

Quantification of REIT Disaster Scores and Their Impact on REIT Value

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1. Introduction

A Real Estate Investment Trust (REIT) is an investment structure that collects funds from investors to purchase real estate and distributes the resulting income. The properties held by REITs include residential buildings, offices, retail facilities, and other types of real estate. Some REITs invest in a variety of property types, while others specialize in a particular sector. Listed REITs, which are accessible to general investors, face risks not only from overall market fluctuations and economic conditions, but also from the characteristics of the properties they own. Property-specific risks include changes in local real estate markets. For example, economic downturns, decreasing population, or new competing properties in a region can adversely affect property performance. Additionally, property aging and increasing maintenance costs can also pose risks. These factors may lead to reduced rental income and lower sales prices, so investors need to evaluate these risks. If a property is highly dependent on a single tenant, the tenant's declining business performance or withdrawal can also affect REIT's earnings. Therefore, understanding the unique features of properties in a REIT's portfolio is important for stable investment. Investors need to recognize and manage these risks. In recent years, climate change has made natural disaster risk a more important factor. Damage from natural disasters can reduce both rental income and property values, negatively

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affecting returns. As a result, evaluating and managing natural disaster risk is now a necessary part of REIT management.

Some studies have examined how real estate prices are affected by natural disaster risk. For example, Baldauf et al. (2020), Bernstein et al. (2019), and Keenan et al. (2018) have shown that sea level rise can reduce the value of coastal properties, while other studies have found little or no effect (Hino & Burke, 2021; Murfin & Spiegel, 2020). Research on REITs and natural disaster risk includes Ertl and Fuerst (2025) and Nguyen (2023). Ertl et al. (2025) used event study methods to investigate the relationship between wildfire risk, REIT beta, and abnormal returns, finding that greater exposure to wildfire risk is associated with lower REIT beta. They also reported that negative abnormal returns are observed when wildfires occur near the boundary between wildland and urban areas, rather than in remote rural areas. Nguyen (2023) used flood insurance payout data to examine the effect of hurricanes on REIT capital structure and suggested that hurricanes can influence REIT financing decisions in ways similar to other distress events.

In this report, we measure natural disaster risk at the REIT level using two datasets: FACTSET-Real Estate Industry ver.1.4.0 (hereafter, FactSet) and FEMA-National Risk Index Census Tracts² (hereafter, FEMA). FactSet contains information about REITs and their properties. The FEMA dataset, provided by the United States Federal Emergency Management Agency, assigns risk scores for 18 types of natural disasters³ at the census tract level (a geographic unit defined by the U.S. Census Bureau; FEMA, 2023).

The rest of this report is organized as follows. Chapter 2 describes the data. Chapter 3 outlines the methods for calculating natural disaster risk at both the property and REIT levels. In addition, we examine how these risks relate to REIT yields.

2. Overview of the Data

2.1. Individual Property Data and REIT Data

We first review the FactSet data utilized in this analysis. As previously described, the FactSet dataset comprises both REIT attribute information and details on individual

² The data we have used so far is not currently accessible. Instead, we can use OpenFEMA database. For details, refer to <https://www.fema.gov/about/reports-and-data/openfema>.

³ The 18 types of natural disasters are: avalanche, coastal flooding, cold wave, drought, earthquake, hail, heat wave, hurricane, ice storm, landslide, lightning, river flooding, strong wind, tornado, tsunami, volcanic activity, wildfire, and winter weather.

properties held by REIT entities; for the purposes of this study, we use data for the United States as of 2023. The down panel of Figure 1 illustrates the number of properties (vertical axis) by U.S. state (horizontal axis), revealing that the largest concentrations of properties are found in California, Texas, and Florida. The right panel of Figure 1 presents the distribution of properties by property type (horizontal axis: property use; vertical axis: number of properties), with Retail, Healthcare, and Industrial being the most prevalent categories, in that order. Because each property record is uniquely linked to a REIT identifier, it is possible to aggregate the data at the REIT level. For example, as of 2023, there are 168 REITs with associated individual property data. During aggregation at the REIT level, we designate the most common property type within each REIT as its representative property type. Figure 2 reports the number of REITs by representative property type. The results indicate that REITs focusing primarily on Retail, Residential, or Office properties are most numerous, while those specializing in Land, Data Centers, or Gaming properties are comparatively fewer.

