International Journal of Strategic Property Management
ISSN: 1648-715X / eISSN: 1648-9179
2023 Volume 27 Issue 2: 105–119
https://doi.org/10.3846/ijspm.2023.19092

# DOES LOCAL ECONOMIC UNCERTAINTY MATTER FOR RISK OF PROPERTY COMPANIES? EVIDENCE FROM US REITs

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Received 09 January 2023; accepted 17 April 2023

**Abstract.** With the growing number of publicly listed property companies worldwide, investors are increasingly interested in assessing the risks of such real estate companies in the stock market. This study aims to investigate the risk of US equity real estate investment trusts (REITs) in the local market context. Using US equity REITs data from 1997 to 2020, this study examines the impact of local economic uncertainty (LEU) on risk of REITs. To measure LEU, we first exploit textual analysis to extract geographical information from REITs' annual financial reports (10-K filings) and construct state-level regional exposure for each firm. We then obtain LEU by incorporating the regional exposure with local market uncertainty based on locally headquartered firms. In the empirical results, we find that REITs with higher LEU are strongly and positively associated with higher future risks. This positive relationship is robust to a variety of alternative risk and LEU measures. Moreover, the effects of LEU are stronger for geographically concentrated REITs and LEU is positively priced by investors. Our findings suggest that local market uncertainty is an important driver of risk of publicly listed property companies.

**Keywords:** risk, local market, uncertainty, real estate investment trusts (REITs).

## Introduction

Over the last few decades, more and more property companies have been listed in the stock market across the world, leading to more attention on risk traits of these public real estate companies. Different from traditional real estate investment, risk factors of listed property firms are associated with various regions because real estate firms tend to have many properties in multiple regions. Among listed property firms, identifying the determinants of risk is particularly important for REITs, given the historical fact that REITs have been more volatile than the aggregate stock market (Sun et al., 2015). REITs have been recognized by investors as relatively stable assets because REITs' expected cash flow is based on a diversified real estate portfolio, which generates consistent rental incomes from tenants. However, REITs are vulnerable to volatile economic conditions due to their unique characteristics. For example, REITs cannot hoard enough cash since they have to pay out at least 90% of their income to shareholders. In addition, REITs tend to have higher leverage, which makes REITs more volatile in response to unexpected shocks (Kawaguchi et al., 2017). Thus, understanding the underlying factors of risk of REITs is of central importance for investors who are concerned about portfolio management. However, surprisingly little is known about how risk of REITs is characterized by regional market uncertainty, even though localized uncertainty could change local REIT investors' future expectations.

This paper examines whether local economic uncertainty affects risk in the cross-section of REITs. To this end, we propose a novel measure of the local economic uncertainty (LEU) using the geographical information from the annual reports (10-K filings) of REITs. Specifically, we obtain the firm-level LEU, estimated as their geographical exposure to state-level cash flow uncertainty of locally headquartered firms. Different from previous studies that have used property-level data to measure local exposure (e.g., Ling et al., 2018, 2021), we use state-level information from 10-K filings. Using 10-K filings for local exposure measures allows us to capture REITs' local market projection through which REITs would construct or rebalance their portfolio in the future.[1] To the best of our

[1] The unique asset structure of REITs also enables us to identify economically relevant areas more obviously from textual information of financial reports. Specifically, most REITs hold over 75% of assets as real estate and gain most of their revenues

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knowledge, this study is the first to examine the regional factors of REITs using the geographical information from 10-K filings.

We hypothesize that REITs exposed to higher local market uncertainty provide higher risk, compared to REITs with lower exposure to regional uncertainty. The underlying asset of REITs is real estate, which is one of the most representative local assets (Tuzel & Zhang, 2017). Thus, the fluctuation of the local economy is highly associated with the performance of real estate held by REITs (Feng & Wu, 2022; Li & Zhu, 2022). Given the significant impact on the local economy, previous studies have also shown that REIT investors actively respond to geographical information about REITs (Ling et al., 2021; Milcheva et al., 2021). In addition, classical asset pricing literature suggests that investors are averse to the second moment shock, so require significant price drops from stocks that are expected to have higher uncertainty, which leads to higher returns as compensation in the future (Merton, 1973; Kelly & Jiang, 2014). Therefore, we expect that REITs with higher LEU would suffer higher future risk and provide higher returns compared to REITs with lower LEU.

The main results show that LEU is positively and strongly associated with future risk in the cross-section of REITs. The impact of LEU is not affected by well-known firm characteristics and local characteristics. In the robustness check, LEU also predicts other risk measures, including ES based on raw returns, systematic components of ES, value-at-risk, volatility, and the log difference of ES. LEU based on property information also shows positive and statistically significant effects on future risk but to a lesser degree compared to citation-based LEU. In addition, we find that both headquarters and non-headquarters states document a strong positive relationship between LEU and the risk of REITs. Notably, the effect of LEU is especially stronger for geographically concentrated REITs, suggesting that diversifying localized economic uncertainty is important for risk reduction. Finally, the empirical asset pricing tests confirm that REITs with higher LEU present higher expected excess returns than REITs with lower LEU.

The rest of the article is organized as follows. Section 1 describes the literature review. Section 2 provides an explanation of the methodologies with regard to LEU and risk and explains the data and relevant variables for our main analysis. Section 3 presents the results of empirical tests. The last section concludes this article.

## 1. Literature review

This study relates to several strands of the literature. First, our study contributes to REIT literature exploring the geographical characteristics of REITs. Previous studies have investigated REITs' various regional features, including geographical concentration (Ling et al., 2018; Milcheva et al., 2021), local investors (Ling et al., 2021), and locally segmented asset pricing features (Li & Zhu, 2022; Feng & Wu, 2022; Song & Liow, 2022; Fisher et al., 2022). Our findings provide another geographical asset pricing feature by showing that stock returns of REITs are significantly discounted by locally isolated market uncertainty. In addition, given that previous studies have exploited property holding data for local exposure measures, we provide a new dimension of local market information using annually circulated 10-K filings.

Second, our paper relates to the literature on the implication of location in finance. Since the seminal work of Coval and Moskowitz (1999), many studies have explored the geographical effects on investment portfolios (Coval & Moskowitz, 2001; Baik et al., 2010), cash flow (Dougal et al., 2015), and asset price correlation (Parsons et al., 2020). More recently, the literature has expanded the geographical boundary from the headquarters area to a wider area where the company is likely to be of economic interest through financial reports (García & Norli, 2012; Bernile et al., 2015). In particular, these geographical segmentation studies have generally focused on the first-moment impact of the local market via the locally aggregated stock returns, liquidity, or economic fundamentals (Pirinsky & Wang, 2006; Korniotis & Kumar, 2013; Smajlbegovic, 2019). This study is distinct from these studies in the following two dimensions. First, previous empirical approaches have exploited raw returns that could not be clearly separated from the systematic factors. This indicates that the impact of local factors might be spuriously correlated with unobserved systematic risk. We address this issue by extracting the common market factors from the returns of locally headquartered firms. This orthogonalization approach enables us to investigate the isolated effects of local market factors on firms. Second, this study adds to asset pricing implications of risk in the local market context. In general finance studies, it is still on debating whether high risk provides higher returns (Lintner, 1965; Lehmann, 1990; Ang et al., 2006). Given that we show a significantly positive relation between stock returns and LEU, which is orthogonal to the major asset pricing factors, our empirical findings suggest that locally specified uncertainty could be an important driver of asset price anomaly for the REIT market.

