# REIT Operational Efficiency: Performance, Risk and Return

Eli Beracha, Ph. D.
Assistant Professor
Tibor and Sheila Hollo School of Real Estate
Florida International University
1101 Brickell Avenue, Suite 1101-S
Miami, FL 33131

William G. Hardin, Ph. D.
Professor and Tibor and Sheila Hollo Research Fellow
Director of the Tibor and Sheila Hollo School of Real Estate and the Jerome Bain Real Estate Institute
Florida International University
1101 Brickell Avenue, Suite 1101-S
Miami, FL 33131

Zifeng Feng
Tibor and Sheila Hollo School of Real Estate
Florida International University
1101 Brickell Avenue, Suite 1101-S
Miami, FL 33131
zfeng@fiu.edu

# REIT Operational Efficiency: Performance, Risk and Return*


## Abstract

The impact of Real Estate Investment Trust (REIT) efficiency on operational performance, risk and stock return is examined. REIT-level operational efficiency is measured as the ratio of operational expenses to revenue, where a higher operational efficiency ratio (OER) indicates a less efficient REIT. Using a sample of U.S. equity REITs during the modern REIT era, we find that REITs' operational performance measured by return on assets (ROA and FFOA) as well as return on equity (ROE and FFOE) is negatively and significantly associated with their previous-year operational efficiency ratios. Results also show that more efficient REITs are exposed to fewer market and credit risks. Furthermore, we provide evidence that the cross-sectional stock return of REITs is partially explained by their operational efficiency ratios, and that a portfolio consisting of high efficiency REITs earns, on average, a higher cumulative stock return than a portfolio consisting of low efficiency REITs.



**Key Words:** Real Estate Investment Trusts, REIT, Efficiency, Performance


---


* *Current Version: February 12, 2017.*


*Preliminary draft. Please do not cite without permission. All comments are welcomed.*

## 1. Introduction

The literature focused on REITs is extensive. The majority of studies, however, is focused on several broad areas including diversification benefits, acquisition strategies, differences in equity and mortgage investments, corporate governance and capital structure[1]. Few studies investigate the relations between revenues from real estate assets and the expenses needed to generate those revenues. Specifically, little work has been applied to: (1) the appropriate classification of REIT revenues and expenses, such as gross rent, net rent, depreciation, amortization and tenant pass-throughs; and (2) exploring the value implications associated with these relations. In the present research, we introduce measures of REIT operational efficiency similar to those found in the banking literature. These measures of efficiency, linking various types of operational expenses to revenues, are defined within a REIT context. The impact of these measures on REIT operational performance, risk and stock return is concurrently explored.

Efficiency in financial institutions has been investigated in great detail. The most common efficiency ratio found in the literature and used by analysts and bank executives, is usually defined as a bank's non-interest expense divided by revenue or net income (Bikker and Haaf, 2002; Bonin, Hasan, and Wachtel, 2005; Jacewitz and Kupiec, 2012). In the Quarterly Banking Profile from the Federal Deposit Insurance Corporation (FDIC), efficiency is defined as "noninterest expense less amortization of intangible assets as a percent of net interest income plus noninterest income". The FDIC further explains that "this ratio measures the proportion of net operational revenue that are

[1] See Brounen and de Koning (2013) and Baker and Chinloy (2014) for more details.

absorbed by overhead expense, so that a lower value indicates greater efficiency."[2] REITs are, in fact, similar to financial institutions in many ways. The National Association of Real Estate Investment Trusts (NAREIT) defines a REIT as "A company that owns or finances income-producing real estate. Modeled after mutual funds, REITs provide investors of all types regular income streams, diversification and long-term capital appreciation. REITs typically pay out all of their taxable income as dividends to shareholders." [3] A REIT is an intermediary that passes income and cash flows to its shareholders and its value should be related to how efficient it is in providing this service.

While some REIT studies focus on technical efficiency, X-efficiency and economies of scale (Anderson, Lewis, and Springer, 2000; Anderson, et al. 2002; Devaney and Weber, 2005; Kuhle, Walther and Wurtzebach, 2009), this study employs an efficiency ratio that is based on the banking efficiency concept described above. The efficiency ratios used measure the amount of revenue REITs generate revenue relative to their operational expenses. Specifically, we create two REIT operational efficiency ratios defined as: a) total expenses less real estate depreciation and amortization expense to total revenue and b) total expenses less real estate depreciation and amortization expense adjusted for property specific expenses to total revenue less expense reimbursements.[4] In the accounting and financial economics literature, similar ratios of operating expense divided by annual sales are used as an agency cost proxy because they serve as a measure

[2] https://www.fdic.gov/bank/analytical/qbp/glossary.html
[3] https://www.reit.com/investing/reit-basics/what-reit
[4] The measure is adjusted to reflect those costs that are directly associated with asset operations and management. The adjustment is made for expenses that are passed through to tenants. Not all property expenses are reimbursed while we also control for property type.

of the effectiveness of the management team in controlling operations and direct agency costs (Ang, Cole and Lin, 2000).

Using a broad sample of U.S. equity REITs from the modern REIT era, we show that REIT return on assets and REIT return on equity are strongly related to firm operating efficiency. The results suggest that more efficient REITs are associated with better operational performance. Further results show that REIT market and credit risks benefit from greater operational efficiency. Finally, we also illustrate that REIT cross-sectional stock returns may be partially explained by operational efficiency. A portfolio consisting of more efficient REITs earns, on average, higher cumulative stock returns compared with a portfolio consisting of less efficient REITs. Overall, these findings illustrate the importance of REIT operational efficiency on performance, risk and return.

## 2. An Overview of Related Literature

There is a rich banking literature on the efficiency of financial institutions. Most of the literature focuses on four types of common efficiency measures. The first type is scale efficiency. The idea is that financial institutions benefit from economies of scale. Hence, larger firms are more likely to have better performance (Berger, Hancock, and Humphrey, 1993; Berger, Hunter, and Timme, 1993). The second one is scope efficiency, whereby financial institutions benefit from lowering average costs by producing and selling a wide array of products (Zardkoohi and Kolari, 1994). The third efficiency measure is X-efficiency, which illustrates whether financial institutions are operating with an efficient mix of inputs, (Berger, Hunter, and Timme, 1993; Allen and Rai,1996). Finally, the fourth and most common efficiency measure is an efficiency ratio

defined as non-interest expense divided by revenue or net income (Bikker and Haaf, 2002; Bonin, Hasan, and Wachtel, 2005; Jacewitz and Kupiec, 2012). This efficiency measure is a straight forward indicator of overhead expenses relative to operational revenues. Financial institutions associated with lower ratios are considered to be more efficient.

Anderson, Lewis and Springer (2000) provide a comprehensive review of the efficiency literature for real estate brokerage services and REITs. Allen and Sirmans (1987), Linneman (1997), Bers and Springer (1997) and Vogel (1997) show that REIT mergers and acquisitions are due in part to the existence of economies of scale. Similarly, Anderson, et al. (1999) and Anderson, et al. (2002) analyze REITs' scale economies and X- efficiency using data envelopment analysis (DEA). They show that REITs are generally scale inefficient. In their narrow 1992-1996 sample period, REITs' overall efficiency scores measured between 44.1% and 60.5% (out of 100%). They also show that large REITs are more efficient than small REITs and suggest that expansion mayi improve performance. Using a stochastic frontier methodology and Bayesian statistics to define REITs' efficient cost frontiers, Lewis, Springer and Anderson (2003) find that REITs are almost 90% efficient and show that REIT performance and efficiency are positively related.

There is, however, conflicting evidence with respect to economies of scale in REITs. For example, McIntosh, Liang and Thompkins (1991) and McIntosh, Ott and Liang (1995) provide evidence against the existence of scale economies. Similarly, Mueller (1998) and Ambrose, et al. (2000) show that smaller REITs are more profitable, indicating there may be an optimal REIT size based on their cash flows. More recently, Chung, Fung and Hung (2010) show that institutional ownership can help to reduce REITs' inefficiency. The ambiguity may be related to sample frame and the maturation of the REIT industry.

Bers and Springer (1998a, 1998b) use the ratio of different REIT costs, such as general and administrative (G&A) expense, management fees, operating expense, interest expense and interest expense, to total liabilities to examine scale economies. This measure, which is conceptually similar to the efficiency measures we use in this paper, allowed them to show a negative cost elasticity associated with interest expense related to total liabilities. In a related paper, they assess differences in scale economies among a variety of REIT characteristics and find that internally or externally management, capital structure and property types are related to their scale economies.

The present investigation builds on this existing, older literature primarily focused on the pre-modern REIT era by introducing efficiency ratios similar to those found in the banking literature. The question of interest is straight forward. Are REITs rewarded for their efficiency?

## 3. Data Sources and Summary Statistics

From SNL Financial, the main data source for this study, we collect firm characteristics for U.S. equity REITs for the modern REIT era (1993 – 2015) with annual frequency. Each observation includes share price, total dividends paid, common shares outstanding, implied market capitalization (MktCap), total revenue (TR)[5], expense reimbursements (ExpReim)[6], total expenses (TotExp), real estate depreciation and amortization (REDA), rental operational expense (RentExp), interest expense (IntExp), total assets (TA), total debt (TD), total equity (TE), earnings before

[5] All revenue including nonrecurring. Revenue is net of interest expenses for banks, thrifts, lenders, FHLBs, investment companies, asset managers and broker-dealers, as defined by SNL.

