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How Does Information Asymmetry Affect REIT Investments? Cost of Capital, Performance, and Executive Compensation

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ABSTRACT

This study empirically examines the impact of information asymmetry on firm-level investment behavior using data from U.S. equity real estate investment trusts (REITs). We show that firms with lower levels of information asymmetry, measured as bid–ask spread and stock return volatility, generally experience higher growth on their real estate investment, property investment, and total assets. Conversely, high-information-asymmetry REITs are less active in their property acquisition and disposition activities, as well as involved in fewer mergers and acquisitions than their counterparts. We also show that the levels of information asymmetry are, on average, positively related to capital costs and negatively related to operational performance. Lastly, the study sheds light on the importance of aligning interests of managers with those of stakeholders, by illustrating that executives in firms with a high level of information asymmetry receive higher total compensation compared with their peers.

KEYWORDS

Information asymmetry; investments; firm growth; cost of capital; REIT

In recent decades, real estate investment trusts (REITs) have become one of the major investments for both institutional and individual investors. The dramatic growth of REITs has made it a very active sector in the capital market.[1] The U.S. REIT industry equity market capitalization has an average annual compound growth rate of 16% during the modern REIT era, from 1993 to 2017, (from just $26 billion in 1993 to over $1,065 billion in 2017).[2] In 2016, a new real estate sector was created under the Global Industry Classification Standard (GICS) by S&P Dow Jones Indices and MSCI Inc.[3] A growing stream of literature explains the dramatic growth of REITs (e.g., Eichholtz & Yönder, 2015; An et al., 2011).

The relation between firms' investment behavior and their information asymmetry has been investigated by the finance literature in great detail (e.g., Ascioglu et al., 2008; Chowdhury et al., 2016). However, neither investment behavior nor growth of REITs are sufficiently addressed in regard to information asymmetry. This shortcoming in coverage appears more pressing for REITs than non-REIT firms because of unique qualities of REITs. For instance, REITs are more "finance-dependent." To keep their tax-exempt status, REITs must distribute a minimum of 90% of their income to the shareholders. With limited internal funding thus available, REIT marginal investments are mostly financed by external equity or debt. As a result, large REIT investments are more likely to be funded by the issuance of debt or an increase in the share count (e.g., Ott et al., 2005; Hardin et al., 2009). This implies that REITs generally have less information asymmetry and are more efficient in price discovery as compared with non-REITs. Few studies investigate the relation between REIT information asymmetry and their growth as well as the cost of capital. Given the

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gap in the literature and the importance of this issue, the impact of information asymmetry on the firm-level investment behavior is the empirical question we focus on in this paper.

Furthermore, REITs investments are easier to identify because they are almost exclusively tangible. Compared with Non-REIT firms, REIT investments are easily observed and measured because most of them are physical properties. Although non-REIT firms often invest in intangible assets such as advertising, branding, research, and development, whose payoffs come years later, REITs invest almost all their capital into properties, which are tangible assets. Hence, a REIT could be considered to be a portfolio of physical real estate assets (Feng et al., 2019). Eichholtz and Yönder (2015) show that a typical REIT holds 98.6% of its assets in the form of real estate properties, although the legal requirement is just 75%. Therefore, REIT investment behaviors are easy to identify and measure. This feature provides a way to examine REIT investment behaviors conditional on their information asymmetry in a more homogenous environment. Compared with non-REIT firms, which are often heterogeneous, an analysis of REITs is expected to yield clearer and stronger evidence on the simultaneous interactions among REITs investments, cost of capital, and information asymmetry.

According to the National Association of Real Estate Investment Trusts (Nareit), a REIT "is a company that owns, operates, or finances income-producing real estate. REITs provide all investors the chance to own valuable real estate, present the opportunity to access dividend-based income and total returns, and help communities grow, thrive, and revitalize." [4] The business model of REITs is to create a property portfolio and provide shareholders with stable dividend income and capital gains (Beracha et al., 2019a, 2019b). Hence, REIT managers must increase transparency to grow the business as well as to advance their careers. In fact, understanding the relationship between information asymmetry and firm investment has important implications for REIT stakeholders. If the information asymmetry of REITs is one of the important determinants of firm investments in the cross-section, stakeholders should pay close attention to the role of information asymmetry in the dramatic growth of REIT assets.

Another reason to examine symmetric information is because it is the core of many unethical behaviors in business. Employees, especially top executives, may have a moral hazard problem and retain superior information for their own benefits (Holmstrom,1979) from insider gain (Aboody and Lev, 2000) and negative net present value investments. Hence, one of the solutions for a fair market is to gain more transparency, and thus, less information asymmetry to stakeholders.

The purpose of this study is to examine the relationship between information asymmetry and investment activities at the firm level, using the unique setting of REITs. Three separate proxies are adopted to evaluate REIT investment activities. They are real estate investment growth, property investment growth, and total asset growth. These three measures can capture the magnitude of real estate portfolio or size from one period to another. Real estate investment growth and property investment growth are commonly used REIT-specific measures, and total asset growth is often adopted in finance literature as a composite measure of overall corporate investment growth and asset expansion (e.g., Cooper et al., 2008).

Two market-based measures of information asymmetry, bid–ask spread and stock return volatility, are employed as two separate proxies to evaluate the level of REIT information asymmetry. The bid–ask spread reflects the availability of information about investors' holdings (Merton, 1987). The bid–ask spread would decrease when there is more information available publicly about the underlying assets (Amihud & Mendelson, 1989; Copeland & Galai, 1983; Glosten & Milgrom, 1985). Damodaran & Liu (1993) also show that the insiders of a firm would have advantages to obtain information, comparing with other shareholders. This phenomenon might reflect on the liquidity of REIT stocks (e.g., Wei et al., 1995). Thus, we follow recent REIT literature (Devos et al., 2019), and adopt the bid–ask spread as the first information asymmetry measure.[5] Since uninformed investors are less likely to trade the high information asymmetry stocks (e.g., Leuz & Verrecchia, 2000). The changes in total information flow on a stock would reflect on the share prices (e.g., Tetlock, 2010),

we follow the finance literature (e.g., Harris & Raviv, 1993; Moeller et al., 2007) and adopt stock return volatility as the second measure for information asymmetry of REITs. Moreover, we also employ the absolute analysts' forecast errors, another commonly used information asymmetry measure, in the robustness check.[6]

If a REIT's level of information asymmetry is high, it is likely to have difficulties in financing its future investments in the equity market as well as the debt market (Watanabe et al., 2013). Recent REIT literature shows that corporate transparency assists firm growth (An et al., 2011) and that REITs increase their information disclosure when they want to raise capital (Devos et al., 2019). Hence, REIT investments are potentially linked to their cost of financing. In this study, we explore the relationships between REIT information asymmetry and investment behavior as well as the costs of financing.

Using a sample of U.S. equity REITs from the S&P Global Market Intelligence (formerly SNL Financial) database for the period from 1993 to 2017, we empirically examine the relationship between REIT information asymmetry and investment activity as well as the cost of capital. The results show that REITs with higher information asymmetry, measured as bid–ask spreads and stock return volatility, generally have fewer investment activities, measured as real estate investment growth, property investment growth, and total asset growth. We further enhance the existing body of knowledge by distinguishing the selling and buying of real estate assets. The result shows that high information asymmetry REITs generally acquire fewer properties and may also be less likely to sell their holdings.

