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# Effect of Lockdowns and Vaccination on REITs return during the COVID-19 Pandemic

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Research Report
MSc in Building by Research

# Effect of Lockdowns and Vaccination on REITs return during the COVID-19 Pandemic




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**Supervisor:** Prof Kola Akinsomi

A research report submitted to the Faculty of Engineering and the Built Environment, University of Witwatersrand, Johannesburg.

12 August 2025

# Declaration

I declare that this Research Report is my own, unaided work. It is submitted in partial fulfilment of the degree of Master's in Building by Research at the University of the Witwatersrand, Johannesburg.

It has not submitted before for any degree or examination in any other university.

Signature of Candidate:



Harim Sung (1619505)

12th day of August 2025

# Abstract

The Covid-19 pandemic reshaped global financial markets, and Real Estate Investment Trusts (REITs) were no exception. This study examines how Covid-19 policies influenced REIT performance across 10 global markets, focusing on vaccination rates and lockdown restrictions. The findings reveal that while vaccination rates boosted REIT performance, stricter lockdown measures had a significant negative impact. However, when analysed separately, these effects were more pronounced in developed markets, whereas emerging markets exhibited contrasting responses, highlighting variations in economic recovery. By providing a comprehensive analysis across the full sample, developed, and emerging markets, this study provides critical insights into how government interventions shaped REIT market dynamics during the pandemic.

## Acknowledgements

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I also extend my appreciation to the University of Witwatersrand for providing the opportunity and necessary resources to complete this research.

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# List of Figures

**Figure 1:** The Stringency Index of developed markets ..... **21**

**Figure 2:** The Stringency Index of emerging markets ..... **22**

# List of Tables

**Table 1:** Countries covered in this study ..... **23**

**Table 2:** FTSE EPRA/NAREIT Global Real Estate Index Series: Regional Total Returns ... **23**

**Table 3:** Variable Description Table ..... **35**

**Table 4:** Covid-19 Vaccination Rollout Start Dates ..... **36**

**Table 5:** Descriptive Statistics ..... **37**

**Table 6:** Correlation Matrix ..... **38**

**Table 7** Combined Regression ..... **39**

**Table 8:** Robustness check ..... **43**

# Table of Contents

Declaration ..... 2

List of Figures ..... 5

List of abbreviation ..... 4

1. Introduction ..... 5

1.1. Background to the Study ..... 5

1.2. Substantiation of the Problem ..... 6

1.3. Problem Statement ..... 7

1.4. Primary Research Question ..... 7

1.5. Secondary Research Questions ..... 8

1.6. Research Aim ..... 8

1.7. Research Objectives ..... 8

1.8. Hypothesis ..... 8

1.9. Contributions of the Study ..... 9

1.10. Limitations ..... 9

1.11. Assumptions ..... 9

1.12. Chapter Summary ..... 9

2. Literature Review ..... 11

2.1. Introduction to the literature review ..... 11

2.2. Methodology of Literature Review ..... 12

2.3. The performance of REITs ..... 12

2.4. Global Financial Crisis and Covid-19 Pandemic in Real Estate Market ..... 14

2.5. Performance of Financial Markets in Comparison to Real Estate Market ..... 17

2.6. Lockdown Restrictions and Vaccination Program ..... 19

2.7. Theoretical Framework and Hypothesis Development ..... 25

2.8. Key findings of the Literature Review ..... 26

2.9. Chapter Summary ..... 27
3. Research Design ..... 28
3.1 Research Philosophy and Approach ..... 28
3.2 . Research Strategy ..... 28
3.3 . Population and Sampling ..... 29
3.4 Development of the Research Instrument(s) ..... 29
3.5 Data collection Protocol ..... 33
3.6 Validity and Reliability ..... 33
3.7 Data Analysis ..... 34
3.8 Ethical Risks and Mitigation Strategy ..... 34
3.9 Chapter Summary ..... 34
4 Data analysis and Discussion ..... 35
Robustness Check ..... 42
Conclusion ..... 46
Limitations, Recommendation, Further Work ..... 48
References ..... 50

# List of abbreviation

| ***Abbreviation*** | ***Description*** |
|---|---|
| APREA | Asia Pacific Real Estate Association |
| A-REIT | Australian Real Estate Investment Trusts |
| COVID | Corona Virus |
| CRE | Commercial Real Estate |
| EREITs | Equity Real Estate Investment Trusts |
| GDP | Gross Domestic Product |
| GFC | Global Financial Crisis |
| HAR-RV | Heterogeneous autoregressive realized volatility |
| HK-REITs | Hong Kong Real Estate Investment Trusts |
| J-REITs | Japanese Real Estate Investment Trusts |
| NAV | Net Asset Value |
| N-REITs | Nigerian Real Estate Investment Trusts |
| REIT | Real Estate Investment Trusts |
| REIT-DJ | Dow Jones REIT Total Return Index |
| REIT-EVW | enterprise value weighted REIT portfolio |
| REOC | real estate operating company |
| SA REIT | South African Real Estate Investment Trusts |
| SOCIMIs | Spanish Real Estate Investment Trusts |
| SPX | Standard & Poor’s 500 Index |
| WHO | World Health Organization |

# 1. Introduction

## 1.1. Background to the Study

Numerous academics have examined REIT market performance (Akinsomi 2020; Brounen and de Koning 2012; Newell and Marzuki 2018), yet the findings remain inconsistent due to regional variation, differing market structures, and the influence of uncertainties and methodological approaches. Newell and Peng (2009) identified a strong linkage between global and U.S. stock markets, while Morri and Liu (2017) demonstrated that REIT returns are closely aligned with stock market performance. The collapse of the U.S. real estate market (Chang, Chou, and Fung, 2012) had a global ripple effect, contributing to a downturn in international property activity (Newell and Najib Razali, 2009). Building on these patterns of financial vulnerability, the Covid-19 pandemic introduced an unprecedented shock that disrupted financial markets worldwide (He, Liu, Wang and Yu 2020; Rouatbi, Demir, Kizys and Zaremba 2021; Zeren and Hizarci 2020), accelerating declines in global stock indices and GDP growth.

This research investigates how two key pandemic-related policy responses–lockdown restrictions and vaccination programs–have affected global REIT returns. While broader economic uncertainties have historically influenced REIT performance (Cepti, Dul, Gupta and Wohar, 2021), the Covid-19 pandemic introduced unprecedented disruptions to both real estate fundamentals and investor behaviour. Unlike prior economic shocks, the pandemic brought simultaneous health, mobility, and economic crisis that reshaped real estate markets (Bonato, Cepni, Gupta and Pierdzioch, 2021). Understanding how targeted government interventions during Covid-19, such as lockdowns and vaccinations, impacted REIT performance is crucial for evaluating REIT resilience and portfolio design during periods of systemic risk.

