficients for the premiums. Consistent with the significant FF factor loadings in Panel A, H-L BM is positively correlated with L-H I/A and negatively correlated with H-L PRYR under the value-weighted measurement. S-B SZ is positively correlated with L-H I/A and H-L BM is negatively correlated with H-L PRYR under the equally-weighted measurement. We will discuss about the positive relation between H-L PRYR and H-L ROE in Section 8.

Table 2 Return Premiums in REITs

Panel A presents the insignificant return premiums (i.e. differences) of all of the explanatory variables in Table 1 using median breakpoints. VW (EW) refers to value-weighted (equally-weighted) portfolio raw returns. Panel B presents the significant return premiums so it includes portfolio abnormal (Intercept) returns and factors coefficients (b for market risk premium, s for size premium, and h for value premium) calculated by using the Fama-French (1993) model. Panel C reports the pair-wise correlation coefficients of the premiums. The numbers in parentheses are the p-values.

Panel A: Insignificant Premiums								
	VW	EW		VW	EW		VW	EW
Small SZ	0.913	1.115	High BM	0.859	1.092	High ROE	0.883	0.929
t-stat	3.64	4.13	t-stat	3.25	3.55	t-stat	3.80	4.05
Big SZ	0.834	0.876	Low BM	0.864	0.897	Low ROE	0.855	0.988
t-stat	3.42	3.25	t-stat	3.56	3.73	t-stat	2.77	2.88
S-B SZ	0.079	0.238	H-L BM	-0.005	0.195	H-L ROE	0.028	-0.059
t-stat	0.60	1.64	t-stat	-0.04	1.29	t-stat	0.17	-0.29

Panel B: Significant Premiums					
VW	Raw Ret	*Intercept*	*b*	*s*	*h*
Low I/A	0.988	0.146	0.982	-0.042	0.103
t-stat	3.98	2.16	78.86	-1.53	3.72
High I/A	0.780	-0.084	1.032	-0.062	-0.033
t-stat	3.06	-1.73	115.83	-3.14	-1.67
L-H I/A	0.208	0.231	-0.050	0.020	0.136
t-stat	2.06	2.32	-2.75	0.49	3.36
High PRYR	1.099	0.289	0.906	-0.003	-0.074
t-stat	4.87	5.08	86.85	-0.13	-3.19
Low PRYR	0.476	-0.507	1.259	0.114	0.251
t-stat	1.47	-4.83	65.59	2.68	5.85
H-L PRYR	0.623	0.796	-0.354	-0.117	-0.325
t-stat	3.39	5.13	-12.46	-1.86	-5.13
EW	Avg Ret	Intercept	b	s	h
Low I/A	1.153	0.143	0.975	0.087	0.042
t-stat	4.33	2.02	69.59	3.26	1.46
High I/A	0.859	-0.083	1.012	-0.347	0.105
t-stat	3.05	-1.30	80.57	-14.55	4.07
L-H I/A	0.294	0.226	-0.037	0.434	-0.063
t-stat	2.37	2.06	-1.72	10.52	-1.41
High PRYR	1.201	0.331	0.863	0.041	-0.271
t-stat	5.50	4.93	64.88	1.63	-9.88
Low PRYR	0.808	-0.324	1.150	-0.046	0.281
t-stat	2.47	-4.96	88.99	-1.85	10.54

(Continued…)

(Table 2 Continued)

EW	Avg Ret	Intercept	b	s	h
H-L PRYR	0.393	0.655	-0.287	0.087	-0.551
t-stat	2.14	5.07	-11.22	1.79	-10.47

Panel C: Correlation

VW	L-H I/A	H-L PRYR	S-B SZ	H-L BM
H-L PRYR	0.153			
p-value	(0.000)			
S-B SZ	0.141	-0.140		
p-value	(0.001)	(0.001)		
H-L BM	0.181	-0.306	0.558	
p-value	(0.000)	(0.000)	(0.000)	
H-L ROE	-0.022	0.532	-0.308	-0.496
p-value	(0.616)	(0.000)	(0.000)	(0.000)
EW	**L-H I/A**	**H-L PRYR**	**S-B SZ**	**H-L BM**
H-L PRYR	0.150			
p-value	(0.001)			
S-B SZ	0.466	-0.178		
p-value	(0.000)	(0.000)		
H-L BM	0.162	-0.607	0.544	
p-value	(0.000)	(0.000)	(0.000)	
H-L ROE	-0.045	0.616	-0.327	-0.700
p-value	(0.298)	(0.000)	(0.000)	(0.000)

