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Bachelor Thesis

From Mines to Markets: Exploring the Ripple Effects of Steel Price Shocks on Industrial REIT Performance

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Abstract

This paper investigates the relationship between steel price shocks and the performance of American Industrial Real Estate Investment Trusts (REITs) using an event study methodology. The analysis focuses on three events: the unexpected announcement of the steel production reduction mandate for the 2016 International Horticultural Exposition in Tangshan, Hebei; the implementation of a 25% steel tariff in 2018 by President Donald Trump; and the Brumadinho Dam Disaster in 2019. The study examines the impact of these events on Industrial REIT performance across three distinct event windows and contrasts the results with those for other REIT types, including Equity, Hotel, Mortgage, Office, Residential, and Retail REITs. The findings reveal that Industrial REITs exhibit varied responses to steel price shocks depending on the event. Positive abnormal returns followed the Tangshan announcement, while negative returns were observed after the 2018 steel tariff and the Brumadinho Dam Disaster. These results highlight the sensitivity of Industrial REITs to steel price fluctuations due to their heavy reliance on steel. This research contributes to the understanding of how non-energy commodity prices influence REIT performance, offering valuable insights for investors, policymakers, and analysts in real estate markets. The findings emphasize the need for sector-specific strategies to manage the impact of commodity price volatility effectively.

Keywords: *REITS, real estate, steel, iron ore, industrial, event study*

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Chapter 1: Introduction

Since their establishment in the United States during the Eisenhower era in the 1960s, Real Estate Investment Trusts (REITs) have offered investors, including small-scale ones, a gateway to real estate – a sector traditionally dominated by large financial bodies and affluent individuals. The evolution of REITs, especially after significant legislative shifts post-1990, underscored their growing appeal and integration into global investment portfolios, with a worldwide valuation surpassing $1.3 trillion in 2024 (NAREIT, 2024). REITs democratize real estate investment, offering attractive returns, lucrative tax benefits, and ease the burdens of high transaction costs, carrying costs, and illiquidity concerns (ERPA, 2023). This study implements the event study methodology to investigate how steel price shocks – measured based on changes in iron ore prices – affect the performance of U.S. Industrial REITs, and contrasts the results against the findings for six other REIT types – Equity, Hotel, Mortgage, Office, Residential & Retail REITs based on three steel price shocks. The first examined event is the announcement of a steel production reduction mandate prior to the International Horticultural Exposition in Hebei, China, which resulted in the highest iron ore price increases seen until that moment (The Guardian, 2016). The second event is President Trump's exercise of Section 232 of the Trade Expansion Act of 1962, and more specifically the implementation of a 25% tariff on steel imports, which was followed by a significant decrease in global iron ore prices due to a lowered projected global demand (Hersh & Scott, 2021). The final event considered is the Brumadinho Dam Disaster at the Córrego do Feijão iron ore mine in Brazil, which, due to an unexpected fall in iron ore supply, lead to substantial price increases of the commodity (AFR, 2024).

The relevance of this topic stems from the minimal research on how non-energy commodity prices – which are crucial in construction and impact the profitability of real estate projects – influence the stock performance of REITs. Industrial REITs are chosen specifically due to their focus on owning and managing real estate properties used for manufacturing, production, storage, and distribution of goods such as warehouses, logistics centers and storage centers, and their rising popularity in recent years characterized by increased demand for storage units and e-commerce warehouses (CFI, 2024). Steel, which is often more affordable than other building materials and offers high durability is used extensively in the development of industrial buildings for elements such as beams and frames, and steel structures (Madhav CRG Group, 2024). For these reasons, it is hypothesized that steel price shocks impact the performance of American Industrial REITs. By exploring this relationship, this paper aims to shed light on a largely uncharted area, providing insights into the complex interplay between commodity prices and real estate investment which could assist investors and policymakers in better navigating the real estate market dynamics in the face of commodity price changes, enhance housing affordability and industrial construction sector regulation. Overall, the analysis has significant potential

to advance understanding in the field of REIT market dynamics and the broader implications of commodity price fluctuations on real estate finance, portfolio management and hedging strategies.

Due to data availability limitations, steel price movements are represented by iron ore price movements. Iron ore is the fundamental component in steel production and directly influences steel prices, thus significantly affecting construction costs, profitability, and strategic decisions in real estate development (IEA, 2020). Using daily time-series data from the Bloomberg Database for American REIT Indexes Performance and the Iron Ore Spot Price Index 62% Import Fine Ore CFR Qingdao USD Index, the following research question will be investigated:

"To what extent do steel price shocks influence the performance of American Industrial REITs?"

The relationship of interest will be examined using the event study methodology. Due to its setup resembling that of a natural experiment, and under the assumption that all necessary requirements are met, this methodology offers the best ability to isolate the effect of a particular setting change on the variable of interest (Fama et al., 1969). The examination of the three, different in nature, events will yield a better understanding of how such commodity price shocks become reflected in REIT performance. The event window of main interest is event date +/- 2 days, and two additional event window frames are introduced as robustness checks: event date +/- 4 days and event date +/- 6 days. An inverse relationship is broadly hypothesized – positive global steel price shocks (price decreases) are associated with higher Industrial REIT returns, and negative global steel price shocks (price increases) are associated with lower Industrial REIT returns.

Previously conducted studies have shed light on the interplay between energy commodities and REIT performance. For instance, Nazlioglu et al. (2016) investigate the price and volatility transmission between oil prices and REIT types, and Hanif et al. (2024) attempt to understand the safe haven properties of fourteen major country-specific REIT indices as hedges against oil prices. Furthermore, papers such as Odusami (2021) find that particular financial and macroeconomic variables tend to predict the magnitude of volatility jumps in REIT returns. While such literature contributes to a better understanding of REIT performance, it still harbors gaps, particularly regarding the influence of non-energy commodities on REIT performance. Apart from the energy discussion, there is minimal academic coverage of the relationship between commodity prices and the stock performance of publicly traded REITs, despite the increasing popularity of REITs which have been proven to tend to outperform stocks on 20-to-50-year horizons (DiLallo, 2024). This lack may be caused by most REITs having been established not long ago, as well as their differing structure from regular asset classes, with REITs having to distribute 90% of their taxable income as dividends (SEC, 2024). Due to construction costs having been proven to have sizable effects on real estate returns, and thus also REITs (Zainal et al., 2016), investigating the impact of commodities crucial to real estate constitutes a potentially insightful

research area. From a cost-push inflation perspective, it can be hypothesized that rising steel prices lead to increased development costs, potentially reducing the profitability of REITs involved in development projects. This rationale aligns with the supply chain impact theory, where input costs affect final product market dynamics. Moreover, research on the impact of commodity prices on economic sectors suggests that significant input costs can influence sector performance (Chandrasekhar & Ghosh, 2016; Sirmans & Worzala, 2003).

Chapter 2: Theoretical Framework

There is significant past academic literature covering the market interplay between commodity prices and real estate performance. Most well-established papers focus on the correlation between equity and real estate returns, and the role of commodity investments as a potential hedging mechanism. This chapter will first introduce the literature focused on commodity performance and real estate which is most relevant to this paper, and then proceed to narrow the academic overview to findings related specifically to REITS, and metal price shocks.

Chapter 2.1: Commodities & Real Estate

Lombardi and Ravazzolo (2016) analyze the interrelationship between equity and commodity returns using a time-varying Bayesian Dynamic Conditional Correlation model, finding that the integration of commodity investments, despite enhancing portfolio forecasts, increases portfolio volatility and contradicts the traditional view of commodities as straightforward hedging devices to equity. This suggests that commodity price dynamics, including those of metals, could potentially impart similar volatility to real estate markets, particularly through their influence on economic cycles and investment flows, however this theory is not directly examined by the authors. Further dissecting the commodity spectrum, Chan et al. (2011) also delineate the linkages between financial markets, including commodities such as oil and gold, with real estate assets. Their use of a multivariate GARCH model to analyze volatility and correlation underscores a regime-dependent behavior in asset prices across different economic conditions, implying that correlation between these asset classes is evident during periods of economic decline, yet not during periods of economic expansion. This regime shift is particularly crucial to understanding how steel, a critical industrial commodity, might behave differently from energy commodities in affecting real estate sectors, however it must be noted that neither iron ore nor steel are covered within the analysis of these authors. Moreover, the analysis assumes a fixed number of regimes (two regimes: tranquil and crisis) – a simplification which might not capture more nuanced market states or transitions that could be significant. Within each regime, the model also assumes homogeneous behavior for asset returns, which may overlook intra-regime variations and nuances that could influence investment decisions (Chan et al., 2011).

Jensen et al., (2000) also explore a similar topic area, investigating the role of commodity futures in asset allocation, finding differing results depending on the monetary stringency present in the time of the asset allocation process. More specifically, they find that during periods characterized by restrictive monetary policy, the role of commodity futures in the creation of the most efficient portfolio is detrimental, whereas in times of expansive monetary policy, the weight of commodity futures in efficient portfolios is close to zero. While the paper has contributed significantly to the understanding of the role of commodity futures, some weaknesses that should be considered are the 25-year period (1973-1997) the authors apply which provides robust statistics, however may not reflect more recent market dynamics and structural changes. The chosen time also includes unique historical events that may have disproportionately influenced asset performance (e.g., oil crises, changes in monetary policy). These events might not recur, limiting the generalizability of the results to future periods. Further, the findings might be less applicable to the current financial environment. Taking a somewhat similar approach, Ankrim and Hensel (1993) contrast real estate with commodities in asset allocation, emphasizing real estate and collateralized commodities. They argue that while real estate has traditionally been favored for inflation hedging, its performance in the 1980s and issues like illiquidity have led to collateralized commodities emerging as viable alternatives to real estate investments, and not necessarily a hedge, as proposed by others (Ankrim & Hensel, 1993).

The historical perspective taken by all mentioned authors is crucial for understanding current dynamics in which steel could potentially be conceptualized as part of a broader strategy of real asset investment impacting real estate indirectly through economic growth and infrastructure development, with the impact differing based on the economic cycle or state of the economy. While this paper does not focus on differentiating the effects based on the aforementioned factors, an attempt is made to cover a wide time range to avoid elements such as economic cycles from emerging as omitted variables.

Chapter 2.2: Factors Affecting REIT Performance

There has been a growing amount of literature developing the understanding of REIT dynamics in recent years, however little differentiation considered between REIT types, and no relevant literature concerning Industrial REITs. Focusing on REITs and the impact of economic conditions on performance, Chong, Miffre, and Stevenson (2009) identify how these trusts' correlations with commodities fluctuate based on economic indicators and monetary policies. Interestingly, their analysis reveals that such correlations, along with REIT correlations with equity and bond markets, intensify during periods of high volatility in equity and bond markets, suggesting that REITs, like commodities, are sensitive to broader economic shifts – findings which are in line with those previously mentioned obtained by academics such as Chan et al. (2011). These findings initiate speculation regarding the source and depth of the relationship with broader economic conditions as opposed to commodities

specifically. It must, however, be considered that the authors use the GSCI Index as a commodity proxy, failing to capture the potentially different effects which may depend on the nature of the commodity being considered, with commodities such as gold, coffee, oil, or steel differing significantly.

Approaching the subject from a diverse angle and using a proxy Structural Vector Autoregressive (SVAR) model, Cepni et al. (2020) examine the impact of uncertainty shocks on the returns of U.S. REITs over monthly periods from January 1972 to December 2015, also considering sub-samples to account for the effects of the Global Financial Crisis (GFC) and subsequent unconventional monetary policy decisions. The findings are that uncertainty shocks have a larger negative impact on REIT returns in the post-GFC period compared to the pre-GFC period, however, contrary to intuition, the impact of overall uncertainty shocks on REIT returns was higher during the pre-GFC era. The study uses variations in the price of gold as an instrument for identifying uncertainty shocks. While this is a creative approach, it assumes that gold price variations are an accurate and isolated proxy for uncertainty, which might not always be the case. Gold prices can be influenced by other factors, potentially confounding the results. Expanding on other factors influencing REITs, Khan and Siddiqui (2019) attempt to dissect how internal and external elements such as dividend yields, net income, inflation, and particular market indexes affect REIT performance across different global regions, with a focus on Asian markets, highlighting the diversity of factors at play, however unfortunately not differentiating between REIT types. They find that a general positive association exists of net asset value (NAV) of a REIT with its dividend yield, net income, size, inflation, and stock index, while a negative relationship of interest rate with NAV exists, however, unfortunately, they do not expand upon the investigation of construction expenses and REIT performance.

Many papers, such as Baeur et al. (2010) and Campbell et al. (2009) further touch upon corporate governance and its influence on REIT performance and M&A performance, as REITs are said to offer unique insight into the role of governance, considering that due to the legal setting and regulations surrounding them, very little cash flow remains for management. The first authors find a strong and significantly positive relation between the used governance index and many performance variables, indicating that the partial lack of a relation between governance and performance in the real estate sector might be explained by a REIT effect (Bauer et al., 2010). On the other hand, investigating the market for corporate control, it has been found that bidder returns tend to be higher for REITs with smaller boards, more experienced CEOs, but with shorter tenure, and the acquirers' announcement returns are also significantly and positively related to higher ownership by their CEOs and board directors (Campbell et al., 2009). A limitation, however, is that they are based upon linear regression models which may not fully capture the complex relationships between corporate governance variables and abnormal returns. More sophisticated modeling techniques (e.g., panel data models, mixed-effects models) could provide deeper insights into the subject.