The global REIT market has experienced substantial fluctuations during the Covid-19 pandemic, reflecting macroeconomic uncertainties and varying regional impacts. The goal of this paper is to study the effect of lockdown restrictions and vaccination programs on REIT returns. Coronavirus was first reported on December 31, 2019, by the World Health Organization, prompting many nations to implement lockdowns, quarantines, and other restrictions that influenced the global economy, with the real estate market being no exception (Akinsomi 2020; Balemi, Füss and Weigand 2021). The total number of cases and fatalities due to the COVID-19 had a detrimental effect on stock markets (Awadhi, Alsaifi, Al-Awadhi

and Alhammadi 2020; He, Liu, Wang and Yu 2020; Zeren and Hizarci 2020); an increase in the cases led to a negative real estate return (Ling, Wang and Zhou 2020; Milcheva 2021). According to Scherf, Matschke, and Rieger (2022), government intervention had an unfavourable effect on the world economy, however Chong and Phillips (2021) highlighted how government action helped to prevent a severe downturn in the real estate market.

Lockdown measures, including travel restrictions and workplace closures, severely impacted real estate markets, with hospitality, retail, and office REITs suffering the most, while industrial REITs benefited from increased demand for logistics ((Mathieu et al., 2021; Akinsomi, 2020; Anglin, Cui, Gao, & Zhang, 2021). Rising Covid-19 cases caused negative real estate returns (Ling, Wang, & Zhou, 2020) and sharp declines in average daily returns (Milcheva, 2021). Vaccination programs, however, positively influenced financial markets, improving S&P 500 and REIT-related returns due to their close relationship with stock market performance (Khalfaoui, Nammouri, & Ben Jabeur, 2021; Rouatbi, Demir, Kizys, & Zaremba, 2021). Therefore, understanding the effects of vaccination programs and lockdown restrictions on the global REIT return is crucial for guiding investor strategies and providing insights into REIT resilience during crises.

## 1.2. Substantiation of the Problem

The spread of Covid-19 significantly impacted the global economy, financial markets, and real estate sector as it disrupted the global supply chain, halted business operations, and triggered lockdowns, leading to sharp declines in financial markets, negative real estate returns, and significant losses in various sectors (Mathieu et al., 2021; Akinsomi, 2020; Ling, Wang, & Zhou, 2020). However, studies on Covid-19 and REITs have focused on the government intervention (lockdowns) and left out the global immunization campaigns (vaccination program or rollout of vaccination). It is important to find out how implementation of government regulation and Covid-19 pandemic affected REITs but also find out the specific effects of vaccination program and lockdown restrictions on REIT returns.

Covid-19 is recognized as a global pandemic and public health crisis that has profoundly affected economies, healthcare systems, and social structures worldwide. Chu, Lu, and Tsang (2021) observed that the Covid-19 stock market collapse in the United States was more catastrophic than the two largest previous financial crises, namely the Great Recession and the Global Financial Crisis. While REITs are generally regarded as a reliable investment platform

(Anglin, Cui, Gao and Zhang, 2021) and typically show a positive correlation with stock market returns (Morri and Liu, 2017), investors were advised to avoid stock market investment as Covid-19 cases surged (Zeren and Hizarci, 2020). The high number of cases (Al-Awadhi, Alsaifi, Al-Awadhi and Alhammadi, 2020), and fatalities (Alfaro, Chari, Greenland and Schott, 2020) negatively impacted the stock market, while unprecedented monetary and fiscal policy interventions impacted the real estate sector, resulting in significant losses for global REITs (Akinsomi, 2020). The initiation of vaccination programs had a significant and positive effect on S&P 500 returns (Khalfaoui, Nammouri, and Ben Jabeur, 2021). This paper analyses the historical performance of REITs under pandemic-induced uncertainty, with a focus on how lockdown restrictions and vaccination rollouts affected returns. While Covid-19 impacted all countries with REIT legislation, few empirical studies have considered the role of vaccination programs. This study addresses that gap by incorporating vaccination data and focusing on 10 global REIT markets that together account for approximately 50% of the global REIT index.

## 1.3. Problem Statement

The Covid-19 pandemic significantly impacted the global economy (Akinsomi, 2020; Balemi, Füss and Weigand, 2021), disrupting financial markets (He, Liu, Wang and Yu 2020; Zeren and Hizarci 2020) and causing substantial losses in the REIT sector (Akinsomi. 2020). Real Estate firms experienced negative returns due to falling demand and restricted access to commercial properties (Chu, Lu and Tsang, 2021). Lockdown restrictions imposed by governments further amplified market volatility, with clear spillover effects on the stock market (Scherf, Matschke and Rieger, 2022). Given the close relationship between REIT and stock market returns (Morri and Liu, 2017), the vaccination program was found to have a beneficial effect on equity and stock market returns (Rouatbi, Demir, Kizys and Zaremba, 2021). However, existing research tends to examine either the effect of lockdown restrictions or vaccination programes in isolation. Few studies have explored their combined impact on REIT performance, especially in a cross-country context. This study addresses that gap by jointly analysing the effects of lockdown severity and vaccination rollout on REIT returns across 10 global markets – using daily panel data and distinguishing between developed and emerging markets

## 1.4. Primary Research Question

To address the impact of Covid-19 on global REITs, the primary research question is as

follows:

*How did government-imposed lockdown restrictions and Covid-19 vaccination programs affect global REIT returns during the pandemic?*

## 1.5. Secondary Research Questions

*What is the individual effect of the Covid-19 vaccination program on global REIT returns?*

*What is the individual effect of lockdown restriction severity on global REIT returns?*

*Do REIT return responses to lockdown restrictions and vaccination rates differ between developed and emerging markets?*

## 1.6. Research Aim

The aim of this study is to examine the effect of Covid-19 lockdown restrictions and vaccination programs on REIT returns across 10 global markets, with a focus on cross-country comparisons between developed and emerging economies.

## 1.7. Research Objectives

From the aim, the following research objectives are identified:

- To identify key patterns in the historical performance of REITs and their sensitivity to economic uncertainty, particularly during the Global Financial Crisis and the Covid-19 pandemic
- To assess the impact of government -imposed lockdown restrictions on REIT returns across 10 global markets during Covid19 period
- To evaluate the effect of Covid-19 vaccination programs on REIT returns in both developed and developing countries
- To compare REIT market responses between developed and developed markets, highlighting differences in investor sentiment, policy effectiveness and economic resilience
- To examine whether the effect of lockdowns and vaccinations on REITs varies across different phases of the pandemic

## 1.8. Hypothesis

- Ho: There is no statistically significant relationship between REIT returns and lockdown restrictions.
- H1: An increase in the Covid-19 vaccination rate has a positive and statistically

significant effect on global REIT returns

- H2: The severity of lockdown restrictions has a negative and statistically significant effect on global REIT returns

## 1.9. Contributions of the Study

This study contributes to the REIT literature by jointly analysing the effects of lockdown restrictions and vaccination rollouts, two policy tools that have often been studied separately, as shown by Rouatbi et al. (2021) and Oanh (2022). Drawing on daily panel data across 10 countries that represent approximately 50% of the Global REIT Index, the research offers a comparative perspective between developed and emerging markets. By accounting for macroeconomic factors, time variation, and Covid-specific indicators such as vaccination period and the Stringency Index, and incorporating robustness checks across pandemic phases, the study provides insights of academic and practical relevance for REIT investors and policymakers.