Figure 1: Count of property by state in the U.S. [Up] and Count of property by property type [Down]

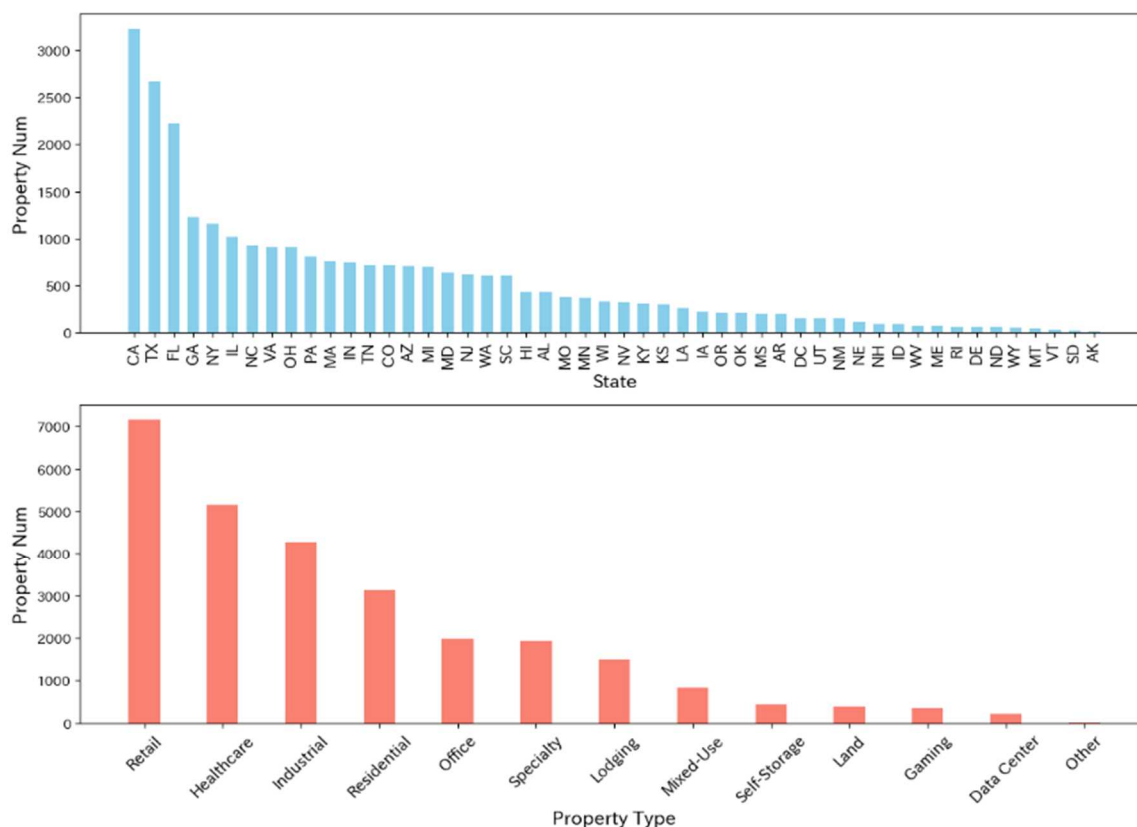
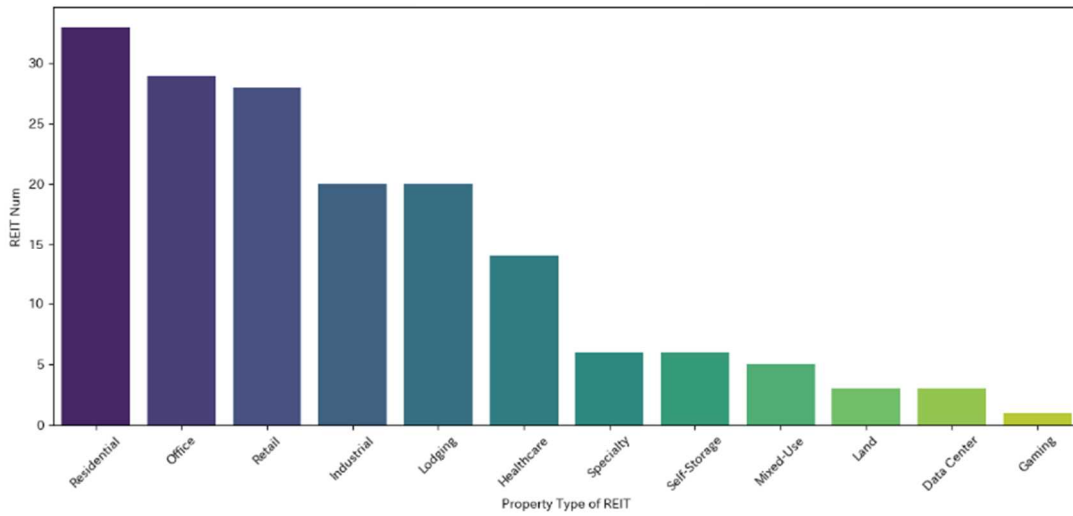