[6] Expenses reimbursed from tenants for common area maintenance and improvements, including operating expenses such as real estate taxes, insurance, and utilities, as defined by SNL.

interest, tax, depreciation and amortization (EBITDA), net income (NI), funds from operations (FFO), IPO date, the year the REIT was established and real estate property type.[7] We also obtain daily stock return data from the Center for Research in Security Prices (CRSP) and daily market factors and risk free rate from Kenneth French's website[8].

We define REIT operational efficiency ratio (OER) in general terms as total operational expenses divided by revenue. Hence, the higher the efficiency ratio the less efficient the REIT and vice versa. More specifically, we define two variations of the general REIT operational efficiency ratio as: a) the ratio of non-real-estate-depreciation-and-amortization expense, defined as total expenses minus real estate depreciation and amortization, to total revenue (operational efficiency ratio type one, *OER1*), and b) the ratio of non-real-estate-depreciation-and-amortization expense adjusted for property expenses to total revenue less expense reimbursements (operational efficiency ratio type two, *OER2*). These two variations account for real estate depreciation and amortization and for property operational expense reimbursements, in order to better reflect the more controllable cash flow related expenses associated with each REIT. More formally, *OER1* and *OER2* are defined as the following:

$$OER1_{i,t} = \frac{TotExp_{i,t} - REDA_{i,t}}{TR_{i,t}} \quad OER2_{i,t} = \frac{TotExp_{i,t} - REDA_{i,t} - RentExp_{i,t}}{TR_{i,t} - ExpReim_{i,t}} \tag{1}$$

where $i, t$ represents REIT $i$ at year $t$.

[7] When REIT's accounting information is not available in one period but is available for the pervious and subsequent periods, it is replaced by the estimation calculated from the characteristics in their pervious and subsequent periods using the formula: $Value^{x}_{i,t} = \left(Value^{x}_{i,t+1} + Value^{x}_{i,t-1}\right)/2$. Where $Value^{x}_{i,t}$ is the value of $x$ (TA, TE, etc.) of REIT $i$ in year $t$.

[8] Kenneth R. French's Data Library: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

The cost of holding and maintaining real properties varies across types as does lease structure. Therefore, REIT operational expense ratios likely vary due to the type of properties owned. To address this issue, we employ measures that adjust for operational efficiency differences within REITs that are associated with particular real estate property types. These standardized operational efficiency measures (*std_OER1* and *std_OER2*) are defined as the operational efficiency ratio of each REIT divided by the mean of the operational efficiency ratios of all REITs that specialize in the same real estate property type at that year.

To evaluate REIT operational performance, we compute return on assets (ROA and FFOA), which are defined as net income and funds from operations, respectively, divided by total assets in the previous period. Similarly, we compute REIT return on equity (ROE and FFOE), which are defined as net income and funds from operations, respectively, divided by total equity in the previous period. REIT market risk is measured by the standard deviation of their annualized stock return and referred to as return volatility (RetVol). REIT credit risk is proxied by the EBITDA-to-Debt ratio (EBITDA/Debt). The stock return (Return) for a REIT is defined as the sum of share price change and dividends divided by share price in the previous period. Other variables used in this study include firm size (Size), which is defined as the logarithm of implied market capitalization; market leverage (MktLev), which is defined as total debt divided by the sum of market capitalization and total debt; Age, which is defined as logarithm of one plus firms' years since IPO[9]; book-to-market ratio (BM), which is defined as the natural logarithm of the ratio of total asset to market capitalization; and self-managed (SelfMgt), which is a binary variable that

[9] In case that IPO date are not available, we use the year a REIT status established and real estate property type instead.

takes a value of 1 for a REIT who is reported by SNL as a self-managed REIT. The variable used in this paper along with their definition are displayed in Table A1 of the Appendix.

Because our regression specification includes lagged variables, we exclude firms with fewer than two consecutive years of stock price and operational efficiency information. Variables have been winsorized at the 1% and 99% tails of the distributions to avoid contamination of our data by data errors or extreme observations. The final sample used in the analysis consists of 332 REITs.

*[Insert Table 1 here]*

Table 1 provides summary statistics on the characteristics of the REITs included in the sample as well as their operational performance, risk, stock return and operational efficiency measures. Over the full sample time period (1993 – 2015), REIT market capitalization (MktCap) has a mean of $1.46 billion and a median of $0.64 billion. The total REIT revenue per year has a mean of $0.29 billion and a median of $0.13 billion. Return on assets (ROA) has an average ROA of 2.97% and a median of 3.05%, while average FFOA has an average of 6.13% and a median of 6.15%. Return on equity measured by ROE and FFOE has an average of 6.35% and 14.97%, respectively. The average annual stock return during the examined period was 12.14%, with an annualized stock return volatility of 0.30 and average EBITDA-to-Debt ratio of 0.20.

In terms of the operational efficiency ratios, the average operational efficiency ratio type one (OER1) is 0.69 and average operational efficiency ratio type two (OER2) is 0.47. The annual mean and median of the operational efficiency ratios for all REITs during the 1993 – 2015 sample time period is displayed in Figure B1 of the Appendix.

4. Research Methodologies

To begin the analysis, we first evaluate whether a REIT's operational performance is associated with its operational efficiency ratios. Specifically, we regress REIT return on assets measured by ROA and FFOA on each of our measures of operational efficiency while controlling for REITs characteristics. We use an ordinary least squares (OLS) model with heteroscedasticity-robust standard errors that are clustered at the firm level and with property type and year fixed effects, as per equation (2).

$$ROA_{i,t}(FFOA_{i,t}) = \beta_0 + \beta_1 Size_{i,t-1} + \beta_2 MktLev_{i,t-1} + \beta_3 Age_{i,t-1} + \beta_4 BM_{i,t-1} + \beta_5 SelfMgt + \beta_6 OER_{i,t-1} + \varepsilon_t \quad (2)$$

Where $ROA_{i,t}$ ($FFOA_{i,t}$) is the net income and funds from operations, respectively, divided by lagged total assets of $REIT\ i$ at year $t$, and the other variables included in equation (2) are as defined earlier in the text. Additionally, we apply our multivariate regression from equation (2) using a nonparametric analysis approach by sorting REITs into quintiles based on their standardized operational efficiency ratios in each year. We also report the spreads of the mean and median of the *ROA* and *FFOA* coefficients from the extreme quintiles, along with their associated two-sample *t* test and Wilcoxon rank-sum test values.

For the purpose of visual illustration, we create figures in which we plot the measures of return on assets versus each of the standardized operational efficiency ratios for the previous year.

The slope, *t*-statistics, *p*-value and adjusted *R*-squared from the univariate regression associated with each figure are reported on the top of each figure.

Return on equity is another profitability ratio that measures the ability of a firm to generate profits. It can be argued that from the shareholder's perspective, return on equity is the best indicator of firm performance (Elayan, Meyer and Li, 2009). Hence, we explore whether REIT return on equity (measured by ROE and FFOE) is associated with our two measures of operational efficiency.

$$\begin{aligned} ROE_{i,t}(FFOE_{i,t}) \\ &= \beta_0 + \beta_1 Size_{i,t-1} + \beta_2 MktLev_{i,t-1} + \beta_3 Age_{i,t-1} \\ &+ \beta_4 BM_{i,t-1} + \beta_5 SelfMgt + \beta_6 OER_{i,t-1} + \varepsilon_t \end{aligned} \quad (3)$$

where $ROE_{i,t}$ ($FFOE_{i,t}$) is the net income and funds from operations, respectively, divided by lagged total equity of $REIT\ i$ at year $t$, and other variables are as previously defined. As with equation (2), we apply our multivariate regression from equation (3) using a nonparametric analysis approach and create figures in which we plot the measures of return on equity versus each of the standardized operational efficiency ratios for the previous year.

A similar approach is used to examine the relations between REIT market and credit risk and REIT operational efficiency. The market risk of a REIT is measured as its annualized stock return volatility (RetVol) and the credit risk of a REIT is measured as its EBITDA-to-Debt ratio (EBITDA/Debt), which is an indicator of the REIT's ability to satisfy its debt payment obligations. The regression specified in equation (4) examines this relation.

$$Volatility_{i,t}\left(EBITDA/Debt_{i,t}\right) = \beta_0 + \beta_1 Size_{i,t-1} + \beta_{24} MktLev_{i,t-1} + \beta_3 Age_{i,t-1} + \beta_4 BM_{i,t-1} + \beta_5 SelfMgt + \beta_6 OER_{i,t-1} + \varepsilon_t \quad (4)$$

Where $Volatility_{i,t}$ is annualized stock return volatility and EBITDA/Debt is the EBITDA divided by total debt, respectively, of $REIT\ i$ at year $t$ and the other variables are as previously defined. Once again, we apply our multivariate regression from equation (4) using a nonparametric analysis approach and create figures in based on risk measures and standardized operational efficiency univariate regression results.