## 1.10. Limitations

The following limitations has been identified in this study:

- Interpreted in the context of global REITs and not of the varying property sectors
- Only 10 global REITs based on market capitalization are examined
- The study excludes different kinds of risks and other internal and external factors
- Different types of vaccines are not considered
- Formal panel unit root testing was not conducted due to dataset being unbalanced and time gaps, which may pose risks of non-stationarity despite mitigation efforts through log transformation and fixed effects

## 1.11. Assumptions

Th following assumptions has been made in this study:

- All countries are affected by Covid-19
- Government intervention took place in all the countries
- The severity of restrictions is different
- All countries initiated the vaccination program
- The model: It is efficient market and even though it is used for financial market performance, it can be used for REITs performance

## 1.12. Chapter Summary

The principle aim of this section is to introduce the knowledge on general REIT market and provide a foundation for Covid pandemic and REITs return – The role of lockdowns and vaccinations. The detailed literature review will follow in the next section.

# 2. Literature Review

## 2.1. Introduction to the literature review

In this section, the contextual and theoretical background of Real Estate Investment Trusts (REITs) is presented and discussed. The literature review focuses on the performance of REITs over time, the impact of economic uncertainties in the real estate market, the effect of the Global Financial Crisis (GFC) and Covid-19 pandemic on real estate market, and a review of the lockdown restrictions and vaccination programs around the world.

The objective of the literature review is first to understand REIT performance, second to analyse how the economic uncertainties affected the property sector and lastly, to compare how different markets reacted to the GFC and to the Covid-19 pandemic. The section concludes by exploring, the lockdown restrictions (government intervention) and vaccination programs in various nations.

The literature indicates that REIT performance has been inconsistent (Smith and Shulman, 1976; Titman and Warga, 1986) with findings varying based on performance measurement methods, time frames, and geographic location. During periods of uncertainty, investor willingness to act declines as investment plans are often postponed. Following the Great Recession, such uncertainty shocks had a significant negative influence on REIT returns (Cepti, Dul Gupta and Wohar, 2021). Similarly, Covid-19 brought uncertainty to the economy, and it heavily affected the real estate market (Gholipour, Tajaddini, Farzanegan and Yam, 2021). For example, the unanticipated Covid-19 pandemic caused a loss of around 30% globally and 32% in the United States for REITs (Akinsomi, 2020). The GFC affected the performance of REITs in many different regions due to the U.S stock market having a close relationship with the world market (Newell and Najib Razali, 2009). Although not all REITs were affected in the same way, the GFC put pressure on REITs throughout several nations (Dimovski and O'Neill, 2012; Reddy and Wong, 2017).

The Covid-19 pandemic led to a sharp fall in real estate average daily returns (Milcheva, 2021). Impacts varied depending on how the nation responded (Koh, 2020) and the type of real estate market (Akinsomi, 2020). Other financial markets also faced significant repercussions as many countries experienced economic losses driven in part by the rising numbers of COVID-19 cases and fatalities.

Since the announcement of Covid-19 the virus spread rapidly and nations initiated a vaccination

program to reduce the virus's potentially deadly effects (Schaffer DeRoo, Pudalov and Fu, 2020). Authors also looked at the stock market together with the vaccination program because REITs performance is highly correlated to stock market performance (Rouatbi, Demir, Kizys and Zaremba, 2021). Early immunization campaigns were proven to have a favourable outcome on stock market return (Acharya et al., 2020, cited by Rouatbi, Demir, Kizys and Zaremba, 2021). Lockdowns and other government interventions had an impact on the stock market. There were mixed findings in the study, with some markets suffering a loss (Scherf, Matschke and Rieger, 2022), while others discovered that the market would have suffered a greater loss in the absence of these actions (Chong and Phillips, 2021). However, However, another study found evidence supporting the role of the vaccination program on the stock market recovery along with governmental and monetary authorities (Behera, Pasayat and Behera, 2022).

This chapter reviews the relevant literature in four key areas: REIT performance and uncertainty, the effects of GFC and the Covid-19 pandemic on real estate markets, the relationship between financial and real estate markets during crisis periods; and the role of lockdown restrictions and vaccination programs in shaping market behaviour.

## 2.2. Methodology of Literature Review

The literature study details the REITs performance throughout various time periods and in various geographic locations. These academic studies are included as it is important to know how REITs performed prior to the Covid-19 pandemic. Real estate market uncertainty is examined as it is crucial to consider when creating a portfolio for REITs and it impacts the return on investment of REITs. The effect of COVID-19 pandemic and the GFC on the real estate market are reviewed and compared due to the similarities in the detrimental impacts on the market. The market was severely impacted by the lockdown measures, such as government implementation on daily activity. Thus, comprehension of lockdown restrictions and the vaccination program will enable to undertake the study on how REITs are impacted.

## 2.3. The performance of REITs

### 2.3.1. General Performance of REIT

“The Real Estate Investment Trust Act of 1960 was first established in the United States”. Since 1972, there has been a significant movement in the REIT performance (Corgel, McIntosh and Ott, 1995). The performance of REITs market has been a popular topic among researchers. Brounen and de Koning (2012), in their review of 50 years of REIT history, concluded that in their early years, REITs delivered lower returns than direct real estate investments and lacked the liquidity

advantages of stocks. Smith and Shulman (1976) found a poor performance of REIT stocks by comparing the S&P index for a period of 1963, Kuhle and Walther (1986, cited in Han and Liang, 1995) found poor performance of REITs in the middle of the 1970s, and Han and Ling (1995) highlighted that there was a comparable or slightly poorer performance of REITs compared to stock market portfolios during 1970 through 1993. In addition, Corgel, McIntosh and Ott (1995) underlined that REIT performed poorly between 1986 and 1990 but it outperformed the S&P 500 and Russell NCREIF index of securitized real estate from 1990. Brounen and de Koning (2012) added that this could have been due to the REITs boom in the 1990s as it slowly started adapting and became one of the major asset classes.

The performance of REITs was inconsistent as Equity REITs (EREITs) performed similarly or underperformed the market portfolio (Smith and Shulman,1976; Titman and Warga, 1986). However, Kuhle's (1987) and Sagalyn's (1990) study (cited in Han and Liang, 1995) noted the outperformance of Equity REITs in comparison to the portfolio of stock market.

Reddy and Wong (2017) examined the overall stock market of A-REITs for 20 years (1995-2015) and found that it had lower returns with high volatility. Yet, when the authors examined the performance by splitting it into pre, during and post-GFC periods, the risk-adjusted returns of A-REIT outperformed Australian equities before and after the GFC; this was done by comparing the Sharp ratio.