We also find that high-information-asymmetry REITs suffer higher costs of debt and equity compared with low-information-asymmetry REITs, and that information asymmetry is linked to poor operational performance. Moreover, we provide evidence that the REITs with high levels of information asymmetry give higher levels of total pay to their executives compared with REITs with low levels of information asymmetry.

This research contributes to the literature in the following ways. First, it demonstrates a strong positive correlation between REIT investment behaviors and the lagged level of information asymmetry, suggesting that information asymmetry plays an important role in determining REIT growth. More importantly, we exploit the fact that REIT investments are mostly tangibles, that REIT managers are usually unable to use their internally generated funds to invest, and that real estate investments are for the most part capital intensive. These features provide a more homogenous environment to investigate a firm's investment behavior and the cost of capital jointly with information asymmetry. An intensive investigation of the relationship between information asymmetry and firm investment activities using a sample of equity REITs provides an extension to the firm investment literature.[7] We expect our results to be clearer and stronger compared with those obtained from firms across different industries because these firms have large variations in both capital and capital intensity.

Second, this study provides new evidence on the relationship between information asymmetry and capital constraints using two market-based information asymmetry measures. Whereas previous studies mainly focus on the importance of analyst forecasts and third-party credit ratings (e.g., Healy & Palepu, 2001; Watanabe et al., 2013), this research examines how REIT investment activities are used to mitigate cost of capital, using bid–ask spread and stock return volatility as information asymmetry measures.

This study also contributes to the literature on the REIT' growth, by showing that REITs with high levels of information asymmetry, on average, have a high cost of financing and low operational performance. The paper confirms prior literature that less transparent REITs have higher financing costs and thus have fewer investments that would offer returns high enough to cover their high cost of capital.

Lastly, our results shed light on recent REIT executive compensation reform related to information asymmetry, we provide evidence that REITs with a high level of information asymmetry pay

more for their executives. The empirical findings here contribute to a rapidly growing strand of executive compensation literature by studying the implication of information asymmetry on executive total pays. The study sheds light on the importance of aligning the interests of managers with those of stakeholders. Although compensation contracts should be designed to motivate managers to align the interests of shareholders with those of mangers, and to improve REIT performance, the results here highlight important issues regarding the level of information asymmetry at work. Recent REIT executive compensation reforms pay close attention to two important dimensions of executive compensation contract design: pay-for-performance and pay-for-risk. It is also important to decrease the level of information asymmetry in REITs.

The remainder of this paper is organized as follows. We next describe our data source, key variable constructions, and summary statistics. The following section illustrates the empirical specifications. We then present our main empirical findings and some additional analysis. The final section provides our conclusions.

Data Sources, Variable Construction, and Summary of Statistics

Data Sources

The data set consists of U.S. listed equity REITs recorded in S&P Global Market Intelligence (formerly SNL Financial) during the 1993–2017 period. To avoid survivorship bias, we include both operating REITs and acquired/defunct REITs. The following annual variables of REIT have been included: total assets, total equity, total debt, cash, net income, funds from operations (FFO), credit lines drawn/available, real estate investment growth, net property investment, share price, common share outstanding, property acquisitions, property dispositions, year IPO or REIT status established, and merger and acquisition activities.[8]

We also obtain the daily highest trading price (ask), lowest trading price (bid), holding period return from the Center for Research in Security Prices (CRSP), the Fama–French MKTRF (excess return on the market), SMB (Small Minus Big), HML (High Minus Low) factors from Kenneth French's website, [9] the executive compensation data from S&P's ExecuComp database, the institutional ownership data from Thomson Reuters' 13F database, and the analysts' forecast on REIT FFO from the I/B/E/S database.

Variable Construction

The information asymmetry measures adopted in this paper are bid–ask spread and stock price volatility.[10] REIT literature suggests that bid–ask spreads are related to the level of information disclosure (e.g., Danielsen et al., 2014). The changes in the information asymmetry of REITs are normally reflected in their share prices. It may also depend on their portfolio size because large REITs generally show low levels of information asymmetry. It may also rely on the share turnover (Bhasin et al.,1997; Cannon & Cole, 2011). Hence, we first calculate the daily bid–ask spread (Spread), following Mohd (2005), Silber (2005), and Devos et al. (2019), as

$$Spread = \frac{(Ask - Bid)}{(Ask + Bid)/2} \tag{1}$$

Then, we average the spread over the calendar year because stock return volatility could indicate the changes in the total information of a stock (e.g., et al., 2004). If there exist differentials between the total information known by informed investors and uninformed investors, the changes in total information flow would show up in the share price changes (e.g., Tetlock, 2010). Hence, we follow Altınkılıç and Hansen (2003) and Corwin (2003), and adopt REIT' stock return volatility, measured by using the standard deviation of daily stock returns at each firm-year, as the second information asymmetry measurement.[11]

For robustness, we also use absolute analysts' forecast error as another proxy for information asymmetry, which is another commonly adopted metric. The absolute analysts' forecast error is calculated as the absolute value of the difference between the actual FFO and the median estimated of FFO scaled by its share price at the same period, as

$$Absolute\ Analyst\ Forecast\ Errors = \frac{Absolute\ (Actual\ FFO - Median\ Estimate\ of\ FFO)}{Share\ Price} \tag{2}$$

Following REIT literature (e.g., Eichholtz & Yönder, 2015; Soyeh & Wiley, 2019), our primary measure of investment activity of REITs is annual real estate investment growth, obtained from S&P Global Market Intelligence. Additional to the existing literature, we also calculate the property investment growth for every REIT for which two consecutive years of data are available for net property investment as the log difference of net property investment (i.e., property investment growth). Besides, we follow finance literature (e.g., Cooper et al., 2008), and employ which are the log difference of total assets (i.e., total asset growth), as another proxy for the overall asset expansion and investment growth.

Since there exist disposition effects on REIT investment activity (i.e., Eichholtz & Yönder 2015), we follow Brounen et al. (2007) and separate the property acquisition and property dispositions activities. Thus, the property acquisition (dispositions) of a REIT is defined as the aggregate contractual gross sales price of operating properties purchased (sold) scaled by the average of the total market-value capitalization, less the book value of all non-operational real estate assets, in the current year and previous year. More formally:

$$Acquisitions = \frac{Value\ of\ Properties\ Purchased_{i,t}}{(Real\ Estate\ Value_{i,t-1} + Real\ Estate\ Value_{i,t})/2} \tag{3}$$

$$Dispositions = \frac{Value\ of\ Properties\ Sold_{i,t}}{(Real\ Estate\ Value_{i,t-1} + Real\ Estate\ Value_{i,t})/2} \tag{4}$$

As for the cost of capital measures, we use the ratio of REIT total interest expenses to total debt as the proxy of the cost of debt. Since the cost of equity of a firm is unobservable, it is estimated with return-based asset pricing models, following methods suggested in Fama and French (1997) and D'mello and Shroff (2000). While several methods are currently available to estimate the implied cost of equity of firms, we choose their method because it is based on the stock market information and directly related to equity issuance for REITs new projects.[12] Specifically, the measurement of the cost of equity is the expected return based on the Fama and French (1993) three-factor model. The first step is to run the following regression on each REIT at each year:

$$R_{i,t} = \alpha + \beta_1 MKTRF_t + \beta_2 SMB_t + \beta_3 HML_t + \varepsilon_t, \tag{5}$$

where $R_{i,t}$ is the excess stock return of REIT i, $MKTRF_t$ is the risk-free stock return of the market, SMB_t (Small minus Big) and HML_t (High minus Low) are the return to zero investment factor-mimicking portfolios designed to capture the size and book-to-market effects, respectively, on day t.