Finally, we examine whether REIT operational efficiency ratios help explain the cross-sectional stock return of REITs. Specifically, we regress the annual excess REIT stock return using the Carhart (1997) four-factor model while including the REIT operational efficiency ratio factor with property type and year fixed effects: [10]

$$R_{i,t} = \alpha_0 + \alpha_1 rmrf_t + \alpha_2 smb_t + \alpha_3 hml_t + \alpha_4 mom_t + \beta_1 OER_{i,t} + \varepsilon_t \quad (5)$$

Where $R_{i,t}$ is the annual stock return of $REIT\ i$ minus the risk-free rate at year $t$; $rmrf_t$ is the value-weighted market return minus the risk-free rate at year $t$; $smb_t$ (Small minus Big), $hml_t$ (High minus Low), and $mom_t$ (Momentum) are the year $t$ return to zero investment factor-mimicking portfolios designed to capture size, book-to-market, and momentum effects,

[10] Similar models can be found in Baker and Wurgler (2006) and Giacomini, Ling and Naranjo (2015), among others.

respectively. $\beta_1$ is the coefficient of interest in this regression, as it captures the relations between REIT stock return and the operational efficiency ratios after controlling for market risk.

In order to further evaluate whether REIT operational efficiency ratios have a long lasting effect on REIT stock return, we construct portfolios by sorting the standardized operational efficiency ratios ($std\_OER1$ and $std\_OER2$) of each REIT in the previous year. Specifically, we divide REITs based on the median (or 30 and 70 percentiles) of their $std\_OER1$ and $std\_OER2$, respectively, and place REITs with above or below median (or 70 or 30 percentiles) $std\_OER1$ and $std\_OER2$, in the low or high efficiency portfolios, respectively. These portfolios are rebalanced each year. We then compare the one- to three- year cumulative return of these operational efficiency based portfolios.

## 5. Empirical Results

### 5.1 Operational Performance and Operational Efficiency

As described in the methodology section, we first explore the relations between REIT operational efficiency ratios and REIT operational performance measured by return on assets (ROA and FFOA) and return on equity (ROE and FFOE). The results from equation (2) are reported in Panel A of Table 2. Overall, the results provide evidence that more efficient REITs have, on average, higher return on assets, even after controlling of size, financing, management and growth strategy.

When ROA is the dependent variable the coefficients of the previous year *OER1* and *OER2* variables are negative with statistical significant at the 1% level (-0.032 and -0.027, respectively).

These results suggest that more efficient REITs (lower efficiency ratio) generate higher ROAs. The results presented in columns (3) and (4) with respect to FFOA are very similar to the results presented in columns (1) and (2) and display statistical significance at the 1% level. The estimated coefficients of -0.048 and -0.044 for the previous year *OER1* and *OER2* variables, respectively, suggest a positive relation between REIT efficiency and FFOA. Aside from our coefficients of interest we also show that REITs with lower book-to-market REITs are associated with higher ROA and FFOA while higher leverage is associated with higher ROA. It is worth noting that achieving a higher relative level of return on assets is difficult to do in a capital-intensive business such as equity REITs. This further highlights the importance of REITs operational efficiency on operational performance.

*[Insert Table 2 here]*

The positive relation between operating efficiency and operating performance also shows in our univariate regression models. Figure 1 plots ROA (top row) and FFOA (bottom row) versus each of the previous year standardized operational efficiency ratios (std_OER1 and std_OER2). The negative slop is visually clear in each of the four plots.

*[Insert Figure 1 here]*

Panel B of Table 2 presents the results from a quintile analysis approach that compares REIT mean and median ROA and FFOA sorted by their previous year standardized operational efficiency ratios (*std_OER1* and *std_OER2*). The results show that the mean and median ROA of REITs sorted by previous year standardized operational efficiency ratios decrease monotonically

from the first quintile (highest operational efficiency) to the fifth quintile (lowest operational efficiency) in each of the four displayed cases. The spreads of the mean (median) of ROA between the two extreme quintiles is 4.62% (4.19%) and 3.54% (3.01%), respectively, while the spreads of the mean (median) of FFOA between the two extreme quintiles is 5.02% (1.41%) and 4.16% (3.34%), respectively. Each of these differences are statistical significant at the 1% level using the *t*-statistic from the two-sample *t* test or the *z*-statistics from the two-sample Wilcoxon rank-sum test. The results from the nonparametric analysis support our multivariate regression results and clearly show, not only positive relations between return on assets and operational efficiency, but that the relation is monotonic and continuous.

*[Insert Table 3 here]*

The results from equation (3) are reported in Panel A of Table 3. Overall, the results presented in this panel are very similar to the results reported in Panel A of Table 2, where the relation between return on assets and operational efficiency was examined. The coefficients of our operating efficiency measures are negative and statistical significant in all four specifications. These results support our results from the previous table and suggest that REIT operating efficiency is positively related to return on equity. All else equal, if a REIT is able to decrease its *OER1* by 1% it would realize an average ROE increase of 5.6 basis points (column (1)). Also similar to the results from Panel A of Table 2, there is evidence for a positive relation between leverage and return on equity and a negative relation between the book-to-market ratio and return on equity.

Consistent results can also be found in Figure 2, which plots ROE (top row) and FFOE (bottom row) versus each of the previous year *std_OER1* and *std_OER2* measures. The negative slop (positive relation between operational efficiency and return on equity) is visually clear.

*[Insert Figure 2 here]*

Like Panel B of Table 2, Panel B of Table 3 presents the results from a quintile analysis. Again, the results of this panel are similar to the results presented in Table 2. The mean (median) of ROE between the first quintile (highest operational efficiency) to the fifth quintile (lowest operational efficiency) of REITs sorted by previous year standardized operational efficiency ratios are (mostly) monotonically decreasing and the spread between the values associated with the extreme quintiles (1 and 5) are statistically significant at the 1% level.

Collectively, our results provide strong evidence that REIT operational performance is positively related to their previous year operational efficiency. On average, more efficient REITs (lower operational efficiency ratios) are able to generate higher return on assets and return on equity.

## 5.2 Firm Risk and Operational Efficiency

The results presented in this subsection shed light on whether and the extent to which a REIT's risk is associated with its operational efficiency ratios. As mentioned earlier, we measure REIT market risk using stock return volatility (RetVol) and we measure REIT credit risk using the EBITDA-to-Debt ratio (EBITDA/Debt). Stock return volatility plays an essential role in the finance literature, including asset pricing, cost of capital, risk management and asset allocation

and there is ample evidence that higher volatility is associated with higher expected returns. The EBITDA-to-Debt ratio measures the ability of a firm to withstand a negative shock to its profitability without defaulting on its debt obligations. This measure is especially important for REITs given that the real estate sector is more levered than most other industry sectors (Morri and Beretta, 2008). Moreover, 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 use of debt or an increase in share count.

*[Insert Table 4 here]*

The results from Equation (4) are reported in Panel A of Table 4. The positive coefficients, 0.085 and 0.088, respectively, of previous year *OER1* and *OER2* in columns (1) and (2), with statistical significant at 1%, indicate that REITs with higher efficiency ratios (lower operating efficiency) have, on average, higher stock return volatility. The estimated coefficients of *OER1* and *OER2* in column (3) to (4) for EBITDA-to-Debt ratio are both negative (-0.099, and -0.099, respectively) and statistically significant at the 1% level. Together, the results imply that more efficient REITs (lower efficiency ratio) are exposed to less market risk and are associated with lower debt levels relative to their cash flow.[11]

[11] For robustness, we apply the same model but use market beta to measure REITs' market risk and interest coverage ratio to measure REITs' default risk. The signs of the estimated coefficients of the previous-year operational efficiency ratios remain the

*[Insert Figure 3 here]*

Similar to Figures 1 and 2, Figure 3 plots the univariate results of stock return volatility (top row) and EBITDA-to-Debt ratio (bottom row) versus the previous year *std_OER1* and *std_OER2*. The slope, *t*-statistics, *p*-value and adjusted *R*-squared are reported on the top of each figure. The results are consistent with the findings reported using multivariate regression.

Panel B of Table 4 presents the quintile analysis results. These results support the results presented in the previous panel. When return volatility is considered, the means and medians are monotonically increasing from the first quintile (highest operational efficiency) to the fifth quintile (lowest operational efficiency) of REITs sorted by previous year standardized *std_OER1* and *std_OER2*. The mean (median) difference between these extreme quintiles are -8.79 (-4.72) and -7.91 (-3.30) for *std_OER1* and *std_OER2*, respectively, and associated with statistical significance. Similarly, when the EBITDA-to-Debt ratio is considered, the means and medians are monotonically decreasing from the first to the fifth quintile. The EBITDA-to-Debt ratio spread of the mean (median) between the two extreme quintiles are 12.95 (8.15) and 12.93 (7.33) for *std_OER1* and *std_OER2*, respectively, and are significant at 1% level in both the two-sample *t* test and Wilcoxon rank-sum test.

---

same as the results reported in Table 4, but with lower statistical significance. For brevity, these results are not reported, but are available upon request.