Chapter 2.3: Metal Price Shocks

An extensive academic coverage of the relationship between oil price shocks and many assets exists. Papers such as Behmiri and Manera (2015) or Zhang and Tu (2016) dissect the effect of oil price shocks on the volatility and performance of metal markets, finding that oil price shocks, indeed, transmit their volatility to metal prices, and more specifically there is an asymmetric reaction of metal prices to oil price shocks, with copper being more influenced by shocks than aluminum, Based on these and other influential articles, it has been widely acknowledged that oil price shocks have significant impacts on not only equities, but also other commodity price movements.

The direct literature on metals however, and particularly iron ore or steel, and their impact on real estate is significantly sparse compared to literature covering oil price shocks. Analogies can potentially cautiously be drawn from studies focusing on broader commodity shocks, and those covering the implications of metal price shocks on markets. The research conducted by Gutierrez and Vianna (2020), is the closest to the relationship of interest in this paper. Through structural VAR and GARCH methodologies, the authors highlight the differential responses of stock markets in various geographies to steel price shocks. Interestingly, they examine one of the events considered in this paper, namely the implications of U.S. steel import tariffs and their influence on global equity prices, noting particularly strong reactions in commodity-sensitive economies such as Australia, Japan, and South Korea, compared to more diversified financial markets like the U.S. and Germany. The authors do not differentiate between equity types in their analysis; however it may be reasoned that perhaps American REITS operate in relatively insulated environments where direct impacts of such price shocks might be first subtle, and only significant over longer periods or during heightened volatility in metal markets. The use of weekly data can be considered a drawback of the analysis, as this can lead to missing significant intra-week volatility and short-term market reactions. Moreover, the structural VAR and GARCH models used, especially when used on weekly data, may be prone to overfitting, potentially leading to results that perform well on the sample data but poorly on new data, reducing the model's predictive power and generalizability (Faster Capital, 2024). While this seems to be the closest research to that conducted in this paper, other papers also contribute to the understanding of the relationship between steel and REITS.

Labys et al. (1999) dive into the cyclical nature of metal prices and their correlation with broader macroeconomic variables, such as industrial production, consumer prices, interest rates, stock prices, and exchange rates. The concept of "comovement" of metal prices – prices collectively reflecting macroeconomic trends – supplies a critical perspective. Similarly, Reboredo and Ugolini (2016) provide insights into how external shocks to oil markets lead to significant spillovers in metal markets, illuminating the asymmetric nature of these spillovers, which is crucial for understanding how steel

prices react to external economic shocks. While the paper covers only aluminum, copper, lead, nickel, tin, and zinc, by understanding the common factors influencing metal prices, one can extrapolate the findings to steel, which as a significant component of the construction and development sectors can help anticipate how shifts in prices might cascade into the real estate markets and REIT performance.

Altogether, the academic research sets the stage for an in-depth empirical examination of the impact of steel price shocks on the performance of American Industrial REITs – a topic area which has yet to be covered by academics and offers unlimited potential for insightful findings, simultaneously providing valuable insights for investors, policymakers, and economists alike.

Chapter 2.4: Event Choices

This section introduces the events chosen for the analysis. A fundamental premise of reliable estimation in event study methodologies is that the occurrence of an event of interest is not inherently linked to future changes that would have happened even if the event had not taken place (Kothari & Warner, 2006). In alignment with this principle, the events were carefully chosen to ensure a robust evaluation and provide three diverse perspectives. The rationale for the inclusion of each event is detailed below.

2.4.1. Event 1: The Steel Reduction Mandate for the International Horticultural Exposition in Tangshan, Hebei, China.

In 2010, the city of Tangshan in Hebei province, China – a significant steel production hub – won the bid to become the host of the 2016 International Horticultural Exposition, scheduled from April until October 2016 (AIPH, 2016). The exposition's theme was announced as "Green Life, Beautiful Home." In preparation for this event and to ensure a pollution-free environment for its duration, local authorities unexpectedly mandated a reduction in steel production in the area to mitigate air pollution in early March 2016. This directive led steel producers to significantly ramp up their output in anticipation of the enforced curtailments in an extremely short amount of time (The Guardian, 2016). As Tangshan accounts for roughly 10% of China's total steel output due to its extensive deposits of coal and iron ore, this unexpected increase in production activities precipitated a substantial and unforeseen surge in iron ore demand, as steel manufacturers aggressively accumulated stock. This dynamic caused a notable shock in iron ore prices (The Guardian, 2016). In a typical year, the city’s steel production is on par with that of the United States, which ranks as the fourth-largest steel producer worldwide (FT, 2019).

On the day of the announcement, the steel industry in Tangshan, a central city in China’s primary steel-producing region with a population of approximately seven million, saw iron ore prices surge by nearly 20% (FT, 2019) – the event resulted in the highest single-day price increase for iron ore in terms of both percentage and absolute dollar value until that date, as depicted on Figure 1 and 2 below. Although

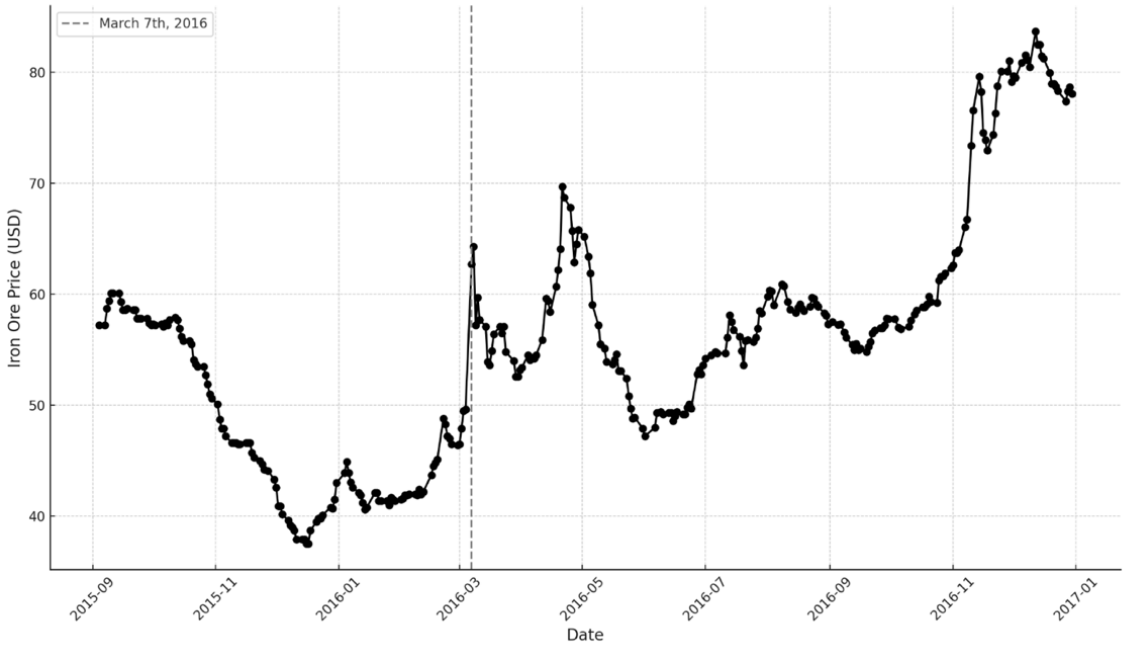
other price spikes are present, this event resulted in the most highly concentrated price increase, while others took longer to develop. The relevant event date is March 7th, 2016, corresponding with the exposition announcement.

i) The primary event window (event date +/- 2 trading days) spans from March 3rd, 2016, to March 9th, 2016, with Iron Ore Spot Price Index returns recorded at +**15.56%**[1]

ii) The second event window extends from March 1st, 2016, until March 11th, 2016, with Iron Ore Spot Price Index returns of **+24.09%**[1]

iii) The third event window ranges from February 26th, 2016, until March 15th, 2016, with Iron Ore Spot Price Index returns of **+15.91%**[1]

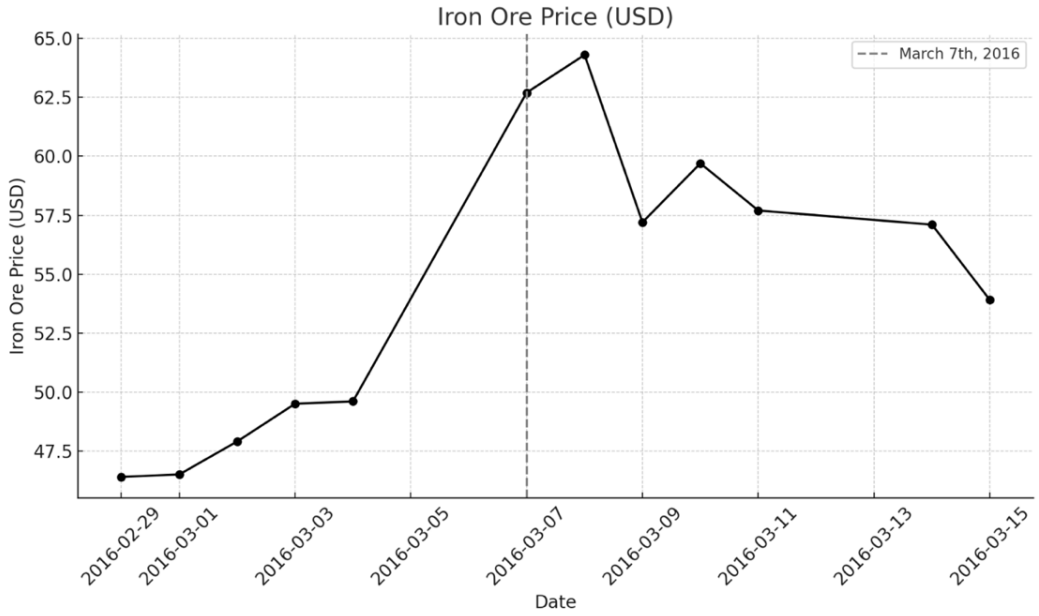
Figure 1. Iron Ore Price Behavior in the Months Surrounding the Event Date on March 7th, 2016.



Note. *The Iron Ore Prices are represented by the Iron Ore Spot Price Index 62% Import Fine Ore CFR Qingdao USD Index' (ISIX62IU). The spot price data was sourced from Bloomberg and is listed in USD per metric ton, exclusive of VAT and shipping costs.*

[1] See Table 3 and 4 in Appendix for details regarding Iron Ore Index prices and daily returns during the event windows around Event 1.

Figure 2. Iron Ore Price Behavior in the Days Surrounding the Event Date on March 7th, 2016.



Note. *The Iron Ore Prices are represented by the Iron Ore Spot Price Index 62% Import Fine Ore CFR Qingdao USD Index' (ISIX62IU). The spot price data was sourced from Bloomberg and is listed in USD per metric ton, exclusive of VAT and shipping costs.*

It is reasoned that the unexpected order of a iron ore production slash in relation to the upcoming exposition in Hebei which resulted in a significant increase in global iron ore and steel prices leads to an increase in construction costs, and so a decrease in Industrial REIT profits, and therefore a decrease in REIT returns. The first hypothesis can, therefore, be stated:

H1: *The increase in global steel prices resulting from the announcement of the horticultural exposition in Hebei in March 2016 leads to a decrease in the returns of American Industrial REITs*

2.4.2. Event 2: President Trump's Exercise of his Authority under Section 232 of the Trade Expansion Act of 1962 to impose a 25% tariff on steel imports.

On March 8, 2018, President Trump invoked Section 232 of the Trade Expansion Act of 1962 to implement a 25% tariff on steel imports, exempting Canada and Mexico. This measure was intended to safeguard national security by promoting American steel production and aimed at curtailing the availability of imported metals within the United States, thereby increasing domestic prices of these metals and enhancing the profitability of American metal manufacturers (BIS, 2024). Conversely, as depicted on Figure 3 and 4 below, this restriction also led to an abrupt surplus of more affordable metal in non-U.S. markets, decreasing the global prices of steel and iron ore, resulting in a bifurcated market structure (NYT, 2019).