Third, our study relates to the empirical literature on the determinants of risk. Since the seminal work of

from real estate, suggesting that the economic interests of REITs are concentrated on real estate. In particular, REITs are required to report the location of properties under portfolios in 10-K filings. Thus, the citations of states in financial reports are highly associated with the location of real estate that REITs would operate, buy, or sell. In addition, it has been well established that real estate is one of the most representative local assets in the sense that various local factors could affect local real estate prices (e.g., Chaney et al., 2012; Tuzel & Zhang, 2017). Therefore, state citation of REITs could capture not only local economic interest but also potential exposure to the local economy. However, we further show how our textual-based exposure measure is associated with property-based measures in Appendix table.

Merton (1987), who found that idiosyncratic risk is difficult to diversify in the incomplete market, this line of research has explored the various characteristics that affect the cross-section of idiosyncratic risk. For firm characteristics, Xu and Malkiel (2003) documented that firms with high expected earning growth are associated with high idiosyncratic volatility. Furthermore, Pastor and Veronesi (2003) found that idiosyncratic volatility increases with the uncertainty of a firm's profitability, which is particularly strong for young firms. In general, most of the existing studies use idiosyncratic return volatility to proxy for idiosyncratic risk. However, idiosyncratic volatility may not completely capture asymmetries associated with the magnitude of idiosyncratic risk from negative returns (Longin & Solnik, 2001; Ang & Chen, 2002). In this paper, we focus on the downside part of the return for risk measure by exploiting the risk measures based on the expected shortfall.

Finally, this study adds to REIT studies exploring the effects of aggregate factors on REITs. Among many other factors, the fluctuation of inflation risk has been closely associated with REITs based on debates about whether REITs show a hedging role against inflation (e.g., Park et al., 1990; Bahram et al., 2004). For example, Chatrath and Liang (1998) document the inflation-hedging effect of REITs in the long run, while Basse (2012) finds REITs to be a hedging tool for housing price dynamics. The recent strong increasing trend of interest rates gives further highlights of inflation factors in the REIT market. This inflation dynamic is highly related to the local economy. For instance, regions exposed to oil companies might be more covarying with the time-varying inflation rate. Furthermore, regions that are composed of industries with high leverage would show greater fluctuation of stock returns since the cost of liabilities positively varies with an interest rate, which generally positively responds to the inflation rate. Given that this study investigates the impact of the local economy where locally headquartered industries are differentially affected by inflation dynamics, our factor, local economic uncertainty, also reflects the potential indirect linkage with inflation risk.

## 2. Methodology and data

### 2.1. Local economic uncertainty

In this section, we aim to estimate the firm-level regional economic uncertainty using textual information from 10-K filings. Previous studies have generally exploited property information of REITs from the SNL REIT database to proxy for regional exposure of REITs (e.g., Ling et al., 2018, 2021). However, there are two potential limitations of this approach. First, property holdings do not provide the geographical prospects of REITs associated with real estate developments, acquisitions, or exits. These future plans could also be an important local economic interest of REITs because shareholders evaluate the stock price of REITs based on expected future cash flows. Another concern is that there is a non-negligible loss of observations in property-level information in the REIT market (e.g., Ling et al., 2018), leading to a potential selection bias problem. On the other hand, submission of annual 10-K filing is compulsory for all the REITs. Furthermore, REITs have to provide business projections as well as the location of their properties. Thus, we can identify the state-dependent geographical interest of REITs from 10-K filings. Although the state citation from financial reports cannot capture the real value and exact location of the property portfolio, our approach could allow us to obtain other important aspects of regional economic interests from state citations.

Since 1997, firms are mandated to submit 10-K filings on the Electronic Data Gathering, Analysis, and Retrieval (EDGAR) system of the US Securities and Exchange Commission (SEC). Since equity REITs generally exceed these conditions, the majority of REITs have submitted 10-K filings annually. Between 1997 and 2020, we retrieve 4,402 firm-year 10-K filings of US equity REITs. As in Bernile et al. (2015), we merge 10-K filling information with the Compustat-CRSP-merged database (CCM). In each financial report, we use a parsing algorithm to extract the number of citations on US states by REITs. A standard form of 10-K filling is composed of four parts and fifteen items, covering various issues, such as business overview, properties, financial data, legal proceedings, and management's discussion and analysis. Since REITs provide their property, development, and acquisition plans throughout various parts, all items of filling contain important geographic information. Thus, we apply a parsing algorithm to obtain the number of citations for US states using all items in a 10-K filing. Our parsing strategy is similar to the previous approach (e.g., see García & Norli, 2012; Bernile et al., 2015). Then, following previous studies (Smajlbegovic, 2019), we employ the citation weight for each state as the geographical relevance for REITs.

Since the introduction of García and Norli (2012), recent empirical finance studies have used state-level citation information to identify the implication of geographical exposure in terms of asset pricing. For example, Bernile et al. (2015) document that firms show a significant fundamental comovement with local market factors. In particular, they identify that this comovement increases with the level of exposure to the state based on the relative frequency of state citations. In addition, Smajlbegovic (2019) shows that stock returns of firms positively covary with the economic activity of US states through economic exposure of state-level citation information. This suggests that underlying geographical information is closely related to local economic interests. Following these empirical studies, we assume that state-level citations of REITs in 10-K filings indicate the local economic relevance of REITs. Given that REITs are operating mostly in real estate, which solely relies on the local economy, our assumption of citation-based local exposure should well capture the geographical information of REITs. We further check the robustness of our measure using the property weight approach in Section 3.3.

Specifically, there are three steps to measure the LEU of REITs. In the first step, we obtain a vector of citation weights on all US states for REITs. For REIT $i$, the citation weight is estimated as the total number of citations for state $j$ divided by the total citations for all US states:

$$CW_{i,j,y} = \frac{CN_{i,j,y}}{\sum_{j=1}^{T} CN_{i,j,y}}, \quad (1)$$

where: $CN_{i,j,y}$ is the number of citations for state $j$ extracted from the 10-K filling of REIT $i$ in year $y$; $T$ is the number of states that are cited at least one time in an annual report; $CW_{i,j,y}$ is the citation weights of REIT $i$ on state $j$ in year $y$, reflecting the geographical exposure of REIT $i$ in the assumption that REITs would cite more for states if they have a greater economic interest.

In the second stage, we measure the state-level uncertainty by exploiting the value-weighted cash flow volatility of each state based on locally headquartered firms. Specifically, we measure the quarterly firm-level cash-flow volatility of local nonfinancial firms. Following the cash flow volatility measure of Irvine and Pontiff (2009), we use cash flow estimated as the innovation of EBITDA scaled by the lagged total asset. However, raw cash flow may contain systematic market factors, which could confound the local effects of our interest. In addition, Jurado et al. (2015) show that the uncertainty component needs to be separated from past information, which is more associated with realized risk. Thus, for each local firm, we extract a residual cash flow component from the following regression:

$$CF_{i,k,t} = \alpha_i + \beta_1 CF_{i,k,t-1} + \beta_2 MKTCF_{t-1} + \beta_3 INDCF_{k,t-1} + \varepsilon_{i,k,t}, \quad (2)$$

where: $CF_{i,t}$ is the cash flow of local firm $i$ in industry $k$ at quarter $t$; $MKTCF_{t-1}$ is the value-weighted market-level cash flow; $INDCF_{k,t-1}$ is the value-weighted cash flow of industry $k$ based on the Fama-French 48 industry classification; $\varepsilon_{i,k,t}$ is the residual cash flow of a local firm $i$.