We then use the market return in excess of the risk-free rate, the compounded annual *SMB* and *HML* annual risk factors, and the estimated factor loadings (α, β_1, β_2 and β_3) of the three-factor model estimated using daily return in the previous year to obtain the estimated expected return, $\hat{R}_{i,t}$, which is the cost of equity estimate based on the Fama and French (1993) three-factor model.

We also use two measures to assess REIT operational performance. The first one is funds from operations divided by total assets (FFO/TA), because FFO is considered a more proper financial performance measure for the real estate industry.[13] Following the finance literature, we also include return on assets (ROA), which is defined as net income divided by total assets, as the second measure for REIT performance. We then follow Cheng et al. (2015) to calculate executive compensation for REIT managers. We define executive compensation as the average total compensation of each REIT' top five executives. If a firm reports compensation information for fewer than five executives, the average of all the executives reported is calculated.

Table 1. Summary statistics.

	Mean	Median	Std. Dev.	Min	Max	Obs.
Total Assets ($B)	2.803	1.282	4.140	0.009	23.027	3,773
Total Equity ($B)	1.127	0.483	1.705	−0.026	9.356	3,773
Market Capitalization ($B)	2.174	0.769	3.961	0.005	24.136	3,763
Year Listed	13.200	9.000	12.657	0.000	64.000	3,657
Leverage	1.461	1.100	2.104	−8.364	13.352	3,773
Market-to-Book Equity Ratio	1.776	1.444	1.604	−3.478	10.799	3,763
Cash Stock	0.028	0.012	0.048	0.000	0.317	3,769
Credit Line Drawn / Available	0.347	0.313	0.290	0.000	0.998	3,327
Log Analyst Coverage	7.549	6.750	4.851	1.000	20.250	2,515
Institutional Ownership	0.649	0.729	0.323	0.001	0.990	3,773
Real Estate Investment Growth	0.197	0.070	0.415	−0.391	2.400	3,577
Property Investment Growth	0.137	0.063	0.258	−0.406	1.184	3,283
Total Assets Growth	0.129	0.064	0.237	−0.359	1.124	3,389
Acquisitions	0.125	0.060	0.182	0.000	0.981	1,820
Dispositions	0.043	0.016	0.071	0.000	0.432	1,796
Equity Growth	0.114	0.039	0.283	−0.581	1.351	3,328
Debt Growth	0.159	0.077	0.350	−0.807	1.602	3,262
Interest-to-Debt Ratio (%)	5.602	5.421	2.055	1.106	13.361	3,630
Estimated Cost of Equity (%)	0.114	0.101	0.151	−0.339	0.567	3,424
Funds from Operations on Assets (%)	5.354	5.419	3.452	−7.771	15.456	3,667
Return on Assets (%)	2.902	2.796	3.726	−10.097	16.722	3,767
Executive Compensation ($M)	1.679	1.231	1.564	0.021	7.725	2,168
Bid–ask Spread	2.444	1.962	1.473	0.915	9.064	3,773
Stock Return Volatility	0.296	0.227	0.199	0.122	1.171	3,773

Note. This table reports the summary statistics of key variables used in the analysis of this paper. The sample period is from 1993 - 2017. All variables are defined in Appendix A1. To be in the final panel, we require that a firm-year have total assets and bid–ask spreads for the fiscal year. Variables have been winsorized at the 1% and 99% tails of the distributions to avoid the influence of extreme observations.

Following REIT investment literature, other control variables in the analysis are: firm size (defined as the natural logarithm of share price times common share outstanding), firm age (the natural logarithm of 1 plus the number of years since IPO or year REIT status is established), leverage ratio (defined as the ratio of total debt to total equity), market-to-book equity ratio (defined as the ratio of market capitalization to total equity), cash stock (defined as the ratio of cash and cash equivalents to total assets), credit line drawn/available (defined as the evolving credit lines are drawn down as a percent of revolving credit lines available), the natural logarithm of analyst coverage (defined as the natural logarithm of the numbers of analyst reported an FFO forecast, and institutional ownership (defined as the percentage of shares are owned by institutions). The definitions for the variables mentioned above are also listed in the appendix.

Summary Statistics

The summary statistics for REIT investment activity measures, information asymmetry measures, as wells as other firm characteristics used in the empirical analysis, are reported in Table 1. Firm year observations without total assets and the bid–ask spread variable are excluded. To reduce the effect of outliers in the data, the numeric variables are winsorized at the 1% and 99% tails of the distributions. The main sample consists of about 3,773 firm-year observations of 382 REITs from 1993 to 2017. All the variables included in this paper are defined in the appendix.

For the investment activity measures, over the full sample period (1993-2017), the average (median) real estate investment growth, property investment growth, and asset growth are 19.7% (7%), 13.7% (6.3%), and 12.9% (6.4%), respectively. The mean and median acquisition (disposition) rate of a typical REIT is 12.4% (4.3%) and 6% (1.6%). In terms of the REIT cost of capital, the mean (median) interest-to-debt ratio is 5.6% (5.4%), while the mean (median) of their cost of equity

Table 2. Investment activities.

Variables	(1) Real Estate Investment Growth	(2) Real Estate Investment Growth	(3) Property Investment Growth	(4) Property Investment Growth	(5) Total Assets Growth	(6) Total Assets Growth
Bid–ask Spread, *t-1*	−0.060***		−0.032***		−0.041***	
	[−4.19]		[−3.13]		[−4.63]	
Stock Return Volatility, *t-1*		−0.440***		−0.255***		−0.301***
		[−4.32]		[−3.57]		[−4.69]
Firm Size, *t-1*	−0.116***	−0.116***	−0.053***	−0.054***	−0.064***	−0.063***
	[−4.76]	[−4.69]	[−3.26]	[−3.31]	[−4.08]	[−3.98]
Firm Age, *t-1*	−0.087**	−0.077**	−0.052**	−0.046**	−0.064***	−0.057***
	[−2.33]	[−2.06]	[−2.52]	[−2.23]	[−3.26]	[−2.91]
Leverage, *t-1*	−0.065***	−0.065***	−0.042***	−0.042***	−0.044***	−0.044***
	[−5.45]	[−5.40]	[−5.29]	[−5.25]	[−5.57]	[−5.55]
Market-to-Book, *t-1*	0.102***	0.102***	0.067***	0.067***	0.069***	0.069***
	[5.39]	[5.38]	[5.74]	[5.73]	[5.67]	[5.68]
Cash Stock, *t-1*	1.642***	1.642***	0.971***	0.975***	−0.009	−0.011
	[4.12]	[4.13]	[4.13]	[4.17]	[−0.04]	[−0.05]
Credit Line Drawn, *t-1*	−0.073***	−0.071***	−0.050***	−0.048***	−0.059***	−0.058***
	[−3.01]	[−2.97]	[−3.01]	[−2.96]	[−4.00]	[−3.95]
Log Analyst Coverage, *t-1*	−0.008**	−0.008*	−0.007***	−0.007**	−0.006**	−0.006**
	[−2.01]	[−1.93]	[−2.63]	[−2.55]	[−2.50]	[−2.43]
Institutional Ownership, *t-1*	0.003	0.011	0.041	0.045	0.023	0.028
	[0.05]	[0.17]	[0.89]	[0.98]	[0.57]	[0.71]
Constant	1.870***	1.849***	0.965***	0.973***	1.136***	1.116***
	[6.03]	[5.92]	[4.53]	[4.58]	[5.76]	[5.62]
Number of Observations	2,273	2,273	2,263	2,263	2,284	2,284
Number of Firms	266	266	266	266	266	266
R-squared	0.323	0.323	0.292	0.293	0.329	0.329
Firm Fixed Effects	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES