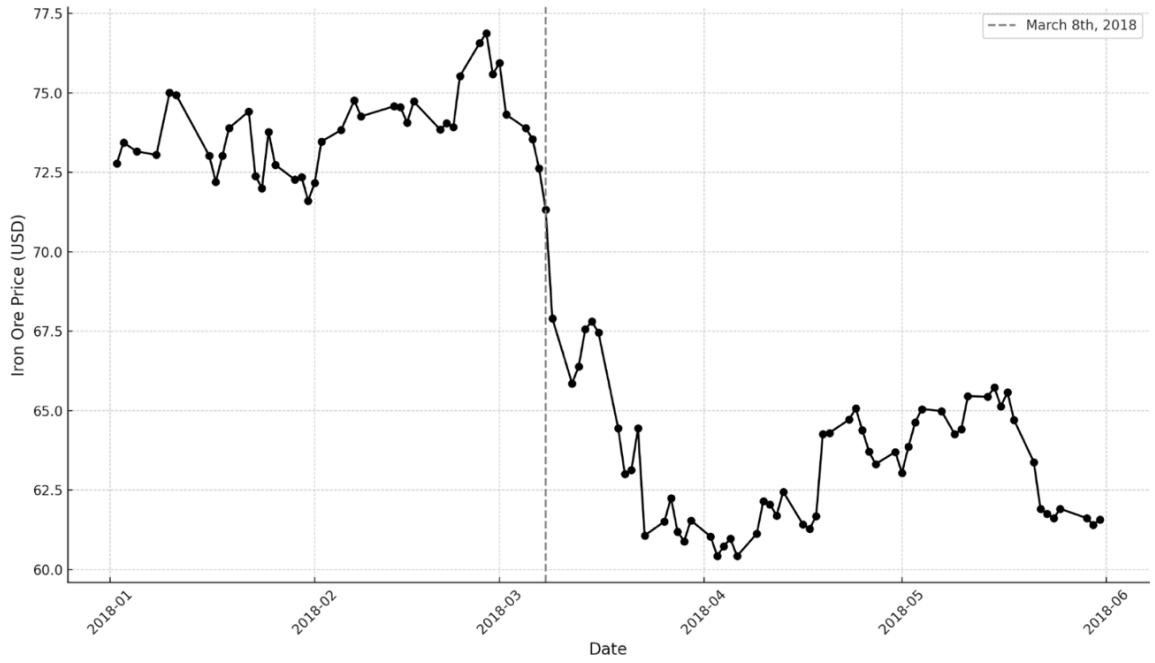
While there had been discussions and mentions of potential tariffs in political campaigns and speeches prior to the official document signature, substantial uncertainty about details and enforcement persisted until the official announcement. It is presumed that the definitive impact on steel prices stemmed primarily from the formal enactment of the tariffs under Section 232, with other potential price impacts being mainly speculative in nature. The official announcement date, March 8th, 2018, is, therefore, used as the event date for this analysis. The event windows are defined as follows:

i) The primary event window (event date +/- 2 trading days) spans from March 6th, 2018, to March 12th, 2018, with Iron Ore Spot Price Index returns noted at **-10.46%**[2]

ii) The second event window (event date +/- 4 days) runs from March 1st, 2018 until March 15th, 2018, with Iron Ore Spot Price Index returns at **-9.10%**[2]

iii) The third event window (event date +/- 6 days) extends from February 28th, 2018 until March 16th 2018, with Iron Ore Spot Price Index returns at **-10.76%**[2]

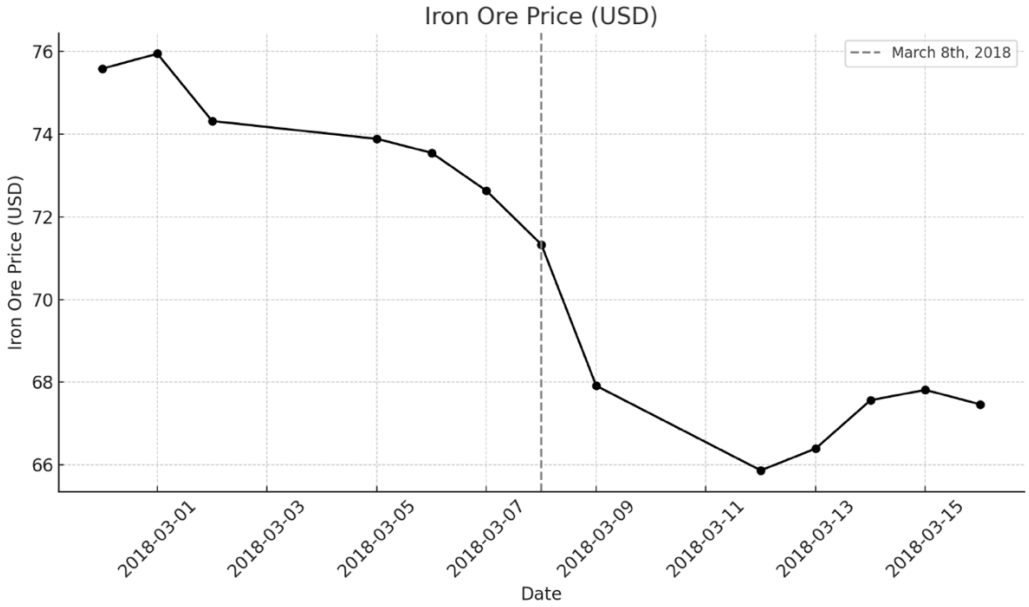
Figure 3. Iron Ore Price Behavior in the Months Surrounding the Event Date on March 8th, 2018.



Note. *The Iron Ore Prices are represented by the Iron Ore Spot Price Index 62% Import Fine Ore CFR Qingdao USD Index' (ISIX62IU). The spot price data was sourced from Bloomberg and is listed in USD per metric ton, exclusive of VAT and shipping costs.*

[2] See Table 5 and 6 in Appendix for details regarding Iron Ore prices and daily returns during the event windows around Event 2.

Figure 4. Iron Ore Price Behavior in the Days Surrounding the Event Date on March 8th, 2018.



Note. *The Iron Ore Prices are represented by the Iron Ore Spot Price Index 62% Import Fine Ore CFR Qingdao USD Index' (ISIX62IU). The spot price data was sourced from Bloomberg and is listed in USD per metric ton, exclusive of VAT and shipping costs.*

The imposition of the tariffs caused an immediate decrease in global steel and iron ore prices due to reduced demand from American buyers, and was coupled with an increase in U.S. steel prices, thus boosting profitability for domestic steel manufacturers (Cox, 2022). Simultaneously, however, it is reasoned that this led to increased construction costs for American Industrial REITs, which rely on steel for property developments, affecting market indices negatively. Hence, the second hypothesis posits:

H2: *The elevation in American steel prices resulting from the enactment of the 25% steel tariff in March 2018 leads to a decline in the returns of American Industrial REITs*

2.4.3. Event 3: The Brumadinho Dam Disaster at the Córrego do Feijão iron ore mine.

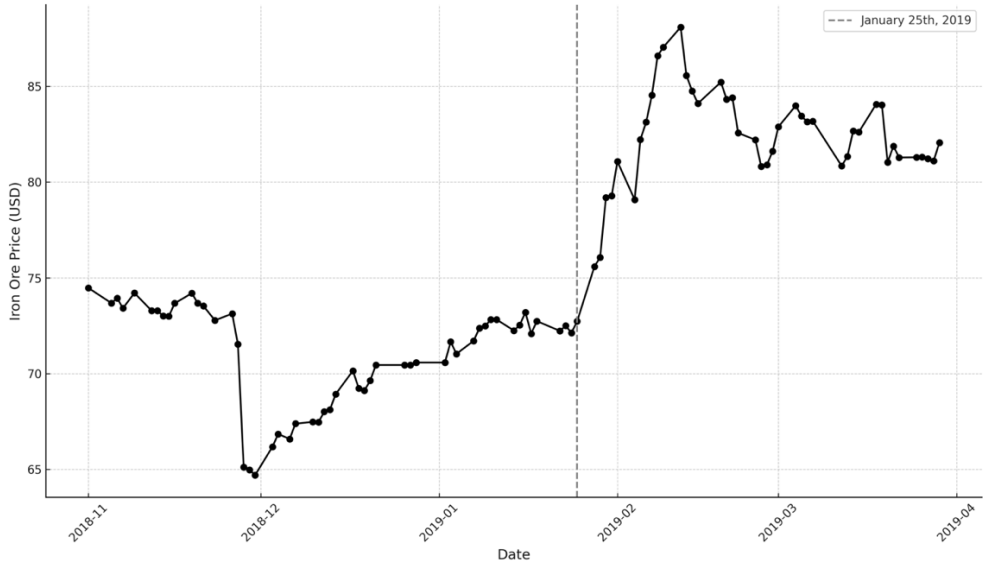
On January 25, 2019, a catastrophic failure occurred at a tailings dam belonging to Vale, the then-largest iron ore miner in the world, at its Córrego do Feijão mine in Brazil. A significant production shutdown was enforced across many of Vale's operations in Brazil, including the Brucutu mine, which resulted in nearly a quarter of Vale's projected annual production of 400 million tonnes being halted, representing approximately 6% of annual global seaborne iron ore market (Rotta et al., 2019). The disaster unfolded when the tailings dam, which stored the by-products of iron ore mining known as tailings, burst, unleashing approximately 10 million cubic meters of these liquefied residues. The resulting mudslide devastated the mine's surroundings, destroyed local communities, and demolished infrastructure including a railway bridge, tragically claiming the lives of at least 270 people (ETH, 2019).

The operational repercussions for Vale were also severe. The company's output plummeted in 2019, as the disaster's impact reverberated through the iron ore industry. Further, approximately 300 individuals were either killed or reported missing due to the disaster, triggering both internal investigations and widespread condemnation, which led to a significant dent in Vale's reputation (Bloomberg, 2019). The company's total iron ore production for 2019 was reported at 301,972 million tonnes, marking a 21.5% decrease from the previous year, with a particularly steep 55.2% reduction in its Southern System operations (Mining Technology, 2019). Meanwhile, a close competitor – Rio Tinto reported that iron ore prices had increased by 37% by the end of 2019 compared to the previous year, reflecting the tightened global supply following the Brumadinho incident (Mining Technology, 2019). As seen in Figure 5 and 6 below, there was a significant reaction of the market to the catastrophe, with immediate, unexpected increases in iron ore prices being visible. The event date is, therefore, identified as January 25th, 2019, the day the dam failure was reported.

i) The primary event window (event date +/- 2 trading days) extends from January 23rd to January 29th, 2019, during which the Iron Ore Spot Price Index increased by **4.92%**[3]

ii) The second event window (event date +/- 4 days) spans from January 18th until January 31st, 2019, with a **8.98%**[3] return of the Iron Ore Spot Price Index.
iii) The third event window (event date +/- 6 days) covers from January 16th, until February 4th, 2019, showing an Iron Ore Spot Price Index return increase of **8.03%**[3]

Figure 5. Iron Ore Prices Behavior in the Months Surrounding the Event Date on January 25th, 2019.



Note. *The Iron Ore Prices are represented by the Iron Ore Spot Price Index 62% Import Fine Ore CFR Qingdao USD Index' (ISIX62IU). The spot price data was sourced from Bloomberg and is listed in USD per metric ton, exclusive of VAT and shipping costs.*

[3] See Table 7 and 8 in Appendix for details regarding Iron Ore prices and daily returns during the event windows around Event 3.

Figure 6. Iron Ore Prices Behavior in the Days Surrounding the Event Date on January 25th, 2019.

Note. *The Iron Ore Prices are represented by the Iron Ore Spot Price Index 62% Import Fine Ore CFR Qingdao USD Index' (ISIX62IU). The spot price data was sourced from Bloomberg and is listed in USD per metric ton, exclusive of VAT and shipping costs.*

It is reasoned that the substantial rise in global iron ore and steel prices resulting from the Brumadinho Dam Disaster consequently increased operational costs for American Industrial REITs, leading to a decline in their index returns due to heightened expenses. Hypothesis 3 is, therefore, stated, as follows:

H3: *The increase in steel prices caused by the Brumadinho Dam Disaster in January 2019 leads to a decrease in the returns of American Industrial REIT indices*

2.5. Other Event Considerations

There were events which were considered for the analysis, however finally not included. For example, the commence of the renegotiation of the North American Free Trade Agreement by Canada, Mexico and the United States in August 2017, which U.S. President Donald Trump had called "the worst trade deal in history" in 2016 (Manak, 2020). The renegotiations brought several significant changes to the trade agreement in the areas of IP rights, agriculture, and digital trade. Furthermore, while not directly part of the USMCA text, the negotiations involved discussions on U.S. tariffs on steel and aluminum (Section 232 tariffs). The U.S. reached agreements with Canada and Mexico to lift these tariffs and replace them with a system to prevent dumping and import surges (CEPR, 2017). While it was expected that this event will lead to a reaction of steel purchasers as it can be reasoned that changes in tariffs and trade policies could impact the cost structure of U.S. steel producers, after examining the data, it was found that the effect did not materialize and thus the event was not included.

Another example is the shock to iron ore supply in March 2019 caused by Cyclone Veronica, which, having pummelled Western Australia's Pilbara Coast, forced major local iron-ore mines to shut down production. As a result, iron ore prices sailed past the $100-per-tonne mark, before being driven even further skywards during the second quarter after Rio Tinto reported dramatic declines in output. Australia's Port Hedland – the world's largest bulk export port halted iron ore exports. Australia supplies approximately 60% of the world's iron ore (ABC, 2019), and when iron ore production was significantly reduced, prices increased because of the unexpected event, however, the effects did not materialize within the event frames considered, therefore the event was omitted.