## 5.3 Stock Return and Operational Efficiency

As a final step, after examining the relation between operational efficiency and operational performance and risk, we investigate whether REITs' operational efficiency is related to their stock return.

*[Insert Table 5 here]*

Table 5 presents the OLS regression coefficient estimates of the Carhart (1997) four-factor model along with a REIT operational efficiency factor, as in Equation (5). REIT stock return net of the risk-free rate is the dependent variable in these regressions. In each of the four specifications, the operational efficiency ratio used is found to be negative and statistically significant at the 1% level. More specifically, the coefficients associated with *OER1*, *OER2*, *std_OER1* and *std_OER2* in columns (1) to (4) are -0.110, -0.127, -0.094 and -0.049, respectively. These results suggest that REITs that with higher operational efficiency are associated with higher risk-adjusted stock return in cross section.[12]

Additionally, to determine whether cumulative stock returns are different between high and low efficiency REITs, we construct portfolios by sorting REITs based on their previous year

[12] For robustness, we apply the same model, but replacing REIT's operational efficiency factor with its one period lag. The negative signs of the coefficients of lagged REIT's operational efficiency factor remain, but are associated with lower statistical significance. For brevity, these results are not reported, but are available upon request.

standardized operational efficiency ratio (*std_OER1* and *std_OER2*) and then examine the cumulative return differentials for periods of one to three years after portfolio formation. The results of this analysis are illustrated in Figure 4.

*[Insert Figure 4 here]*

A glance at Figure 4 reveals that, in the medium term, portfolios that consist of low efficiency REITs materially underperform portfolios that consist of high efficiency REITs. Specifically, the three-year cumulative return differential between the portfolio consisting of the bottom 30% of *std_OER1* and the portfolio consisting of the top 30% of *std_OER1* is about 5%. Similarly, and even more pronounced, the three-year cumulative return differential between the portfolio consisting of the bottom 30% of *std_OER2* and the portfolio consisting of the top 30% of *std_OER2* is as large as 8%. These results are consistent with the findings we present in Table 5. The fact that the return differentials by sorting based on *std_OER2* are greater than that by sorting based on *std_OER1* highlights the importance of correctly accounting for non-property level specific expenses.

## 6. Conclusions

We define REIT operational efficiency and examine whether and to what extent to REIT operational efficiency is related to operational performance, risk and stock return. The relatively homogenous revenue and expense structure of equity REITs provides us with a clean environment to examine operational efficiency.

Using a sample of U.S. equity REITs during the modern REIT era (1993 – 2015), we find that more efficient REITs are associated with higher operational performance measured by return on assets as well as return on equity. Similarly, the results of our analysis show that more efficient REITs are exposed to lower market volatility and are associated with lower credit risk, measured by their EBITDA-to-Debt ratios. Furthermore, we provide evidence that higher efficiency REITs outperform, on average, lower efficiency REITs in terms of risk-adjusted cross-sectional stock return as well as in terms of cumulative stock return in the medium term.

Collectively, our findings illustrate the importance of correctly measuring and accounting for REIT operational efficiency. The research paper opens the door for more research on REIT operational efficiency to include institutional ownership and governance factors that might impact operational efficiency. Further research that examines in detail the importance of the components of REIT revenue and expenses concurrent with management and ownership structure will likely yield considerable insights.

## References


Allen, P. R., and Sirmans, C. F. (1987). An analysis of gains to acquiring firm's shareholders: The special case of REITs. *Journal of Financial Economics*, *18*(1), 175-184.

Allen, L., and Rai, A. (1996). Operational efficiency in banking: An international comparison. *Journal of Banking and Finance,* 20(4), 655-672.

Ambrose, B., and Linneman, P. (2009). REIT organizational structure and operating characteristics. *Journal of Real Estate Research*.

Anderson, R. I., R. Fok, L. V. Zumpano and H. W. Elder, (1999). Measuring the Efficiency of Residential Real Estate Brokerage Firms: An Application of the Data Envelopment Analysis, *Journal of Real Estate Research*, 16:2, 139-68.

Anderson, R. I., Fok, R., Springer, T., and Webb, J. (2002). Technical efficiency and economies of scale: A non-parametric analysis of REIT operating efficiency. European *Journal of Operational Research*, 139(3), 598-612.

Anderson, R., Lewis, D., and Springer, T. (2000). Operating efficiencies in real estate: a critical review of the literature. *Journal of Real Estate Literature*,8(1), 1-18.

Ang, J. S., Cole, R. A., and Lin, J. W. (2000). Agency costs and ownership structure. *the Journal of Finance*, 55(1), 81-106.

Baker, H. K., and Chinloy, P. (Eds.). (2014). Public Real Estate Markets and Investments. *Oxford University Press*, USA.

Baker, M., and Wurgler, J. (2006). Investor sentiment and the cross-section of stock return. *The Journal of Finance*, 61(4), 1645-1680.

Bikker, J. A., and Haaf, K. (2002). Competition, concentration and their relationship: An empirical analysis of the banking industry. *Journal of Banking and Finance*, 26(11), 2191-2214.

Berger, A. N., Hancock, D., and Humphrey, D. B. (1993). Bank efficiency derived from the profit function. *Journal of Banking and Finance*, 17, 317– 347.

Berger, A. N., Hunter, W. C., and Timme, S. G. (1993). The efficiency of financial institutions: A review and preview of research past, present and future. *Journal of Banking and Finance*, 17, 221– 249.

Bers, M. and T M. Springer, (1997) Economies of Scale for Real Estate Investment Trusts, *Journal of Real Estate Research*, 14:3, 275-90.

Bers, M. and T M. Springer, (1998a) Sources of Scale Economies for REM, *Real Estate Finance*, 14:4, 47-56.

Bers, M. and T M. Springer, (1998b) Differences in Scale Economies Among Real Estate Investment Trusts, *Real Estate Finance*, 15:3, 37-44.

Bonin, J. P., Hasan, I., and Wachtel, P. (2005). Bank performance, efficiency and ownership in transition countries. *Journal of banking and finance*, 29(1), 31-53.

Brounen, D., and de Koning, S. (2013). 50 Years of Real Estate Investment Trusts: An International Examination of the Rise and Performance of REITs. *Journal of Real Estate Literature*, 20(2), 197-223.

Carhart, M. M. (1997). On persistence in mutual fund performance. *The Journal of finance*, 52(1), 57-82.

Chung, R., Fung, S., and Hung, S. Y. K. (2012). Institutional investors and firm efficiency of real estate investment trusts. *The Journal of Real Estate Finance and Economics*, 45(1), 171-211.

Devaney, M., and Weber, W. L. (2005). Efficiency, scale economies, and the risk/return performance of real estate investment trusts. *The Journal of Real Estate Finance and Economics*, 31(3), 301-317.

Elayan, F., Meyer, T., and Li, J. (2009). Evidence from tax-exempt firms on motives for participating in sale-leaseback agreements. *Journal of Real Estate Research*.

Giacomini, E., Ling, D. C., and Naranjo, A. (2015). REIT Leverage and Return Performance: Keep Your Eye on the Target. Available at SSRN 2659630.

Jacewitz, S., and Kupiec, P. (2012). Community Bank Efficiency and Economies of Scale. *FDIC Special Study*, December.

Kuhle, J., Walther, C., and Wurtzebach, C. (2009). The financial performance of real estate investment trusts. *Journal of Real Estate Research*.

Linneman, P. (1997), Forces Changing the Real Estate Industry Forever. *Wharton Real Estate Review*, Spring, 1-12.

Lewis, D., Springer, T. M., and Anderson, R. I. (2003). The Cost Efficiency of Real Estate Investment Trusts: An Analysis with a Bayesian Stochastic Frontier Model. *The Journal of Real Estate Finance and Economics*, *26*(1), 65-80.

McIntosh, W., Y. Liang and D. L. Thompkins, (1991). An Examination of the Small-Firm Effect within the REIT Industry, *Journal of Real Estate Research*, 6:1, 9-18.

McIntosh, W., S. H. Ott and Y. Liang, (1995). The Wealth Effects of Real Estate Transactions: The Case of REITs, *Journal of Real Estate Finance and Economics*, 10:3, 299-306.

Morri, G., and Beretta, C. (2008). The capital structure determinants of REITs. Is it a peculiar industry?. *Journal of European Real Estate Research*, 1(1), 6-57.