4. Firm-Level Regression and Investment and Momentum Premiums

4.1 Cross-Sectional Firm-Level Regression Tests

Table 3 shows the cross-sectional regressions of monthly REIT returns. Panel A (B) of the table reports the estimated univariate (bivariate) coefficients (i.e. b and c) of the slope in the following Fama and MacBeth (1973) cross-sectional regression:

$$R_{i,t+1} = a + b.\ln\left(1 + \frac{I}{A_{i,t}}\right) + c.PRYR_{i,t} + \epsilon_{i,t+1} \tag{2}$$

The result shows that I/A is statistically significant in explaining for the subsequent REIT returns. I/A drives returns with a slope of -0.874% (t=-2.65) and -0.964% (t=-3.15) under univariate and bivariate specifications, respectively. When the bivariate regression is augmented by the profitability variable of the ROE to complete the q-theory specification that both investment and profitability effects must be simultaneously spelled out, I/A drives returns by a slope of -0.810% (t=-2.33). PRYR is also statistically significant in explaining for the subsequent REIT returns under univariate and bivariate specifications. PRYR drives the returns by a slope of 1.131% (t=2.74) and 1.192%

(t=2.45) under univariate and bivariate specifications, respectively. When the bivariate regression is augmented by the profitability variable of the ROE, PRYR drives returns by a slope of 1.547% (t=3.12). Table 3 therefore shows that I/A and PRYR do not subsume each other and the complete specification or q-theory that requires both I/A and ROE does not change the results either.

Table 3 Cross-Sectional Regressions of Monthly REIT Returns

Panel A (B) reports the estimated univariate (bivariate) coefficients (i.e. b and c) of the slope in the following Fama and MacBeth (1973) cross-sectional regression:

$$R_{i,t+1} = a + b.\ln\left(1 + \frac{I}{A_{i,t}}\right) + c.PRYR_{i,t} + \epsilon_{i,t+1},$$

where R_{t+1} is the monthly raw return between July of year t and June of year t+1. Other variables are defined as in Table 1. Panel C reports the coefficients where the bivariate regression specification above is augmented by the *ROE*. All coefficients are in percentage.

		b	*c*
Panel A:			
	Slope	-0.874%	1.131%
	t-stat	-2.65	2.74
Panel B:			
	Slope	-0.964%	1.192%
	t-stat	-3.15	2.45
Panel C:			
	Slope	-0.810%	1.547%
	t-stat	-2.33	3.12

4.2 Segregated and Cross-Explanatory Investment and Momentum Premiums

Table 4 shows that under the value-weighted approach, when I/A is controlled so that it is low (high), H-L PRYR generates a return spread of 0.495 (0.571)% with a t-stat of 2.05 (2.71). Under the equally-weighted approach, when I/A is controlled so that it is low (high), H-L PRYR generates a return spread of 0.232 (0.425)% with a t-stat of 0.92 (1.97). Also, under the value-weighted approach, when PRYR is controlled so that it is high (low), L-H I/A generates a return spread of 0.221 (0.297)% with a t-stat of 1.80 (1.85). Under the equally-weighted approach, when PRYR is controlled so that it is high (low), H-L PRYR generates a return spread of 0.226 (0.419)% with a t-stat of 1.91 (2.48). As shown by the higher t-statistics that range from 0.92 and 1.97 (in the equally weighted portfolio raw returns (EW)) to be 2.05 and 2.71 (in the value weighted portfolio raw returns (VW)) for low I/A and high I/A, respectively, the isolated momentum premiums are higher when the value-weighted approach is applied. On the contrary, the isolated investment premiums are higher when the equally-weighted approach is applied as the t-statistics increase from 1.80 and 1.85 (in the VW) to be 1.91 and 2.48 (in the EW) for high PRYR and low PRYR, respectively.

Table 4 Return Premiums in REITs sorted by Investment-to-Assets and Prior Returns

This table presents the isolated premiums sorted by investment-to-assets and prior returns by using median breakpoints. VW (EW) refers to value-weighted (equally-weighted) portfolio raw returns.

VW	Low I/A	High I/A	L-H I/A	EW	Low I/A	High I/A	L-H I/A
High PRYR	1.223	1.002	0.221	High PRYR	1.302	1.076	0.226
t-stat	5.16	4.24	1.80	t-stat	5.80	4.83	1.91
Low PRYR	0.728	0.431	0.297	Low PRYR	1.070	0.651	0.419
t-stat	1.98	1.28	1.85	t-stat	2.85	1.89	2.48
H-L PRYR	0.495	0.571		H-L PRYR	0.232	0.425	
t-stat	2.05	2.71		t-stat	0.92	1.97	

Table 5 Investment and Momentum Premiums in REITs Explained by Each Other

Panel A (B) presents the results from regressing the excess returns from two (i.e. Low and High) investment (momentum) portfolios, and also their premium, on momentum (investment) premium. VW (EW) refers to value-weighted (equally-weighted) portfolio construction.