To find the performance of REITs, Khan and Siddiqui (2019) used NAV as a figure from 2008 to 2018. Through the multiple regression analysis, they analysed the factors influencing the performance of REITs in a mixture of nascent, emerging and developed markets. They considered both internal (net income, size, dividend yield) and external (inflation, interest rates and stock index) factors; different markets had different results. For instance, Khan and Siddiqui (2019) found that in the nascent (Pakistan), emerging (Malaysia and Thailand) as well as developed (Singapore and Hong Kong) markets, the performance of REITs was positively correlated with all internal variables. The key factor that affected the REITs performance in the nascent and developed market was inflation; in emerging markets like Malaysia, was the interest rate (the external factors predominantly influenced the performances). In Thailand, size, the internal factor, was the major factor that affected its performance for the studied period.

Marzuki and Newell (2018) used mixed asset portfolio to find the significance and risk-adjusted performance of Spanish REITs. Through the period 2014 to 2018, the highest average

annual returns were found and exceeded different assets like stocks and bonds. Spanish REIT is a part of the nascent REITs market, yet through the research done by Marzuki and Newell (2018), Spanish REIT delivered superior performance classes.

### 2.3.2. Uncertainties in Real Estate Sector

In designing REIT portfolios, it is essential to account for uncertainty shocks , especially those linked to pandemics. Bonato, Çepni, Gupta, and Pierdzioch (2021) argue that infectious disease-related uncertainty should be incorporated into REIT forecasting models, given the increasing frequency of global health crisis. Christou et al. (2019) and Strobel et al. (2020, as cited in Gholipour et al., 2021) also underline the negative relationship between real estate performance and economic uncertainty.

Gholipour et al. (2021) found that under conditions of heightened uncertainty, investors tend to delay decision-making, resulting in suppressed REIT returns. Their review showed that economic variables such as inflation and monetary policy (Ewing & Payne, 2005, cited in Gholipour et al., 2021) significantly affect REIT performance – a dynamic amplified during global crises like Covid-19. They also used the macroeconomic uncertainty proxy proposed by Ozturk and Sheng (2018), finding that Covid-19 had the most pronounced impact on commercial real estate compared to other shocks.

Bonato et al. (2021), introduced the EMVID index, based on newspaper coverage of infectious disease-related uncertainty, and showed that it significantly improved negative effects on REIT returns, with even greater volatility observed during the Covid-19 outbreak.

While these studies underscore the historical sensitivity of REITs to uncertainty, Akinsomi (2020) provided direct evidence of the Covid-19 shocks, reporting a 30% drop in global REIT values and a 32% loss in the United States during the early pandemic months. These findings support the use of Covid-specific variables – such as lockdown stringency and vaccination rates – to evaluate REIT market responses to uncertainty in this study.

## 2.4. Global Financial Crisis and Covid-19 Pandemic in Real Estate Market

The Global Financial Crisis (GFC) of 2007-2009 had a significant effect on global REIT performance, driven by a sharp decline in U.S. real estate market values (Chang, Chou, and Fung, 2012), which in turn led to a reduction in property activity worldwide (Newell and Najib Razali, 2009).

In contrast, the Covid-19 pandemic represented a different type of disruption – an exogeneous health shock that triggered sudden and widespread policy interventions such as lockdowns,

travel restrictions, and business closures. These measures had immediate consequences for REITs, particularly those in retail, hospitality, and office sectors. Balemi, Füss and Weigand (2021) confirm that the uncertainty and economic restrictions introduced by Covid-19 led to abnormal REIT return volatility and significant short-term drawdowns across global markets.

The study on Australian REITs (A-REITs) showed underperformance through the GFC (Newell and Peng, 2009). According to Dimovski and O'Neill (2012), the total return of A-REIT decreased by 35.29% from 2006 until the end of 2011. It showed that since December 2007 the GFC put A-REIT sector under pressure. Moreover, the decline in the financial market condition and the 70% fall of A-REIT in 2009 were caused by GFC (Reddy and Wong, 2017). Ampountolas and Shaw (2022) observed that Lodging REITs had strong return prior to the pandemic and have shown resilience in recovery, underscoring the variation in Covid-19 impacts across REIT sectors.

Among the 20 global REITs performance, this performance was the second-worst performance of the REITs market across the post-GFC (Newell and Peng, 2009). The Australian real estate market was significantly impacted by the U.S. real estate market from 2004 through 2009 (Kim, 2009). Similarly, Ling, Wang and Zhou (2020) mentioned that a higher number of Covid cases resulted in negative returns and Milcheva (2021) emphasized that Covid-19 was associated with a steep decline in average daily real estate returns.

Chong and Phillips (2021) emphasized that commercial real estate was heavily impacted by the Covid-19 pandemic and lockdown restrictions. They looked at how Covid-19 outbreak impacted the value in the United States of the commercial real estate. Their results showed that the commercial real estate value declined due to Covid-19 and an estimated loss of 2.66% was found in the total asset of the United States for the period of 13th March to 14th September 2020 (Chong and Phillips, 2021). The commercial real estate sector was severely influenced by the shutdown; hence hotel and retail properties were experiencing the uppermost degree of uncertainty (Balemi, Füss and Weigand, 2021). Additionally, greater vacancy rates in the commercial real estate sector were anticipated because of the slowdown in developments (Balemi, Füss and Weigand, 2021).

According to Chu, Lu and Tsang (2021), the Covid-19 pandemic is location-specific as the case differs from country to country and depends on the government actions and measures to stop the circulation of the virus. They examined the significance of geographic scope and diversification using samples of Chinese real estate firms to examine the influence of Covid-

19 pandemic. The geographic scope mitigated the negative impact caused by Covid-19 and found that when the larger firms adapted a geographically diversified corporate strategy, it helped to moderate the impact of Covid-19 (Chu, Lu and Tsang, 2021). Milcheva (2021) found that in Asia, the office market was affected the most, while in the United States, retail and hotels were affected the most. Hence, the sensitivity of the Asian real estate sector seemed to be negative while the United States remained positive at the beginning of the Covid-19 pandemic (Milcheva, 2021).

Xie and Milcheva (2020) found a relationship between the real estate equity returns and the proximity to COVID-19 cases. The lower returns were found within the real estate companies with properties close to COVID-19 cases. Ma (2020) emphasized the implementation of the diversified portfolio theory can diversify risks and increase returns. Therefore, it is important to understand factors that make the firms stronger during a crisis like Covid-19 (Chu, Lu and Tsang, 2021).

"REITs are known as stable investment platform" said Anglin, Cui, Gao and Zhang (2021). However, the view changed due to the pandemic as countries with REIT legislation reported Covid-19 cases (Akinsomi, 2020), Balemi, Füss and Weigand (2021) found that not all the real estate markets were affected in the same way as the hospitality REITs, retail REITs and Office REITs were heavily impacted by the pandemic. Anglin, Cui, Gao and Zhang (2021) added that the hospitality sector suffered the most and the industrial sector benefited.