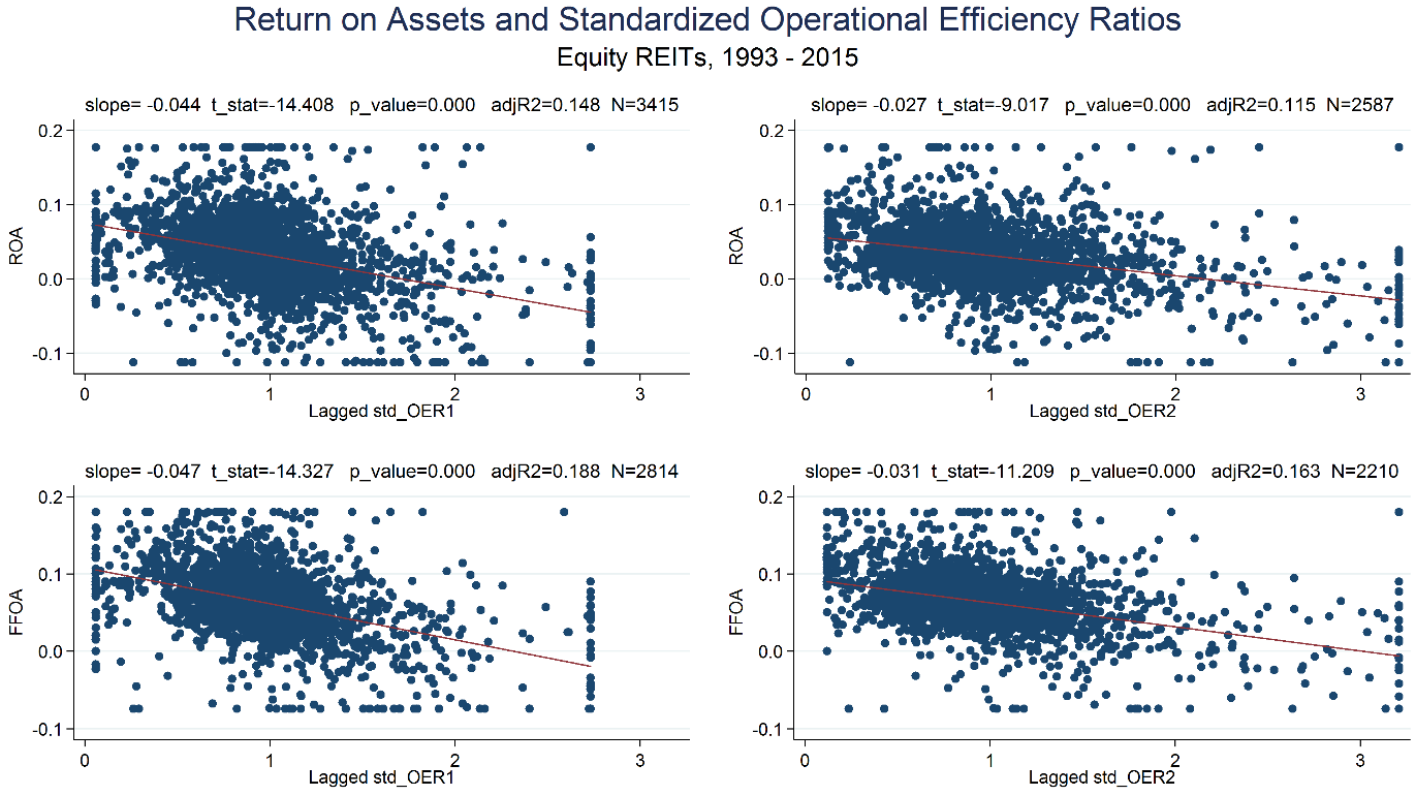
Mueller, G. R., (1998) REIT Size and Earnings Growth: Is Bigger Better or a New Challenge, *Journal of Real Estate Portfolio Management*, 4:2, 149-58.

Vogel, J. H., Jr., (1997) Why the New Conventional Wisdom About REITs is Wrong, *Real Estate Finance*, 13:2.7-12.

Zardkoohi, A., and Kolari, J. (1994). Branch office economies of scale and scope: Evidence from saving banks in Finland. *Journal of Banking and Finance*, 18, 421– 432.

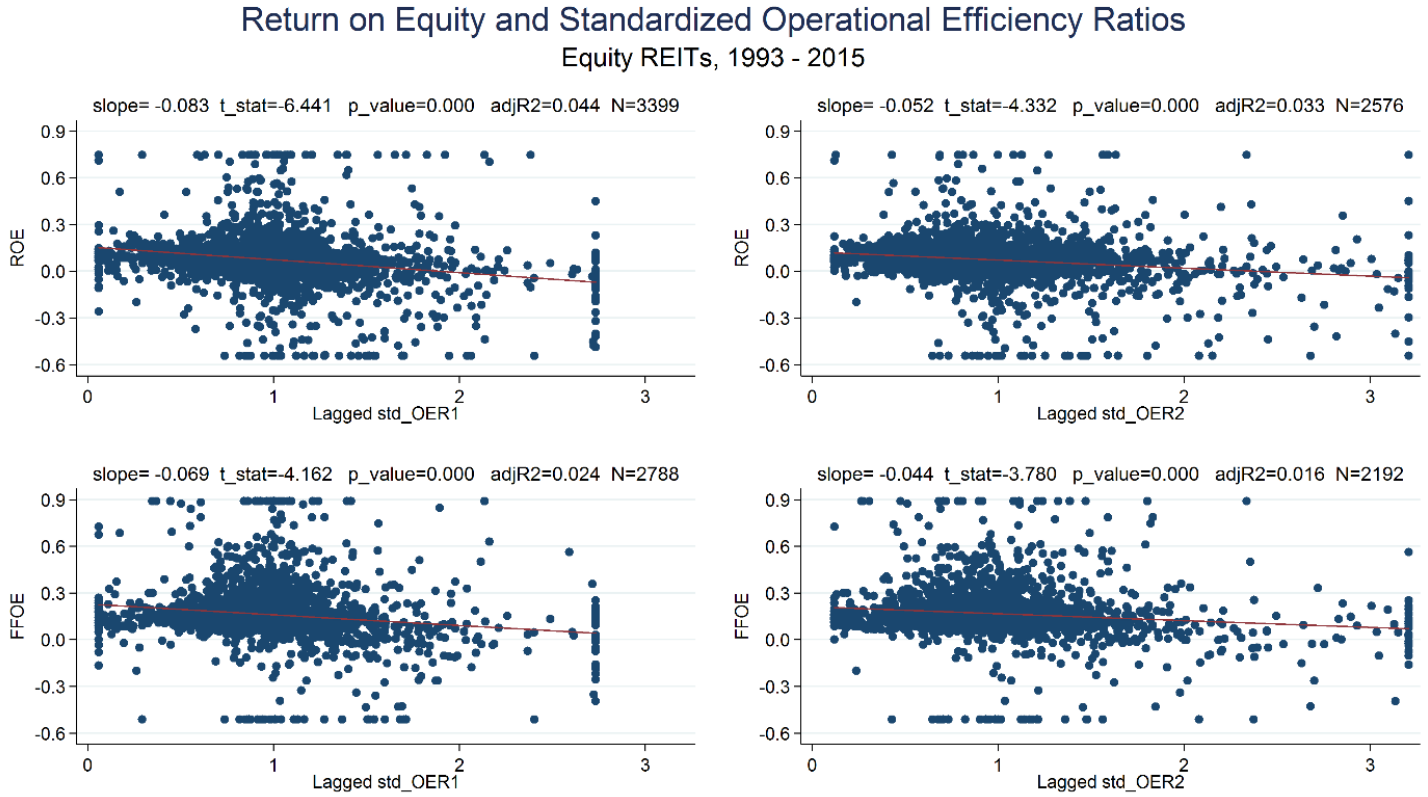
## Figure 1: Return on Assets and Operational Efficiency

This figure plots return on assets (ROA and FFOA, respectively) on the vertical axis against two lagged standardized operational efficiency ratios (std_OER1 and std_OER2, respectively) on the horizontal axis for our sample period (1993 – 2015). The slope, *t*-statistics, *p*-value and adjusted *R*-squared are reported on the top of each figure. Standard errors are clustered at the firm level and are heteroscedasticity-robust. Significance at the 1%, 5% or 10% levels are shown with 3, 2, or 1 asterisks, respectively. All variables are defined in Appendix A1. Because our regression specification includes lagged variables, we exclude firms with fewer than two consecutive years of stock return and operational efficiency (OER1) information. Variables have been winsorized at the 1% and 99% tails of the distributions to avoid the influence of extreme observations.