We conduct the above regression based on the rolling window method over the past twelve quarters and obtain the residual from each window for every firm. This residual approach allows us to concentrate on the regional uncertainty component, which is not explained by past available information as well as the systematic factors. We then obtain the firm-level cash flow volatility (CFV) estimated as the standard deviation of the residual cash flow over the past four quarters. Next, we estimate local cash flow volatility (LCFV) based on the CFV of locally headquartered firms:

$$LCFV_{j,t} = \sum_{i=1}^{M_j} w_{i,j,t} \times CFV_{i,j,t}, \quad (3)$$

where: $w_{i,j,t}$ is the value of market capitalization weight for firm $i$ headquartered in state $j$ at quarter $t$; $M_j$ is the number of local firms at state $j$; $CFV_{i,j,t}$ is cash flow volatility of firm $i$.[2]

In the final step, we use the estimated citation weight (*CW*) and local cash flow volatility (*LCFV*) to obtain the local economic uncertainty as follows:

$$LEU_{i,t} = \sum_{j=1}^{T} CW_{i,j,y-1} \times LCFV_{j,t}, \quad (4)$$

where: $CW_{i,j,y-1}$ is the citation weight of state $j$ for REIT $i$ in the previous year; $LCFV_{j,t}$ is the state-level cash flow volatility for state $j$. We use a one-year lagged state citation weight $CW_{i,j,y-1}$ to ensure that the economic relevance of states is not simultaneously associated with time-varying regional characteristics. $LEU_{i,t}$ a variable of main interest to examine our key question about whether the cross-sectional distribution of risk in the US REITs market is characterized by local economic uncertainty.

## 2.2. Risk measure

In financial econometric literature, various measures of firm-level risk have been introduced. In particular, extreme risk approaches have been frequently used since their focus on the left part of the return distribution, which is generally of central importance to investors' attention. The importance of the left tail of stock returns is also empirically supported due to the leverage effects of the negative returns (Black, 1976; Wu, 2001). Among extreme measures, value-at-risk and expected shortfall (ES) are the most popular measures due to their intuitive and straightforward approaches. In this study, we estimate the risk of REITs using the ES, which evaluates the expected loss conditional on returns lower than the threshold of $\alpha$-quantile (Acharya et al., 2017). The ES captures several aspects of extreme returns that the value-at-risk does not contain. For example, the ES allows us to obtain a coherent measure of risk due to its subadditivity and continuity (Artzner et al., 1999). Furthermore, the value-at-risk cannot provide any information on losses over the threshold, while the ES considers this amount (Liang & Park, 2007). Although we use ES as our main risk measure of REITs, we further explore other risk measures for robustness check in section 3.2.

Specifically, in the extension of Ellul and Yerramilli (2013) and Srivastav et al. (2017), we estimate ES using the nonparametric approach based on the empirical distribution of daily returns. Since raw returns contain both common market components, raw return-based ES may not capture the risk that is specific to individual REITs.

[2] As we use the rolling window estimation to obtain the cash flow volatility, it could be subject to a serial correlation. However, we use this level variable for the following reason. As Gulen and Ion (2016) explain in their adoption of the level variable of Economic Policy Uncertainty, the nature of uncertainty tends to be long-lasting by containing rich information on the aggregate volatility over certain periods. This important information could be eliminated if we use the first difference of LEU. Nevertheless, we further show the robustness of our LEU measure against the first difference in Section 3.2.

Thus, we use orthogonalized returns from the Carhart (1997) 4-factors:

$$r_{i,d} - rf_d = \alpha_i + \beta_{MKT} MKT_d + \beta_{SMB} SMB_d + \beta_{HML} HML_d + \beta_{MOM} MOM_d + \varepsilon_{i,d}, \quad (5)$$

where: $r_d - rf_d$ is the daily excess return of REIT *I*; $rf_d$ is risk-free rate using the 1-month US treasury bill; $MKT_d$ is the market excess return; $SMB_d$, $HML_d$, and $MOM_d$ are the returns based on the portfolio of size, BM, and momentum, respectively; $\varepsilon_{i,d}$ represents residuals of REIT *i*.[3] For every quarter, we conduct the above regression and obtain residual returns, $\varepsilon_{i,d}$. Then, for REIT *i*, we estimate ES as follows:

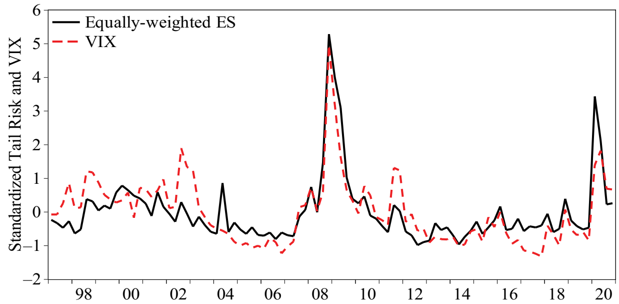
$$ES_{i,t}^{\alpha} = -E[\varepsilon_{i,d,t} \,|\, \varepsilon_{i,d,t} \le -VaR_{i,t}^{\alpha}], \quad (6)$$

where: $\varepsilon_{i,d,t}$ is the daily residual return for REIT *i* at day *d* in quarter *t*; $VaR_{i,d,t}^{\alpha}$ is α% Value-at-Risk of residual returns at quarter *t*.

Following the rule of Gabaix et al. (2006) and existing studies (e.g., Kelly & Jiang, 2014; Srivastav et al., 2017), we choose 5% for α, which corresponds to about three days of lowest returns in quarterly distribution. We multiply minus one with the average return below 5% of a distribution to ensure that ES increases with the risk of REITs. In the later section, we also use alternative risk measures for robustness checks.

In Figure 1, we plot the evolution of equally-weighted aggregate expected shortfall (ES) and the volatility index (VIX) from CBOE. Finance studies have exploited VIX to proxy for the aggregate stock market risk in that it measures the expected volatility of S&P 500 index options for the next 30 days following the measurement time point. Comparison of the aggregated ES of REITs and VIX allows us to explore how the patterns of extremely negative returns in the REIT market are associated with the second moment of the aggregate stock market. As shown in Figure 1, the aggregated ES of the REIT market shows similar patterns with the aggregate market volatility, in line with previous findings (e.g., An et al., 2016). Interestingly, even though we exclude the first-moment common market factors in the ES estimation, the pattern of ES still contains the second-moment effects of the aggregate economy. For example, the average ES of REITs corresponds to volatile periods, such as the Asian Financial Crisis, LTCM crisis, 9/11 terrorist attacks, subprime mortgage crisis, and recent COVID-19.

[3] As previous REIT studies have shown a significant interaction between the REIT and general stock markets (e.g., Ling and Naranjo, 1999; Glascock et al., 2000; Chiang et al., 2017), we obtain the residual by employing the aggregate stock market factors, including Fama-French 3 factors and Carhart's (1997) momentum factor. Hartzell et al. (2020) introduce the REIT-based market factors to evaluate the performance of REIT mutual funds, but we rely on Carhart's four factors since our objective is to obtain idiosyncratic information of REITs (REIT-specific) that are not explained by the other aggregate information.