Chapter 3: Event Study Methodology

This section will provide a summary of the event study set up, to be followed by a specification of the characteristics of the event studies in this analysis, such as the chosen estimation and event windows.

Chapter 3.1: Event Study Setup

An event study comprises four key elements: identifying the specific day of the event, assessing the stock's return during the period when the announcement is made, calculating the expected return for this period if the announcement had not occurred, and determining the abnormal return (the difference between the actual return and the expected return) along with its statistical and economic relevance (Kothari & Warner, 2006). The process followed for this event study methodology reflects such an approach, and is that from the Priceton University Library Guide (2024) and 'Econometrics of Event Studies' paper written by Kothari & Warner (2006).

Chapter 3.2: Event Study Background Information

The event study methodology was developed by Fama et al., (1969) to evaluate the impact of unexpected occurrences on stock prices, and is considered as one of the most successful uses of econometrics in accurate policy and shock analysis. Specifically, it quantifies the average shift in share price following the announcement of a significant event that likely offers fresh insights into future earnings potential of the affected companies. This approach has been extensively applied across accounting, economics, and finance disciplines to analyze the effects on stock prices resulting from major corporate announcements (McWilliams & Siegel, 1997). It is considered adequate for this analysis, as the aim is to determine the direct impact of steel price shocks on the stock performance of Industrial REITs, separating this effect from other market variables that could influence stock prices simultaneously, while providing quantitative evidence of the significance of the effects. Using the event study methodology allows for a focused, rigorous analysis of how steel price shocks impact the stock performance of Industrial REITs, leveraging its strengths in isolating and quantifying the economic impacts of external shocks within the context of an efficient market.

The event study technique utilizes the market model for stock valuation, which posits that a stock's price embodies the risk-adjusted, time-discounted present value of all anticipated future cash flows accruing to the stock's holder – under the semi-strong form of the efficient market hypothesis, stock prices are thought to integrate all publicly accessible information impartially (Bouchaud et al., 2009). Consequently, it can be assumed that at any moment, the stock price reflects this comprehensive information, rendering it unfeasible for an average investor to achieve abnormal returns from stock market investments (McWilliams & Siegel, 1997). Specifically, the return on asset i at time t (R_{it}) is determined by available market information, which is represented by the return on a broad portfolio of stocks (R_{mt}). The market model posits a consistent linear relationship between these two variables:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \epsilon_{it}$$

where the error term: $\epsilon_{it} \sim N(0, \sigma^2)$ is based on unexpected random events and is purely white noise (Khotari & Warner, 2006). Consequently, it can be reasoned that only unforeseen events can alter stock prices, which reflect anticipated changes in future cash flows or the risk associated with cash flows. In the context of this study, all unexpected returns which are above normal, can be attributed to the event which is causing the unexpected steel price shock.

An abnormal return is characterized as the difference between the actual ex-post return and the expected return, where the normal return is the return expected if the event had not occurred (MacKinlay, 1997). Formally, the abnormal return for index i at the event date τ can be defined as follows:

$$AR_{i\tau} = R_{i\tau} - E(R_{i\tau}|R_{n\tau})$$

where $E(R_{i\tau}|R_{n\tau})$ are the expected normal index returns and $R_{n\tau}$ is the pre-event conditioning for the normal returns model (see Abnormal Return Tables 10, 11, 12, 14, 15, 16, 18, 19, 20 for all events in the Appendix). The normal returns of each index were assumed as the average returns over a 120-day trading window proceeding the event window, calculated separately for each event and event window (see Tables 9, 13 and 17 in the Appendix). Further, based on the abnormal returns obtained, cumulative abnormal returns (CAR) were calculated for each index by summing all the abnormal returns identified during each event window separately to measure the total effect of the event on the chosen index (see Tables 21, 22 and 23 in the Appendix),

$$CAR_{i\tau = \sum_{\tau=\tau_1}^{\tau_2} AR_{i\tau}}$$

where $CAR_{i\tau}$ is the cumulative abnormal return for index i from time τ_1 to τ_2, $AR_{i\tau}$ represents the abnormal return for the index i at time t, and τ_1 and τ_2 define the event window, with τ_1 typically being a negative number (indicating a start point before the event) and τ_2 being a positive number (indicating

an endpoint after the event). This window captures periods both before and after the event to observe anticipatory movements and reactions.

Next, using a T-Test, under the assumption that abnormal returns are normally distributed, it was tested whether the CAR obtained for Industrial REITs is significantly different from zero, as actual returns should not significantly differ from the normal returns estimated earlier if there is no impact of the event on the variable of interest (Khotari & Warner, 2006). For events which result in higher returns than usual, both Abnormal Returns (AR) and Cumulative Abnormal Returns (CAR) will be positive and significantly different from zero, and vice-versa for for adverse events. It is also assumed that the event affects only the mean and not the variance of abnormal returns during the event window, and so the distribution characteristics of abnormal returns can be used for the purpose of statistical analysis (Khotari & Warner, 2006). The null hypothesis assumes that there is no significant difference from zero in the abnormal returns during the event window.

Chapter 3.3: Estimation Window

The estimation window can be defined as the expected returns of the equity during the event window, if the event in question, or any other unusual event, had never taken place (Kothari & Warner, 2006). The length of the estimation window was chosen based on statements made by MacKinlay (1997) and Sayed and Eledum (2021), who suggest applying an estimation-window of 120 days to event studies using daily data as 120 days are considered to be sufficient in formulating a benchmark for normal returns. The estimation window is, thus, set as 120 (trading) days prior to the first day of the event window for each of the event studies conducted, and is considered as an indicator of normal returns. While a longer estimation window would lead to a potentially more accurate estimation of normal returns, it would also increase the likelihood of including event windows caused by other unexpected events (Kothari & Warner, 2006). The actual event window returns are subtracted from the estimated normal returns and defined as abnormal returns.

Chapter 3.4: Event Window

The purpose of event window is to capture the real effect of the price shock on the chosen equity, under the assumption that the market’s immediate response to significant events accurately mirrors their economic implications without bias (Kothari & Warner, 2006). The initial step of pinpointing the first public announcement of the event is pivotal to event studies, as according to the semi-strong form of the efficient market hypothesis, the firm's stock value should react at the moment the event information becomes publicly available (i.e., on the announcement date) (MacKinlay, 1997).

i) The primary event window, therefore, considered is: event date +/- 2 (trading) days. This event window heavily relies on the assumption of a perfectly efficient market, in which all public information is expected to immediately be reflected in prices (Fama et al., 1970).

Chapter 3.5: Robustness Checks

To ensure a maximum amount of robustness, two novelties are introduced. Firstly, with the focus of the paper remaining on Industrial REITs, the results for this REIT type are contrasted against those obtained for other REIT types to verify that the findings are exclusive for Industrial REITs, and to ensure that the observed effects are not artifacts of a specific REIT type's characteristics but are consistent across different types. The additionally chosen REITs are introduced in the data section.

Secondly, it should be noted that the efficient market hypothesis has been criticized by numerous academics such as R. Schiller (CBR, 2016) who argues against it, implying that the effect transmission can vary depending on many aspects of an event. Further, Andrew W. Lo (2004), who together with A. Craig MacKinlay developed the Adaptive Market Hypothesis posits that market efficiency is not a static condition but one that can evolve as the behavior of market participants changes. Consequently, to account for the efficient market hypothesis the common criticism of it while gaining deeper insights into how the effects of steel price shocks on REIT performance vary over time while ensuring the highest robustness possible, two additional event windows are introduced. These are as follows:

i) The second event window considered is: event date +/- 4 (trading) days. This event window allows to account for real world imperfections in the form of potential information leaks occurring close to the event date and influencing the price fluctuations on the trading days surrounding the event date.

ii) The third event window considered is: event date +/- 6 (trading) days. This event window further accounts for real world imperfections, and time lags caused by a potentially uncertain evaluation of the economic impact of the event on particular assets (MacKinlay, 1997). This may be particularly applicable to the third event – a mining disaster, the effects of which were most likely hard to decode within the first days following the accident.

Chapter 4: Data

The data for the analysis was collected from the Bloomberg Terminal, where all REIT index and iron ore index spot prices were extracted from using the 'historical price' database. The dataset spans from September 4th, 2015 until December 31st, 2019 to ensure full and accurate coverage of the estimation and event windows for each of the events. All together, data points from 1000 dates are considered for

eight different securities, yielding 8000 observations all together. Weekends, non-trading days, and dates on which at least one of the securities was not being traded were removed from the final dataset.

Chapter 4.1: REIT Indices

To gain the most accurate understanding of the reaction of Industrial REITs to steel price shocks, the findings for Industrial REITs are contrasted with the effects observed for six additional REIT types. The additional REIT indices were chosen with the objective of covering as many REIT types as possible, while minimizing overlaps. Some REIT types not included due to data availability complications are Hybrid REITs which invest both in real estate developments and real estate-backed loans, Timberland REITs which focus on timberland production in combination with wood-manufacturing facilities, and Self-storage REITS which generate their revenue from self-storage facilities (Motley Fool, 2024).

All the REIT indices were established either by Dow Jones or the S&P500, both of which belong to the group of the most followed equity indices in the United States (Schwab, 2022). Due to a lack of data availability it was not possible to gather data concerning all indices from one source. Nevertheless, owing to the equivalent nature of the index establishment methods, and close collaboration between S&P500 and Dow Jones, one can remain confident about a lack of overlap between the categories. All indices follow a REIT classification based on majority property type holdings, with weighting being dependent on market capitalization (S&P, 2024). This paper focuses on the performance of American Industrial REITs specifically due to the United States having the most established REIT market, and most data being available for that region. The REIT category of interest, as well as the remaining REITs are listed below and characterized:

i) REIT of Interest: The Industrial REIT Index is represented by the S*&P 500 Composite 1500 Industrial REITs (Sub-Industry),* which includes companies from the S&P Composite 1500 identified as part of the GICS® Industrial Real Estate sector. Industrial entities purchase, renovate and utilize a variety of real estate types for the creation, manufacturing, or good production. These activities demand specialized properties that facilitate the transportation and storage of products such as light and food manufacturing facilities, temperature-controlled warehouses, cultivation sites, and logistical properties – warehouses and fulfillment centers (S&P, 2024).

Additional REITs:

ii) The Equity REIT Index is represented by the *Dow Jones Equity REIT Index*, which encompasses all publicly listed real estate investment trusts categorized under the equity REITs classification in the Dow Jones U.S. stock universe, following the guidelines set by the S&P Dow Jones Indices REIT Industry Classification Hierarchy. The focus of these companies is mainly on owning and managing income-generating real estate, while not being limited to any particular property type (Dow Jones, 2024). It is the broadest REIT index being considered in the analysis, which overlaps with other indices.

iii) The Hotel REIT Index represented by the *Dow Jones US Hotel & Lodging REIT Index*, including REITs that specialize in hotels and leisure facilities. Distinct from other REITs, hotel REITs primarily engage in short-term leasing agreements, leading to unique characteristics, as hotel REITs generate income by renting out rooms and event spaces. While buying and selling real estate is also a part of their operations, it does not constitute the main source of revenue (Bloomberg, 2024).

iv) The Mortgage REIT Index represented by the *Dow Jones US Mortgage REIT Index*, also known as the mREIT, is made up of REITs that invest in both residential and commercial mortgages, along with residential mortgage-backed securities (RMBS) and commercial mortgage-backed securities (CMBS). MREITs generally concentrate on either the residential or commercial mortgage sectors, though some may invest in both RMBS and CMBS (Bloomberg, 2024). Their structure differs significantly from other REIT types being considered because they do not invest in physical real estate.

v) The Office REIT Index represented by the *S&P 500 Composite 1500 Office REITs (Sub-Industry)* serves as the basis for the Office REIT Index, which encompasses REITs engaged in constructing, managing, and upkeeping office properties, and renting these spaces to businesses seeking office accommodations for their workforce (S&P, 2024).

vi) The Residential REIT Index is represented by the *S&P 500 Composite 1500 Residential REITs (Industry)*, which consists of REITs that construct, own and operate residential properties and leasing spaces to residents. This category includes REITs focused on apartments, student housing, manufactured housing, and single-family homes (Marketwatch, 2024).

vii) The Retail REIT Index is represented by the *S&P 500 Composite 1500 Retail REITs (Sub-Industry)* and covers Retail REITs specializing in major regional shopping malls, outlet centers, grocery-anchored shopping complexes, and power centers hosting large retailers. Retail REITs generate most revenue by leasing space to retailers and various tenants, predominantly using gross leases where tenants pay a fixed rent based on the leased square footage and a share of the common areas (Marketwatch, 2024).