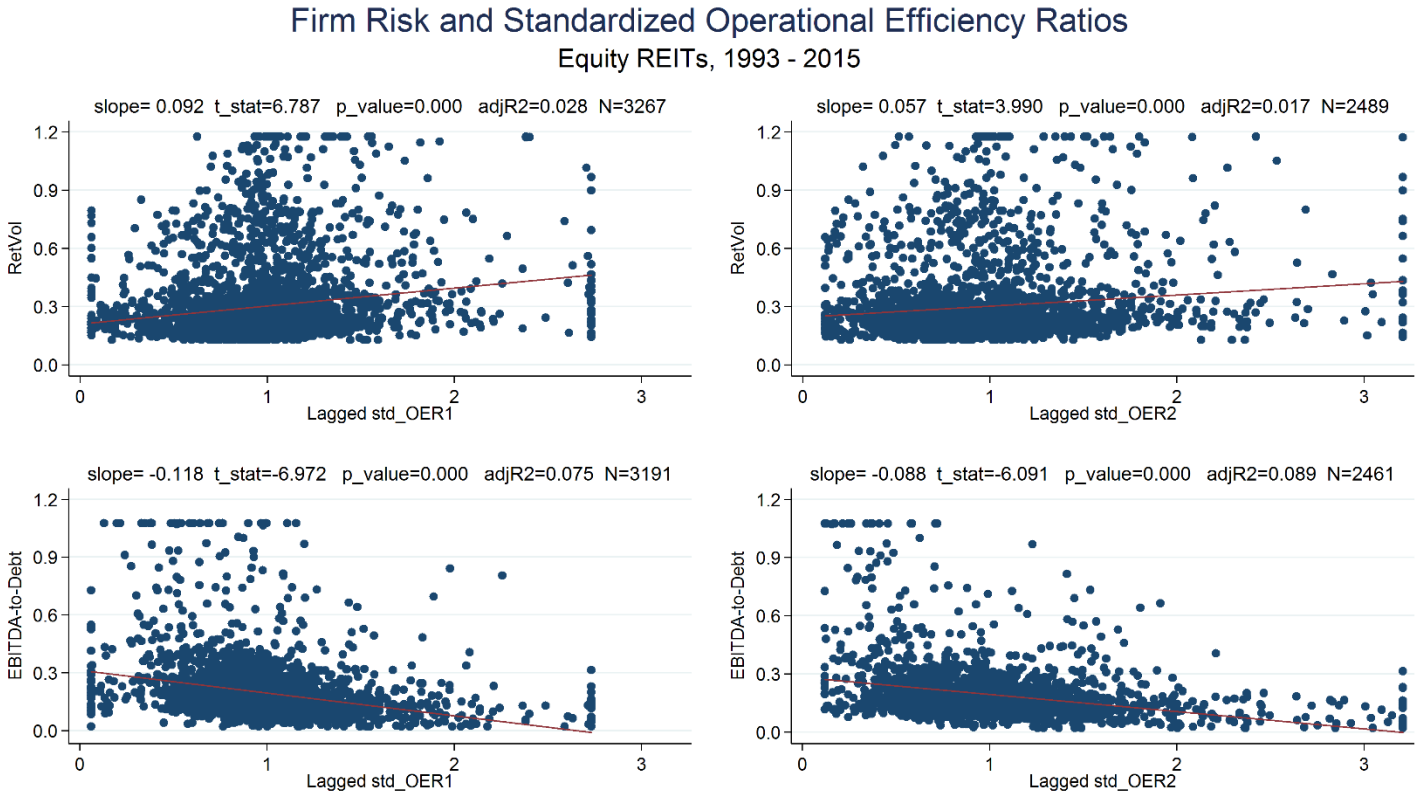
## Figure 2: Return on Equity and Operational Efficiency

This figure plots return on equity (ROE and FFOE, respectively) on the vertical axis against two lagged standardized operational efficiency ratios (std_OER1 and std_OER2, respectively) on the horizontal axis for our sample period (1993 – 2015). The slope, *t*-statistics, *p*-value and adjusted *R*-squared are reported on the top of each figure. Standard errors are clustered at the firm level and are heteroscedasticity-robust. Significance at the 1%, 5% or 10% levels are shown with 3, 2, or 1 asterisks, respectively. All variables are defined in Appendix A1. Because our regression specification includes lagged variables, we exclude firms with fewer than two consecutive years of stock return and operational efficiency (OER1) information. Variables have been winsorized at the 1% and 99% tails of the distributions to avoid the influence of extreme observations.



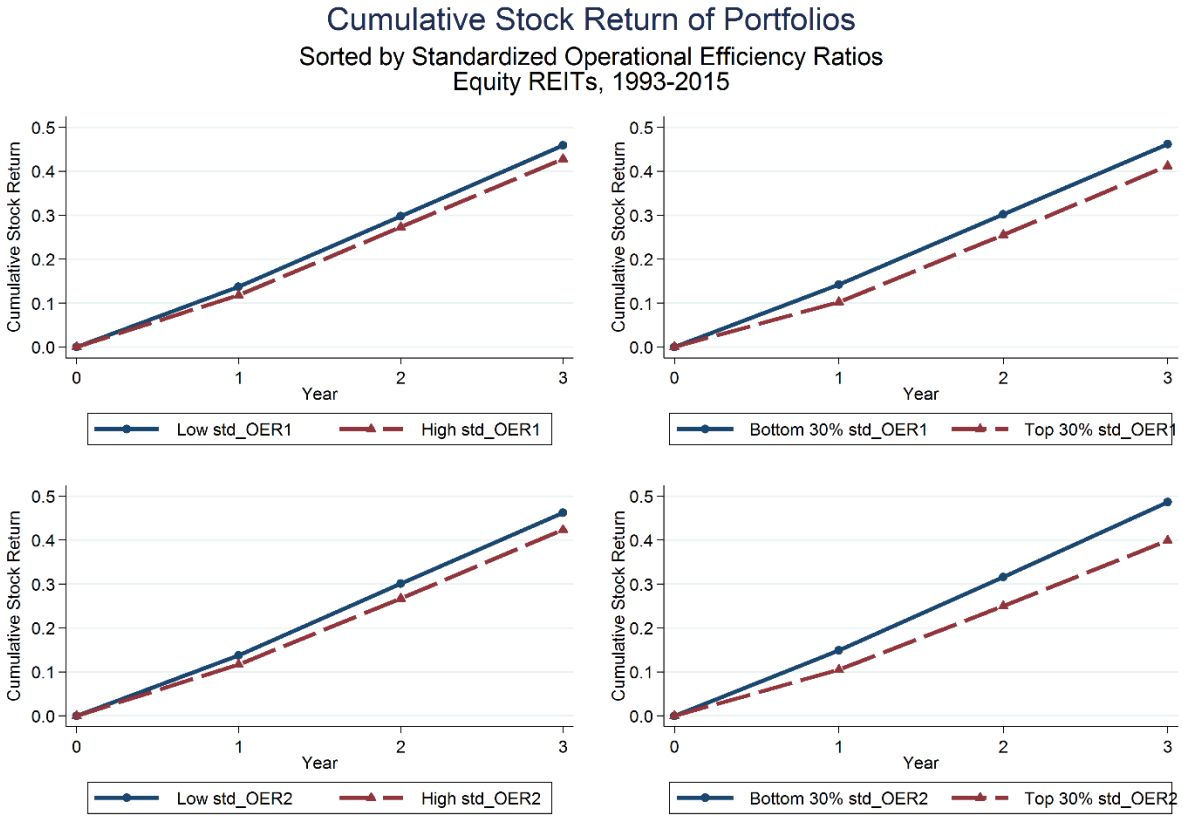
## Figure 3: Firm Risk and Operational Efficiency

This figure plots market risk measured as annualized stock return volatility (RetVol) and credit risk (EBITDA/Debt) on the vertical axis against two lagged standardized operational efficiency ratios (std_OER1 and std_OER2, respectively) on the horizontal axis for our sample period (1993 – 2015). The slope, *t*-statistics, *p*-value and adjusted *R*-squared are reported on the top of each figure. Standard errors are clustered at the firm level and are heteroscedasticity-robust. Significance at the 1%, 5% or 10% levels are shown with 3, 2, or 1 asterisks, respectively. All variables are defined in Appendix A1. Because our regression specification includes lagged variables, we exclude firms with fewer than two consecutive years of stock return and operational efficiency (OER1) information. Variables have been winsorized at the 1% and 99% tails of the distributions to avoid the influence of extreme observations.



## Figure 4: Cumulative Return of Stock Portfolios Sorted by Standardized Operational Efficiency Ratios

This figure illustrates the one- to three- year cumulative return of stock portfolios sorted by standardized operational efficiency ratios (std_OER1 and std_OER2). We construct portfolios by sorting REITs based on their previous year std_OER1 and std_OER2. Each year, we divide REITs based on the median (or 30 and 70 percentiles) of std_OER1 and std_OER2, and place REITs with above median (or 70 percentiles) in the low operational efficiency portfolio and those below median (or 30 percentiles) in the high operational efficiency portfolio. These portfolios are rebalanced each year. Then we investigate their one- to three- year cumulative return within each portfolio. All variables are defined in Appendix A1. Because our regression specification includes lagged variables, we exclude firms with fewer than two consecutive years of stock return and operational efficiency (OER1) information. Variables have been winsorized at the 1% and 99% tails of the distributions to avoid the influence of extreme observations.