*Note:* The figure presents the evolution of quarterly expected shortfall and quarterly average VIX over the sample period from 1997Q1 to 2020Q4. We obtain equally-weighted quarterly risk from the quarterly cross-section of REITs. To compare, two variables are standardized to have a mean of zero and a standard deviation of one across the sample period.

Figure 1. Time series of quarterly expected shortfall

## 2.3. Data

We employ publicly listed US equity REITs from 1997 to 2020. Our sample begins in 1997, which marks the first year of 10-K filing submission as an obligation in an electronic system. We obtain daily values of the stock return, the trading volume, and the market capitalization from the Center for Research in Security Prices (CRSP). Firm-level financial characteristics are collected from Compustat. Our sample includes Delisted REITs in the sample to mitigate survivorship bias (Shumway, 1997). We require REITs to have at least 25 days of valid trading days for quarterly estimation and have over four consecutive quarters of observations. We winsorize all the variables at the

Table 1. Summary statistics

| Panel A. Summary statistics | | | | | |
|---|---|---|---|---|---|
| | Mean | St. Dev. | p25 | Median | p75 |
| ES | 3.262 | 2.535 | 1.969 | 2.534 | 3.538 |
| LEU | 0.013 | 0.007 | 0.011 | 0.012 | 0.015 |
| Size | 6.866 | 1.734 | 5.934 | 7.035 | 8.003 |
| Market-to-book | 2.307 | 2.453 | 1.206 | 1.680 | 2.420 |
| Market leverage | 0.436 | 0.188 | 0.310 | 0.419 | 0.550 |
| ROA | 0.006 | 0.011 | 0.001 | 0.006 | 0.011 |
| Cash | 0.035 | 0.055 | 0.007 | 0.016 | 0.038 |
| Cash flow volatility | 0.009 | 0.015 | 0.002 | 0.004 | 0.010 |
| Beta | 0.677 | 0.537 | 0.282 | 0.600 | 1.000 |
| Turnover | –1.258 | 0.874 | –1.700 | –1.136 | –.0691 |
| CW_ΔUnemp | 0.000 | 0.117 | –0.035 | –0.018 | 0.007 |
| CW_ΔHP | 0.010 | 0.014 | 0.007 | 0.012 | 0.017 |

*Note:* This table presents summary statistics for firm characteristics and regional exposure measures. The five columns show the mean, standard deviation, 25th percentile (p25), median, and 75th percentile (p75), skewness, and kurtosis. ES is the quarterly expected shortfall with a 5% threshold in the distribution of residual returns relative to Carhart (1997) 4 factors. To ensure that the results are not driven by extreme values, all variables are winsorized at 1 and 99 percentile levels.

1st and 99th percentiles to mitigate the impact of a potential outlier. We require non-missing variables for baseline control variables as well as our main variables, LEU and ES. The resulting samples include 271 unique REITs with 10,221 firm-quarter observations. Table 1 reports the summary statistics of risk, LEU, and other characteristics. A detailed description of all the control variables used in this study is provided in Table A1.

## 3. Empirical results

### 3.1. LEU and risk

To examine how local economic uncertainty is associated with the future risk of REIT, we implement the Fama-MacBeth (1973) quarterly cross-sectional regression. All explanatory variables are lagged by one quarter to test whether the LEU has predictable effects on the risk of REIT. The specification of the regression is as follows:

$$ES_{i,t} = \beta_1 + \beta_2 \cdot LEU_{i,t-1} + \gamma' \cdot Controls_{i,t-1} + \varepsilon_{i,t}, \quad (7)$$

where: $ES_{i,t}$ is the expected shortfall for REIT $i$ at quarter $t$; $LEU_{i,t-1}$ is the local economic uncertainty for REIT $i$ at quarter $t$–1; $Controls_{i,t-1}$ is a vector of one-quarter lagged risk and other firm characteristics that have been shown to affect firm-specific risk. Following Bennett et al. (2003), all independent variables are standardized to have zero mean and one standard deviation so that we can directly compare the slope coefficients. In the regression results, we report the time-series average of the quarterly cross-sectional regression coefficients and their $t$-statistics. $t$-statics are estimated based on the adjusted standard error of Newey and West (1987) for potential autocorrelations.

Table 2 reports the results of panel regression with different specifications. In column (1), we conduct the regression test with control variables of fundamental firm characteristics. The result shows that the LEU has a positive

Table 2. LEU and Cross-section of risk

| Panel A. Baseline results | | | | |
|---|---|---|---|---|
| Dependent variable: ES | | | | |
| | (1) | (2) | (3) | (4) |
| LEU | 0.045*** | 0.053*** | 0.060*** | 0.072*** |
| | (6.74) | (5.29) | (5.86) | (6.55) |
| Lagged ES | 0.547*** | 0.517*** | 0.511*** | 0.508*** |
| | (34.85) | (31.71) | (30.71) | (29.51) |
| Size | –0.357*** | –0.304*** | –0.278*** | –0.276*** |
| | (–18.71) | (–13.15) | (–7.25) | (–7.59) |
| Market-to-book | –0.002 | –0.019 | –0.031 | –0.024 |
| | (–0.17) | (–0.98) | (–1.55) | (–1.20) |
| Market leverage | 0.153*** | 0.139*** | 0.148*** | 0.146*** |
| | (4.35) | (3.34) | (3.69) | (3.73) |
| ROA | | –0.151*** | –0.150*** | –0.157*** |
| | | (–3.34) | (–4.02) | (–4.35) |
| Cash | | 0.107*** | 0.098*** | 0.098*** |
| | | (7.67) | (7.44) | (5.84) |
| Cash Flow Volatility | | 0.092*** | 0.101*** | 0.104*** |
| | | (2.72) | (2.90) | (2.83) |
| Beta | | | 0.088*** | 0.089** |
| | | | (2.77) | (2.60) |
| Turnover | | | –0.102*** | –0.109*** |
| | | | (–2.74) | (–3.09) |
| CW_ΔUnemp | | | | 0.007 |
| | | | | (0.78) |
| CW_ΔHP | | | | 0.008 |
| | | | | (0.39) |
| Constant | 1.568*** | 1.669*** | 1.702*** | 1.712*** |
| | (15.25) | (15.25) | (13.97) | (13.85) |
| R-squared | 0.516 | 0.551 | 0.575 | 0.585 |
| Obs. | 10,221 | 10,221 | 10,221 | 10,221 |

*End of Table 2*

| Panel B. Persistent effects | | | | | | |
|---|---|---|---|---|---|---|
| | t+1 | t+2 | t+3 | t+4 | t+5 | t+6 |
| LEU | 0.072*** | 0.065*** | 0.056*** | 0.034* | 0.035 | 0.005 |
| | (6.55) | (6.78) | (4.51) | (1.96) | (1.31) | (0.19) |
| Control | Yes | Yes | Yes | Yes | Yes | Yes |
| R-squared | 0.585 | 0.545 | 0.527 | 0.521 | 0.512 | 0.509 |
| Obs. | 10,221 | 9,948 | 9,672 | 9,398 | 9,130 | 8,866 |

*Note:* This table reports coefficient estimates from quarterly Fama-MacBeth (1973) regressions. Panel A presents the baseline results. The dependent variable is the quarterly expected shortfall. Panel B presents the prolonged effect of local economic uncertainty on the future expected shortfall. We expand the lag between the dependent variable and independent variables from 1-quarter (t+1) to 6-quarter (t+6) and report the coefficients on LEU for the corresponding lag. The sample period for the regression is from 1997Q1 to 2020Q4. Newey and West (1987) standard error adjusted *t*-statistics are in parenthesis. *, **, and *** indicate statistical significance at the 10%, 5%, 1% levels, respectively.