Chapter 4.2: Iron Ore Prices

Due to the lack of widely available accurate global commodity pricing data, this analysis is based on the justified assumption that iron ore price movements are an appropriate proxy for steel price movements. This has previously widely been proven by Ma (2021) who, based on an effect spillover analysis, found that steel prices are determined by iron ore prices. Moreover, iron ore is a fundamental component in steel production, serving as a primary ingredient in the production of pig iron and steel, directly influencing steel prices, thus significantly affecting construction costs in real estate (IEA, 2020). It is crucial to formally introduce the previously mentioned assumption of a high correlation between

steel and its inputs. In other words, it is assumed that changes in global steel prices have a direct impact on the demand for its production inputs.

The 'Iron Ore Spot Price Index 62% Import Fine Ore CFR Qingdao USD Index' (ISIX62IU) is selected as a representation of global iron ore prices. The index, sourced from Beijing CUSTEEL E-commerce, determines the prices based on iron ore samples collected in 33 cities across China. The prices are listed in USD per metric ton, exclusive of VAT, and are quoted FOB, unless specified otherwise (Bloomberg database, 2024). The ISIX62IU is based on iron ore samples collected from 33 cities across China, which provides a broad and representative sample of iron ore prices across a significant portion of the global market. Given that China is the largest importer and consumer of iron ore globally, prices sourced from these diverse locations are assumed to provide an accurate reflection of global iron ore price trends (SMCP, 2021). Furthermore, China leads the world not only in the consumption of iron ore but also in steel production, and the pricing dynamics within China often set the benchmark for global pricing due to the sheer volume of its demand (Metal Miner, 2024). Thus, an index that captures the movement of iron ore prices within China is assumed to be a reliable indicator of global price trends. The prices being quoted FOB (Free on Board) from Qingdao – one of China's major maritime hubs for the export and import of iron materials – also adds to the index's relevance as Qingdao is a pivotal point for pricing as it handles a significant portion of China's iron ore imports and exports, making it an essential reference point for global traders and analysts (Institutional Investor, 2022). Lastly, the methodology behind the ISIX62IU, which is derived from prices determined by Beijing CUSTEEL E-commerce and reported by Bloomberg, ensures a high level of data integrity and accuracy (Bloomberg, 2024).

The other side of the supply chain is dominated the 'Big Three' iron suppliers – Vale, Rio Tinto, and BHP Billiton. In 2010, Vale had a market share of 25.6%, Rio Tinto held 19.8%, and BHP Billiton maintained 14.6% (UNCTAD, 2010). Prior to 2009, these producers traded most iron ore at annual fixed prices, which would represent a significant obstacle to the analysis of price fluctuations (UNCTAD, 2010). Post-2010, however, these three major suppliers concurred on adopting a Platts price index for iron ore spot transactions to more accurately mirror immediate market conditions – this introduction of spot pricing for iron ore has been pivotal, enabling both providers and purchasers to mitigate the risks associated with price volatility (Warell, 2014).

Chapter 4.3: Data Analysis

After the data was collected and cleaned, the daily returns were calculated based on closing prices, separately for all REIT indices, and Iron Ore Spot Price Index for the whole time period considered:

$$Daily\ Index\ Return = \frac{Closing\ Index\ Price_{t+1} - Closing\ Index\ Price_t}{Index\ Price_t}$$

The daily returns were then used for the event study setup, where, under the assumption that T is the last day of the event window, the event window return can be defined as:

$$Event\ Window\ Index\ Return = \frac{Closing\ Index\ Price_{t=T} - Closing\ Index\ Price_{t=1}}{Closing\ Index\ Price_{t=1}}$$

The normal returns were calculated as the average returns over a 120-day trading window proceeding the event window, calculated separately for each event and event window (see Tables 9, 13, 17 in the Appendix). Next, the event study methodology was incorporated into the analysis.

Chapter 4.4: Descriptive Statistics

The summary statistics for the dataset can be found in Table 1 which contains both a summary of the index price statistics, as well as the index return statistics. For the pricing statistics, it can be noted that both the average price and standard deviation is highest for Equity REITs, and the lowest for Mortgage REITs. The average daily returns are the highest for Industrial REITs and lowest for Retail, Hotel and Mortgage REITs, however the differences are very slight.

Table 1. Descriptive Statistics

Variable	Obs	Mean	St. Dev	Min	Max
Industrial REIT	1000	78.5061	16.4150	47.7	117.06
Industrial REIT Returns	1000	0.0008	0.0300	-0.1097	0.1062
Office REIT	1000	120.7547	6.1858	97.88	135.43
Office REIT Returns	1000	0.0005	0.0227	-0.1343	0.1109
Retail REIT	1000	110.0201	11.3425	89.85	143.73
Retail REIT Returns	1000	0.0003	0.0249	-0.1081	0.1006
Residential REIT	1000	176.4412	17.1117	144.8	225.21
Residential REIT Returns	1000	0.0007	0.0242	-0.0882	0.0968
Hotel REIT	1000	114.597	9.4209	84.44	137.02
Hotel REIT Returns	1000	0.0003	0.0236	-0.0868	0.0955
Mortgage REIT	1000	56.037	3.6146	43.56	63.85
Mortgage REIT Returns	1000	0.0003	0.0216	-0.0863	0.0883
Equity REIT	1000	351.9781	25.2743	290.02	417.64
Equity REIT Returns	1000	0.0005	0.0186	-0.0823	0.0913
Iron Ore Index	1000	69.2422	16.2182	37.2	118.96
Iron Ore Index Returns	1000	0.0006	0.020	-0.1108	0.262

Notes. This table presents the descriptive statistics for the data used for the event studies. The spot price data was sourced from Bloomberg and the daily returns were calculated in Excel based on the closing prices. All prices are quoted in USD. The Iron Ore Spot Price Index is the Iron Ore Spot Price Index 62% Import Fine Ore CFR Qingdao USD Index' (ISIX62IU). The Iron Ore Index prices are listed in USD per metric ton, exclusive of VAT and shipping costs.

Chapter 5: Results

Chapter 5.1: Results Presentation & Interpretation

Table 2. Cumulative Abnormal Returns for Industrial REITs

Event Number	Event Window 1	Event Window 2	Event Window 3
Event 1	0.0297**	0.0197**	0.0056
	(0.0084)	(0.0061)	(0.0091)
Event 2	-0.0166**	-0.0066	-0.0027
	(0.0053)	(0.0062)	(0.0048)
Event 3	-0.0102	-0.0160*	-0.0133
	(0.0058)	(0.0085)	(0.0095)

*Notes. This table presents the cumulative abnormal returns for the Industrial REIT for all three events and each of the three event windows. The first event window is: event date +/- 2 (trading) days, the second event window is: event date +/- 4 (trading) days, and the third event window is: event date +/- 6 (trading) days. The spot price data is listed in USD was sourced from Bloomberg, the daily returns were calculated in Excel and the statistical analysis was conducted in Stata. The event frames are calculated based on trading days. Standard errors are reported in parentheses. *, **, and *** indicate significance levels of 90%, 95% and 99%, respectively.*

Table 2 presents the cumulative abnormal returns (CAR) results for Industrial REITs for each of the events, and event windows. Event 1 is the announcement of the steel production reduction mandate in advance of the International Horticultural Exposition in Tangshan, Event 2 is President Trump's Excercise of his Authority under Section 232 of the Trade Expansion Act of 1962 to impose a 25% tariff on steel imports, and Event 3 is the Brumadinho Dam Disaster at the Córrego do Feijão iron ore mine in Brazil.

For Event 1, it can be observed that the CAR is positive and significant only for Industrial REITs both during the first and second event window, negative and significant only during the first event window for Event 2, and negative and significant for the second event window for Event 3.

5.1.2 Results for Event 1 – International Horticultural Exposition in Tangshan

The first hypotheses – previously stated as below – can, therefore, be rejected, as the Industrial REITs do not show a statistically significant decrease in returns throughout the event windows, yet a positive CAR in the range of approximately 1.9% to 3%.

H1: *The increase in global steel prices resulting from the announcement of the horticultural exposition in Hebei in March 2016 leads to a decrease in the returns of American REIT indices*

When steel prices increase, Industrial REIT returns tend to increase by approx. 2.97% within the first event window, and by 1.97% within the second event window – the effect, hence, is diminishing over time, and becoming insignificant in the third event window, as the effect's magnitude decreases. The positive CAR for Industrial REITs, contrary to the initial hypothesis, suggests that the immediate increase in steel prices resulting from the announcement of the exposition may have had an unexpectedly beneficial effect on Industrial REIT returns. This can be potentially explained by several factors. The unexpected surge in steel prices might have led industries that rely heavily on steel production to expand or adjust their operations in anticipation of such future unexpected cost increases. This increased demand for industrial spaces, such as warehouses and production facilities, likely drove up rents and, consequently, the returns on Industrial REITs. If the Industrial REITs in question have significant exposure to markets that benefit directly or indirectly from steel price increases, this could also enhance their returns. For instance, REITs with properties in logistics hubs or areas connected to ports handling steel or iron ore might have benefited from the sudden increased trading activity. Rising steel prices can also increase the costs of new construction projects, creating a competitive advantage for existing industrial properties. To further verify these explanations, a deeper analysis of the specific holdings and geographic distribution of the Industrial REITs would be necessary.

In conclusion, the first hypothesis (H1) is rejected based on the evidence that Industrial REITs did not show a statistically significant decrease in returns. Instead, they experienced positive abnormal returns in the immediate aftermath of the steel production reduction mandate, highlighting the complex and multifaceted relationship between commodity price shocks and real estate investment performance.

5.1.3 Results for Event 2 – President Trump's 25% Tariff on Steel Imports

The results for Event 2 – a negative and statistically significant CAR during Event Window 1 – indicate that Industrial REITs experienced a significant negative abnormal return in response to the steel price shock, with the effect diminishing and becoming insignificant in the subsequent event windows, with the effect magnitude also decreasing. The negative CAR for Industrial REITs aligns with the second hypothesis, as stated below, which can be accepted.

H2: *The elevation in American steel prices resulting from the enactment of the 25% steel tariff in March 2018 leads to a decline in the returns of American REIT indices.*

Industrial REITs likely face the most direct negative impact from increased steel prices, as their properties (warehouses, factories, distribution centers) heavily rely on steel for both maintenance and new construction, and this effect seems to take a more significant weight than in the case of the first event, most likely due to its longer-term effect. The immediate negative market reaction likely also

reflects investor concerns about the long-term financial burden on Industrial REITs, as compared to the first event, which was a rather temporary change. Higher steel costs reduce profit margins and the cash flows available for distributions to shareholders, making Industrial REITs less attractive to investors. Furthering this argument, the increased steel costs resulting from the tariff implementation may have led to delays or cancellations of new construction projects, adversely affecting the growth prospects of Industrial REITs. This reduction in development activity can have a cascading effect on future rental income and overall returns. Finally, the tariff introduced significant overall uncertainty into the market. Investors may have anticipated broader economic implications, such as potential retaliatory trade measures and their impact on the business environment, further contributing to the negative sentiment.

The findings for Event 2 underscore the direct negative impact of increased steel prices on Industrial REITs, reflecting higher operating expenses and reduced financial performance. This highlights the importance for Industrial REIT managers to develop strategies to mitigate the effects of commodity price volatility, such as hedging and cost management practices.

5.1.4 Results for Event 3 – Brumadinho Dam Disaster

The negative, significant CAR (-1.6%) for Industrial REITs during the second event window aligns with the third hypothesis, suggesting that the increase in steel prices due to the Brumadinho Dam Disaster had an adverse impact on Industrial REIT returns, leading to an acceptance of the third hypothesis, below.

H3: *The increase in steel prices caused by the Brumadinho Dam Disaster in January 2019 leads to a decrease in the returns of American REIT indices*

The Industrial REITs – as also seen based on previous events – are likely sensitive to fluctuations in steel prices due to their heavy reliance on steel for building and maintaining industrial properties. The disaster's impact on iron ore supply might have heightened concerns about rising construction and renovation costs for the longer term. The disaster not only affected iron ore supply but also introduced significant uncertainty into global supply chains. Industrial sectors, which are deeply integrated into these supply chains, might have been more directly affected by the disruptions, leading to negative investor sentiment. Overall, the event created a high level of uncertainty in the market, impacting investor confidence. The potential long-term implications of the disaster, such as regulatory changes and increased operational risks, likely contributed to the negative abnormal returns for Industrial REITs.

The findings for Event 3 underscore the direct negative impact of increased steel prices on Industrial REITs, reflecting higher long-term construction and renovation costs, supply chain disruptions, and heightened market uncertainty.

5.2. Other REIT Types

As previously mentioned, other REIT types were analyzed under the same conditions as Industrial REITs to ensure robustness. The results for these REIT types provide additional context and validation for the observed effects. Table 21 in the Appendix portrays the results for Event 1.