Panel A: Investment Effect explained by Momentum Effect					
VW	H-L PRYR		EW	H-L PRYR	
	Intercept	Coeff		Intercept	Coeff
Low I/A-rf	0.959	-0.57	Low I/A-rf	1.097	-0.840
t-stat	4.20	-10.80	t-stat	4.99	-16.27
High I/A-rf	0.804	-0.659	High I/A-rf	0.842	-0.940
t-stat	3.53	-12.40	t-stat	3.75	-17.83
L-H I/A	0.156	0.084	L-H I/A	0.254	0.101
t-stat	1.54	3.56	t-stat	2.07	3.49
Panel B: Momentum Effect explained by Investment Effect					
VW	L-H I/A		EW	L-H I/A	
	Intercept	Coeff		Intercept	Coeff
High PRYR-rf	0.746	-0.163	High PRYR-rf	0.847	-0.110
t-stat	3.29	-1.68	t-stat	3.85	-1.44
Low PRYR-rf	0.182	-0.440	Low PRYR-rf	0.519	-0.332
t-stat	0.56	-3.19	t-stat	1.58	-2.91
H-L PRYR	0.565	0.278	H-L PRYR	0.328	0.222
t-stat	3.09	3.56	t-stat	1.80	3.49

The results of the premium regressions are reported in Table 5. The test of the investment (momentum) premium is presented in Panel A (B). The performance of each premium is measured by its ability to produce an insignificant intercept. Consistent with Table 4 that H-L PRYR (L-H I/A) is dominant under the value- (equally-) weighted approach, Table 5 shows, for the investment premium, L-H I/A is fully explained by H-L PRYR with an insignificant intercept of 0.156% and a t-stat of 1.54 under the value-weighted approach. However, H-L PRYR cannot completely explain for L-H I/A when the equally-weighted approach is applied since the intercept is significant at 0.254% with a t-stat of 2.07. For the momentum premium, H-L PRYR cannot be fully explained by L-H I/A since the intercept is significant at 0.565% with a t-stat of 3.09 under the value-weighted approach. On the contrary, L-H I/A completely explains for H-L PRYR when the equally-weighted approach is applied since the intercept is insignificant at 0.328% with a t-stat of 1.80.

5. Investment Effect with Frictions

This section investigates if the negative relation between investment and expected return is stronger when investments are costlier to make, as predicted by the q-theory. In other words, a given reduction in expected return is associated with a smaller increase in investment when investment frictions are higher. Table 6 shows the cross-sectional regressions of monthly REIT returns with interaction between investment and investment friction. Panel A reports the estimated trivariate coefficients of the slope (i.e. *b*, *c*, and *d*) in the following Fama and MacBeth (1973) cross-sectional regression:

$$R_{i,t+1} = a + b.\ln\left(1 + \frac{I}{A_{i,t}}\right) + c.PRYR_{i,t} + d.DUMMY_{i,t}.\,ln\left(1 + \frac{I}{A_{i,t}}\right) + \epsilon_{i,t+1} \quad (3)$$

The variable of interest is time-series averages on the Fama-MacBeth slopes of the interaction terms between the investment friction dummy and I/A. The investment friction dummy is set to be one (zero) if a firm is in the small (large) asset size group using median breakpoints. The slopes of the interaction terms refer to the additional investment effect when investment friction is high. According to the q-theory, these slopes are predicted to be significant with a negative value. The results show otherwise that the investment effect is not significantly stronger when investment frictions are more severe. Specifically, the slope of the interaction term, in fact, becomes a positive value of 0.765% with an insignificant t-value of 1.41 when the ROE is not augmented into the regression. The result is similar when the ROE is augmented as the slope of the interaction term becomes 0.154% with an insignificant t-value of 0.14. Additionally, the table shows that both the investment and momentum effects remain. Investment and prior return still explain for future returns with a slope of -1.703% (t stat = -3.63) and 1.182% (t stat = 2.43), respectively, when the

ROE is not augmented. Investment and prior return explain for future returns with a slope of -1.486% (t stat = -3.52) and 1.588% (t stat = 3.23), respectively, when the ROE is augmented.