Note. This table reports the results of the regressions of the investment activities of REITs on their information asymmetry measures in the previous year. All regressions include firm fixed effects and year fixed effects. Standard errors are clustered at the firm level and are heteroskedasticity-robust. The *t*-statistics are reported in brackets.
*, **, *** mean significance at 10%, 5%, and 1%, respectively. All variables are defined in the appendix.

estimated using the Fama–French three-factor model is 11.4% (10.1%). For the two performance measures, the mean and median of FFO/TA ROA are 5.35% and 5.42%, while the mean and median of ROA are 2.9% and 5.2%, respectively. Regarding executive compensation, the mean and median are $1.7 million and $1.2 million, respectively. Regarding the information asymmetry measures, the bid–ask spread has a mean of 2.44 and a median of 1.96, while the stock return volatility is 0.30 and 0.23.

Model Specification

To empirically investigate the relationship between REIT information asymmetry and investment activities, we run the following firm and year fixed-effect equation, with heteroskedasticity-robust standard errors clustered at the firm level:[14]

$$\begin{aligned} Invt\ Growth_{i,t} = {} & \beta_0 + \beta_1 Info\ Asymmetry_{i,t-1} + \gamma_1 Firm\ Size_{i,t-1} + \gamma_2 Firm\ Age_{i,t-1} + \gamma_3 Leverage_{i,t-1} \\ & + \gamma_4 Market - to - Book_{i,t-1} + \gamma_5 Cash\ Stock_{i,t-1} + \gamma_6 Credit\ Line\ Drawn/Available_{i,t-1} \\ & + \gamma_7 Analyst\ Coverage_{i,t-1} + \gamma_8 Institutional\ Ownership_{i,t-1} + \eta_i + \alpha_t + \varepsilon_{i,t} \end{aligned} \quad (6)$$

The dependent variables, $Invt\ Growth_{i,t}$, are real estate investment growth, property investment growth, total asset growth, respectively, of REIT *i* in year *t*. $Info\ Asymmetry_{i,t-1}$ is the information

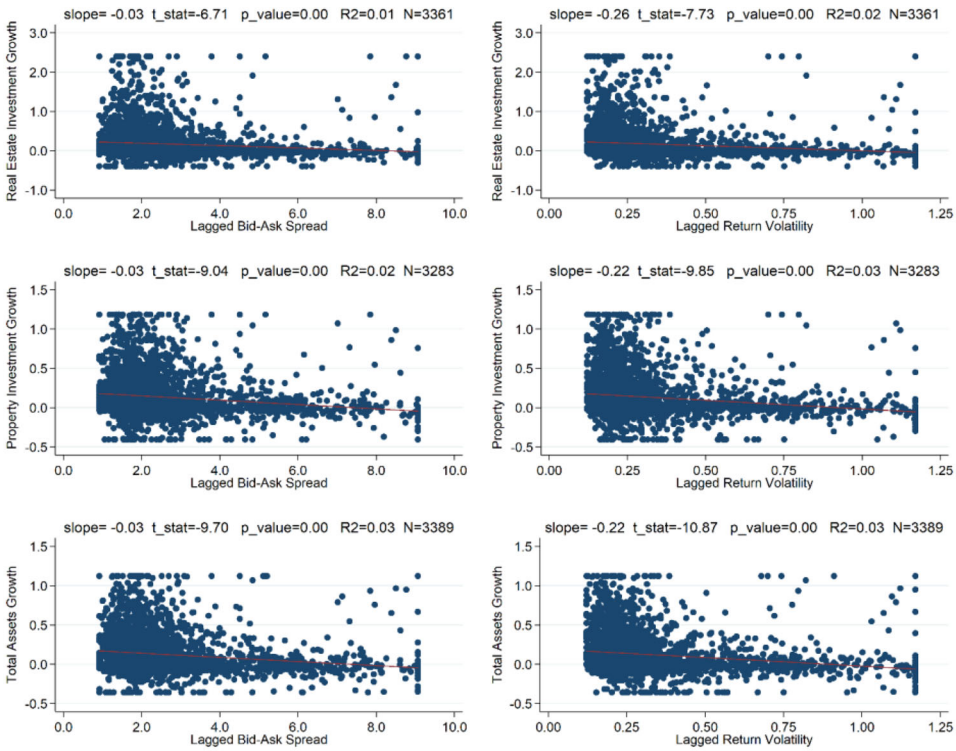

Figure 1. Information asymmetry and investment activities.
Notes. This figure plots the investment activity measures [i.e., real estate investment growth, property investment growth, and total asset growth] of REITs on the vertical axis against two lagged information asymmetry measures [i.e., bid–ask spread and stock return volatility] on the horizontal axis for the sample period. The slope, *t*-statistics, *p*-value, and *R*-squared are reported on the top of each figure.
*, **, *** mean significance at 10%, 5%, and 1%, respectively. All variables are defined in the appendix. Variables are winsorized at the 1% and 99% levels to avoid the influence of extreme observations

asymmetry measures (i.e., bid–ask spread and stock return volatility) of REIT *i* in year *t-1*. η_i and α_t represent firm and year fixed effects, respectively, $\varepsilon_{i,t}$ is the error term. Other variables included in Equation (6) are as defined earlier in Section 2 and the appendix.

It is argued that property purchases and sales may be driven by different factors (Eichholtz & Yönder, 2015). When purchasing a property, investors mainly consider it further performance. However, when selling a property, investors would contemplate its past and future performance. These effects have been documented in both finance (e.g., Shefrin & Statman, 1985) and real estate literature (e.g., Eichholtz & Yönder, 2015). Besides, if information asymmetry negatively affects REIT's ability to raise capital, it might have a stronger impact on property acquisition than with property disposition. Thus, we replace the dependent variable in Equation (6) as property acquisitions and property disposition, respectively, to study the relationship between the real estate acquisition and disposition activities of REITs and their information asymmetry.

The investment activities of REITs are heavily dependent on capital markets. Unlike other firms, the ability of REITs to fund investments via internally generated cash flows is limited due to their mandatory distribution requirement of at least 90% of earnings to shareholders. As a result, large REIT investments are more likely to be funded by the issuance of debt or an increase in the share count. If the cost of equity or the cost of debt is positively associated with information asymmetry, the higher information asymmetry REITs have, more difficult in increasing their equity or debt (An et al., 2011). To empirically examine this channel by which REIT information asymmetry influences

Table 3. Property acquisition and disposition.