5.2.1. Other REITs during Event 1

For Event 1, the CAR is significant and positive for the Office REIT Index during the first event window at a 5% significance level. The remaining CARs for other REIT types are insignificant for this event, indicating that the effect is specific to Office REITs. The positive CAR for Office REITs (+1.2% significant at the 5% level) can be explained by the nature of office properties, which often undergo significant interior renovations and adaptive reuse. These renovations may not require as much steel as new constructions, making Office REITs less sensitive to steel price increases. Additionally, office properties in prime business districts with high demand and limited supply can command higher rents, offsetting any potential cost increases.

The announcement by local authorities in Tangshan to reduce steel production resulted in a significant and unexpected shock to iron ore and steel prices. However, there is very little effect transmission to the performance of American REITs other than Industrial REITs, confirming that the results for Industrial REITs are not applicable to the whole industry.

5.2.2. Other REITs during Event 2

Table 22 in the Appendix presents the CAR results for the additional REITs for the second event. The CAR is positive and significant during the first event window for the Residential REIT Index at a 5% significance level and positive and significant for the Equity REIT Index at a 10% significance level. The remaining CARs are insignificant for this event. The first event window captures most effects for this event, with the second and third windows not yielding any significant results.

The positive significant CAR for Residential REITs (+2.49%, significant at the 5% level) during the first event window suggests that these REITs have a better ability to pass on increased costs to tenants through higher rents, especially in markets with strong demand and limited housing supply. The construction of residential buildings may use less steel compared to industrial properties, and many

costs might be fixed or hedged in the short term. Additionally, investors might often believe that residential markets will remain robust, supporting growth despite higher costs.

The positive CAR (+1.5%, significant at the 10% level) for Equity REITs may be driven by the diversified nature of Equity REIT portfolios, which include various property types. This diversification can buffer against sector-specific shocks of steel price increases. The specific leading REIT type within this category remains unidentified, however the overall positive response suggests resilience to immediate cost changes due to the steel tariff.

The insignificant results in other REIT sectors imply that the market might have already priced in the anticipated impacts of the steel tariff introduction, or these sectors are less sensitive to the immediate cost changes due to steel tariffs.

5.2.3. Other REITs during Event 3

Table 23 in the Appendix presents the CAR results for the additional REITs for the third event. The CAR is statistically significant for all REIT types during at least one event window, though the sign of the effect differs. While the effect was negative and significant for Industrial REITs, it was positive and significant for other REIT types.

For Office REITs, CAR is positive and significant (+1.60%) during the second and third event windows at a 5% significance level. Office REITs rely more on renovations and location quality, making them less sensitive to changes in construction costs (NAREIT, 2023). Similarly, for Retail REITs, CAR is positive and significant across all three event windows, with significance levels of 10% for windows one and three, and 5% for window two. This suggests that retail real estate markets are also resilient to increased construction costs, possibly due to stable consumer confidence which may be unaffected by the disaster, and smaller portions of operational expenses attributed to construction costs.

The CAR is positive and significant during the first (10%) and second (5%) event windows for Residential REITs, which could be due to demographic trends and housing demand, as well as pre-sale mechanisms or long-term financing that shield against immediate material price hikes (Bao et al., 2023). The CAR is positive and significant (+1.75%) for Hotel REITs only in the third event window at a 5% significance level. Hotels may have been less affected by the disaster due to continued performance in tourism and travel, focusing on renting out rooms rather than property development (Bloomberg, 2024).

Mortgage REITs illustrate a positive and significant CAR (+1.80%) during the first and second event windows at a 1% significance level. The diversified nature of mortgage REITs, holding various property

types or mortgages, spreads risk and may explain the positive response. Equity REITs, somewhat similarly, show a positive and significant CAR in all event windows, with a 10% significance level for the first event window and 5% for the remaining two. Equity REITs often hold a variety of property types, which spreads risk and offsets losses, making them a safer asset class during uncertain times. Further, in uncertain times, investors might flock to real estate as a safer asset class, especially if the stock market reacts negatively to global events such as the Brumadinho Dam Disaster (EH, 2021).

This event had the most significant impact on REIT performance overall, although the effect on Industrial REITs was negative as hypothesized. The concentrated impact in later event windows suggests that natural disasters may take longer to be priced in by the market due to higher uncertainty and potential long-term implications.

Chapter 6: Conclusion

Chapter 6.1: Purpose of Study & Results

The purpose of this study was to understand the effects of steel price shocks on the performance of American Industrial REITs. REITs, which have become more popular portfolio components in recent years, invest into and operate diverse types of real estate (ERPA, 2023). This research was inspired by previous studies conducted on the effect spillovers of oil price shocks on varying equity types, including REITs, the lack of coverage of the relationship between commodities used in the construction process and REIT performance, and the growing importance of Industrial REIT projects, such as datacenters.

It was hypothesized that steel price shocks will be directly reflected in Industrial REIT returns, showing an inverse relationship between price increases and returns. Employing an event study methodology, the research examined three significant events: the steel production reduction mandate in Tangshan, the 2018 steel tariff announcement, and the Brumadinho Dam Disaster. Each event was analyzed across three separate event windows to comprehensively capture the effects of steel price shocks.

The findings challenge the initial hypothesis, revealing a more nuanced response of Industrial REITs to steel price shocks: In response to the Tangshan Steel Production Reduction Mandate, Industrial REITs showed a CAR of +2.96% in the first event window, yielding an effect opposite to that hypothesized. This unexpected result suggests that the immediate increase in steel prices may have driven short-term demand for industrial spaces, as industries relying on steel possibly ramped up operations in anticipation of future cost increases. After the 2018 Steel Tariff Announcement, a negative CAR of -1.7% was observed in the first event window, somewhat in line with expectations of a negative response. This indicates a direct negative impact on Industrial REITs, likely due to increased construction and maintenance costs because of higher domestic steel prices. The immediate investor reaction reflects

concerns about the long-term financial burden on Industrial REITs. Following the Brumadinho Dam Disaster, a -1.6% CAR was recorded during the second event window. The disaster caused a significant rise in global iron ore prices, translating into higher steel costs and, consequently, increased expenses for Industrial REITs. The negative return is indicative of investor apprehension regarding the sustained impact of such price shocks on REIT profitability. These results indicate that while steel price increases generally lead to negative returns for Industrial REITs, the specific context and nature of the event play crucial roles in determining the extent and direction of the impact.

Other REIT types, analyzed as a robustness check, showed varied responses to the same events. For instance, Residential REITs demonstrated a +2.49% CAR following the 2018 steel tariff announcement and a +3.4% CAR in reaction to the Tangshan steel production reduction. Equity and Mortgage REITs showed mixed results, reflecting broader market conditions and diversified strategies. Overall, most results for other REIT types were statistically insignificant, indicating that American REIT performance is not uniformly affected by global steel price shocks. However, Industrial REITs are more sensitive due to their heavy reliance on steel for construction and maintenance. This study highlights the importance of context in the REIT market, where different REIT types respond distinctly. Sector-specific resilience or vulnerability can be attributed the nature of leased properties, geographical and economic diversity, and operational strategies in managing costs and capitalizing on opportunities.

Chapter 6.2: Study Implications

There are many implications that this study has for portfolio management, policymaking, as well as the understanding of Industrial REIT performance. Firstly, the findings suggest that REIT investors need to consider sector-specific factors when assessing the impact of commodity price changes on REIT performance. Tailoring investment strategies to account for the differentiated impacts across various REIT types can enhance portfolio management and diversification, particularly in segments that show an ability to hedge against these risks or pass them through to consumers.

From the perspective of Industrial REIT managers, this study highlights the importance of strategic supply chain management which is crucial for mitigating the impact of steel price volatility. Managers should consider hedging against steel price fluctuations and diversifying their portfolios not just geographically but also across different property types. This can provide a buffer against sector-specific shocks and contribute to more stable performance. Finally, for the purpose of policymaking, understanding the sector-specific impacts of commodity price shocks can inform policies that stabilize the real estate market during economic disruptions. Policymakers could develop regulatory frameworks that provide incentives for Industrial REITs to adopt technologies and practices reducing dependency on volatile commodities like steel. Such measures can enhance the resilience of the real estate market.

Chapter 6.3: Limitations & Further Research

Several limitations of this research must be acknowledged. Firstly, the iron ore price index, which was chosen as a proxy for steel prices, although being relevant and accurate, may be subject to hidden measurement inaccuracies. Additionally, the study assumes a direct linear relationship between iron ore and steel prices, which is justified, however perhaps may oversimplify the actual dynamics. Data availability also limited the scope of analysis for certain REIT types and regions. Although unlikely, there may be overlaps within the chosen REIT indices, which could introduce a bias in reasoning, as some REITs can be very similar in nature. Lastly, different event frames seem to be required for different event types to capture full effect transmission. While the three event frames applied can be considered exhaustive, perhaps longer frames would have been more accurate in effect measurement.

This topic area offers vast opportunities for future research. For instance, an interesting contribution to the overall field of event studies would be the creation of an event date framework for different event types (such as natural disasters, political events, company announcements) to measure direct event effects more effectively. The analysis could also be extended to other commodities such as concrete, however, this is limited by the availability of accurate data. An additional valuable contribution could also be a comparison of the effects of global commodity price changes on Industrial REITs in different world regions. Further studies could also explore long-term effects of sustained changes in commodity prices on REIT performance, considering macroeconomic variables such as interest rates and economic growth, which would be in line with previously conducted research. The intersection between commodities and REITs remains vastly underexplored, presenting a fertile ground for future studies that could potentially transform how these assets are perceived in investment portfolios.

While it can be concluded that steel price shocks generally have inverse effects on Industrial REITs, the broader implications highlight the complexity of market dynamics. This study contributes to a nuanced understanding of the intricate relationships between commodity prices and real estate investments, offering a strategic framework for stakeholders in real estate markets, while emphasizing the need for sector-specific strategies and policies to navigate the challenges posed by commodity price volatility effectively.

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Appendix

Table 3. Iron Ore Index Prices during Event 1

Date	IO Price	IO Daily Return
26/02/2016	46.50	-1.0000%
29/02/2016	46.40	-0.2794%
01/03/2016	46.50	0.2802%
02/03/2016	47.90	2.9443%
03/03/2016	49.50	3.3403%
04/03/2016	49.60	0.3434%
07/03/2016	62.70	26.2412%
08/03/2016	64.30	2.5997%
09/03/2016	57.20	-11.0420%
10/03/2016	59.70	4.3706%
11/03/2016	57.70	-3.3501%
14/03/2016	57.10	-1.0399%
15/03/2016	53.90	-5.6042%

Notes. This table presents Iron Ore Spot Price Index 62% Import Fine Ore CFR Qingdao USD Index' (ISIX62IU) daily prices and daily returns for the time period 26.02.2016-15.03.2016 which covers all three event windows. The spot price data was sourced from Bloomberg and the daily returns were calculated in Excel. The Iron Ore Index prices are listed in USD per metric ton, exclusive of VAT and shipping costs. The chosen event date is 07/03/2016 which is when the local authorities in Tangshan mandated a reduction in steel production in the area to mitigate air pollution before the 2016 International Horticultural Exposition. The event frames are calculated based on trading days.

Table 4. Iron Ore Index Returns during Event 1 per Event Window

Event Window	IO Index Total Return
1: 03/03 – 09/03/2016	15.5556%
2: 01/03 – 11/03/2016	24.0860%
3: 26/02 – 15/03/2016	15.9140%

Notes. This table presents the Iron Ore Spot Price Index 62% Import Fine Ore CFR Qingdao USD Index' (ISIX62IU) returns for each of the three event windows chosen. The spot price data was sourced from Bloomberg and the daily returns were calculated in Excel. The Iron Ore Index prices are listed in USD per metric ton, exclusive of VAT and shipping costs. The chosen event date is 07/03/2016 which is when the local authorities in Tangshan mandated a reduction in steel production in the area to mitigate air pollution before the 2016 International Horticultural Exposition. The event frames are calculated based on trading days. The first event window is: event date +/- 2 (trading) days, the second event window is: event date +/- 4 (trading) days, and the third event window is: event date +/- 6 (trading) days.

Table 5. Iron Ore Index Prices during Event 2

Date	IO Price	IO Daily Return
28/02/2018	75.59	-1.6779%
01/03/2018	75.95	0.4763%
02/03/2018	74.32	-2.1461%
05/03/2018	73.89	-0.5786%
06/03/2018	73.55	-0.4601%
07/03/2018	72.63	-1.2508%
08/03/2018	71.33	-1.7899%
09/03/2018	67.91	-4.7946%
12/03/2018	65.86	-3.0187%
13/03/2018	66.39	0.8047%
14/03/2018	67.56	1.7623%
15/03/2018	67.81	0.3700%
16/03/2018	67.46	-0.5161%

Notes. This table presents the Iron Ore Spot Price Index 62% Import Fine Ore CFR Qingdao USD Index' (ISIX62IU) daily prices and daily returns for the time period 28.02.2018-16.03.2018 which covers all three event windows for this event. The spot price data was sourced from Bloomberg and the daily returns were calculated in Excel. The Iron Ore Index prices are listed in USD per metric ton, exclusive of VAT and shipping costs. The chosen event date is 08/03/2018 which is the date of President Trump's Excercise of his Authority under Section 232 of the Trade Expansion Act of 1962 to impose a 25% tariff on steel imports. The event frames are calculated based on trading days.