Table 6 Cross-Sectional Regressions of Monthly REIT Returns with Interaction between Investment and Investment Frictions

Panel A reports the estimated trivariate coefficients of the slope (i.e. *b*, *c*, and *d*) in the following Fama and MacBeth (1973) cross-sectional regression:

$$R_{i,t+1} = a + b.\ln\left(1 + \frac{I}{A_{i,t}}\right) + c.PRYR_{i,t} + d.DUMMY_{i,t}.\ln\left(1 + \frac{I}{A_{i,t}}\right) + \epsilon_{i,t+1},$$

where R_{t+1} is monthly raw return between July of year t and June of year t+1. *DUMMY* is a dummy variable that equals one (zero) if a firm is in the small (large) asset size group by using median breakpoints. Other variables are defined as in Table 1. Panel B reports the coefficients where the trivariate regression specification above is augmented by the *ROE*. All coefficients are in percentage.

	b	*c*	*d*
Panel A:	-1.703%	1.182%	0.765%
t-stat	-3.63	2.43	1.41
Panel B:	-1.486%	1.588%	0.154%
t-stat	-3.52	3.23	0.14

6. Momentum and Profitability Premiums

This section investigates how momentum can be affected by the level of profitability. Zhang (2017) explains the momentum effect by using the following argument. Earnings momentum winners that have recently experienced positive shocks to profitability tend to be more profitable, with higher expected profitability, than earnings momentum losers that have recently experienced negative shocks to profitability. The earnings momentum is linked to expected returns through two channels: (1) the profitability effect (i.e. profitability explaining expected returns) causes earnings momentum winners to earn higher expected returns than earnings momentum losers, and (2) shocks to earnings that are positively correlated with returns contemporaneously (i.e. profitability explaining current returns) cause earnings momentum winners to earn higher expected returns than earnings momentum losers. These two channels imply that earnings momentum winners with higher expected profitability should earn higher expected returns than earnings momentum losers.

To start the investigation, we would like to first ensure that the profitability effect is indeed insignificant in the REIT sample as previously shown in Section 3. Robustness checks are needed since the profitability effect is important as it is one of the two main effects in the q-theory. We employ an additional 14 proxies for profitability variables that comprise: 1. quarterly cash-based operating profits-to-lagged assets, 2. quarterly return on assets, 3. quarterly gross profits-to-lagged assets, 4. quarterly operating profits-to-lagged assets, 5. quarterly operating profits-to-lagged equity, 6. annual income before extraordinary items-to-equity, 7. annual ROE, 8. annual income before extraordinary items-to-assets, 9. annual ROA, 10. annual operating profits-to-equity, 11. annual operating profits-to-lagged equity, 12. annual cash-based operating profits-to-assets, 13. annual gross profits-to-assets, and 14. annual operating profits-to-assets. The definitions and ways of constructing all of these premiums are found in the Appendix. Table 7 shows that none of the alternative proxies can generate a significant profitability premium.[6]

Since the profitability effect is not significant as we discussed in Section 3 and is confirmed in this section, earnings momentum can only provide a rational explanation to price momentum via the second channel as discussed above. That is, the earnings momentum is linked to the expected returns not through the profitability effect which causes earnings momentum winners to earn higher expected returns than the earnings momentum losers but by the logic that shocks to earnings are positively correlated with returns contemporaneously. We investigate the second channel empirically as follows.

It is seen from Table 3 that prior returns cannot be subsumed by the complete specification of the q-theory with the presence of both I/A and ROE. In Table 8, cross-sectional regressions as in Table 3 are performed again but with an additional term: the interaction between PRYR and the ROE dummy. Panel A reports the estimated trivariate coefficients of the slope (i.e. *b*, *c*, and *d*) in the following Fama and MacBeth (1973) cross-sectional regression:

$$R_{i,t+1} = a + b.ln\,(1 + \frac{I}{A_{i,t}}) + c.PRYR_{i,t} + d.DUMMY_{i,t}.PRYR_{i,t} + \epsilon_{i,t+1} \quad (4)$$

The ROE dummy turns 1 (0) when the ROE is high (low) based on the ROE medians. Panel A of Table 8, which is the bivariate regression from Table 3 with an added interaction term, shows that PRYR is subsumed by the interaction term. Panel B of Table 8, which the regression is augmented by the ROE shows a similar outcome. The finding means that, at the firm level, even though momentum in REITs is very significant, the explanatory power of prior returns on expected returns is, in fact, controlled by the profitability level.

Table 9 is used to further investigate this issue with a portfolio analysis. Using the value- (equally-) weighted approach, the time-series regression of momentum on profitability premium shows a very significant coefficient of the

[6] To investigate this issue of the insignificant profitability effect even further, we replicate Bond and Xue (2017) who find a significant profitability effect in REITs by using quintile portfolios with breakpoints and the timespan only from January 1994 to December 2013. With this setting, we find that the replicated profitability effect turns significant. However, we stress that using median portfolios with breakpoints (i.e. 100% utilization of data as previously discussed in Section 2) and longer time span provide more conservative results.