Variables	(1) Property Acquisition	(2) Property Acquisition	(3) Property Disposition	(4) Property Disposition
Bid–ask Spread, *t-1*	−0.025***		−0.007*	
	[−2.90]		[−1.89]	
Return Volatility, *t-1*		−0.188***		−0.044*
		[−3.37]		[−1.73]
Firm Size, *t-1*	−0.047***	−0.048***	−0.012*	−0.012*
	[−2.83]	[−2.83]	[−1.83]	[−1.77]
Firm Age, *t-1*	−0.074***	−0.066**	0.002	0.004
	[−2.77]	[−2.46]	[0.29]	[0.53]
Leverage, *t-1*	−0.024***	−0.024***	0.004*	0.004*
	[−4.08]	[−4.03]	[1.93]	[1.91]
Market-to-Book, *t-1*	0.033***	0.033***	−0.010***	−0.010***
	[4.02]	[4.00]	[−2.92]	[−2.90]
Cash Stock, *t-1*	0.838***	0.842***	0.029	0.030
	[3.88]	[3.90]	[0.69]	[0.72]
Credit Line Drawn, *t-1*	−0.012	−0.011	0.009	0.009
	[−0.75]	[−0.70]	[1.20]	[1.22]
Log Analyst Coverage, *t-1*	−0.003	−0.002	0.002**	0.002**
	[−1.22]	[−1.12]	[2.01]	[2.04]
Institutional Ownership, *t-1*	−0.005	0.002	0.004	0.006
	[−0.11]	[0.04]	[0.27]	[0.43]
Constant	0.751***	0.752***	0.175**	0.168**
	[3.62]	[3.60]	[2.16]	[2.02]
Number of Observations	1,472	1,472	1,458	1,458
Number of Firms	194	194	196	196
R-squared	0.195	0.195	0.070	0.069
Firm Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES

Notes. This table reports the results of the regressions of the property acquisition and disposition activities of REITs on their information asymmetry measures in the previous year. All regressions include firm fixed effects and year fixed effects. Standard errors are clustered at the firm level and are heteroskedasticity-robust. The *t*-statistics are reported in brackets.
*, **, *** mean significance at 10%, 5%, and 1%, respectively. All variables are defined in the appendix.

investment activities through the cost of capital, we regress growth of equity and growth of debt along with the estimated cost of equity and cost of debt measures on REIT previous-year information asymmetry measures, using a similar setting as in Equation (6).

Next, to empirically investigate whether there are differentials in the operational performance among REITs with various levels of information asymmetry, we regress REIT performance on the previous-year information asymmetry measures. Lastly, we examine the relationship between executive compensation and levels of information asymmetry in REITs, to investigate the misalignment between the interests of REIT shareholders and managers (i.e., principle-agent problem) in the aspect of REIT level of information asymmetry.

Empirical Results

Main Results

As described in the methodology section, we begin the analysis of the empirical links between REIT investment activities and information asymmetry. The results from Equation (6) with real estate investment growth, property investment growth, and total asset growth as the dependent variables, and bid–ask spread or stock return volatility as the independent variables in a firm and year fixed-effect model are reported in Table 2.

Columns (1) and (2) reveal that the estimated coefficients of the previous year bid–ask spread and stock return volatility are negative (−0.06 and -0.44) with statistical significance at the 1%

Table 4. Growth on equity and debt.

Variables	(1) Equity Growth	(2) Equity Growth	(3) Debt Growth	(4) Debt Growth
Bid–ask Spread, *t-1*	−0.037***		−0.031**	
	[−3.43]		[−1.99]	
Return Volatility, *t-1*		−0.211***		−0.323***
		[−2.97]		[−2.99]
Firm Size, *t-1*	−0.089***	−0.085***	−0.030	−0.035
	[−4.17]	[−3.97]	[−1.18]	[−1.40]
Firm Age, *t-1*	−0.094***	−0.090***	−0.067**	−0.059*
	[−3.82]	[−3.65]	[−2.13]	[−1.88]
Leverage, *t-1*	−0.004	−0.005	−0.062***	−0.061***
	[−0.26]	[−0.30]	[−4.94]	[−4.89]
Market-to-Book, *t-1*	0.072***	0.073***	0.088***	0.087***
	[3.67]	[3.73]	[5.14]	[5.09]
Cash Stock, *t-1*	−0.381	−0.390	1.043***	1.053***
	[−1.51]	[−1.55]	[3.06]	[3.09]
Credit Line Drawn, *t-1*	0.020	0.020	−0.177***	−0.175***
	[0.87]	[0.87]	[−6.88]	[−6.86]
Log Analyst Coverage, *t-1*	−0.003	−0.003	−0.010**	−0.009**
	[−1.07]	[−1.06]	[−2.56]	[−2.47]
Institutional Ownership, *t-1*	0.003	0.010	0.082	0.084
	[0.07]	[0.21]	[1.22]	[1.25]
Constant	1.467***	1.398***	0.714**	0.789**
	[5.48]	[5.25]	[2.23]	[2.51]
Number of Observations	2,249	2,249	2,281	2,281
Number of Firms	266	266	266	266
R-squared	0.261	0.259	0.248	0.250
Firm Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES

Notes. This table reports the results of the regressions of the growth rate of equity and debt of REITs on their information asymmetry measures in the previous year. All regressions include firm fixed effects and year fixed effects. Standard errors are clustered at the firm level and are heteroskedasticity-robust. The *t*-statistics are reported in brackets.
*, **, *** mean significance at 10%, 5%, and 1%, respectively. All variables are defined in the appendix.

level. These results suggest that higher information asymmetry REITs are, on average, associated with lower real estate investment growth. The coefficients of the previous year bid–ask spread or stock return volatility are also negative (−0.03 and -0.26 when the dependent variable is property investment growth, and -0.04 and -0.30 when the dependent variable is total asset growth) with statistical significance at the 1% level as shown in columns (3) to (6). Overall, the results presented in this table indicate that the REIT investment activities are negatively related to their level of information asymmetry.

In addition to the coefficients of interest, we also show that REITs of larger size, older age, higher leverage, less available credit line, and more analyst coverage are associated with fewer investment activities, and REITs with higher market-to-book equity ratio and cash stock are associated with more investment activities. This is in line with expectations and is consistent with the literature. The negative relationship between firm growth and size and age (e.g., Ambrose et al., 2000), leverage (e.g., Capozza & Seguin, 2001), and credit line usage (e.g., Hardin & Hill, 2011), analyst coverage (e.g., Derrien & Kecskés, 2013) are widely found in the literature. Feng et al. (2007) also show that the growth opportunities of a firm are positively related to market valuation. Hardin et al. (2009) and Denis and Sibilkov (2010) provide evidence on the positive association between cash holdings and levels of investment. The negative relationship between analyst coverage and REIT investment is another piece of evidence on the impact of information asymmetry on firm growth because transparency increases with greater analyst coverage (e.g., Riddiough et al., 2005).

Table 5. The cost of financing.