Chong and Phillips (2021) used "MacroRisk.com's commercial stock valuation model" and found that the economy would have experienced about a 3% decline in the REIT-EVW, REIT-DJ and SPX as the economy was slowing in Autumn 2020 even without Covid-19. Nonetheless, due to Covid-19 the economic structure changed, the real estate experienced a greater loss compared to the overall market (Chong and Phillips, 2021). Min, Shin, and de La Paz (2021) observed the effect of Covid-19 on three main industrial stock indices of the Korean Stock Exchange, including the construction industry sector index, real estate operating company industry index, and REIT industry index. The study covered January 2020 to March 2020 when no lockdown restrictions were applied in Korea. The study used daily stock market indices, "a short-term analysis of temporary impact factors" and because the restrictions heavily affected the economy, they took Covid-19 as the main research variable (Alfaro et al., 2020 and Zhang et al., 2020, cited by Min, Shin and de La Paz, 2021). The result showed that among the three major industrial stock indices, the stock return rate of the REIT sector was comparatively less

sensitive to the Covid-19 pandemic's effects. Besides the hospitality properties, Min, Shin and de La Paz (2021) mentioned that the cash inflow to REIT might be relatively stable.

Fernández, Lamas, Roibasand and Vegas (2021) emphasized that the Covid-19 pandemic impacted the Spanish REITs (SOCIMIs) concentrating in the commercial real estate market. Since Covid-19, the commercial real estate performed poorly, and this could have been due to the reaction of firms to the crisis. Overall, there was a sharp incline in non-residential investment in Spain. Authors found that the stock prices of SOCIMI decreased and struggled until July 2021 while the United States and Europe showed a slow recovery of pre-pandemic levels. Ling, Wang and Zhou (2020) analysed the link between the increase in the number of cases (GeoCOVID) and commercial real estate (CRE) portfolios. They used a sample of Equity REITs (United States) from 21st January 2020 to 15th April 2020, and with use of multivariable analysis, a negative relationship was found between abnormal returns and GeoCOVID which were consistent. In addition, retail and residential properties experienced the utmost negative effect whereas the health care and technology sector had a positive correlation to GeoCOVID. Ma (2020) found that the United States and Singapore REITs were negatively impacted when the overall economic environment due to Covid-19 was unstable. The most affected type of REITs were hotel REITs and Retail REITs. According to Balemi, Füss and Weigand (2021), devaluation of commercial property portfolios, private equity funds, and private and public REITs or developers were encountered due to the low growth expectations. Nonetheless, the researchers found that the existing model may not be applicable in a such pandemic, hence new measurements must be introduced (Ling, Wang and Zhou, 2020).

Consumer perception of commercial real estate has changed due to Covid-19 pandemic (Chong and Phillips, 2021) and Akinsomi (2020) suggested that to accommodate the consumers, REITs need to adapt to the new changing demand for space caused by Covid-19.

## 2.5. Performance of Financial Markets in Comparison to Real Estate Market

REIT performance is highly associated with stock market returns (Morri and Liu, 2017). Khan and Siddiqui (2019) analysed REIT performance data from the Asian Pacific Real Estate Association (APREA) in 2012, and found a superior performance of Asian REITs, higher returns with lower risks and superior risk-adjusted performance over the stock markets after the GFC. Yet, when Khoi Pham (2011) examined the Thai REITs, a poor risk-adjusted performance for pre and during GFC was found in the mixed-asset portfolio. This illustrated that Thai-REIT did not contribute much to the mixed-asset portfolio when the risk level was low. Kim (2009)

found that the GFC had an aftereffect on the Korean real estate market, however, an insignificant impact on Japanese REITs (J-REITs).

Hong Kong REITs (HK-REITs) outperformed the overall stock market and property sector was found from 2005 through 2008 (Newell, Yue, Kwong Wing and Siu Kei, 2010). Moreover, HK-REITs outperformed property companies and shares in Hong Kong when the analysis was done on a risk-adjusted basis. As a result, during GFC, HK-REITs showed outstanding risk-adjusted performance.

Newell and Marzuki (2018) analysed the German REIT performance for the period 2007 through 2015. Risk-adjusted returns were used for the analysis and found that there was an underperformance of German REITs compared to overall stock markets. However, German REITs illustrated a positive attitude after the GFC (Newell and Marzuki, 2018). The study found highest return from German REITs after GFC which exceeded stocks and property firms. The performance of German REIT was analysed using the Sharpe ratio and it was considered as a "best-performed asset class in the post GFC period". Nigerian REITs were not significantly correlated with the market portfolio. Moreover, it was seen as a good risk-diversifiers for investors due to its characteristics of low risk and noncyclical during 2008-2011 (Aro-Gordon, Bashir, Abdulsalam and Abdullahi, 2014).

According to Balemi, Füss and Weigand (2021), the global economy was in good condition at the beginning of 2020. However, Rouatbi, Demir, Kizys and Zaremba (2021) found a historically significant influence on the financial market with Covid-19 outbreak on a global scale with the outbreak of Covid-19, the cases increased in a daily basis (WHO, 2020). He, Liu, Wang and Yu (2020) found that Covid-19 influenced the European and USA stock markets as it led to a "backflow effect" on Asian Stock markets, notably on Chinese stock market. Zeren and Hizarci (2020) found that China, Italy, France and Germany experienced significant economic losses as a result of the pandemic.

Compared to the GFC and the Great Depression, the stock market crash caused by Covid-19 was reported to be worse (Chu, Lu and Tsang, 2021; Milcheva, 2021), and the uncertainty and increased volatility caused by Covid-19 were much bigger compared to the fluctuations and unpredictability related to GFC (Baker et al., 2020, cited by Balemi, Füss and Weigand 2021).

Stock market returns decreased due to Covid-19-related fatalities (Awadhi, Alsaifi, Al-Awadhi and Alhammadi, 2020) and due to rising in number of cases (Ashraf, 2020). According to Al-

Awadhi, Alsaifi, Al-Awadhi and Alhammadi (2020), the stock returns across all companies in China had a significant negative impact due to Covid-19 daily increases in deaths and confirmed cases. In the study on the emerging stock market, Covid-19 had an unfavourable and statistically significant impact, and the effect of Covid-19 was worst in Asia compared to Europe (Topcu and Gulal, 2020). The U.S stock market was impacted by the unexpected fluctuation in the number of cases (Alfaro, Chari, Greenland and Schott, 2020). He, Liu, Wang and Yu (2020) studied countries with leading stock indices such as Germany, South Korea, the United States, France, China, Italy, Spain and Japan, and discovered that stock market had a short-term effect from Covid-19. Authors suggested that the end of Covid-19 will reshuffle the cards and new indications of movements will be sent by the world's market (Zeren and Hizarci, 2020).

Due to the influence of Covid-19, Balemi, Füss and Weigand (2021), estimated that the global real GDP growth would result -5.4% or more than 10% in 2020. Hence, there was about a 30% decrease in the global stock markets over March 2020 (Singh et al., 2020, cited by Chu, Lu and Tsang 2021). Hence, Zeren and Hizarci (2020) highlighted that the investors should not invest in stock market when there is an increase in Covid-19 cases.