Figure 2: Count of REIT by Property Type.



2.2. Natural Disaster Risk Score Data

To quantify natural disaster risk, we utilize the FEMA dataset. This dataset provides both a composite index and disaster-specific risk indices, each normalized to a scale from 0 to 100 and calculated at the Census Tract level—a geographic unit defined by the U.S. Census Bureau. According to the official FEMA website (<https://hazards.fema.gov/nri/>) and the FEMA Technical Report (FEMA, 2023), the National Risk Index (NRI) is designed to conduct a comprehensive assessment of risks faced by communities and to quantify those risks based on region-specific characteristics. The NRI consists of three main elements: Expected Annual Loss, Social Vulnerability, and Community Resilience. Expected Annual Loss is the estimated yearly economic loss from disasters like floods, earthquakes, wildfires, and storms in each area. This helps residents and local governments identify which disasters are most likely to cause damage and plan accordingly. Social Vulnerability measures how easily residents in an area may be affected by disasters, using factors such as income, education, age, and the proportion of immigrants. For instance, areas with more low-income households or elderly people may have more difficulty responding to disasters. Community Resilience reflects how well a region can recover from natural disasters, considering the condition of infrastructure, local community ties, and disaster preparedness. Regions with higher resilience can recover more quickly, which reduces the impact of disasters. The NRI score is calculated using the following formula, which integrates these three main components:

$$NRI = \text{Expected Annual Loss} \times \frac{\text{Social Vulnerability}}{\text{Community Resilience}}. \quad (1)$$

3. Quantification of Natural Disaster Risk

3.1. Method for Merging Property Data with Natural Disaster Risk Data

This section outlines the procedure for merging the individual property data from FactSet with FEMA’s natural disaster risk scores at the Census Tract level. FactSet provides address information and latitude/longitude coordinates for each property, while the FEMA dataset includes Census Tract identifiers and their corresponding geographic coordinates. For the purposes of this analysis, we employ a geospatial matching approach using latitude and longitude. The merging process involves calculating the distance between each property and each Census Tract based on their respective coordinates, then assigning each property to the nearest Census Tract. Although several methods exist for calculating geodesic distances, the Haversine formula is the most widely adopted. The Haversine formula computes the great-circle distance between two points on a sphere, which serves as a practical approximation for Earth’s surface. While the Earth is not a perfect sphere and some minor error is inherent, this approximation is sufficiently accurate for analyses confined to the continental United States. Let x denote latitude and y denote longitude, with (x_1, y_1) representing the coordinates of a property and (x_2, y_2) those of a Census Tract. The distance d between the property and the Census Tract is calculated as follows:

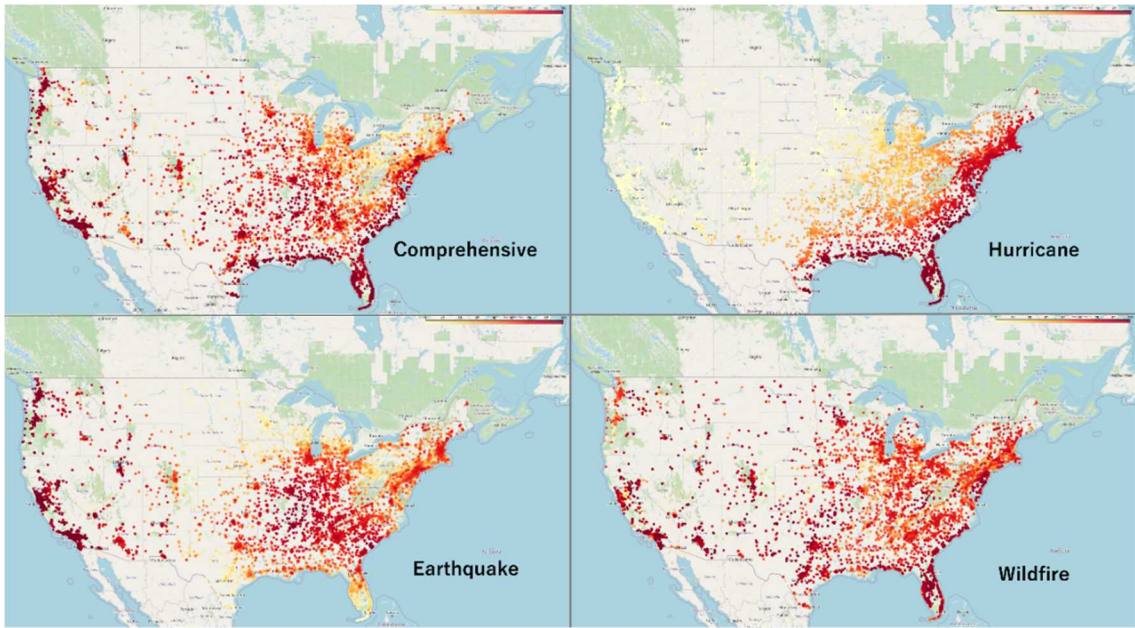
$$d = 2r \sin^{-1} \sqrt{\sin^2 \left(\frac{x_1 - x_2}{2} \right) + \cos(x_1) \cos(x_2) \cos^2 \left(\frac{y_1 - y_2}{2} \right)}, \quad (2)$$

where r is the radius of the Earth, taken as 6,371 km. After computing d for all possible pairs, each property record is matched to the Census Tract with the smallest distance.

3.2. Visualization of Natural Disaster Risk

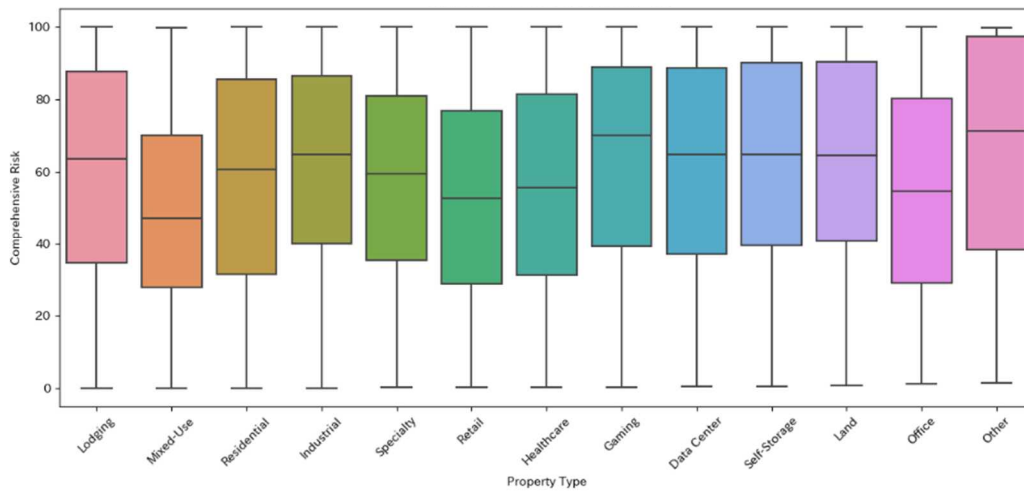
Applying the methodology outlined in the previous section, we visualize natural disaster risk at the individual property level. Figure 3 displays a map of all properties across the United States, excluding Alaska and Hawaii. On the map, each point represents a property, with the color intensity indicating the level of natural disaster risk—darker colors correspond to higher risk. Of the 18 disaster categories, the comprehensive risk score, as well as the scores for earthquakes, hurricanes, and wildfires, are visualized. The results indicate higher earthquake risk along the West Coast, higher hurricane risk in Florida and the Gulf Coast, and greater wildfire risk near Los Angeles. These patterns are consistent with past disaster records.