and statistically significant impact on risk. Specifically, the slope coefficient of LEU is 0.045, with a *t*-statistics of 6.63. In economic interpretation, a one-standard-deviation increase in LEU leads to an increase in the annualized risk by 11.34 percentage points. This suggests that LEU of REITs has economically significant and positive impacts on risk. Consistent with previous findings related to idiosyncratic risk (Irvine & Pontiff, 2009; Brandt et al., 2010), the risk is highly associated with its lagged value, indicating that risk tends to be persistent. In addition, in line with the relationship between size and idiosyncratic volatility (e.g., Brandt et al., 2010), the coefficient estimate of firm size is strongly negative and significant. Overall, these results show that our risk measures share similar factors with idiosyncratic volatility. The possible explanation is that our risk measure is based on residual returns, which are basically exploited to estimate the idiosyncratic volatility. Finally, the market-to-book (MB) has a negative but not significant effect on risk. Market leverage has a statistically significant and positive coefficient.

When we include the other three firm characteristics in column (2), the coefficient of LEU remains highly positive and statistically significant. Not surprisingly, ROA has negative impacts on risk, indicating that REITs with better performance have lower risks than REITs with worse performance. We find a positive relationship between cash holding and risk. This finding is surprising in that cash is generally reserved for future risk (Harford et al., 2014). The potential reason is that a larger cash reserve is more likely to be done by REIT managers who expect higher future risk. Finally, firm-level cash flow volatility is highly associated with the future risk of REITs, suggesting that investors discount more regarding REITs with more volatile cash flow.

The specification of column (3) includes additional control variables related to characteristics in the market trade. We find that the coefficient estimate of LEU increases to 0.060 and is highly significant at a 1% significance level, indicating that the positive impact of LEU is robust to various factors that could affect firm-specific risks. Among the additional control variables, the coefficient estimate of market beta is highly significant and positive. This finding implies that REITs with higher systematic risks have larger risks. In addition, we find that the volume turnover ratio is negatively associated with risk, suggesting that more actively traded REITs are less correlated with future risk.

In column (4), we add regional exposure to local state variables (unemployment growth and housing price growth) to ensure that the relationship between LEU and cross-sectional risk is not driven by the first-moment shock of the regional economy. Column (4) shows that the LEU has a consistently significant coefficient of 0.072 at the 1% significance level, indicating an 18.144% increase in annualized expected shortfall. This evidence suggests that the effect of LEU captures an important feature of risk that is not captured by local economic activity.

We further investigate the long-term impacts of LEU on risk. To this end, we separately run a regression with full control variables through lags from 1 to 6 quarters. From each result of the 12 regressions, we obtain the coefficient of LEU and report the coefficients in Panel B of Table 2. As shown, the coefficient of LEU is positive and statistically significant up to a 4-quarter lag, and this positive effect moderately decreases to zero thereafter. This suggests that increases in local market uncertainty lead to increases in the risk of REITs until the next 1-year.

### 3.2. Robustness check

This section investigates whether our results are robust to several alternative measures of our main variables. In Panel A of Table 3, we examine the effects of LEU on various risk measures. Specifically, we report the coefficient of LEU from each specification with full control variables. First, we explore the effects of LEU on the ES based on raw returns and find that LEU has economically similar effects compared to our ES measure based on residual returns relative to Carhart's (1997) 4-factor model. Next, we examine whether LEU is associated with systematic risk. As argued by Korniotis and Kumar (2013), the local macroeconomic condition can affect the

Table 3. Robustness check

| Panel A. Alternative risk measures | | | | | |
|---|---|---|---|---|---|
| Dependent variables: | ES_raw | ES_syst | VaR | Volatility | ΔES |
| | (1) | (2) | (3) | (4) | (5) |
| LEU | 0.073*** | 0.032*** | 0.042*** | 0.032*** | 0.017*** |
| | (8.03) | (3.97) | (6.87) | (8.26) | (6.77) |
| Control | Yes | Yes | Yes | Yes | Yes |
| R-squared | 0.554 | 0.490 | 0.618 | 0.638 | 0.334 |

| Panel B. Alternative LEU | | | | | | |
|---|---|---|---|---|---|---|
| Dependent variable: ES | | | | | | |
| LEU measures: | Raw CF | Idio-CF | Industry-adjusted | Sales growth | ΔLEU | EPU excl. |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| LEU | 0.074*** | 0.048*** | 0.076*** | 0.062*** | 0.139*** | 0.076*** |
| | (8.04) | (4.00) | (5.87) | (3.45) | (5.35) | (7.81) |
| Control | Yes | Yes | Yes | Yes | Yes | Yes |
| R-squared | 0.586 | 0.586 | 0.586 | 0.584 | 0.585 | 0.592 |

*Note:* This table presents the robustness results for cross-sectional regression with different specifications. Panel A provides the coefficient estimates of LEU with different risk measures as the dependent variable Panel B reports the coefficient estimates of LEU, which are measured based on alternative approaches. The sample period for the regression is from 1997Q1 to 2020Q4. Newey and West (1987) standard error adjusted *t*-statistics are in parenthesis. *, **, and *** indicate statistical significance at the 10%, 5%, 1% levels, respectively.

systematic risk of local firms because some regions could be more covary with the aggregate economy. Thus, REITs with higher LEU might be more sensitive to extreme systematic risk. To test this hypothesis, we follow the approach of Srivastav et al. (2017) and use the systematic component of Equation (4).[4] Column (2) shows that the coefficient of LEU is highly positive and statistically significant, suggesting that REITs with greater exposure to local market uncertainty are highly associated with future systematic risk as well.

We further investigate the effects of LEU on value-at-risk (VaR) and volatility based on residual returns obtained from Equation (4). We obtain quarterly volatility as the standard deviation of daily residual returns. Columns (3) and (4) consistently show the positive and significant effects of LEU. This suggests that LEU shows predictive effects on other distributional dimensions of risk in the cross-section of REITs. Overall, we can identify that the impact of LEU is comprehensively applicable to other risk measures, which are popularly adopted in existing finance literature.

Finally, in column (5), we further investigate whether LEU affects the log difference of risk. In addition to the inclusion of lagged risk variables in the regression, this test further explores whether the persistence of risk drives our results. The results show that the impact of LEU remains positive and statistically significant at the 1% level, suggesting that LEU directly affects the short-term growth of risk in the next quarter.

In Panel B of Table 3, we check the robustness of our results to different proxies for LEU. First, we re-estimate LEU using the raw cash flow without the orthogonalization process and run the cross-sectional regression. Column (1) shows that LEU based on raw cash flow volatility has economically similar and significant effects on the ES of REITs. Second, we explore whether the effect of LEU is also robust to the idiosyncratic cash flow based on residual cash flow from the contemporary orthogonalization rather than the lagged orthogonalization approach in our baseline measure.[5] Column (2) shows that the coefficient estimate of LEU remains strongly positive with marginally decreased economic magnitude, suggesting that contemporary fluctuations of the market- and industry-wide cash flow do not drive our results.