## 2.6. Lockdown Restrictions and Vaccination Program

The global spread of Covid-19 rapidly escalated into a heath crisis that triggered severe economic consequences, prompting governments to adopt measures such as lockdowns and social restrictions (Atalan, 2020). These interventions disrupted business activity and investor confidence, particularly in real estate sector. In response, large-scale vaccination programmes were developed and implemented globally as a long-term strategy to mitigate the pandemic's effect (Schaffer Deroo, Pudalov and Fu, 2020). However, the mere availability of vaccines did not ensure consistent uptake; public hesitancy and systemic trust issues posed significant barrier to effective rollout in many countries.

Mathieu et al. (2021) documented vast differences in vaccination coverage between nations, linked to socioeconomic, political, and logistical factors. Chu, Lu and Tsang (2021) emphasized that government responses and policy effectiveness varied widely across countries, shaping investor expectations and real estate performance. Yet, despite widespread recognition of these issues, few studies examine how the combined effects of vaccination strategies and lockdown policies shaped REIT outcome across global markets.

Early studies confirm that financial markets reacted negatively to the rising numbers of Covid-

19 cases and deaths. Al-Awadhi et al. (2020) found that firm-level stock returns in China declined significantly in response to daily growth in confirmed cases and deaths. Ashraf (2020) extended this analysis globally across 64 countries and concluded that markets responded more strongly to the rise in infection rates than to fatalities, especially during the early stage of outbreaks. These findings suggests that investor sentiment is more sensitive to forward-looking signals like case growth rather than lagging indicators such as death tolls. In contrast, Khalfauoi et al. (2021) studied the U.S context and showed that vaccination rates, case fatality ratios, and infection rates collectively influenced S&P 500 returns at various cyclical frequencies, indicating a more complex relationship between health data and market movements.

Rouatbi, Demir Kizys and Zaremba (2021) examined the relationship between Covid-19 vaccination programs and stock market volatility across global equity markets. They emphasized that high market volatility undermined economic objectives by discouraging both investment and consumption. Their findings indicated that stock market volatility declined significantly as vaccination rate increased. Acharya et al. (2020) demonstrated that reducing the expected vaccine deployment time by one year could result in a 4% to 8% daily increase in stock market returns, reflecting the significant pricing of medical solutions in investors' expectations. Their study further revealed that sectors most negatively affected by Covid-19 such as hospitality and retail – experienced the strongest positive market reaction to early vaccination efforts. Similarly, Behera, Pasayat and Behera (2022) found that in India, vaccination contributed to both reduction in Covid-related deaths and a significant positive response in the stock market.

While these findings support the view that vaccination restored investor confidence and market stability, most existing studies focus on aggregate indices and broad market trends. These remains limited insight into how vaccination affected specific asset classes like REIT, particularly across countries with differing pandemic policies and market conditions.

Lockdown restrictions were widely adopted to contain the spread of Covid-19, but their intensity and implementation varied significantly across countries (Mathieu et al., 2021; Koh, 2020). For instance, while Italy experienced sharp stock market declines following government restrictions, Scherf, Matschke, and Rieger (2022) argued that these economic shocks were more attributable to the lockdown measures than the virus itself. In contrast, Chong and Phillips (2021) contended that such interventions helped cushion the potential downfall of the real

estate market in the United States, suggesting that the absence of intervention might have led to even steeper declines. This contrast reveals the contested nature of policy effectiveness, highlighting the need to evaluate lockdowns contextually.

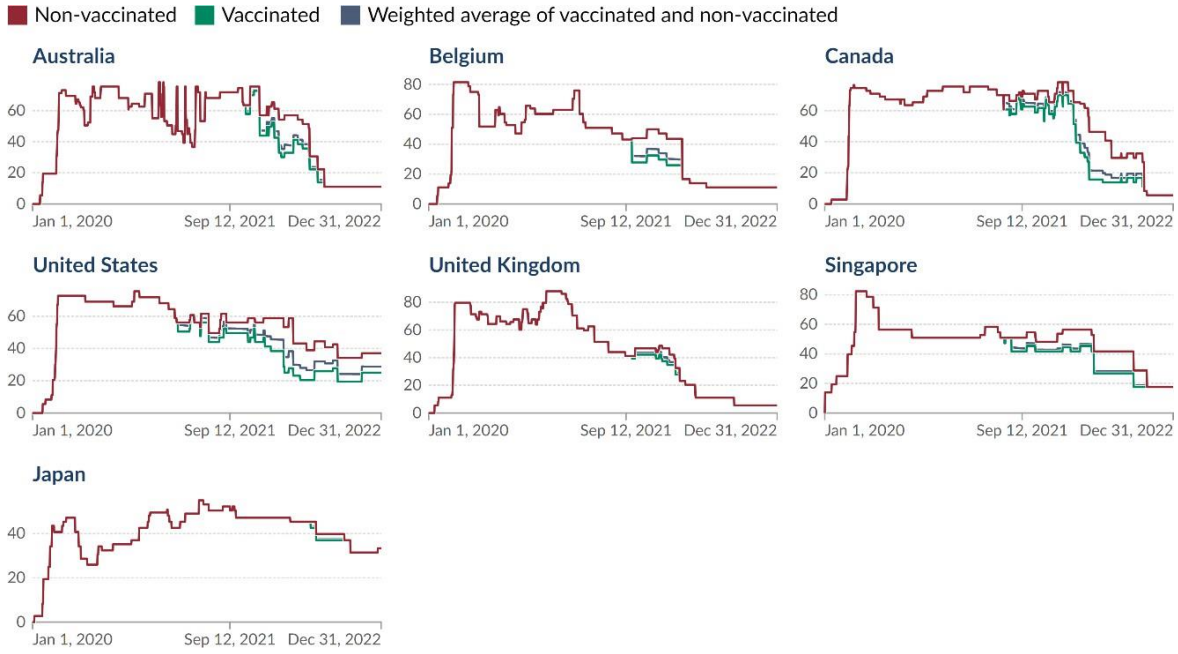


**Figure 1**: The Stringency Index of developed markets covered in this study

Source: Hale, T., Angrist, N., Goldszmidt, R. et al. A global panel database of pandemic policies (Oxford COVID-19 Government Response Tracker). Nat Hum Behav 5, 529–538 (2021). https://doi.org/10.1038/s41562-021-01079-8

Behera, Pasayat, and Behera (2022) further noted that government measures, along with vaccine rollout, played a crucial role in stabilizing markets, particularly in emerging economies like India. The diversity in policy design – ranging from curfews to full travel bans and school closures (Koh, 2020) – reflects a wide spectrum of socio-political responses. To quantify such variation, Rouatbi et al. (2021) employed the Oxford Stringency Index developed by Hale et al. (2021), which offers a standardized measure (0-100) of governmental response severity. As shown in Figures 1 and 2, this index reveals clear cross-country disparities, justifying the need to control for stringency in cross national REIT performance analysis.