Variables	(1) Estimated Cost of Equity	(2) Estimated Cost of Equity	(3) Interest-to-Debt Ratio	(4) Interest-to-Debt Ratio
Bid–ask Spread, *t-1*	1.903***		0.173**	
	[3.77]		[2.15]	
Return Volatility, *t-1*		14.782***		1.649***
		[3.90]		[3.09]
Firm Size, *t-1*	−0.550	−0.508	−0.261*	−0.239*
	[−1.25]	[−1.14]	[−1.91]	[−1.76]
Firm Age, *t-1*	1.766***	1.428**	0.160	0.120
	[2.74]	[2.12]	[1.04]	[0.78]
Leverage, *t-1*	0.194	0.190	0.150***	0.147***
	[1.41]	[1.40]	[2.95]	[2.90]
Market-to-Book, *t-1*	−0.491***	−0.495***	−0.249***	−0.245***
	[−2.66]	[−2.73]	[−3.65]	[−3.62]
Cash Stock, *t-1*	−3.476	−3.492	−1.122	−1.164
	[−0.54]	[−0.55]	[−0.74]	[−0.77]
Credit Line Drawn, *t-1*	−0.154	−0.216	−0.084	−0.095
	[−0.25]	[−0.35]	[−0.68]	[−0.77]
Log Analyst Coverage, *t-1*	0.135**	0.125**	0.029**	0.028**
	[2.27]	[2.08]	[2.14]	[2.02]
Institutional Ownership, *t-1*	1.409	1.182	−0.351	−0.362
	[1.16]	[0.99]	[−0.96]	[−1.00]
Constant	0.575	0.584	8.965***	8.671***
	[0.10]	[0.10]	[5.32]	[5.23]
Number of Observations	2,284	2,284	2,281	2,281
Number of Firms	266	266	266	266
R-squared	0.871	0.872	0.322	0.324
Firm Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES

Notes. This table reports the results of the regressions of the estimated cost of equity and the cost of debt of REITs on their information asymmetry measures in the previous year. All regressions include firm fixed effects and year fixed effects. Standard errors are clustered at the firm level and are heteroskedasticity-robust. The *t*-statistics are reported in brackets.
*, **, *** mean significance at 10%, 5%, and 1%, respectively. All variables are defined in the appendix.

It is worth noting that achieving a higher relative level of investment activities is difficult to do in a capital-intensive business, such as equity REITs, which must distribute most of their income and heavily rely on the capital markets to grow. This further highlights the importance of information asymmetry on investment activities.

The negative relationship between information asymmetry and investment activities in the sample is also shown in the univariate regression models. Figure 1 plots the real estate investment growth, property investment growth, and total asset growth of REITs versus the previous year bid–ask spread and stock return volatility, respectively. The negative slope is visually clear in each of the plots.

Next, we separate REIT investment activity into real estate acquisitions and real estate depositions. The results from Equation (6) with property acquisition activity as the dependent variable are presented in Column (1) and (2) in Table 3. The estimated coefficients of the previous year's bid–ask spread or stock return volatility are negative (−0.03 and -0.19) with statistical significance at the 1% level. While the dependent variable is property depositions activities, as in Columns (3) and (4), the estimated coefficients are also negative (−0.01 and -0.04) and statistically significant at the 10% level.

The results suggest a strong negative relation between REIT property acquisitions and their information asymmetry, and a weak correlation between more property dispositions and high information asymmetry in REITs. These results make intuitive sense. To acquire more properties,

Table 6. The operational performance.

Variables	(1) FFO/TA	(2) FFO/TA	(3) ROA	(4) ROA
Bid–ask Spread, *t-1*	−0.377***		−0.637***	
	[−2.97]		[−4.74]	
Return Volatility, *t-1*		−2.750***		−4.704***
		[−2.90]		[−5.01]
Firm Size, *t-1*	0.697***	0.693***	0.440*	0.440*
	[3.64]	[3.57]	[1.91]	[1.88]
Firm Age, *t-1*	0.058	0.123	0.427*	0.532**
	[0.24]	[0.51]	[1.73]	[2.13]
Leverage, *t-1*	−0.576***	−0.576***	−0.727***	−0.727***
	[−8.02]	[−8.07]	[−8.37]	[−8.50]
Market-to-Book, *t-1*	0.772***	0.775***	0.928***	0.932***
	[8.91]	[8.90]	[9.05]	[9.18]
Cash Stock, *t-1*	−2.345	−2.341	−2.278	−2.306
	[−1.30]	[−1.31]	[−0.96]	[−0.97]
Credit Line Drawn, *t-1*	0.081	0.093	0.200	0.216
	[0.33]	[0.37]	[0.73]	[0.78]
Log Analyst Coverage, *t-1*	−0.052*	−0.050	−0.049	−0.046
	[−1.69]	[−1.63]	[−1.37]	[−1.30]
Institutional Ownership, *t-1*	−0.649	−0.594	−0.804	−0.721
	[−1.22]	[−1.12]	[−1.28]	[−1.16]
Constant	−1.320	−1.429	−0.780	−1.013
	[−0.53]	[−0.57]	[−0.25]	[−0.32]
Number of Observations	2,228	2,228	2,282	2,282
Number of Firms	265	265	266	266
R-squared	0.246	0.246	0.239	0.239
Firm Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES

Notes. This table reports the results of the regressions of the funds from operations on assets (FFO/TA) and net income on assets (ROA) of REITs on their information asymmetry measures in the previous year. All regressions include firm fixed effects and year fixed effects. Standard errors are clustered at the firm level and are heteroskedasticity-robust. The *t*-statistics are reported in brackets.

*, **, *** mean significance at 10%, 5%, and 1%, respectively. All variables are defined in the appendix.

REITs need to raise capital from the equity or debt market. The information asymmetry of REITs negatively affects their ability to issue more equity and debt, with the impact on equity are larger than that on debt.

Table 4 reports the regression results on the relationship between REIT information asymmetry and the growth of equity or debt. The estimated coefficients are negative (−0.04 for bid–ask spread and -0.21 for stock return volatility) and statistically significant, as in Column (1) and (2), which the dependent variable is equity growth. The results indicate that REITs with a higher level of information asymmetry are, on average, less likely to increase their equity account. The results in Column (3) and (4), which the dependent variable is debt growth, are also very similar to the results presented in Column (1) and (2) and display statistical significance, suggesting that REITs with higher information asymmetry are associated with less debt issuance.

Next, we investigate whether REIT information asymmetry is related to the cost of financing, after examining the relationship between information asymmetry and the growth of equity and debt. Table 5 displays the results. In Column (1) and (2), where the dependent variable is the cost of equity that is estimated using the Fama–French three-factor model, the coefficient estimates of the previous year's bid–ask spread and stock return volatility are all positive (1.90 and 14.78) and statistically significant at the 1% level. In Columns (3) and (4), where the dependent variable is interest-to-debt, the estimated coefficients of bid–ask spread and stock return volatility are also positive (0.17 and 1.65) and statistically significant at the 1% or 5% level, indicating high-information-asymmetry REITs, on

Table 7. Executive compensation.

Variables	(1) Executive Compensation	(2) Executive Compensation
Bid–ask Spread, *t-1*	0.135**	
	[2.42]	
Return Volatility, *t-1*		0.908**
		[2.38]
Firm Size, *t-1*	0.647***	0.638***
	[4.54]	[4.57]
Firm Age, *t-1*	0.048	0.026
	[0.25]	[0.13]
Leverage, *t-1*	−0.050	−0.050
	[−0.77]	[−0.76]
Market-to-Book, *t-1*	0.066	0.064
	[0.66]	[0.64]
Cash Stock, *t-1*	0.024	0.038
	[0.02]	[0.02]
Credit Line Drawn, *t-1*	−0.012	−0.018
	[−0.10]	[−0.15]
Log Analyst Coverage, *t-1*	0.022	0.022
	[1.43]	[1.43]
Institutional Ownership, *t-1*	−1.075***	−1.103***
	[−3.07]	[−3.11]
Constant	−7.911***	−7.725***
	[−4.36]	[−4.39]
Number of Observations	1,576	1,576
Number of Firms	159	159
R-squared	0.422	0.422
Firm Fixed Effects	YES	YES
Year Fixed Effects	YES	YES

Notes. This table reports the results of the regressions of the executive compensation of REITs on their information asymmetry measures in the previous year. The executive compensation is the average of total executive compensation (*tdc1* in ExecuComp database) of top five executives in a firm. All regressions include firm fixed effects and year fixed effects. Standard errors are clustered at the firm level and are heteroskedasticity-robust. The *t*-statistics are reported in brackets.
*, **, *** mean significance at 10%, 5%, and 1%, respectively. All variables are defined in the appendix.

average, pay a higher amount of interest to their principle as compared with low-information-asymmetry REITs. Collectively, this provides evidence that REIT's cost of financing is negatively associated with their previous year's information asymmetry, and supports the previous results on the negative relationship between REIT equity and debt growths and levels of information asymmetry.