We further investigate the effects of LEU based on the adjusted cash flow relative to industry peers within each Fama-French 48 industry. Column (3) presents that LEU based on industry-adjusted cash flow is still highly positive and significant, suggesting that our results are not explained by the heterogenous level of industrial

[4] The systematic component is based on predicted returns composed of Carhart (1997) 4 factors from the Equation (1): $r_{syst,d} = \hat{\alpha} + \hat{\beta}_{MKT} MKT_d + \hat{\beta}_{SMB} SMB_d + \hat{\beta}_{HML} HML_d + \hat{\beta}_{MOM} MOM_d$

[5] We use Fama-French 48 industries for industrial classification to calculate the residual cash flow. Specifically, residual cash flow $\epsilon_{i,t}$ is estimated from following specification: $CF_{i,t} = \beta_1 + CF_{MKT,t} + CF_{IND,t} + \epsilon_{i,t}$.

cash flow. In column (4), we re-obtain LEU based on the sales growth instead of cash flow and obtain economically similar effects. From the perspective of the REITs market, our results suggest that REITs investors evaluate the risk of REITs based on both realized regional market volatility and current deviation from the past trend of volatility.

We then explore whether our results are robust to the first difference of LEU. As our underlying estimation of LEU is based on the rolling window approach, LEU could be subject to a serial correlation. Even though the serially correlated information might be important due to the long-lasting characteristic of uncertainty, we further test our results under the first difference of LEU within each firm, which removes a serial correlation over time. This first differenced LEU is associated with a short-term fluctuation of regional uncertainty in that it captures a shift of LEU from the previous quarter. In column (5) of Panel B, we find that the coefficient of the first differenced LEU is even increased and highly significant, suggesting that a short-term increase in local firms' uncertainty is directly associated with risk of REITs.

Finally, we examine whether our LEU measure is robust to the influence of nationwide Economic Policy Uncertainty (EPU), introduced by Baker et al. (2016).[6] In unreported results, we find that our LEU measure has a correlation of 0.16 with EPU, suggesting that a certain share of the second moment in the local market uncertainty is associated with EPU. To exclude this potential correlation, we exploit orthogonalization using the firm-level univariate regression over the rolling of the last 20 quarters. This approach enables us to obtain LEU components that are not explained by the time-varying interaction between EPU and LEU. In the last column of Table 3, we find that the coefficient of LEU orthogonal to EPU is still strongly positive and statistically significant. This indicates that cross-sectional variation of REIT risk is associated with localized uncertainty, which is above the aggregate influence. We further conduct the robustness of our LEU measure against the state variables in Section 3.4.

### 3.3. Property-based weight approach

A key advantage of using REITs data compared to non-financial firms is that we can identify the specific location of assets under management. In particular, the homogenous characteristics of assets of REITs allow researchers to focus on the implications of geographical factors with fewer concerns of confounding factors that might come from the heterogeneity of the underlying assets as in non-financial firms. Due to these unique features, previous REITs literature has exploited local exposure measures of REITs using property information (e.g., Ling et al., 2018; Zhu & Lizieri, 2022, among many others). Thus, it is a natural question about how our weighting scheme is associated with the traditional measure based on property information and whether LEU based on property information is also associated with the future risk of REITs. This section addresses these questions by exploiting property data of REITs from the SNL REITs database. Following previous methods, we use the adjusted cost and property number, respectively, to re-estimate state-level uncertainty using the property weight approach as follows:

$$PW_{i,j,y} = \frac{prop_{i,j,y}}{\sum_{j=1}^{N_j} prop_{i,j,y}}, \quad (8)$$

where: $prop_{i,j,y}$ indicates the sum of adjusted cost or the number of properties of REIT $i$ at state $j$ in year $y$; $N_j$ indicates the number of states where REITs are holding properties; $PW_{i,j,y}$ denotes the relative share of property investments across US states. We then use the same process to obtain the LEU based on estimated property weight as shown in the following specification:

$$LEU_{i,t}^{prop} = \sum_{j=1}^{N_j} PW_{i,j,y-1} \times LCFV_{j,t}, \quad (9)$$

where $LEU_{i,t}^{prop}$ indicates the local economic uncertainty exposed to REIT $i$ through their property portfolio based on the adjusted cost or the number of properties.

In Panels A and B of Table 4, we explore how citation-based state weight is correlated with property-based state weight. As shown, the unconditional correlation registers over 75% for both the adjusted cost (*PW_adjust cost*) and the number of properties (*PW_property number*). In the panel-based correlation test, the citation-based share is still strongly correlated with the property-based share for both firm-level and state-level analysis. These strong correlations suggest that 10-K filings actually reflect geographical important information about REITs, especially with regard to the underlying assets.

We further investigate whether $LEU^{prop}$ is associated with the future risk of REITs. Since operating real estate of REITs is a key channel of exposure to the regional economy, we can conjecture that investors require a greater price drop for REITs with higher LEU. To this end, we conduct the cross-sectional regression tests with full control variables using $LEU^{prop}$ based on the adjusted cost and the number of properties. As consistent with our prediction, the results in Panel C show that $LEU^{prop}$ is also strongly and positively associated with risk of REITs. Interestingly, the size of the effect from the citation weight approach in column (4) of Table 2 is greater than the property weight approaches. Although the findings need to be interpreted with caution, the results suggest that there would be economically relevant geographical information timely discussed in the 10-K filings, which might not be captured by the property holding information.

[6] We obtain US Economic Policy Uncertainty (EPU) from the website: https://www.policyuncertainty.com/

Table 4. Relationship between citation and property weights

| Panel A. Pairwise correlation | | | | |
|---|---|---|---|---|
| | CW | | PW_adjust cost | |
| CW | | | | |
| PW_adjust cost | 0.768*** | | | |
| PW_property number | 0.776*** | | 0.888*** | |
| **Panel B. Conditional correlation** | | | | |
| | Firm-state-level | | State-level | |
| Dependent variable: CW | (1) | (2) | (3) | (4) |
| PW_adjust cost | 0.601*** | | 0.550*** | |
| | (837.67) | | (74.90) | |
| PW_property number | | 0.676*** | | 0.646*** |
| | | (857.46) | | (80.76) |
| Firm fixed effect | Yes | Yes | | |
| State fixed effect | | | Yes | Yes |
| Time fixed effect | Yes | Yes | Yes | Yes |
| **Panel C. Effects of Property-weighted LEU** | | | | |
| Weight measure | PW_adjust cost | | PW_property number | |
| Dependent variable: ES | (1) | | (2) | |
| $LEU^{prop}$ | 0.052*** | | 0.064*** | |
| | (6.69) | | (4.02) | |
| Control | Yes | | Yes | |
| R-squared | 0.566 | | 0.613 | |
| Obs. | 8,172 | | 9,122 | |

*Note:* This table presents how the citation weight approach is associated with the property-weight approach. Panel A shows the pairwise correlation across the citation weight and two property weight measures, which are estimated based on adjusted cost (PW_adjust cost) and property number (PW_property number), respectively. Panel B provides conditional correlations based on the firm-state level and aggregate state level. Finally, Panel C reports Fama-MacBeth (1973) regression results with full control variables using two property-based weight measures, respectively. The sample period for the regression is from 1997Q1 to 2020Q4. Newey and West (1987) standard error adjusted *t*-statistics are in parenthesis. *, **, and *** indicate statistical significance at the 10%, 5%, 1% levels, respectively.