## Table 1: Summary Statistics

This table reports the number of REITs, yearly observations and the annual cross-sectional averages of time-series averages of key variables used in this paper. The sample period is from 1993 - 2015. All variables are defined in Appendix A1. Because our regression specification includes lagged variables, we exclude firms with fewer than two consecutive years of stock return and operational efficiency (OER1) information. Variables have been winsorized at the 1% and 99% tails of the distributions to avoid the influence of extreme observations.

| | Mean | Median | Std. Dev. | Min | Max | Yearly Obs | # of Firms |
|---|---|---|---|---|---|---|---|
| MktCap($B) | 1.463 | 0.642 | 2.483 | 0.006 | 20.685 | 3,680 | 332 |
| TA($B) | 1.935 | 0.951 | 2.843 | 0.011 | 16.960 | 3,847 | 332 |
| TE($B) | 0.756 | 0.355 | 1.052 | -0.006 | 6.704 | 3,847 | 332 |
| TD($B) | 1.034 | 0.473 | 1.527 | 0.002 | 9.188 | 3,691 | 320 |
| NI($B) | 0.043 | 0.015 | 0.081 | -0.154 | 0.507 | 3,842 | 332 |
| FFO($B) | 0.091 | 0.039 | 0.153 | -0.035 | 1.219 | 3,114 | 318 |
| TotRev($B) | 0.289 | 0.130 | 0.471 | 0.001 | 3.678 | 3,796 | 332 |
| ExpReim($B) | 0.027 | 0.004 | 0.055 | 0.000 | 0.443 | 2,855 | 267 |
| TotExp($B) | 0.258 | 0.110 | 0.428 | 0.001 | 3.403 | 3,756 | 332 |
| REDA($B) | 0.060 | 0.026 | 0.094 | 0.000 | 0.602 | 3,798 | 332 |
| RentExp($B) | 0.069 | 0.023 | 0.119 | 0.000 | 0.691 | 3,756 | 332 |
| IntExp($B) | 0.053 | 0.023 | 0.080 | 0.000 | 0.511 | 3,711 | 323 |
| EBITDA($B) | 0.155 | 0.074 | 0.230 | 0.001 | 1.556 | 3,713 | 330 |
| year_listed | 12 | 11 | 9 | 1 | 51 | 5,916 | 327 |
| ROA | 0.0297 | 0.0305 | 0.0330 | -0.1120 | 0.1191 | 3,504 | 332 |
| FFOA | 0.0613 | 0.0615 | 0.0348 | -0.0744 | 0.1512 | 2,847 | 309 |
| ROE | 0.0635 | 0.0694 | 0.0920 | -0.4737 | 0.3296 | 3,488 | 332 |
| FFOE | 0.1497 | 0.1350 | 0.1193 | -0.2787 | 0.8896 | 2,821 | 309 |
| Return | 0.1214 | 0.1343 | 0.1324 | -0.6845 | 0.6542 | 3,352 | 332 |
| RetVol | 0.2968 | 0.2654 | 0.1191 | 0.1518 | 1.0070 | 3,711 | 324 |
| EBITDA/Debt | 0.2011 | 0.1730 | 0.1375 | 0.0195 | 1.0758 | 3,529 | 315 |
| OER1 | 0.6837 | 0.6632 | 0.2226 | 0.1214 | 1.6519 | 3,749 | 332 |
| OER2 | 0.4688 | 0.4005 | 0.2256 | 0.0456 | 1.1843 | 2,832 | 266 |

## Table 2: Return on Assets and Operational Efficiency

Panel A reports the results of multivariate regressions of REITs' return on assets (ROA) and funds from operations on assets (FFOA) on their lagged operational efficiency ratios (OER1 and OER2, respectively). The *t*-statistics are reported in brackets. The coefficients on variables of property type and years are suppressed from reporting. Standard errors are clustered at the firm level and are heteroscedasticity-robust. Panel B reports the time-series average of ROA and FFOA of portfolios sorted by standardized operational efficiency ratios (std_OER1 and std_OER2). All variables are defined in Appendix A1. The *t*-statistics from two-sample *t* test with equal variances are reported in brackets. The *z*-statistics from two-sample Wilcoxon rank-sum test are reported in parentheses. Significance at the 1%, 5% or 10% levels are shown with 3, 2, or 1 asterisks, respectively. Because our regression specification includes lagged variables, we exclude firms with fewer than two consecutive years of stock return and operational efficiency (OER1) information. Variables have been winsorized at the 1% and 99% tails of the distributions to avoid the influence of extreme observations.

*Panel A: regression results*

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | ROA | ROA | FFOA | FFOA |
| L.Size | 0.000 | 0.001 | 0.001 | 0.000 |
| | [0.48] | [0.86] | [0.56] | [0.37] |
| L.MktLev | -0.030 | -0.031 | -0.011 | -0.001 |
| | [-2.51]** | [-2.28]** | [-0.69] | [-0.07] |
| L.Age | 0.004 | 0.004 | -0.002 | -0.002 |
| | [4.47]*** | [3.29]*** | [-1.60] | [-1.87]* |
| L.BM | -0.021 | -0.020 | -0.027 | -0.029 |
| | [-4.52]*** | [-3.73]*** | [-5.30]*** | [-4.99]*** |
| SelfMgt | -0.003 | -0.003 | -0.002 | 0.001 |
| | [-0.66] | [-0.50] | [-0.33] | [0.14] |
| L.OER1 | -0.032 | | -0.048 | |
| | [-5.03]*** | | [-9.52]*** | |
| L.OER2 | | -0.027 | | -0.044 |
| | | [-3.62]*** | | [-6.68]*** |
| Constant | 0.085 | 0.091 | 0.121 | 0.107 |
| | [9.29]*** | [8.05]*** | [14.64]*** | [8.84]*** |
| Observations | 3,177 | 2,453 | 2,662 | 2,114 |
| Adj R-sq | 0.402 | 0.407 | 0.554 | 0.526 |
| PropertyType FE | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES |

*Panel B: quintiles sorting*

| Ranking, *t* | ROA, *t+1* | | FFOA, *t+1* | |
|---|---|---|---|---|
| | Rank by std_OER1 | Rank by std_OER2 | Rank by std_OER1 | Rank by std_OER2 |
| 1 | 5.42/5.19 | 5.02/4.61 | 8.45/5.20 | 8.24/7.81 |
| 2 | 4.01/3.85 | 3.88/3.72 | 6.92/6.65 | 6.94/6.64 |
| 3 | 3.36/3.24 | 3.23/3.06 | 6.51/6.32 | 6.59/6.22 |
| 4 | 2.60/2.36 | 2.24/2.36 | 5.84/5.53 | 5.75/5.62 |
| 5 | 0.80/1.00 | 1.48/1.60 | 3.42/3.79 | 4.08/4.47 |
| 1-5 Spread | 4.62/4.19 | 3.54/3.01 | 5.02/1.41 | 4.16/3.34 |
| *t* test | [18.24]*** | [13.32] *** | [19.13]*** | [15.16] *** |
| rank-sum test | (18.38) *** | (13.66) *** | (18.09) *** | (14.47) *** |

## Table 3: Return on Equity and Operational Efficiency

Panel A reports the results of multivariate regressions of REITs' return on equity (ROE) and funds from operations on equity (FFOE) on their lagged operational efficiency ratios (OER1 and OER2, respectively). The *t*-statistics are reported in brackets. The coefficients on variables of property type and years are suppressed from reporting. Standard errors are clustered at the firm level and are heteroscedasticity-robust. Panel B reports the time-series average of ROE and FFOE of portfolios sorted by standardized operational efficiency ratios (std_OER1 and std_OER2). All variables are defined in Appendix A1. The *t*-statistics from two-sample *t* test with equal variances are reported in brackets. The *z*-statistics from two-sample Wilcoxon rank-sum test are reported in parentheses. Significance at the 1%, 5% or 10% levels are shown with 3, 2, or 1 asterisks, respectively. Because our regression specification includes lagged variables, we exclude firms with fewer than two consecutive years of stock return and operational efficiency (OER1) information. Variables have been winsorized at the 1% and 99% tails of the distributions to avoid the influence of extreme observations.

*Panel A: regression results*

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | ROE | ROE | FFOE | FFOE |
| L.Size | -0.001 | 0.002 | -0.002 | -0.003 |
| | [-0.21] | [0.43] | [-0.42] | [-0.58] |
| L.MktLev | 0.204 | 0.164 | 0.445 | 0.461 |
| | [3.29]*** | [2.38]** | [4.94]*** | [4.57]*** |
| L.Age | 0.009 | 0.006 | -0.010 | -0.013 |
| | [2.33]** | [1.24] | [-1.83]* | [-2.21]** |
| L.BM | -0.124 | -0.110 | -0.175 | -0.178 |
| | [-5.15]*** | [-4.14]*** | [-5.42]*** | [-4.77]*** |
| SelfMgt | -0.034 | -0.048 | -0.026 | -0.043 |
| | [-1.78]* | [-1.90]* | [-1.17] | [-1.96]* |
| L.OER1 | -0.056 | | -0.085 | |
| | [-2.37]** | | [-2.84]*** | |
| L.OER2 | | -0.065 | | -0.107 |
| | | [-2.36]** | | [-3.86]*** |
| Constant | -0.566 | -0.518 | 0.285 | 0.149 |
| | [-17.37]*** | [-12.07]*** | [3.45]*** | [3.79]*** |
| Observations | 3,163 | 2,443 | 2,641 | 2,097 |
| Adj R-sq | 0.177 | 0.193 | 0.207 | 0.225 |
| PropertyType FE | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES |

*Panel B: quintiles sorting*

| Ranking, *t* | ROE, *t+1* | | FFOE, *t+1* | |
|---|---|---|---|---|
| | Rank by std_OER1 | Rank by std_OER2 | Rank by std_OER1 | Rank by std_OER2 |
| 1 | 10.49/9.23 | 9.65/8.78 | 17.51/15.15 | 17.51/14.82 |
| 2 | 9.84/9.30 | 9.98/8.94 | 17.31/14.81 | 18.18/15.54 |
| 3 | 8.15/8.09 | 7.38/7.42 | 17.67/15.47 | 17.97/15.40 |
| 4 | 7.52/6.61 | 6.29/6.92 | 17.97/14.78 | 17.30/14.50 |
| 5 | 1.88/3.10 | 3.23/4.80 | 10.40/10.01 | 12.97/11.77 |
| 1-5 Spread | 8.60/6.13 | 6.42/3.98 | 7.11/5.14 | 4.53/3.05 |
| *t* test | [9.84]*** | [7.13] *** | [6.80]*** | [3.84] *** |
| rank-sum test | (13.02) *** | (8.70) *** | (9.77) *** | (5.72) *** |

## Table 4: Firm Risk and Operational Efficiency

Panel A reports the results of multivariate regressions of REITs' market risk, measured as annualized stock return volatility (RetVol), and credit risk, measured as EBITDA-to-Debt ratio (EBITDA/Debt), on their lagged operational efficiency ratios (OER1 and OER2). The *t*-statistics are reported in brackets. The coefficients on variables of property type and years are suppressed from reporting. Standard errors are clustered at the firm level and are heteroscedasticity-robust. Panel B reports the time-series average of RetVol and EBITDA/Debt of portfolios sorted by standardized operational efficiency ratios (std_OER1 and std_OER2). All variables are defined in Appendix A1. The *t*-statistics from two-sample *t* test with equal variances are reported in brackets. The *z*-statistics from two-sample Wilcoxon rank-sum test are reported in parentheses. Significance at the 1%, 5% or 10% levels are shown with 3, 2, or 1 asterisks, respectively. Because our regression specification includes lagged variables, we exclude firms with fewer than two consecutive years of stock return and operational efficiency (OER1) information. Variables have been winsorized at the 1% and 99% tails of the distributions to avoid the influence of extreme observations.

*Panel A: regression results*

| VARIABLES | (1) RetVol | (2) RetVol | (3) EBITDA/ Debt | (4) EBITDA/ Debt |
|---|---|---|---|---|
| L.Size | -0.025 | -0.026 | -0.009 | -0.008 |
| | [-4.46]*** | [-3.49]*** | [-2.87]*** | [-2.12]** |
| L.MktLev | -0.096 | -0.125 | -0.727 | -0.755 |
| | [-1.93]* | [-2.14]** | [-8.28]*** | [-7.39]*** |
| L.Age | 0.012 | 0.020 | 0.020 | 0.016 |
| | [3.21]*** | [3.53]*** | [5.22]*** | [3.94]*** |
| L.BM | 0.084 | 0.101 | 0.106 | 0.118 |
| | [4.95]*** | [5.20]*** | [5.19]*** | [5.10]*** |
| SelfMgt | 0.002 | 0.014 | -0.022 | -0.006 |
| | [0.12] | [0.59] | [-1.36] | [-0.32] |
| L.OER1 | 0.085 | | -0.099 | |
| | [4.32]*** | | [-5.73]*** | |
| L.OER2 | | 0.088 | | -0.099 |
| | | [4.90]*** | | [-4.66]*** |
| Constant | 0.442 | 0.474 | 0.681 | 0.668 |
| | [10.85]*** | [8.40]*** | [11.19]*** | [9.85]*** |
| Observations | 3,163 | 2,451 | 2,983 | 2,338 |
| Adj R-sq | 0.682 | 0.716 | 0.433 | 0.429 |
| PropertyType FE | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES |

*Panel B: quintiles sorting*

| Ranking, *t* | RetVol, *t+1* | | EBITDA/Debt, *t+1* | |
|---|---|---|---|---|
| | Rank by std_OER1 | Rank by std_OER2 | Rank by std_OER1 | Rank by std_OER2 |
| 1 | 27.80/23.10 | 28.23/22.95 | 28.19/21.41 | 28.43/20.83 |
| 2 | 26.72/20.92 | 27.51/21.46 | 19.76/17.71 | 19.13/17.22 |
| 3 | 29.05/21.10 | 28.99/21.58 | 18.34/16.64 | 18.46/16.99 |
| 4 | 30.09/22.80 | 29.90/22.81 | 17.31/14.93 | 16.16/15.12 |
| 5 | 36.59/27.82 | 36.14/26.25 | 15.23/13.26 | 15.50/13.50 |
| 1-5 Spread | -8.79/-4.72 | -7.91/-3.30 | 12.95/8.15 | 12.93/7.33 |
| *t* test | [-7.99]*** | [-5.79] *** | [13.00]*** | [11.15] *** |
| rank-sum test | (-8.30) *** | (-5.88) *** | (16.03) *** | (14.16) *** |

## Table 5: Cross-sectional Stock Return and Operational Efficiency

This table presents OLS regression coefficient estimates of REITs' annual excess return on the Fama French (1993) three factors, Carhart (1997) momentum factor and a REITs' operational efficiency factor (OER1, OER2, std_OER1 and std_OER2). The *t*-statistics are reported in brackets. The coefficients on variables of property type and years are suppressed from reporting. Standard errors are clustered at the firm level and are heteroscedasticity-robust. All variables are defined in Appendix A1. Significance at the 1%, 5% or 10% levels are shown with 3, 2, or 1 asterisks, respectively. Because our regression specification includes lagged variables, we exclude firms with fewer than two consecutive years of stock return and operational efficiency (OER1) information. Variables have been winsorized at the 1% and 99% tails of the distributions to avoid the influence of extreme observations.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | Ret | Ret | Ret | Ret |
| mktrf | 0.750 | 0.788 | 0.486 | 0.491 |
| | [9.54]*** | [10.10]*** | [16.64]*** | [15.10]*** |
| smb | -2.240 | -2.481 | 0.450 | 0.451 |
| | [-7.88]*** | [-9.61]*** | [12.88]*** | [11.37]*** |
| hml | 1.546 | 1.622 | 0.647 | 0.650 |
| | [5.63]*** | [5.63]*** | [21.68]*** | [19.34]*** |
| mom | 0.382 | 0.379 | -0.162 | -0.200 |
| | [1.80]* | [1.90]* | [-5.49]*** | [-6.49]*** |
| OER1 | -0.110 | | | |
| | [-3.76]*** | | | |
| OER2 | | -0.127 | | |
| | | [-4.01]*** | | |
| std_OER1 | | | -0.094 | |
| | | | [-5.45]*** | |
| std_OER2 | | | | -0.049 |
| | | | | [-3.22]*** |
| Constant | -0.200 | -0.206 | 0.141 | 0.100 |
| | [-7.40]*** | [-7.71]*** | [8.53]*** | [6.84]*** |
| Observations | 3,266 | 2,499 | 3,266 | 2,499 |
| Adj R-sq | 0.356 | 0.395 | 0.257 | 0.280 |
| PropertyType FE | YES | YES | NO | NO |
| Year FE | YES | YES | NO | NO |

# Appendix

## Table A1: Definition of Variables

This table present the definition of variables used in the paper.

| Variable | Abb. | Definition |
|---|---|---|
| Return on assets | ROA | Net income divided by lagged total assets. |
| Funds from operations on assets | FFOA | Funds from operations divided by lagged total assets. |
| Return on equity | ROE | Net income divided by lagged total equity. |
| Funds from operations on equity | FFOE | Funds from operations divided by lagged total equity. |
| Stock return volatility | RetVol | The annualized standard deviation of daily stock return at each firm year. |
| EBITDA-to-Debt ratio | EBITDA/ Debt | The ratio of EBITDA to total debt |
| Stock return | Return | The sum of stock price and dividend paid divided by lagged stock price, then minus one. |
| Excess stock return | Ret | Stock return minus risk free rate |
| Operational efficiency ratio one | OER1 | the ratio of total expense minus real estate depreciation and amortization to total revenue |
| Operational efficiency ratio two | OER2 | the ratio of total expense minus real estate depreciation and amortization minus rental operating expense to total revenue minus expense reimbursements |
| Standardized operational efficiency ratio one | std_OER1 | The ratio of OER1 to the mean of OER1 of REITs that have the same real estate property type in the same year. |
| Standardized operational efficiency ratio two | std_OER2 | The ratio of OER2 to the mean of OER2 of REITs that have the same real estate property type in the same year. |
| Natural log of Market capitalization | Size | Market capitalization of common equity, assuming the conversion of all convertible subsidiary equity into common. |
| Market leverage ratio | MktLev | The ratio of total debt to the sum of market capitalization and total debt. |
| Year listed | Age | The natural logarithm of the number of years since IPO. |
| Book-to-Market ratio | BM | The natural log of the ratio of total asset to market capitalization. |
| Self-management | SelfMgt | A binary variable indicating whether the REIT is self-managed. |

## Figure B1: Operational Efficiency Ratios

This figure plots the annual mean and median of operational efficiency ratios (OER1 and OER2, respectively) of all REITs in our sample during the 1993 – 2015 time period. All variables are defined in Appendix A1. Because our regression specification includes lagged variables, we exclude firms with fewer than two consecutive years of stock return and operational efficiency (OER1) information. Variables have been winsorized at the 1% and 99% tails of the distributions to avoid the influence of extreme observations.