Table 7 Alternative Profitability Premiums in REITs

Panel A (B) presents five quarterly (nine annual) profitability premiums of the profitability variables in the Appendix by using median breakpoints. VW (EW) refers to value-weighted (equally-weighted) portfolio raw returns. For sufficient data coverage, premiums for CPq and OPq start in July 2010 and premiums for CPa and OPa start in November 2010. The others span July 1973 to December 2017.

Panel A: Quarterly Profitability Premiums										
	CPq		ROAq		GPq		OPq		OPFFq	
	VW	EW	VW	EW	VW	EW	VW	EW	VW	EW
High	0.971	1.106	0.903	0.958	0.877	0.974	0.941	1.259	0.920	0.958
t-stat	1.79	2.11	3.92	4.15	3.49	3.76	1.63	2.32	4.00	4.22
Low	1.304	1.216	0.868	1.016	0.905	1.013	1.248	1.221	0.780	0.961
t-stat	2.19	2.24	3.00	3.19	3.30	3.43	2.17	2.36	2.52	2.80
H-L	-0.333	-0.110	0.035	-0.058	-0.028	-0.039	-0.307	0.038	0.140	-0.003
t-stat	-0.70	-0.28	0.22	-0.31	-0.18	-0.23	-0.68	0.10	0.85	-0.01
Panel B: Annual Profitability Premiums										
	ROE1a		ROE2a		ROA1a		ROA2a		OPFF1a	
	VW	EW	VW	EW	VW	EW	VW	EW	VW	EW
High	0.767	0.844	0.799	0.865	0.877	0.951	0.922	0.974	0.782	0.884
t-stat	2.99	3.13	2.99	3.10	3.66	3.85	3.80	3.95	3.08	3.16
Low	0.986	1.143	0.984	1.150	0.871	1.044	0.829	1.048	0.833	1.053
t-stat	3.85	4.09	3.83	4.14	3.30	3.50	3.06	3.47	3.39	4.01
H-L	-0.219	-0.299	-0.185	-0.285	0.005	-0.093	0.094	-0.074	-0.051	-0.170
t-stat	-1.77	-2.09	-1.41	-1.78	0.05	-0.71	0.81	-0.52	-0.45	-1.32

(Continued…)

(Table 7 Continued)

	OPFF2a		CPa		GPa		OPa	
	VW	EW	VW	EW	VW	EW	VW	EW
High	0.818	0.925	0.713	0.795	0.807	0.951	0.721	0.798
t-stat	3.16	3.33	1.49	1.72	3.22	3.60	1.55	1.76
Low	0.828	1.041	1.199	1.356	0.854	0.990	1.164	1.409
t-stat	3.30	3.84	2.15	2.35	3.37	3.53	2.03	2.45
H-L	-0.010	-0.116	-0.486	-0.562	-0.047	-0.039	-0.443	-0.610
t-stat	-0.09	-0.81	-1.34	-1.52	-0.38	-0.29	-1.19	-1.65

slope with a t-stat of 14.49 (18.06) but the intercept is also significant. By combining these following empirical findings that (1) from Table 3, the ROE itself does not subsume PRYR in a cross-sectional regression (2) from Table 2 and the confirmation results in Table 7, the profitability effect itself is not significantly different from zero (3) from Table 8, the interaction between PRYR and the ROE dummy subsumes the unconditioned PRYR and (4) from Table 9, the H-L ROE has a very high t-stat value for the time-series regression coefficient of the slope in explaining for H-L PRYR but the intercepts are still significant, so we conclude that the ROE itself cannot drive returns in REITs but indirectly via the momentum effect. Insignificant ROE premiums should naturally not be able to explain away the significant momentum but the very significant coefficient of the slope means that it plays a crucial role in the momentum effect. Moreover, the amount of ROE is a necessary factor for the momentum effect to take place. Table 9 also shows that all momentum portfolios (from both the value- and equally weighted approaches) load negatively on H-L ROE and that high momentum portfolios load less negatively than low momentum portfolios.

Table 8 Cross-Sectional Regressions of Monthly REIT Returns with Interaction between Prior Returns and Returns on Equity

Panel A reports the estimated trivariate coefficients of the slope (i.e. *b*, *c*, and *d*) in the following Fama and MacBeth (1973) cross-sectional regression:

$$R_{i,t+1} = a + b.\ln\left(1 + \frac{I}{A_{i,t}}\right) + c.PRYR_{i,t} + d.DUMMY_{i,t}.PRYR_{i,t} + \epsilon_{i,t+1},$$

where R_{t+1} is monthly raw return between July of year t and June of year t+1. *DUMMY* is a dummy variable that equals one (zero) if a firm is in the high (low) *ROE* group as indicated in Table 2. Other variables are defined as in Table 1. Panel B reports the coefficients where the trivariate regression specification above is augmented by the *ROE*. All coefficients are in percentage.

	b	*c*	*d*
Panel A:	-1.085	1.003	1.525
t-stat	-2.84	1.65	2.69
Panel B:	-0.959	0.948	1.596
t-stat	-2.44	1.60	2.37

Table 9 Momentum Premiums in REITs explained by Returns on Equity Premiums

This table presents the results from regressing the excess returns of two median momentum portfolios, and also their premium, on ROE premium. VW (EW) refers to value-weighted (equally-weighted) portfolio construction. All intercepts are in percentage.