Figure 3: Property mapping in North America, excluding Alaska and Hawaii.



Furthermore, Figure 4 presents the Net Book Value (NBV)-weighted average risk scores by property type. Although there is an imbalance in the number of records across property types, the risk scores generally range from 50 to 70. The “Other” category has the highest risk score but includes the fewest properties. Among types with more than 1,000 properties, Industrial properties have the highest risk, likely because many are near coasts or rivers. Retail, Office, and Healthcare properties have lower scores, possibly because they are often located in urban areas with lower disaster risk.

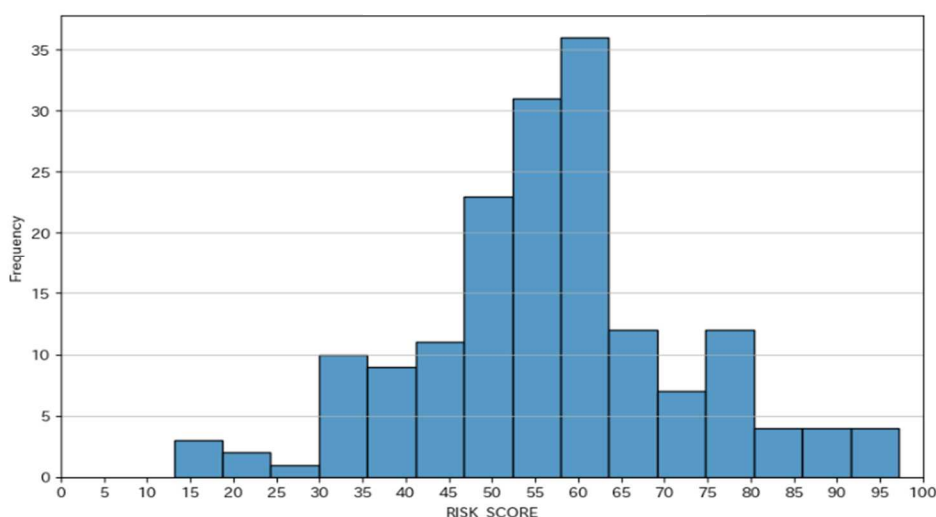
Figure 4: Comprehensive Risk Score by Property Type.



3.3. REITs and Natural Disaster Risk Scores

In this section, we examine how the Net Book Value (NBV)-weighted average natural disaster risk scores calculated for each REIT are distributed according to the REIT's size, representative region, and representative property type. Furthermore, we compare and analyze how the yields of REITs vary with different levels of natural disaster risk scores within the representative regions and property types. For simplicity, we refer to the comprehensive risk score simply as the risk score. As previously noted, there are 168 REITs in the aggregated dataset. The distribution of these risk scores is shown in Figure 5. The most frequent risk scores are in the 50–60 range. However, there are also some REITs with scores as low as 15 or as high as 95, indicating considerable variation in risk exposure among REITs.

Figure 5: Histogram of RISK SCORE.

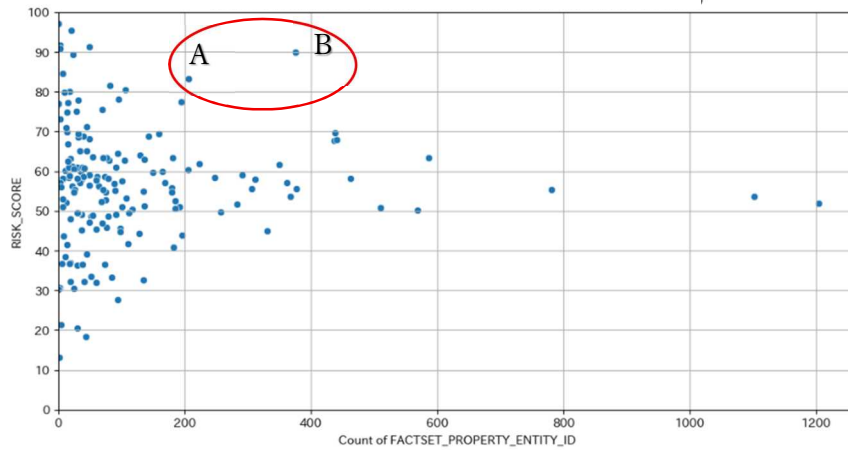


We examined the relationship between natural disaster risk scores and the number of properties held by each REIT using a scatter plot (Figure 6). REITs with a larger number of properties tend to have risk scores clustered around 50–60, likely due to the diversification of property locations and uses, which serves to average out risk. However, there are also REITs with many properties but relatively high-risk scores (see the circled points in Figure 6) ⁴. For