Table 6 displays the results of regressing REIT operational performance and levels of information asymmetry. Negative relations between REIT performance and information asymmetry are evident. When the dependent variable is FFO/TA, the estimated coefficients of the previous-year bid–ask spread (stock return volatility) is -0.38 (−2.75) and statistically significant at the 1% level, as in Columns (1) and (3). Concerning ROA, the estimated coefficient is -0.64 for bid–ask spread and -4.70 for stock return volatility, as in Columns (2) and (4). Both display statistically significant at the 1% level. The results suggest that REITs with high levels of information asymmetry, on average, underperform REITs with low levels of information asymmetry, regardless of whether the performance measure is specific for the real estate industry or non-REIT firms.

The results presented in Table 7 shed light on the mechanism in which a REIT's level of information asymmetry is associated with executive compensation. The dependent variable is the natural logarithm of the average total compensation of the top five executives. The estimated coefficient of the previous-year bid–ask spread is 0.14, while the estimated coefficient of the previous-year stock return volatility is 0.91. Both are statistical significance at the 5% level. These results suggest

Table 8. Mergers and acquisitions in logistic regression.

Variables	(1) Mergers and Acquisitions	(2) Mergers and Acquisitions
Bid–ask Spread, *t-1*	−0.706*	
	[−1.71]	
Return Volatility, *t-1*		−7.717**
		[−2.15]
Firm Size, *t-1*	0.538***	0.539***
	[2.71]	[2.72]
Firm Age, *t-1*	−0.421**	−0.374**
	[−2.54]	[−2.32]
Leverage, *t-1*	−0.026	−0.027
	[−0.22]	[−0.22]
Market-to-Book, *t-1*	0.038	0.041
	[0.30]	[0.32]
Cash Stock, *t-1*	−4.146	−3.962
	[−0.76]	[−0.74]
Credit Line Drawn, *t-1*	−1.977***	−1.951***
	[−3.27]	[−3.22]
Log Analyst Coverage, *t-1*	−0.013	−0.014
	[−0.29]	[−0.33]
Institutional Ownership, *t-1*	−0.746	−0.661
	[−1.11]	[−0.98]
Constant	−6.664**	−6.356**
	[−2.32]	[−2.24]
Number of Observations	2,107	2,107
Pseudo *R*-squared	0.100	0.104
Year Fixed Effects	YES	YES

Notes. This table reports the results of the logistic regressions, where the dependent variable is a count variable which is equal to 1 if a REIT is a buyer in a merger and acquisition, and 0 otherwise. *z*-statistics are in brackets.
*, **, *** mean significance at 10%, 5%, and 1%, respectively. All variables are defined in the appendix.

that REITs with high levels of information asymmetry generally pay more for their executives, compared with REITs with low levels of information asymmetry.

These results also imply there exist strong principle-agent issues in high information asymmetry REITs. Their executives receive higher total pay while their firms underperform their pairs, pay a higher cost for capital, and have fewer investment activities, compared with REITs with low levels of information asymmetry. The study sheds light on the importance of aligning interests of managers with those of stakeholders in recent REIT executive compensation reform. While pay-for-performance and pay-for-risk are the two most important determinations of REIT management compensation plans, the degree of information asymmetry should also be considered.

Additional Analysis

Next, we conduct some additional analysis on the relationship between information asymmetry and REIT investment. The acquisition strategy has been used by REITs to grow rapidly and gain a competitive advantage on the economics of scales and operational efficiency improvements. Hence, we run a logit regression where the dependent variable is a dummy variable with a value of 1 if a REIT is involved in mergers and acquisitions activities as a buyer at a given year, and 0 otherwise. The independent variables include various REIT characteristics similar to the ones we used in the previous tables, excluding the firm fixed effects, as in Table 8. The estimated coefficients of the previous year's bid–ask spread and stock return volatility are both negative (−0.71 and -7.72), with the z-scores of -1.71 and -2.15, respectively. This result indicates that as a REIT's information asymmetry increases, it is less likely to become an acquirer.

Next, we use the absolute analysts' forecast error as an information asymmetry proxy. Table 9 presents the results. REITs investment activities are negatively associated with the level of

Table 9. Analyst forecast errors as information asymmetry proxy.

Variables	(1) Real Estate Investment Growth	(2) Property Investment Growth	(3) Total Assets Growth	(4) Property Acquisition	(5) Property Disposition
Analyst Forecast Errors, *t-1*	−1.430***	−0.808**	−1.072***	−0.356*	−0.063
	[−3.79]	[−2.53]	[−4.14]	[−1.83]	[−0.45]
Firm Size, *t-1*	−0.094***	−0.042**	−0.051***	−0.040**	−0.010
	[−3.28]	[−2.26]	[−2.74]	[−2.30]	[−1.44]
Firm Age, *t-1*	−0.103**	−0.061**	−0.070***	−0.083***	0.001
	[−2.28]	[−2.53]	[−2.99]	[−2.96]	[0.09]
Leverage, *t-1*	−0.069***	−0.045***	−0.047***	−0.025***	0.004*
	[−4.93]	[−4.83]	[−5.02]	[−3.98]	[1.80]
Market-to-Book, *t-1*	0.108***	0.073***	0.074***	0.035***	−0.009***
	[4.77]	[5.04]	[4.95]	[3.89]	[−2.70]
Cash Stock, *t-1*	1.591***	0.924***	−0.104	0.823***	0.033
	[3.61]	[3.70]	[−0.48]	[3.67]	[0.77]
Credit Line Drawn, *t-1*	−0.071***	−0.046**	−0.052***	−0.017	0.010
	[−2.90]	[−2.59]	[−3.35]	[−0.99]	[1.42]
Log Analyst Coverage, *t-1*	−0.010**	−0.008***	−0.007***	−0.002	0.002**
	[−2.16]	[−2.88]	[−2.67]	[−0.86]	[2.12]
Institutional Ownership, *t-1*	0.020	0.052	0.033	0.008	0.010
	[0.29]	[1.09]	[0.76]	[0.19]	[0.69]
Constant	1.500***	0.738***	0.913***	0.621***	0.134
	[4.08]	[3.03]	[3.87]	[2.98]	[1.52]
Number of Observations	2,081	2,079	2,085	1,438	1,426
Number of Firms	241	240	241	191	194
R-squared	0.325	0.303	0.335	0.187	0.068
Firm Fixed Effects	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES

Notes. This table reports the results using REITs analyst forecast errors as a proxy for information asymmetry. The dependent variables are the three measures of REIT investment activities, and REIT property acquisition and disposition activities, respectively, in the previous year. All regressions include firm fixed effects and year fixed effects. Standard errors are clustered at the firm level and are heteroskedasticity-robust. The *t*-statistics are reported in brackets.
*, **, *** mean significance at 10%, 5%, and 1%, respectively. All variables are defined in the appendix.

information asymmetry. Specifically, the estimated coefficients for the previous year Analyst Forecast Errors are -1.43, -0.81 and -1.07 when the dependent variables are real estate investment growth, property investment growth, and total asset growth, respectively, as in Columns (1) to (3), with statistical significance at the 1% or 5% level. The estimated coefficients for Analyst Forecast Errors are negative when the dependent variables are property acquisition and disposition, as in Columns (4) and (5), but only marginally significant concerning property acquisition. Overall, the results using absolute analysts' forecast error confirm the main results that the information asymmetry of REITs is negatively related to their investment activities.