Table 6. Iron Ore Index Returns during Event 2 per Event Window

Event Window	IO Total Return
1: 06/03 – 12/03/2018	-10.4555%
2: 02/03 – 14/03/2018	-9.0958%
3: 28/02 – 16/03/2018	-10.7554%

Notes. This table presents the Iron Ore Spot Price Index 62% Import Fine Ore CFR Qingdao USD Index' (ISIX62IU) returns for each of the three event windows chosen. The spot price data was sourced from Bloomberg and the daily returns were calculated in Excel. The Iron Ore Index prices are listed in USD per metric ton, exclusive of VAT and shipping costs. The chosen event date is 08/03/2018 which is the date of President Trump's Excercise of his Authority under Section 232 of the Trade Expansion Act of 1962 to impose a 25% tariff on steel imports. The event frames are calculated based on trading days. The first event window is: event date +/- 2 (trading) days, the second event window is: event date +/- 4 (trading) days, and the third event window is: event date +/- 6 (trading) days.

Table 7. Iron Ore Index Prices during Event 3

Date	IO Price	IO Daily Return
16/01/2019	73.20	0.9238%
17/01/2019	72.09	-1.5164%
18/01/2019	72.74	0.9017%
22/01/2019	72.23	-0.7011%
23/01/2019	72.50	0.3738%
24/01/2019	72.13	-0.5103%
25/01/2019	72.73	0.8318%
28/01/2019	75.59	3.9324%
29/01/2019	76.07	0.6350%
30/01/2019	79.19	4.1015%
31/01/2019	79.27	0.1010%
01/02/2019	81.07	2.2707%
04/02/2019	79.08	-2.4547%

Notes. This table presents the Iron Ore Spot Price Index 62% Import Fine Ore CFR Qingdao USD Index' (ISIX62IU) daily prices and daily returns for the time period 16.01.2019-04.02.2019 which covers all three event windows for this event. The spot price data was sourced from Bloomberg and the daily returns were calculated in Excel. The Iron Ore Index prices are listed in USD per metric ton, exclusive of VAT and shipping costs. The chosen event date is 25/01/2019 which is the date of the occurrence of the Brumadinho Dam Disaster at the Córrego do Feijão iron ore mine in Brazil. The event frames are calculated based on trading days.

Table 8. Iron Ore Index Returns during Event 3

Event Window	IO Total Return
1: 23.01 – 29.01.2019	4.9241%
2: 18.01 – 31.01.2019	8.9772%
3: 16.01 – 04.02.2019	8.0328%

Notes. This table presents the Iron Ore Spot Price Index 62% Import Fine Ore CFR Qingdao USD Index' (ISIX62IU) returns for each of the three event windows chosen. The spot price data was sourced from Bloomberg and the daily returns were calculated in Excel. The Iron Ore Index prices are listed in USD per metric ton, exclusive of VAT and shipping costs. The chosen event date is 25/01/2019 which is the date of the occurrence of the Brumadinho Dam Disaster at the Córrego do Feijão iron ore mine in Brazil. The event frames are calculated based on trading days. The first event window is: event date +/- 2 (trading) days, the second event window is: event date +/- 4 (trading) days, and the third event window is: event date +/- 6 (trading) days.

Table 9. Normal Returns for Event 1 per REIT Type

REIT Type	Event Window 1	Event Window 2	Event Window 3
Industrial REIT	0.0010	0.0007	0.0009
Office REIT	0.0002	0.0003	0.0004
Retail REIT	0.0013	0.0013	0.0014
Residential REIT	0.0009	0.0008	0.0009
Hotel REIT	-0.0007	-0.0006	-0.0005
Mortgage REIT	-0.0007	-0.0006	-0.0005
Equity REIT	0.0007	0.0007	0.0008

Notes. This table presents the normal returns for each of the seven REIT indices being considered in the analysis, for each of the three event windows being considered for event 1: the first event window is: event date +/- 2 (trading) days, the second event window is: event date +/- 4 (trading) days, and the third event window is: event date +/- 6 (trading) days. The spot price data is listed in USD was sourced from Bloomberg, the daily returns were calculated in Excel and the statistical analysis was conducted in Stata. The chosen event date is 07/03/2016 which is when the local authorities in Tangshan mandated a reduction in steel production in the area to mitigate air pollution before the 2016 International Horticultural Exposition. The event frames are calculated based on trading days.

Table 10. Abnormal Returns during Event 1 (Event Window 1) per REIT Type

Date	Industry REIT	Office REIT	Retail REIT	Residential REIT	Hotel REIT	Mortgage REIT	Equity REIT
03/03/2016	0.0409	0.0542	0.0244	0.0373	0.0581	0.0480	0.0342
04/03/2016	0.0264	0.0422	-0.0062	0.0222	0.0367	0.0065	0.0229
07/03/2016	-0.0015	0.0305	0.0132	-0.0019	0.0107	0.0179	0.0104
08/03/2016	0.0442	0.0511	0.0006	0.0113	0.0266	-0.0140	0.0489
09/03/2016	0.0387	-0.0080	0.0089	-0.0123	-0.0628	0.0468	-0.0137

Notes. This table presents the daily abnormal returns for each of the seven REIT indices being considered in the analysis, for the first event window, which is defined as: event date +/- 2 (trading) days. The spot price data is listed in USD and was sourced from Bloomberg, the daily returns were calculated in Excel and the statistical analysis was conducted in Stata. The chosen event date is 07/03/2016 which is when the local authorities in Tangshan mandated a reduction in steel production in the area to mitigate air pollution before the 2016 International Horticultural Exposition. The event frames are calculated based on trading days.

Table 11. Abnormal Returns during Event 1 (Event Window 2) per REIT Type

Date	Industry REIT	Office REIT	Retail REIT	Residential REIT	Hotel REIT	Mortgage REIT	Equity REIT
01/03/2016	0.0089	-0.0054	-0.0033	0.0131	0.0018	-0.0136	-0.0047
02/03/2016	0.0118	0.0019	0.0060	-0.0002	0.001	-0.0096	0.0072
03/03/2016	0.0411	0.0541	0.0245	0.0375	0.0580	0.0478	0.0342
04/03/2016	0.0266	0.0421	-0.0062	0.0223	0.0367	0.0064	0.0229
07/03/2016	-0.0013	0.0304	0.0133	-0.0018	0.0106	0.0178	0.0105
08/03/2016	0.0443	0.0511	0.0006	0.0114	0.0266	-0.0142	0.0489
09/03/2016	0.0389	-0.0081	0.0090	-0.0122	-0.0629	0.0467	-0.0137
10/03/2016	0.0049	-0.0040	0.0102	-0.0298	-0.0371	0.0386	0.0069
11/03/2016	0.0014	-0.0683	-0.0339	-0.0138	-0.0480	0.0033	-0.0784

Notes. This table presents the daily abnormal returns for each of the seven REIT indices being considered in the analysis, for the second event window, which is defined as: event date +/- 4 (trading) days. The spot price data is listed in USD and was sourced from Bloomberg, the daily returns were calculated in Excel and the statistical analysis was conducted in Stata. The chosen event date is 07/03/2016 which is when the local authorities in Tangshan mandated a reduction in steel production in the area to mitigate air pollution before the 2016 International Horticultural Exposition. The event frames are calculated based on trading days.

Table 12. Abnormal Returns during Event 1 (Event Window 3) per REIT Type

Date	Industry REIT	Office REIT	Retail REIT	Residential REIT	Hotel REIT	Mortgage REIT	Equity REIT
26/02/2016	-0.1230	-0.0058	-0.0114	-0.0047	-0.0103	-0.0001	-0.0059
29/02/2016	-0.0048	-0.0034	-0.0044	-0.0024	0.0004	-0.0036	-0.0016
01/03/2016	0.0088	-0.0055	-0.0035	0.0129	0.0017	-0.0137	-0.0048
02/03/2016	0.0117	0.0017	0.0058	-0.0003	0.0000	-0.0097	0.0071
03/03/2016	0.0410	0.0539	0.0243	0.0374	0.0578	0.0477	0.0341
04/03/2016	0.0265	0.0420	-0.0064	0.0222	0.0365	0.0063	0.0228
07/03/2016	-0.0014	0.0303	0.0131	-0.0019	0.0104	0.0177	0.0104
08/03/2016	0.0442	0.0509	0.0006	0.0113	0.0264	-0.0143	0.0488
09/03/2016	0.0388	-0.0082	0.0089	-0.0123	-0.0631	0.0466	-0.0138
10/03/2016	0.0048	-0.0041	0.0100	-0.0299	-0.0373	0.0385	0.0069
11/03/2016	0.0013	-0.0684	-0.0341	-0.0139	-0.0481	0.0032	-0.0785
14/03/2016	-0.0846	-0.0228	0.0070	0.03303	0.0960	-0.0859	0.0183
15/03/2016	-0.0018	0.0007	0.0000	0.0041	-0.0135	-0.0067	-0.0003

Notes. This table presents the daily abnormal returns for each of the seven REIT indices being considered in the analysis, for the third event window, which is defined as: event date +/- 6 (trading) days. The spot price data is listed in USD was sourced from Bloomberg, the daily returns were calculated in Excel and the statistical analysis was conducted in Stata. The chosen event date is 07/03/2016 which is when the local authorities in Tangshan mandated a reduction in steel production in the area to mitigate air pollution before the 2016 International Horticultural Exposition. The event frames are calculated based on trading days.

Table 13. Normal Returns for Event 2 per REIT Type

REIT Type	Event Window 1	Event Window 2	Event Window 3
Industrial REIT	0.0009	0.0008	0.0005
Office REIT	0.0000	-0.0002	-0.0005
Retail REIT	-0.0003	-0.0001	-0.0003
Residential REIT	-0.0008	-0.0011	-0.0014
Hotel REIT	0.0008	0.0007	-0.0002
Mortgage REIT	-0.0006	-0.0008	-0.0004
Equity REIT	-0.0003	-0.0002	-0.0009

Notes. This table presents the normal returns for each of the seven REIT indices being considered in the analysis, for each of the three event windows being considered for event 2: the first event window is: event date +/- 2 (trading) days, the second event window is: event date +/- 4 (trading) days, and the third event window is: event date +/- 6 (trading) days. The spot price data is listed in USD was sourced from Bloomberg, the daily returns were calculated in Excel and the statistical analysis was conducted in Stata. The chosen event date is 08/03/2018 which is the date of President Trump's Excercise of his Authority under Section 232 of the Trade Expansion Act of 1962 to impose a 25% tariff on steel imports. The event frames are calculated based on trading days.

Table 14. Abnormal Returns during Event 2 (Event Window 1)

Date	Industrial REIT	Office REIT	Retail REIT	Residential REIT	Hotel REIT	Mortgage REIT	Equity REIT
06/03/2018	0.0013	0.0099	0.0072	0.0095	0.0459	-0.0202	0.0284
07/03/2018	-0.0292	0.0351	0.0753	0.0388	0.0391	0.0485	0.0380
08/03/2018	-0.0128	0.0012	0.0384	0.0371	0.0030	0.0080	0.0160
09/03/2018	-0.0173	-0.0271	-0.0098	0.0284	-0.0532	-0.0461	-0.0060
12/03/2018	-0.0252	-0.0050	-0.0093	0.0108	-0.0321	0.0174	-0.0076

Notes. This table presents the daily abnormal returns for each of the seven REIT indices being considered in the analysis, for the first event window, which is defined as: event date +/- 2 (trading) days. The spot price data is listed in USD and was sourced from Bloomberg, the daily returns were calculated in Excel and the statistical analysis was conducted in Stata. The chosen event date is 08/03/2018 which is the date of President Trump's Excercise of his Authority under Section 232 of the Trade Expansion Act of 1962 to impose a 25% tariff on steel imports. The event frames are calculated based on trading days.

Table 15. Abnormal Returns during Event 2 (Event Window 2) per REIT Type

Date	Industrial REIT	Office REIT	Retail REIT	Residential REIT	Hotel REIT	Mortgage REIT	Equity REIT
02/03/2018	0.0013	0.0089	-0.0226	0.0222	0.0042	0.0111	-0.0051
05/03/2018	-0.0029	0.0128	-0.0069	0.0162	0.0086	0.0139	-0.0013
06/03/2018	0.0014	0.0102	0.0069	0.0098	0.0461	-0.0200	0.0283
07/03/2018	-0.0291	0.0353	0.0751	0.0391	0.0393	0.0487	0.0379
08/03/2018	-0.0127	0.0014	0.0382	0.0375	0.0030	0.0082	0.0159
09/03/2018	-0.0172	-0.0268	-0.0010	0.0287	-0.0530	-0.0460	-0.0060
12/03/2018	-0.0251	-0.0048	-0.0095	0.0111	-0.0320	0.0176	0.0076
13/03/2018	-0.0091	-0.0195	-0.0500	-0.0614	-0.0464	0.0096	-0.0821
14/03/2018	0.0337	0.0009	-0.0293	-0.0638	0.0035	0.0015	0.0050

Notes. This table presents the daily abnormal returns for each of the seven REIT indices being considered in the analysis, for the second event window, which is defined as: event date +/- 4 (trading) days. The spot price data is listed in USD and was sourced from Bloomberg, the daily returns were calculated in Excel and the statistical analysis was conducted in Stata. The chosen event date is 08/03/2018 which is the date of President Trump's Excercise of his Authority under Section 232 of the Trade Expansion Act of 1962 to impose a 25% tariff on steel imports. The event frames are calculated based on trading days.