### 3.4. Residual local economic uncertainty

We estimate local economic uncertainty using the residual cash flow, obtained from the regression on the one-quarter lagged cash flow variables of the firm, industry, and market level. However, the aggregation of firm-level uncertainty at the state level and then across US states may incur a measurement error that could be correlated with the aggregate market uncertainty, such as economic policy uncertainty, developed by Baker et al. (2016). To address this issue, we use two methods to obtain the residual LEU and run the cross-sectional regression again for the robustness of our LEU measure. In addition, we further investigate whether our results are robust to the panel regression approach with firm and time, and state-time fixed effects.

First, we follow Smajlbegovic (2019) and estimate the residual LEU by regressing LEU on firm-level return sensitivity to VIX and Carhart's (1997) 4-factors.[7] This process rules out a possibility that our LEU measure captures the sensitivity to aggregate risk factors rather than firm-specific exposure to local market uncertainty. Second, we further estimate the residual LEU by excluding exposures to state-level economic policy uncertainty and economic activity. we obtain the state-level economic policy uncertainty from Baker et al. (2022) who recently develop state-level economic policy uncertainty using daily and weekly local news papers. For state-level economic activity, we use State Coincident Index (SCI) introduced by Crone and Clayton-Matthews (2005).[8]

[7] The return sensitivity is obtained from the rolling window daily-return regression based on the following specification: $r_{i,d} - rf_d = \alpha_{i,t} + \beta_{VIX,t} VIX_d + \beta_{MKT,t} MKT_d + \beta_{SMB,t} SMB_d + \beta_{HML,t} HML_d + \beta_{MOM,t} MOM_d + \varepsilon_{i,d}$, where $\beta_{VIX,t}$, $\beta_{MKT,t}$, $\beta_{SMB,t}$, and $\beta_{MOM,t}$ are the return sensitivities to the aggregate factors at quarter $t$.

[8] State Coincident Index (SCI) is monthly computed based on four state-level indicators: nonfarm payroll employment, unemployment rate, average hours worked in manufacturing, wage, and salary disbursement scaled by the consumer price index.

Table 5. Residuals of LEU

| Panel A. Cross-sectional regression | | |
|---|---|---|
| Dependent variable: ES | Firm-level sensitivity | State-level exposure |
| | (1) | (2) |
| Residual LEU | 0.071*** | 0.066*** |
| | (4.88) | (6.14) |
| Controls | Yes | Yes |
| R-squared | 0.585 | 0.595 |
| Obs. | 10,221 | 9,656 |

| Panel B. Fixed effects | | | | |
|---|---|---|---|---|
| Dependent variable: ES | Firm sensitivity | | State-level exposure | |
| | (1) | (2) | (3) | (4) |
| Residual LEU | 0.058** | 0.095*** | 0.068*** | 0.091*** |
| | (2.10) | (2.52) | (3.23) | (3.06) |
| Controls | Yes | Yes | Yes | Yes |
| Firm fixed effect | Yes | Yes | Yes | Yes |
| Time fixed effect | Yes | No | Yes | No |
| State-time fixed effect | No | Yes | No | Yes |
| R-squared | 0.640 | 0.707 | 0.651 | 0.718 |
| Obs. | 10,221 | 9,511 | 9,649 | 8,940 |

*Note:* This table presents the regression results using two residual LEU measures. Panel A presents the Fama-MacBeth (1973) regression results for two residual measures. Newey and West (1987) standard error adjusted *t*-statistics are in parenthesis. Using two residual measures, Panel B reports panel regression results with fixed effects. Columns (1) and (3) use firm and time-fixed effects, while columns (2) and (4) exploit firm and state-time-fixed effects. State indicates the headquarters state of each REIT. *t*-statistics in Panel B are based on standard errors corrected by the cluster at the firm and time level (Petersen, 2009). The sample period for the regression is from 1997Q1 to 2020Q4. *, **, and *** indicate statistical significance at the 10%, 5%, 1% levels, respectively.

The residual LEU relative to state-level exposure allows us to focus on the effects of LEU, which are not explained by statewide localized economic factors. Panel A of Table 5 reports the coefficients of residual LEU obtained from the above two approaches. As shown, the effects of the residual LEU are still strongly positive and statistically significant, suggesting that the positive effects of LEU are not explained by factors beyond firm-level information.

We further investigate the effects of residual LEU using the fixed effects approaches in Panel B of Table 5. Specifically, we run Panel regression tests with different sets of fixed effects to investigate whether the effects of LEU are alive if we account for heterogeneity in different dimensions. Specifically, in columns (1) and (3), we use firm- and time-fixed effects, while, in columns (2) and (4), we employ firm- and state-time-fixed effects.[9] Importantly, time-fixed and state-time-fixed effects rule out time-varying common market factors, including EPU, and time-variant state-level economic fluctuations, respectively. In addition, there could be a potential serial correlation in our LEU measures in the sense that we obtain LEU based on the rolling estimation. To mitigate the effects of serial correlation on our results, we correct a standard error by clustering at firm and time, as suggested by Petersen (2009). This corrected standard error has been widely used in empirical finance studies as it rigorously controls a cross-sectional correlation across firms and a serial correlation in variables (e.g., Gulen & Ion, 2016; Gu et al., 2018). In columns (1) and (3), we find that the coefficients of residual LEU remain significant at least a 5% level. We further include the headquarters' state-time fixed effect to account for the time-varying local effects surrounding the headquarters location. Columns (3) and (4) show that the effects of the residual LEU are strongly positive and rather increased, suggesting that accounting for unobserved time-variant local effects of headquarters states mitigates the downward bias in the coefficient of LEU.

### 3.5. Local characteristics of REITs

This section investigates how the effects of LEU are associated with the local features of REITs. Previous studies have documented the importance of the headquarters and non-headquarters areas (Baik et al., 2010; Pirinsky & Wang, 2006; Dougal et al., 2015; Smajilbegovic, 2019). We first examine the effects of the two areas on our results. Specifically, we estimate the LEU for the headquarters state (*HQ LEU*) and non-headquarters state (*NonHQ*

[9] State-time-fixed effect is based on the state where REITs are headquartered.

Table 6. Local characteristics of REITs

| Panel A. Effects of the headquarters area | | | |
|---|---|---|---|
| Dependent variable: ES | | | |
| | (1) | (2) | (3) |
| HQ LEU | 0.030** | | 0.037*** |
| | (2.47) | | (3.62) |
| NonHQ LEU | | 0.048*** | 0.052*** |
| | | (2.71) | (2.85) |
| Control | Yes | Yes | Yes |
| R-squared | 0.585 | 0.585 | 0.591 |

| Panel B. Geographical concentration | | | | |
|---|---|---|---|---|
| Dependent variable: ES | | | | |
| | Low | High | Low | High |
| | (1) | (2) | (3) | (4) |
| LEU | 0.037 | 0.066*** | | |
| | (1.26) | (4.86) | | |
| HQ LEU | | | 0.029 | 0.049** |
| | | | (1.43) | (2.58) |
| NonHQ LEU | | | 0.021 | 0.045*** |
| | | | (1.17) | (3.51) |
| Control | Yes | Yes | Yes | Yes |
| R-squared | 0.722 | 0.789 | 0.738 | 0.805 |

*Note:* This table reports the results regarding the effects of local characteristics of REITs. Panel A provides the coefficient estimates of HQ LEU and NonHQ LEU, which are estimated by decomposing LEU depending on whether LEU is subject to the state of headquarters (HQ) or not. Panel B provides subsample regression results based on the median of the geographical concentration of REITs. The sample period for the regression is from 1997Q1 to 2020Q4. Newey and West (1987) standard error adjusted *t*-statistics are in parenthesis. *, **, and *** indicate statistical significance at the 10%, 5%, 1% levels, respectively.