⁴ The REITs under consideration are A (whose representative property type is Residential) and B (whose representative property type is Industrial). Furthermore, the majority of their properties are in California, with 154 out of 206 properties for REIT-A and 375 out of 376 properties for REIT-B situated in the state. As confirmed in Figure 3, California has a high level of disaster risk.

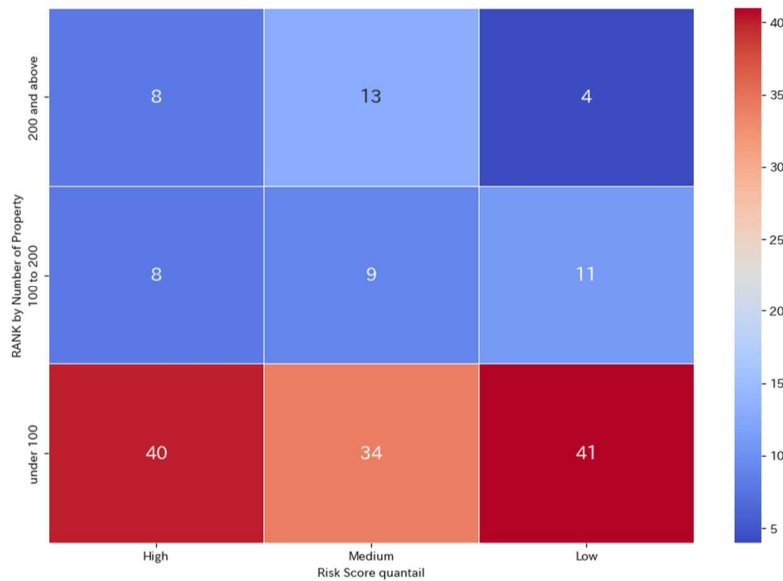
REITs with fewer than 200 properties, risk score dispersion is larger, and this dispersion tends to increase as the number of properties decreases.

Figure 6: Scatter Plot of Risk Score by the number of Properties.



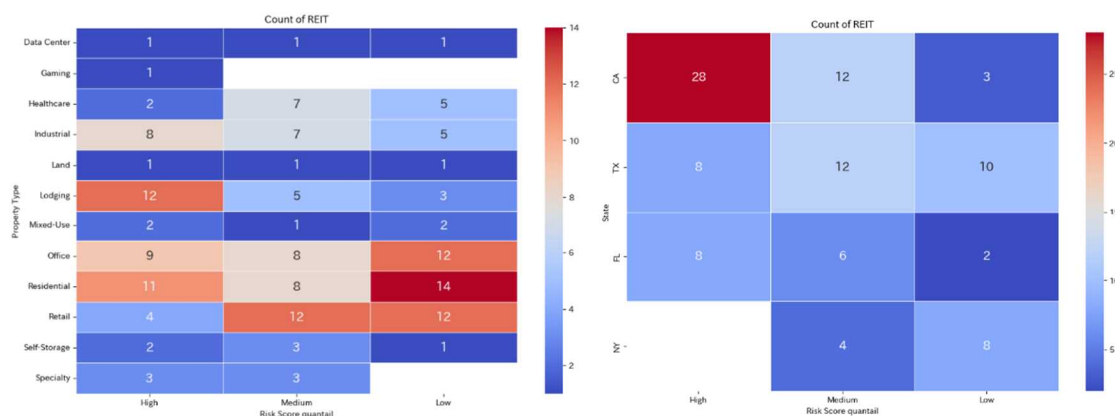
To clarify these findings, we divided risk scores into three quantile groups—high, medium, and low—and similarly grouped REITs by the number of properties they hold: fewer than 100, 100–200, and more than 200. Figure 7 presents the number of REITs in each of these 3×3 segments.