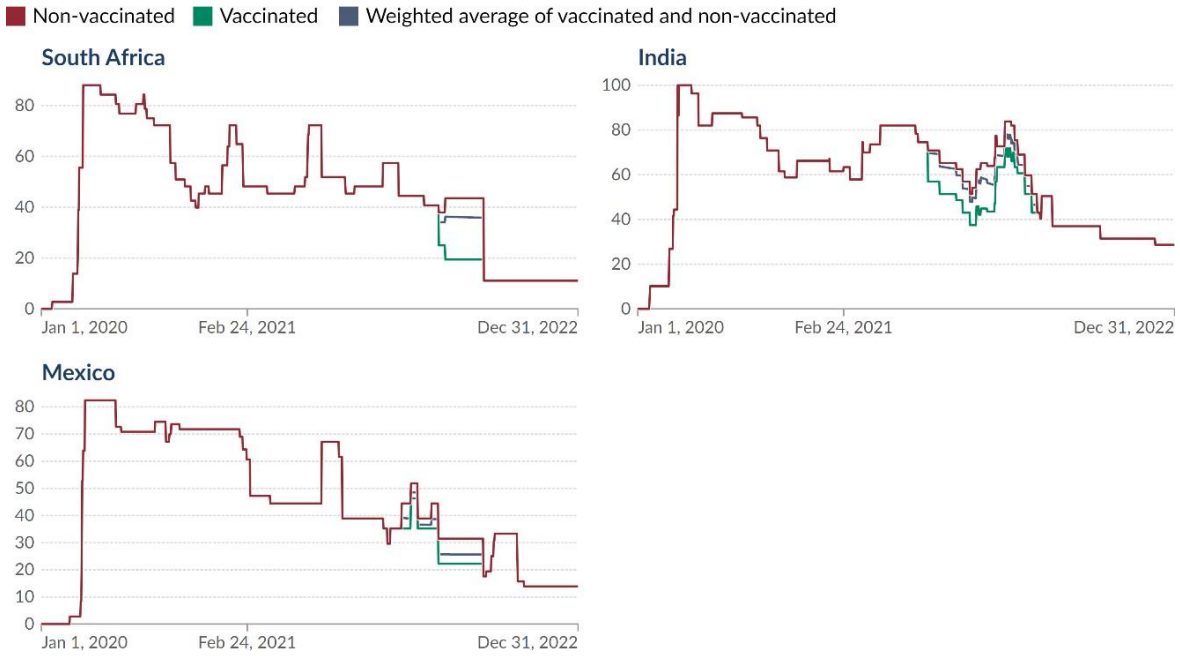


**Figure 2**: The Stringency Index of emerging markets covered in this study

Source: Hale, T., Angrist, N., Goldszmidt, R. et al. A global panel database of pandemic policies (Oxford COVID-19 Government Response Tracker). Nat Hum Behav 5, 529–538 (2021). https://doi.org/10.1038/s41562-021-01079-8

According to data published by the NAREIT, global REIT markets experienced sharp declines during the early phase of the Covid-19 pandemic. The extraordinary monetary and fiscal policy intervention by different governments to deal with the situation influenced the real estate market as well (Chong and Phillips, 2021). Akinsomi (2020) analysed the role of the pandemic in the performance of global REITs, identifying several key mechanisms: lockdown restrictions impaired tenants' ability to pay rent which in turn affected REITs' cash flow and their capacity to meet dividend distribution requirements. Leverage ratios were also affected due to increased debt-servicing risks – contributing to a global REIT market contraction of approximately 30%.

The pandemic's economic and policy effects varied substantially across national context, supporting findings by Chu, Lu and Tsang (2021) that the impact of Covid-19 is highly location-specific. Akinsomi (2020) documented the staggered timeline of lockdown implementation, with developed market such as the United States, Australia and the United Kingdom enforcing restrictions around 23 March 2020, while Japan declared a state of emergency from 8 April. Emerging markets followed similar timelines: Brazil (17 March), South Africa (26 March), and India (24 March). Further examples from Koh (2020), Lemenager et al. (2020), and Hargreaves et al. (2021) demonstrates the breadth of governmental responses, including full-scale lockdowns, curfews, and mandatory isolation

policies. As shown in Figures 1 and 2, the level and duration of lockdown stringency varied significantly across countries. Developed markets such as Canada and the United Kingdom maintained high stringency levels for prolonged periods, while countries like Japan and Mexico reflected the heterogeneous government responses discussed above, validating the use of the Stringency Index as a proxy for severity in this study.

**Table 1**: Countries covered in this study

| Developed Market | | Emerging Market |
|---|---|---|
| Australia | Singapore | India |
| Belgium | Japan | South Africa |
| Canada | | Mexico |
| United States | | |
| United Kingdom | | |

These government actions altered daily routines, business operations, and investor sentiment toward real estate investments. As Anglin et al. (2021) argue, such abrupt policy shifts created uncertainty around REIT performance and challenged assumptions of sector stability. The combination of regulatory responses and pandemic progression across both developed and emerging markets – as reflected in Table 1 – provides essential context to understanding cross-country variations in REIT returns.

**Table 2**: FTSE EPRA/NAREIT Global Real Estate Index Series: Regional Total Returns from February 21, 2020, to November 30, 2021