Table 16. Abnormal Returns during Event 2 (Event Window 3) per REIT Type

Date	Industrial REIT	Office REIT	Retail REIT	Residential REIT	Hotel REIT	Mortgage REIT	Equity REIT
28/02/2018	-0.0050	0.0081	0.0012	0.0054	-0.0021	-0.01137	-0.0007
01/02/2018	0.0242	0.0222	0.0373	0.0319	0.0593	0.0192	0.0466
02/03/2018	0.0016	0.0092	-0.0223	0.0223	0.0051	0.0107	-0.0044
05/03/2018	-0.0026	0.0130	-0.0066	0.0165	0.0095	0.0135	-0.0006
06/03/2018	0.0017	0.0104	0.0072	0.0101	0.0470	-0.0204	0.0290
07/03/2018	-0.0288	0.0356	0.0753	0.0393	0.0402	0.0483	0.0386
08/03/2018	-0.0124	0.0017	0.0385	0.0377	0.0039	0.0078	0.0166
09/03/2018	-0.0169	-0.0266	-0.0097	0.0289	-0.0521	-0.0463	-0.0054
12/03/2018	-0.0248	-0.0045	-0.0093	0.0114	-0.0311	0.0173	0.0083
13/03/2018	-0.0088	-0.0192	-0.0495	-0.0611	-0.0456	0.0092	-0.0814
14/03/2018	0.0340	0.0011	-0.0291	-0.0636	0.0044	0.0011	0.0012
15/03/2018	-0.0005	0.0022	-0.0088	0.0046	0.0018	-0.0046	-0.0005
16/03/2018	-0.0005	0.0113	0.0055	0.0105	0.0083	0.0097	0.0070

Notes. This table presents the daily abnormal returns for each of the seven REIT indices being considered in the analysis, for the third event window, which is defined as: event date +/- 6 (trading) days. The spot price data is listed in USD and was sourced from Bloomberg, the daily returns were calculated in Excel and the statistical analysis was conducted in Stata. The chosen event date is 08/03/2018 which is the date of President Trump's Excercise of his Authority under Section 232 of the Trade Expansion Act of 1962 to impose a 25% tariff on steel imports. The event frames are calculated based on trading days.

Table 17. Normal Returns for Event 3 per REIT Type

REIT Type	Event Window 1	Event Window 2	Event Window 3
Industrial REIT	0.0023	0.0023	0.0028
Office REIT	-0.0004	-0.0001	-0.0005
Retail REIT	0.0004	-0.0001	-0.0000
Residential REIT	0.0010	0.0002	0.0009
Hotel REIT	-0.0011	0.0001	-0.0009
Mortgage REIT	-0.0002	0.0001	-0.0003
Equity REIT	0.0000	-0.0001	-0.0001

Notes. This table presents the normal returns for each of the seven REIT indices being considered in the analysis, for each of the three event windows being considered for event 3: the first event window is: event date +/- 2 (trading) days, the second event window is: event date +/- 4 (trading) days, and the third event window is: event date +/- 6 (trading) days. The spot price data is listed in USD was sourced from Bloomberg, the daily returns were calculated in Excel and the statistical analysis was conducted in Stata. The chosen event date is 25/01/2019 which is the date of the occurrence of the Brumadinho Dam Disaster at the Córrego do Feijão iron ore mine in Brazil. The event frames are calculated based on trading days.

Table 18. Abnormal Returns during Event 3 (Event Window 1) per REIT Type

Date	Industrial REIT	Office REIT	Retail REIT	Residential REIT	Hotel REIT	Mortgage REIT	Equity REIT
23/01/2019	-0.0186	-0.0024	-0.0007	0.0018	-0.0093	-0.0069	0.0008
24/01/2019	-0.0089	-0.0011	0.0033	-0.0009	0.0392	0.0032	0.0029
25/01/2019	-0.0118	0.0166	0.0100	0.0371	0.0077	0.0046	0.0123
28/01/2019	-0.0226	0.0085	-0.0097	0.0284	0.0123	0.0020	0.0098
29/01/2019	-0.0109	0.0099	-0.0058	0.0108	0.0087	0.0041	0.0083

Notes. This table presents the daily abnormal returns for each of the seven REIT indices being considered in the analysis, for the first event window, which is defined as: event date +/- 2 (trading) days. The spot price data is listed in USD and was sourced from Bloomberg, the daily returns were calculated in Excel and the statistical analysis was conducted in Stata. The chosen event date is 25/01/2019 which is the date of the occurrence of the Brumadinho Dam Disaster at the Córrego do Feijão iron ore mine in Brazil. The event frames are calculated based on trading days.

Table 19. Abnormal Returns during Event 3 (Event Window 2) per REIT Type

Date	Industrial REIT	Office REIT	Retail REIT	Residential REIT	Hotel REIT	Mortgage REIT	Equity REIT
18/01/2019	-0.0055	0.0089	0.0020	0.0036	-0.0004	0.0019	0.0027
22/01/2019	0.0204	-0.0029	-0.0039	0.0019	-0.0163	-0.0011	-0.0022
23/01/2019	-0.0185	-0.0028	-0.0002	0.0025	-0.0104	-0.0066	0.0009
24/01/2019	-0.0088	-0.0015	0.0038	-0.0002	0.0027	0.0030	0.0030
25/01/2019	-0.0117	0.0162	0.0151	0.0084	0.0165	0.0044	0.0125
28/01/2019	-0.0226	0.0081	0.0103	0.0130	0.0095	0.0017	0.0099
29/01/2019	-0.0109	0.0095	0.0063	0.0095	0.0108	0.0038	0.0084
30/01/2019	-0.0575	0.0140	0.0101	0.0030	0.0129	0.0012	0.0077
31/01/2019	-0.0504	0.0112	0.0048	0.0015	0.0029	0.0043	0.0093

Notes. This table presents the daily abnormal returns for each of the seven REIT indices being considered in the analysis, for the second event window, which is defined as: event date +/- 4 (trading) days. The spot price data is listed in USD and was sourced from Bloomberg, the daily returns were calculated in Excel and the statistical analysis was conducted in Stata. The chosen event date is 25/01/2019 which is the date of the occurrence of the Brumadinho Dam Disaster at the Córrego do Feijão iron ore mine in Brazil. The event frames are calculated based on trading days.

Table 20. Abnormal Returns during Event 3 (Event Window 3) per REIT Type

Date	Industrial REIT	Office REIT	Retail REIT	Residential REIT	Hotel REIT	Mortgage REIT	Equity REIT
16/01/2019	-0.0750	0.0076	0.0076	-0.0109	0.0113	0.0052	0.0074
17/01/2019	0.0095	0.0052	0.0038	-0.0207	0.0024	0.0032	0.0046
18/01/2019	-0.0060	0.0094	0.0019	0.0030	0.0006	-0.0023	0.0027
22/01/2019	0.0020	-0.0025	-0.0040	0.0013	-0.0153	-0.0007	-0.0022
23/01/2019	-0.0190	-0.0023	-0.0003	0.0019	-0.0095	0.0070	0.0010
24/01/2019	-0.0094	-0.0010	0.0037	-0.0008	0.0037	0.0034	0.0030
25/01/2019	-0.0122	0.0167	0.0150	0.0078	0.0174	0.0048	0.0125
28/01/2019	-0.0231	0.0085	0.0102	0.0124	0.0104	0.0021	0.0100
29/01/2019	0.0104	0.0010	0.0062	0.0088	0.0117	0.0042	0.0084
30/01/2019	-0.0580	0.0144	0.0101	0.0024	0.0139	0.0016	0.0077
31/01/2019	-0.0509	0.0117	0.0047	0.0009	0.0039	0.0047	0.0093
01/02/2019	-0.0133	-0.0119	-0.0165	0.0269	0.0167	-0.0221	0.0175
04/02/2019	0.0538	0.0251	0.0338	0.0242	0.0285	0.0120	0.0302

Notes. This table presents the daily abnormal returns for each of the seven REIT indices being considered, for the third event window, which is defined as: event date +/- 6 (trading) days. The spot price data is listed in USD and was sourced from Bloomberg, the daily returns were calculated in Excel and the statistical analysis was conducted in Stata. The chosen event date is 25/01/2019 which is the date of the occurrence of the Brumadinho Dam Disaster at the Córrego do Feijão iron ore mine in Brazil. The event frames are calculated based on trading days.

Table 21. Cumulative Abnormal Returns (Event 1) per REIT Type

REIT Type	Event Window 1	Event Window 2	Event Window 3
Office REIT	0.0340**	0.0104	0.0047
	(0.0113)	(0.0129)	(0.0092)
Retail REIT	0.0082	0.0023	0.0008
	(0.0053)	(0.0055)	(0.0039)
Residential REIT	0.0113	0.0029	0.0043
	(0.0087)	(0.0068)	(0.0053)
Hotel REIT	0.0139	-0.0016	0.0044
	(0.0207)	(0.0135)	(0.0120)
Mortgage REIT	0.0210	0.0137	0.0020
	(0.0119)	(0.0084)	(0.0095)
Equity REIT	0.0206	0.0038	0.0034
	(0.0107)	(0.0121)	(0.0083)

*Notes. This table presents the cumulative abnormal returns for the additional six REIT indices being considered, for each of the three event windows for event 1: the first event window is: event date +/- 2 (trading) days, the second event window is: event date +/- 4 (trading) days, and the third event window is: event date +/- 6 (trading) days. The spot price data is listed in USD was sourced from Bloomberg, the daily returns were calculated in Excel and the statistical analysis was conducted in Stata. The event frames are calculated based on trading days. Standard errors are reported in parentheses. *, **, and *** indicate significance levels of 90%, 95% and 99%, respectively.*

Table 22. Cumulative Abnormal Returns (Event 2) per REIT Type

REIT Type	Event Window 1	Event Window 2	Event Window 3
Office REIT	0.0283	0.0021	0.0044
	(0.0101)	(0.0061)	(0.0045)
Retail REIT	0.0204	-0.0009	0.0023
	(0.0163)	(0.0125)	(0.0090)
Residential REIT	0.0249**	0.0044	0.0072
	(0.0063)	(0.0013)	(0.0092)
Hotel REIT	0.0005	-0.0030	0.0037
	(0.0194)	(0.0116)	(0.0092)
Mortgage REIT	0.0015	0.0050	0.0042
	(0.0162)	(0.0087)	(0.0062)
Equity REIT	0.0168*	-0.0004	0.0042
	(0.0077)	(0.0114)	(0.0085)

*Notes. This table presents the cumulative abnormal returns for the additional six REIT indices being considered, for each of the three event windows for event 2: the first event window is: event date +/- 2 (trading) days, the second event window is: event date +/- 4 (trading) days, and the third event window is: event date +/- 6 (trading) days. The spot price data is listed in USD was sourced from Bloomberg, the daily returns were calculated in Excel and the statistical analysis was conducted in Stata. The event frames are calculated based on trading days. Standard errors are reported in parentheses. *, **, and *** indicate significance levels of 90%, 95% and 99%, respectively.*

Table 23. Cumulative Abnormal Returns (Event 3) per REIT Type

REIT Type	Event Window 1	Event Window 2	Event Window 3
Office REIT	0.0063	0.0067**	0.0070**
	(0.0036)	(0.0024)	(0.0027)
Retail REIT	0.0065*	0.0054**	0.0059*
	(0.0026)	(0.00019)	(0.0032)
Residential REIT	0.0059*	0.0048**	0.0044
	(0.0024)	(0.0015)	(0.0035)
Hotel REIT	0.0070	0.0031	0.0074**
	(0.0046)	(0.0036)	(0.0032)
Mortgage REIT	0.0042***	0.0029***	0.0021
	(0.0008)	(0.0007)	(0.0022)
Equity REIT	0.00685**	0.0058***	0.0086***
	(0.0022)	(0.0016)	(0.0013)

*Notes. This table presents the cumulative abnormal returns for the additional six REIT indices being considered, for each of the three event windows for event 3: the first event window is: event date +/- 2 (trading) days, the second event window is: event date +/- 4 (trading) days, and the third event window is: event date +/- 6 (trading) days. The spot price data is listed in USD was sourced from Bloomberg, the daily returns were calculated in Excel and the statistical analysis was conducted in Stata. The event frames are calculated based on trading days. Standard errors are reported in parentheses. *, **, and *** indicate significance levels of 90%, 95% and 99%, respectively.*