Conclusions

Information asymmetry is at the heart of unethical behaviors in business and it has drawn great attention from academics, policymakers, and practitioners over the past decades. Despite the importance of information asymmetry, research regarding its impact on investment has been limited. To fill this gap, we examine whether and the extent to which a firm's information asymmetry is related to its investment activities, using the unique setting of REITs. REITs must distribute at least 90% of earnings to shareholders; thus, REITs are not likely to fund investments via internally generated cash flows but are instead heavily dependent on capital markets.

Using two measures of information asymmetry (bid–ask spread and stock return volatility) on a sample of U.S. equity REITs during the 1993–2017 period, we show that information asymmetry is negatively related to investment activities. Specifically, higher-information-asymmetry REITs are associated with lower investment activities measured by real estate investment growth, property investment growth, and total asset growth. Moreover, the higher-information-asymmetry REITs also have, on average, higher cost of equity and debt as compared with lower information asymmetry REITs. This paper also provides evidence that REITs with high levels of information asymmetry pay more for their executives, implying a severe agency problem in those firms.

Collectively, our findings illustrate the importance of information asymmetry and contribute to the literature on this underexplored topic. Firms should strive to overcome information asymmetry between managers and stakeholders. The findings also have implications for investors who may want to pay closer attention to the information asymmetry of the firms that they invest in. From the firm perspective, managers should focus on information asymmetry because it can be a result of agency problems and misappropriation of corporate resources. It would be beneficial for firm managers to improve their information disclosures.

Notes

1. See recent REIT literature (e.g., Eichholtz & Yönder, 2015; Ling et al., 2019; Xu & Ooi, 2018)
2. See FTSE Nareit Real Estate Index Historical Market Capitalization, 1972–2017, at https://www.reit.com/data-research/reit-market-data/us-reit-industry-equity-market-cap.
3. See https://www.msci.com/gics
4. See https://www.reit.com/what-reit.
5. The bid–ask-spread as a proxy for information asymmetry can also be found in accounting literature (e.g., Healy et al., 1999) and finance literature (e.g., Derrien et al., 2016).
6. All these information asymmetry measures are vulnerable to some degree of critique on their potential measurement errors. For instance, bid–ask spreads could be a function of market structure (Huang & Stoll, 1996); stock return volatility can be a function of the volatility of firms' economic fundamentals; analysts' forecasts may be biased by analysts' affiliation (Michaely & Womack, 1999).
7. In this regard, we would also like to know whether the findings from the general finance literature would hold for REITs or not, as REITs are often excluded from such studies.
8. When accounting information is not available at year t but available at year $t–1$ and year $t+1$, it is replaced by the average of the variable at year t-1 and year $t+1$.
9. Kenneth R. French's data library: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.
10. Measurements of information asymmetry fall broadly into three categories: market microstructure measures such as bid–ask spread (e.g., Hasbrouck, 1995), corporate finance measures such as share turnover and stock price volatility (e.g., Moyer et al. 1989), and analysts' forecast measures (e.g., Krishnaswami & Subramaniam, 1999).
11. To ensure our measures are reliable, REITs with less than 60 days of return are excluded in computing the bid–ask spread and stock return volatility.
12. Other measures of the implied cost of equity include a residual income module (e.g., Gebhardt et al., 2001; Claus & Thomas, 2001), a generalization of the Gordon constant growth model (i.e., Ohlson & Juettner-Nauroth, 2005), and a Price-Earnings-Growth model (i.e., Easton, 2004).
13. See the Funds from Operations White Paper - 2018 Restatement by Nareit at https://www.reit.com/nareit/advocacy/policy/financial-standards-reporting/nareit-funds-operations-ffo.
14. For robustness purpose, we also estimated a property type and year fixed effect model. Our untabulated results continue to hold and will be provided upon request.

Author's Note

This research was mainly developed at Frostburg State University, the remainder was completed at the University of Texas at El Paso.

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Appendix
Definition of Variables

Table A1. Definition of variables.

Variable	Definition
Market Capitalization (Firm Size)	The natural logarithm of the market capitalization of common equity. That is share price times common share outstanding.
Year listed (Firm Age)	The natural logarithm of the number of years since the IPO.
Leverage Ratio	The ratio of total debt to total assets.
Market-to-Book Equity Ratio	The ratio of the market capitalization of common equity to total equity.
Cash Stock	The ratio of cash and cash equivalents to total assets
Credit Lines Drawn / Available	Revolving credit lines are drawn down as a percent of revolving credit lines available, as reported by S&P Global Market Intelligence.
Real Estate Investment Growth	Real estate investment growth as reported by S&P Global Market Intelligence.
Property Investment Growth	The log difference of Net Property Investment.
Total Assets Growth	The log difference of total assets.
Log Analyst Coverage	The natural logarithm of the numbers of analysts reported an FFO forecast.
Institutional Ownership	The percentage of shares are owned by institutions.
Property Acquisitions	The aggregate contractual gross sales price of operating properties purchased scaled by the average of the total market-value capitalization, less the book value of all non-operational real estate assets, in the current year and previous year.
Property Dispositions	The aggregate contractual gross sales price of operating properties sold scaled by the average of the total market-value capitalization, less the book value of all non-operational real estate assets, in the current year and previous year.
Mergers and Acquisitions	A binary variable indicating whether the REIT involved in mergers and acquisitions activities as a buyer at a given year.
Total Equity Growth	The log difference of total equity.
Total Debt Growth	The log difference of total debt.
Estimated Cost of Equity	The cost of Equity is estimated based on Fama and French (1993) three-factor model. we use the market return in excess of the risk-free rate, the compounded annual *SMB* and *HML* annual risk factors and the estimated factor loadings, α, β_1, β_2 and β_3, of the three-factor model estimated using daily return in the previous year to obtain the estimated expected return, $\hat{R}_{i,t}$, which is the cost of equity estimate based on the Fama and French (1993) three-factor model.
Funds from Operations on Assets (FFO/TA)	Funds from operations scalded by total assets.
Return on assets (ROA)	Net income scalded by total assets.
Executive Compensation	The average of total compensation (*tdc1* in ExecuComp) of the top five executives at each firm.
Interest-to-Debt Ratio	The ratio of the interest on the debt and other borrowings of the REIT to its total debt.
Bid–ask Spread	Daily bid–ask Spread (Spread) is calculated as $[(Ask - Bid)/(Ask + Bid)/2]$. Then, we average the spread over the calendar year.
Stock Return Volatility	The standard deviation of daily stock returns at each firm-year.