VW	H-L ROE		EW	H-L ROE	
	Intercept	Coeff		Intercept	Coeff
High PRYR-rf	0.725%	-0.429	High PRYR-rf	0.788%	-0.447
t-stat	3.37	-7.54	t-stat	3.95	-10.5
Low PRYR-rf	0.119%	-1.025	Low PRYR-rf	0.362%	-1.01
t-stat	0.43	-13.94	t-stat	1.4	-18.28
H-L PRYR	0.606%	0.596	H-L PRYR	0.426%	0.5576
t-stat	3.89	14.49	t-stat	2.94	18.06

7. Discussion and Conclusions

The REIT industry is excluded from mainstream asset pricing studies because REITs have a different structure in terms of their financial statements compared to those of common stocks. We fill this research gap and investigate all well-known premiums by using a U.S. REIT sample. Among all five major premiums, we find that only investment and momentum are significant. REITs are a suitable sample for investigating the q-theory because, logically, investments in REIT businesses are subject to the interest (i.e. discount) rate. When the rate is low, the cost of borrowing is low, so REIT firms tend to borrow more and invest more (i.e. expansion in assets). Also, when the interest rate is low, the mortgage rate is likely to be low, so households and businesses then tend to buy property assets (house, land, office buildings, etc.) more, so the entire real estate market is likely to be bullish, thus motivating REIT firms to invest more in assets. However, we do not find that the investment effect is greater when investment friction is higher. It is worth discussing the insignificant effect of probability in our study. The q-theory claims that the momentum effect cannot exist without the real driver—profitability. Our empirical evidence shows that profitability indeed governs the momentum effect, thereby giving rise to the profitability explanation even though the profitability effect itself is not statistically significant.

Overall, our findings show that the *q*-theory can explain for REIT returns only via the investment effect. The profitability effect which is another pillar of the theory is not significant in any of the proxies investigated here. Moreover, investment friction cannot intensify the investment effect as predicted by the q-theory. However, we find that the level of profitability indeed controls the price momentum even though profitability itself cannot drive returns. These findings have not been previously reported in the real estate literature. Our results may indicate a market inefficiency as investors who have a better understanding of the significant investment and momentum premiums perform better than those who do not.

In sum, we use the same procedure but a longer time span than previous REIT-specific asset pricing studies and find for the first time that investment and momentum are the two variables that drive REIT returns. This paper provides significant contributions to the body of knowledge for researchers, practitioners, and REIT investors. Our empirical result demonstrates that REIT investors who have a better understanding of significant investment and momentum premiums can outperform those who focus on other variables. With the appropriate factors identified in our empirical study, researchers and real estate industry practitioners can determine the required returns from the asset pricing model under the REIT domain in a more accurate, up-to-date, and specific manner. More accurate required returns would lead to more accurate calculation of risk-adjusted returns of alphas, which reflect the difference between the actual returns compared to the required returns derived from our REIT-specific factors. Moreover, the required returns can be used as the discount rates in REIT valuation. Given that REIT cashflows are relatively consistent compared to those from common stocks (e.g., Boudry 2011), more appropriate and accurate discount rates allow valuations that are even closer to true and fair prices.