Figure 7: Rank of Natural disaster risk Scores and Rank by the number of Properties.



The summary statistics in Figure 7 show that among REITs with fewer than 100 properties, there are many in both the high- and low-risk score groups, with relatively few in the medium group. Among REITs with more than 200 properties, most fall within the medium risk score group. Similarly, Figure 8 shows the distribution of REITs by risk score quantile, segmented by representative property type (left) and by region for states with more than ten REITs (right). The left panel of Figure 8 reveals that REITs with Residential, Office, or Retail as their primary property type tend to have lower risk scores, likely because such properties are typically located in central urban areas or major economic areas, which generally have lower natural disaster risk. In contrast, REITs whose primary property type is Lodging tend to have higher risk scores, possibly because many of their properties are situated in tourist areas, such as coastal or mountainous regions with elevated natural disaster risk. Notably, even some Residential REITs have high risk scores, which can be explained by the geographical concentration of their properties along the West Coast or Gulf Coast. Indeed, as shown in the right panel of Figure 8, most REITs with California as their representative region have high natural disaster risk scores, while no REITs with New York as their representative region fall into the high-risk group.

Figure 8: [Left] Count of REIT by Property Type and Risk Score Quantile. [Right] Count of REIT by States with over 10 REITs.



Figures 7 and 8 examine the relationship between natural disaster risk scores and the number of properties held, representative property type, and representative region for all 168 REITs. The following section quantitatively investigates the relationship between REIT yields and natural disaster risk scores. Generally, REITs select properties to maximize yields, but it is not unclear to what extent the locational natural disaster risk is considered. For example,

Sirmans et al. (2024)⁵ used FEMA risk scores and climate awareness measures to analyze 4,800 properties in the U.S. and found that higher disaster risk was associated with higher yields, especially in areas with greater concern about climate change. In this report, we use the “Implied Normal Cap Rate” (an expected return based on REIT share prices) to compare with REIT-level risk scores. This allows us to test whether investors are factoring disaster risk into their return expectations. First, focusing on the six property types with adequate data—Healthcare, Industrial, Lodging, Office, Residential, and Retail—we classified REITs into three quantiles based on natural disaster risk scores (high, medium, low) and presented the yield distributions as boxplots in Figure 9. Given the high dispersion of values in Figure 9, we focus on the medians: for all property types, the high-risk group exhibits lower yields than the medium- and low-risk groups. In other words, REITs with higher natural disaster risk scores tend to deliver lower yields. Similarly, after dividing natural disaster risk scores into three quantiles, we examined yield distributions by representative region, as shown in Figure 10. In Figure 10, only in California does the high-risk group show higher yields than the medium- and low-risk groups; in other regions, REITs with higher natural disaster risk scores tend to have relatively lower yields. Usually, if investors are pricing disaster risk correctly, higher risk should mean higher expected return. The results here do not match this pattern. Possible reasons include:

- I. Investors may not be fully reflecting disaster risk in yields, resulting in overvaluation of high-risk REITs.
- II. Other factors, such as better locations, newer buildings, or stronger management, may have a bigger influence on market value and returns than disaster risk.
- III. Some regions may be more aware of disaster risk and price it accordingly, while others may not, leading to regional differences.

In summary, factors other than disaster risk seem to have a stronger influence on REIT yields, and there are differences among regions in how disaster risk is considered in pricing. More research is needed to determine how much disaster risk is included in REIT valuations.

⁵ The FEMA natural disaster risk score and the NOAA dataset are employed as risk indicators, while the Yale University climate change beliefs score is used as an indicator of psychological factors.

Figure 9: Boxplot of Implied Normal Cap Rate by Property Type and Risk Score Quantile.