*LEU*), separately, as in Smajilbegovic (2019), and run the cross-sectional regression tests. Panel A of Table 6 reports the coefficients of *HQ LEU* and *NonHQ LEU* and shows that both effects are strongly associated with the risk of REITs, as consistent with previous literature. This finding indicates that considering all states of economic interest is crucial for assessing the risk of REITs.

We further explore the effects of geographical concentration on our results. To this end, we estimate the citation-weight Herfindahl-Hirschman index (HHI) and run the subsample regression tests based on the above (*High*) and below (*Low*) median of HHI for every quarter. As consistent with our expectation, Panel B of Table 6 shows that geographically concentrated REITs show greater effects of LEU on risk for both LEU and decomposed LEU (*HQ LEU* and *NonHQ LEU*). These findings provide important implications that REIT investors can mitigate potential risk by investing in geographically diversified REITs or multiple REITs that are concentrated in different regions.

### 3.6. Asset pricing implication of LEU

It has been established that investors want to hedge against future uncertainty in their consumption since they want to optimize their utility from their lifetime consumption (Merton, 1973). In the final section, we investigate whether the LEU is priced by investors. We first employ univariate portfolio analysis using LEU. Specifically, for every quarter, the sample of REITs is formed into low (less than 30%), medium (between 30% and 70%), and high (higher than 70%) groups. Then, we estimate the equally weighted returns in the next quarter for three portfolios, respectively. Panel A of Table 7 shows that the excess return spread between high and low groups is 0.635% per quarter (2.54% per annum). The return spread is even stronger when we use alphas relative to popular asset pricing factors, CAPM, Fama-French 3-factor (FF3), and Carhart 4-factor. In particular, Carhart alpha provides 1.046% per quarter (statistically significant at 1%), which is the strongest among the results of the three alphas. In addition, the future expected returns increase with the level of LEU from the Low to High group. We further investigate the premium of LEU using the multivariate analysis based on the Fama-MacBeth (1973) cross-sectional regression test. Specifically, we regress the 1-quarter future excess return on LEU and other control variables and report the coefficient estimates of LEU in Panel B of Table 7. The results confirm that the coefficient of LEU is positive and statistically significant.

Table 7. LEU and asset price

| Panel A. Univariate portfolio | | | | |
|---|---|---|---|---|
| | Low | Medium | High | High-Low |
| Excess Return | 1.793 | 2.209 | 2.428 | 0.635* |
| | (1.692) | (2.003) | (2.404) | (1.940) |
| CAPM Alpha | –0.010 | 0.469 | 0.769 | 0.779** |
| | (–0.011) | (0.444) | (0.852) | (2.426) |
| FF3 Alpha | –0.111 | 0.353 | 0.671 | 0.782** |
| | (–0.182) | (0.512) | (0.985) | (2.485) |
| Carhart Alpha | 0.038 | 0.738 | 1.084 | 1.046*** |
| | (0.064) | (1.191) | (1.801) | (4.071) |
| Panel B. Multivariate results | | | | |
| Dependent variable: $r_{t+1}$ | | | | |
| | (1) | | (2) | |
| LEU | 2.548*** | | 2.325** | |
| | (2.81) | | (2.57) | |
| Control | No | | Yes | |
| R-squared | 0.016 | | 0.281 | |
| Obs. | 10,221 | | 10,221 | |

*Note:* This table presents the results of the effects of LEU on the cross-section of REITs. Panel A reports the next-quarter equally weighted average excess returns or alphas based on portfolios sorted by LEU. Excess return is an equally-weighted portfolio return in excess of the 1-month T-bill rate. Panel B reports the coefficient estimates of LEU by conducting Fama-MacBeth's (1973) regression of next-quarter returns on LEU and other control variables. $t$ statistics in the parentheses are estimated based on Newey and West (1987) standard errors. *, **, and *** indicate statistical significance at the 10%, 5%, 1% levels, respectively.

## Conclusions

In this study, we investigate the relationship between local market uncertainty and risk in the REIT market. To this end, we develop a novel estimate of LEU using the text-based analysis on 10-K filings. We document several findings that provide important implications for REIT investment. First, risks are greater among REITs with a higher LEU. This positive relation is robust to alternative risks and LEU measures. These findings suggest that the uncertainty of local market fundamentals is an important source of risk in the REIT market. Second, the impacts of local market uncertainty are stronger for geographically concentrated REITs, implying that the potential risk of REIT portfolios may vary with the firm characteristics of the portfolio constituents. Finally, investors require higher returns from REITs with higher LEU, suggesting that investors recognize the potential risk associated with LEU and demand more returns as compensation.

Our study implies that the local economic uncertainty could be an important firm-specific factor in terms of risk evaluation and asset pricing in the sense that LEU positively covaries with a cross-section of risk and returns. Although we conduct a variety of robustness checks and heterogeneity tests, there could still be an important space for future research. First, the source of local economic uncertainty should significantly vary with the characteristics of the local market. For example, regions like Texas would be more susceptible to the fluctuation of oil prices, while the uncertainty of travel cities, such as Las Vegas, is subject to the systematic factor. This indicates the importance of exploring how the risk of REITs differentially responds to shocks across local industries. Second, another dimension of local uncertainty could be further explored. For example, natural disaster is generally locally specific and, their severity is growing along with global climate change. The geographical and uncertain nature of natural disasters could provide additional implications on how local economic uncertainty influences REITs. Finally, future REIT studies can also consider what happens to other economic decisions of REITs, such as property acquisition or leverage choices, in response to increases in regional uncertainty.

## Acknowledgements

The author would like to thank two anonymous referees for their valuable comments, which could further improve this study. The author also appreciates Kim Hiang Liow's helpful guidance during his PhD student period when this study started.

## Funding

There is no funding for this work.

## Disclosure statement

The author has no conflicts of interest to disclose.

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## Appendix

Table A1. Descriptions of the variables

| Variable | Definition | Source |
|---|---|---|
| LEU | Local economic uncertainty estimated in section 2 | 10-K filings; Compustat |
| ES | The 5% quarterly expected shortfall estimated as the average returns lower than 5% of the quarterly distribution of daily returns | CRSP |
| Size | The natural logarithm of market capitalization | Compustat |
| Market-to-book | The ratio of market capitalization to book equity | Compustat |
| Market leverage | The total debt (short-term debt plus long-term debt) normalized by market value (total debt plus market capitalization) | Compustat |
| ROA | Return on asset estimated as the EBITDA scaled by total book assets | Compustat |
| Cash | The cash and short-term investment divided by the total asset | Compustat |
| Cash flow volatility | The standard deviation of cash flow over the past four quarters | Compustat |
| Beta | Market beta estimated as the linear dependence between daily stock return and market return for every quarter. | CRSP |
| Turnover | Turnover ratio estimated as the quarterly number of trading volumes divided by the number of outstanding shares | CRSP |
| CW_ΔUnemp | Regional unemployment growth based on the state-level unemployment rate and citation weight | 10-K filings; Bureau of Labor Statistics |
| CW_ΔHP | Regional housing price growth based on state-level housing price growth and citation weight | 10-K filings; Federal Housing Finance Agency |