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Appendices

Appendix 1 Variable definitions for Profitability in Table 7

Quarterly Variables:	
CPq	Quarterly cash-based operating profits-to-lagged assets, CPq, is quarterly total revenue (Compustat quarterly item REVTQ) minus cost of goods sold (item COGSQ), minus selling, general, and administrative expenses (item XSGAQ), plus research and development expenditures (item XRDQ), minus change in accounts receivable (item RECTQ), minus change in inventory (item INVTQ), plus change in deferred revenue (item DRCQ plus item DRLTQ), and plus change in trade accounts payable (item APQ), all scaled by one-quarter-lagged book assets (item ATQ). All changes are quarterly changes in balance sheet items and we set missing changes to zero. At the beginning of each month t, we categorize all REITs into two groups based on the median breakpoints of the quarterly CPq for the fiscal quarter ending at least four months ago. Subsequently, we calculate the portfolio returns for month t and rebalance the portfolios in month t+1. CPq premium is the monthly difference between the returns on the high- and low-CPq portfolios.
ROAq	Quarterly return on assets, ROAq, is income before extraordinary items (Compustat quarterly item IBQ) divided by one-quarter-lagged total assets (item ATQ). At the beginning of each month t, we categorize all REITs into two groups based on the median breakpoints of the quarterly ROAq for the fiscal quarter ending at least four months ago. Subsequently, we calculate the portfolio returns for month t and rebalance the portfolios in month t+1. ROAq premium is the monthly difference between the returns on the high- and low-ROAq portfolios.
GPq	Quarterly gross profits-to-lagged assets, GPq, is quarterly total revenue (Compustat quarterly item REVTQ) minus cost of goods sold (item COGSQ) divided by one-quarter-lagged total assets (item ATQ). At the beginning of each month t, we categorize all REITs into two groups based on the median breakpoints of the quarterly GPq for the fiscal quarter ending at least four months ago. Subsequently, we calculate the portfolio returns for month t and rebalance the portfolios in month t+1. GPq premium is the monthly difference between the returns on the high- and low-GPq portfolios.
OPq	Quarterly operating profits-to-lagged assets, OPq, is quarterly total revenue (Compustat quarterly item REVTQ) minus cost of goods sold (item COGSQ), minus selling, general, and administrative expenses (item XSGAQ), plus research and development expenditures (item XRDQ), scaled by one-quarter-lagged book assets (item ATQ). At the beginning of each month t, we categorize all REITs into two groups based on the median breakpoints of the quarterly OPq for the fiscal quarter ending at least four months ago. Subsequently, we calculate the portfolio returns for month t and rebalance the portfolios in month t+1. OPq premium is the monthly difference between the returns on the high- and low-OPq portfolios.
OPFFq	Quarterly operating profits-to-lagged equity, OPFFq, is quarterly total revenue (Compustat quarterly item REVTQ) minus cost of goods sold (item COGSQ, zero if missing), minus selling, general, and

	administrative expenses (item XSGAQ, zero if missing), and minus interest expense (item XINTQ, zero if missing), scaled by one-quarter-lagged book equity. Quarterly book equity is shareholder equity, plus balance sheet deferred taxes and investment tax credit (item TXDITCQ) if available, minus the book value of preferred stock (item PSTKQ). Depending on availability, we use stockholders' equity (item SEQQ), or common equity (item CEQQ) plus the book value of preferred stock, or total assets (item ATQ) minus total liabilities (item LTQ) in that order as shareholder equity. Negative quarterly book equity values are dropped. At the beginning of each month t, we categorize all REITs into two groups based on the median breakpoints of the quarterly OPFFq for the fiscal quarter ending at least four months ago. Subsequently, we calculate the portfolio returns for month t and rebalance the portfolios in month t+1. OPFFq premium is the monthly difference between the returns on the high- and low-OPFFq portfolios.
Annual Variables:	
ROE1a	Annual income before extraordinary items-to-equity, ROA1a, is income before extraordinary items (Compustat annual item IB) divided by annual book equity. Annual book equity is the difference between assets (item AT) and liabilities (item LT), plus balance sheet deferred taxes (item TXDB if available) and investment tax credits (item ITCI if available), minus the book value of preferred stock if available. Depending on data availability, we use liquidation (item PSTKL), redemption (item PSTKRV), or preferred stock at carrying value (item UPSTK), in this order, to represent the book value of preferred stock. Negative annual book equity values are dropped. For ROE1a premiums, we sort REITs into two groups by using median breakpoints for the last fiscal year ending in calendar year t-1. We calculate returns on the portfolios from July of year t to June of t+1, and the portfolios are rebalanced in June of t+1. The ROE1a premium is the monthly difference between the returns on the high- and low-ROE1a portfolios.
ROE2a	Annual ROE, ROE2a, is income before extraordinary items (Compustat annual item IB) divided by one-year-lagged annual book equity. Annual book equity is the difference between assets (item AT) and liabilities (item LT), plus balance sheet deferred taxes (item TXDB if available) and investment tax credits (item ITCI if available), minus the book value of preferred stock if available. Depending on data availability, we use liquidation (item PSTKL), redemption (item PSTKRV), or preferred stock at carrying value (item UPSTK), in this order, to represent the book value of preferred stock. Negative annual book equity values are dropped. For ROE2a premiums, we sort REITs into two groups by using median breakpoints for the last fiscal year ending in calendar year t-1. We calculate returns on the portfolios from July of year t to June of t+1, and the portfolios are rebalanced in June of t+1. The ROE2a premium is the monthly difference between the returns on the high-and low-ROE2a portfolios.
ROA1a	Annual income before extraordinary items-to-assets, ROA1a, is income before extraordinary items (Compustat annual item IB) divided by annual total assets (item AT). For ROA1a premiums, we sort REITs into two groups by using median breakpoints for the last fiscal year ending in