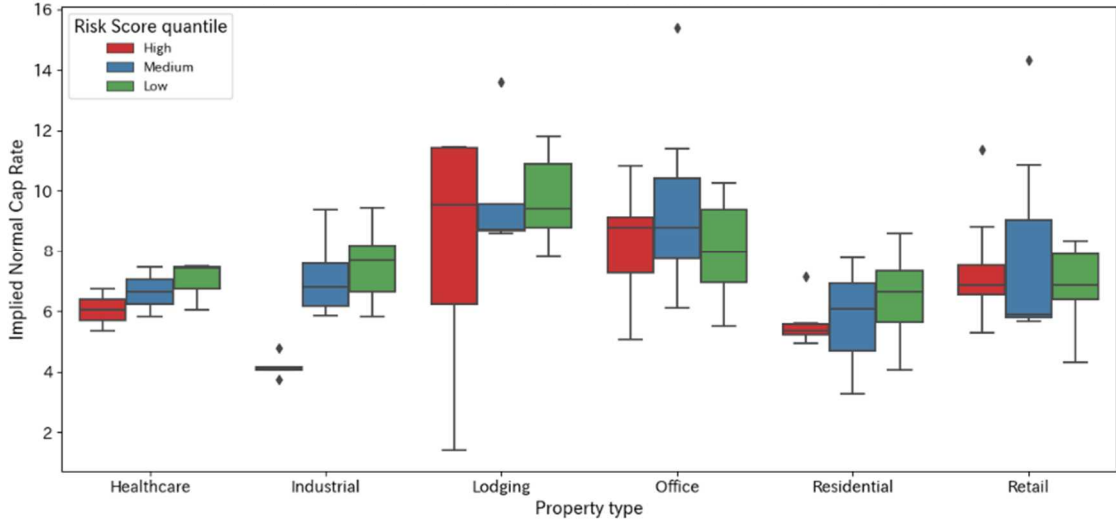
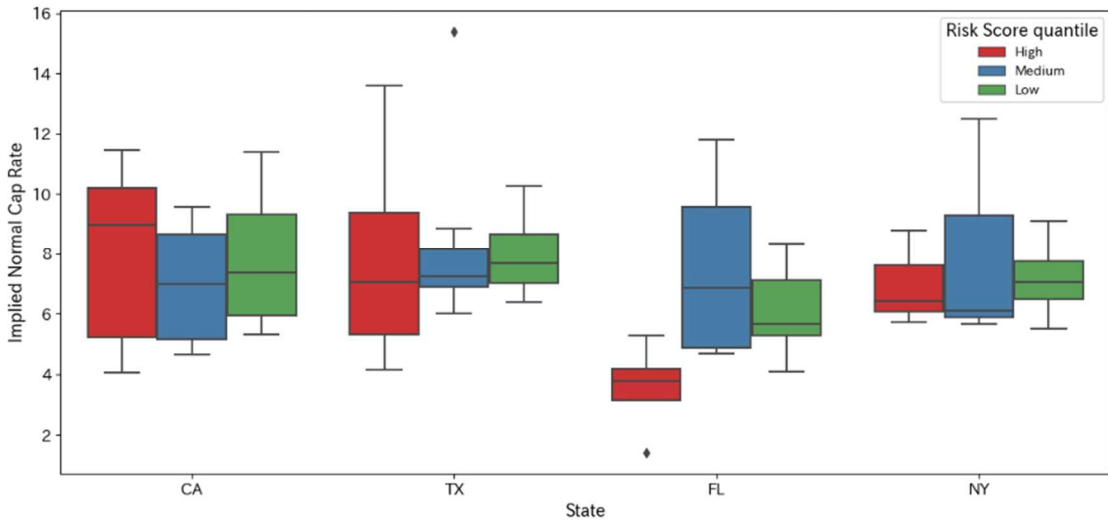


Figure 10: Boxplot of Implied Normal Cap Rate by State and Risk Score Quantile.



4. Conclusion

This report combines external natural disaster risk scores and location data with the FACTSET-Real Estate Industry ver.1.4.0 dataset to measure disaster risk and its effect on yields for 168 REITs. Previous studies have suggested that properties with higher disaster risk offer higher yields, but our results show the opposite: REITs with higher risk scores have lower yields. This may mean that investors are not fully adjusting yields for disaster risk, that other

factors such as location, building age, and management are more important, or that regional differences exist in how disaster risk is recognized and reflected in the market. In most regions (except California), REITs exposed to higher disaster risk tend to have lower yields, suggesting that there are differences among regions. These findings indicate the value of further analysis using time-series, financial, and market data, as well as more advanced methods such as regression analysis, to clarify how disaster risk is reflected in market prices. This report provides a basis for evaluating natural disaster risk and market responses in REIT investment and may help guide future research.

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