	calendar year t-1. We calculate returns on the portfolios from July of year t to June of t+1, and the portfolios are rebalanced in June of t+1. The ROA1a premium is the monthly difference between the returns on the high- and low-ROA1a portfolios.
ROA2a	Annual return on asset, ROA2a, is income before extraordinary items (Compustat annual item IB) divided by one-year-lagged annual total assets (item AT). For ROA2a premiums, we sort REITs into two groups by using median breakpoints for the last fiscal year ending in calendar year t-1. We calculate returns on the portfolios from July of year t to June of t+1, and the portfolios are rebalanced in June of t+1. The ROA2a premium is the monthly difference between the returns on the high- and low-ROA2a portfolios.
OPFF1a	Annual operating profits-to-equity, OPFF1, is gross profit (Compustat annual item GP) less selling and general administrative expenditures (item XSGA, zero if missing) less interest expense (item XINTD, zero if missing), scaled by annual book equity. Annual book equity is the difference between assets (item AT) and liabilities (item LT), plus balance sheet deferred taxes (item TXDB if available) and investment tax credits (item ITCI if available), minus the book value of preferred stock if available. Depending on data availability, we use liquidation (item PSTKL), redemption (item PSTKRV), or preferred stock at carrying value (item UPSTK), in this order, to represent the book value of preferred stock. Negative annual book equity values are dropped. For OPFF1a premiums, we sort REITs into two groups by using median breakpoints for the last fiscal year ending in calendar year t-1. We calculate returns on the portfolios from July of year t to June of t+1, and the portfolios are rebalanced in June of t+1. The OPFF1a premium is the monthly difference between the returns on the high- and low-OPFF1a portfolios.
OPFF2a	Annual operating profits-to-lagged equity, OPFF2, is gross profit (Compustat annual item GP) less selling and general administrative expenditures (item XSGA, zero if missing) less interest expense (item XINTD, zero if missing), scaled by one-year-lagged annual book equity. Annual book equity is the difference between assets (item AT) and liabilities (item LT), plus balance sheet deferred taxes (item TXDB if available) and investment tax credits (item ITCI if available), minus the book value of preferred stock if available. Depending on data availability, we use liquidation (item PSTKL), redemption (item PSTKRV), or preferred stock at carrying value (item UPSTK), in this order, to represent the book value of preferred stock. Negative annual book equity values are dropped. For OPFF2a premiums, we sort REITs into two groups by using median breakpoints for the last fiscal year ending in calendar year t-1. We calculate returns on the portfolios from July of year t to June of t+1, and the portfolios are rebalanced in June of t+1. The OPFF2a premium is the monthly difference between the returns on the high- and low-OPFF2a portfolios.
CPa	Annual cash-based operating profits-to-assets, CPa, is annual total revenue (Compustat annual item REVT) minus cost of goods sold (item COGS), minus selling, general, and administrative expenses (item XSGA), plus research and development expenditures (item XRD), minus change in accounts receivable (item RECT), minus change in inventory (item INVT), plus change in deferred revenue (item DRC plus item

	DRLT), and plus change in trade accounts payable (item AP), all scaled by book assets (item AT). All changes are annual changes in balance sheet items and we set missing changes to zero. For CPa premiums, we sort REITs into two groups by using median breakpoints for the last fiscal year ending in calendar year t-1. We calculate returns on the portfolios from July of year t to June of t+1, and the portfolios are rebalanced in June of t+1. The CPa premium is the monthly difference between the returns on the high- and low-CPa portfolios.
GPa	Annual gross profits-to-assets, GPa, is annual gross profit (Compustat annual item GP) scaled by total assets (item AT). For GPa premiums, we sort REITs into two groups by using median breakpoints for the last fiscal year ending in calendar year t-1. We calculate returns on the portfolios from July of year t to June of t+1, and the portfolios are rebalanced in June of t+1. The GPa premium is the monthly difference between the returns on the high- and low-GPa portfolios.
OPa	Annual operating profits-to-assets, OPa, is annual gross profit (Compustat item GP), minus selling, general, and administrative expenses (item XSGA), plus research and development expenditures (item XRD), scaled by book assets (item AT). For OPa premiums, we sort REITs into two groups by using median breakpoints for the last fiscal year ending in calendar year t-1. We calculate returns on the portfolios from July of year t to June of t+1, and the portfolios are rebalanced in June of t+1. The OPa premium is the monthly difference between the returns on the high- and low-OPa portfolios.