| Index/Property Sector | Number of Constituents | Regional Sector Weight | Total Return (%) Period | | | |
|---|---|---|---|---|---|---|
| | Nov. 30, 2021 | | Feb. 21, 2020 - March 23, 2020 | March 23,2020 - Nov. 8, 2020 | Nov. 8, 2020 - Nov. 30, 2021 | Feb. 21, 2020 - Nov. 30, 2021 |
| Developed | | | (42.8) | 38.6 | 33.2 | 5.6 |
| North America | | | (45.6) | 39.5 | 46.9 | 11.5 |
| Developed Asia | | | (38.5) | 37.3 | 10.3 | (6.8) |
| Developed Europe | | | (39.6) | 38.4 | 21.9 | 2.0 |
| **North America** | | | | | | |
| Residential | 22 | 16.6% | (44.1) | 35.4 | 56.3 | 18.2 |
| Infrastructure | 4 | 15.5% | (28.5) | 39.7 | 12.4 | 12.4 |
| Industrial | 16 | 13.5% | (35.2) | 61.6 | 43.2 | 49.8 |
| Retail | 28 | 12.9% | (54.6) | 27.9 | 79.1 | 4.1 |
| Data Centers | 4 | 9.0% | (24.7) | 43.0 | 12.7 | 21.4 |
| Health Care | 17 | 7.8% | (50.6) | 44.2 | 24.5 | (11.3) |
| Office | 20 | 7.1% | (43.2) | 12.4 | 38.0 | (11.9) |
| Self Storage | 5 | 6.7% | (30.9) | 52.1 | 60.7 | 68.8 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Diversified | 12 | 2.6% | (54.0) | 33.3 | 46.2 | (10.3) |
| Timberland | 4 | 2.4% | (51.1) | 91.4 | 37.6 | 28.7 |
| Lodging/Resorts | 10 | 2.2% | (56.2) | 24.4 | 57.3 | (14.3) |
| **Europe** | | | | | | |
| Diversified | 30 | 28.2% | (43.3) | 27.5 | 31.3 | (5.0) |
| Residential | 19 | 25.5% | (29.2) | 61.9 | (5.6) | 8.2 |
| Industrial | 7 | 12.6% | (33.9) | 69.3 | 44.3 | 61.4 |
| Office | 15 | 10.8% | (44.5) | 25.3 | 23.9 | (13.7) |
| Industrial/Office | 10 | 7.9% | (47.7) | 66.1 | 56.4 | 35.9 |
| Retail | 16 | 6.9% | (46.2) | (25.3) | 54.5 | (37.9) |
| Heath Care | 5 | 3.5% | (32.4) | 33.9 | 10.4 | 0.0 |
| Self Storage | 3 | 2.8% | (43.3) | 66.2 | 55.3 | 46.3 |
| Lodging/Resorts | 1 | 0.4% | (72.8) | 70.5 | 34.0 | (37.8) |
| **Asia** | | | | | | |
| Diversified | 52 | 58.4% | (38.5) | 35.3 | 9.6 | (8.7) |
| Office | 19 | 13.7% | (40.3) | 25.1 | 22.0 | (8.9) |
| Industrial | 17 | 9.0% | (40.5) | 35.3 | 16.3 | (6.4) |
| Retail | 14 | 8.9% | (31.7) | 63.6 | 2.8 | 14.9 |
| Industrial/Office | 9 | 3.8% | (34.5) | 63.3 | (6.3) | 0.2 |
| Residential | 5 | 2.8% | (29.2) | 36.5 | 3.3 | (0.2) |
| Lodging/Resorts | 5 | 1.5% | (59.3) | 88.4 | 3.6 | (20.6) |
| Data Centers | 1 | 0.5% | (24.7) | 63.4 | (18.2) | 0.6 |

(Source: FTSE Russell, EPRA, Nareit)

Table 2 provides a global and regional breakdown of REIT returns during key pandemic phases, illustrating how these heterogeneous policy responses translated into market performance. From February to March 2020, REIT markets experienced sharp declines, with total returns dropping by -42.8% in developed markets globally, including -45.6% in North America, -38.5% in Asia, and -39.6% in Europe. Despite these initial losses, recovery patterns varied significantly across regions. By November 2021, North America recorded the strongest recovery with total returns of 11.5%, while Asia and Europe lagged with returns of -6.8% and 2.0%, respectively. These differences reflect region-specific levels of economic resilience and policy effectiveness.

Sector-level breakdowns reveal that industrial REITs benefited from accelerated shifts in consumer behaviour and logistics demand, whereas sectors like retail and hospitality faced persistent challenges. These disparities reinforce the need to evaluate REIT performance through both geographic and sectoral lenses when assessing pandemic-era volatility and policy outcomes.

## 2.7. Theoretical Framework and Hypothesis Development

This study is grounded in three key theoretical perspectives from the finance and economics literature: the Efficient Market Hypothesis (EMH), uncertainty shock theory, and real options theory. Together, these frameworks guide the interpretation of REIT return behaviour in response to Covid-19 lockdown restrictions and vaccination rollouts.

The Efficient Market Hypothesis (EMH), particularly in its semi-strong form, posits that all publicly available information is fully and rapidly reflected in asset prices (Ţiţan, 2015). In the context of this study, announcements of lockdown measures and vaccine deployment represent major public policy signals. According to EMH, financial markets – including REITs – should respond swiftly and rationally to such developments. If REIT prices adjust immediately following these announcements, it would provide evidence of market efficiency. Conversely, delayed or asymmetric responses could indicate market inefficiencies or behavioural frictions.

Complementing this, uncertainty shock theory explains how large, unexpected events such as the Covid-19 pandemic generate temporary but significant disruptions to economic activity. Bloom (2009) models uncertainty shocks as forces that induce firms and investors to delay decisions, reduce hiring and investment, and drive down output. In REIT markets, lockdown restrictions may act as such shocks, increasing uncertainty over property usage, rental income, and economic continuity. These effects are expected to negatively influence REIT returns. Conversely, the rollout of vaccines may serve to reduce uncertainty, restore investor confidence, and reverse some of the negative sentiment.

Finally, the study draws on real option theory, which conceptualizes investment decisions and options that firms can exercise flexibly under changing conditions. According to Dubreuille et al. (2016), real estate investment – particularly REIT-linked ones – embodies characteristics of real options, such as the ability to defer, expand, or abandon based on future uncertainty. During periods of extreme uncertainty, such as the Covid-19 crisis, REIT managers and investors may exercise caution by delaying decisions or reallocating capital. Lockdowns intensify the option value of waiting, while vaccination rollouts may trigger renewed investment and repositioning in the REIT market.

These theoretical perspectives collectively inform the study's empirical model, guiding the

examination of how REIT markets respond to public health interventions during the Covid-19 pandemic.

## 2.8. Key findings of the Literature Review

The Covid-19 pandemic has significantly influenced global financial market, with REITs being no exception. Existing literature has extensively examined the impacts of economic uncertainty, government interventions, and health crises on financial markets, including the performance of REITs. However, notable gaps remain, which this study seeks to address.

While prior studies have explored the effects of lockdown restrictions (e.g., Koh, 2020; Chong and Phillips, 2021) or vaccination programs (e.g., Behera, Pasayat and Behera, 2022) in isolation, few have conducted integrated analysis examining their combined influence on REIT performance. The concurrent implementation of these interventions introduces complex dynamics that warrant further investigation to understand their joint impact on market stability and recovery. This study addresses that gap by including vaccination data in its analysis of 10 global REIT markets, which collectively accounts for 50% of the worldwide REIT index.

Research on REIT performance during the pandemic has primarily focused on either developed or emerging markets independently. For example, Milcheva (2021) examined the impact of Covid-19 on real estate markets globally but did not systematically compare the responses between developed and emerging markets. This leaves a gap in understanding the differing roles of economic structures, policy responses, and market maturity in shaping REIT outcomes. By comparing 10 countries across developed and emerging markets, this study aims to provide a nuanced perspective on these variations.

The timing and duration of pandemic-related interventions, such as lockdowns and vaccination rollouts, are crucial factors influencing market performance. However, much of the existing research employs static or short-horizon analyses that may not fully reflect the evolving impact of these measures over time. For instance, the study of GFC have highlighted long-term effects on REIT markets (Newell and Najib Razali, 2009), but similar dynamic assessments for the Covid-19 pandemic remain limited. This study addresses that gap by leveraging daily data to capture short-term fluctuations and temporal variation in REIT performance across different stages of the pandemic. Existing studies often rely on traditional economic indicators or broad market metrics, which may overlook specific pandemic-related dynamics. The use of the

Stringency Index and vaccination rates in this study, introduces novel variables to capture the direct effects of policy interventions on REIT performance. These metrics, combined with control variables like new Covid-19 cases and death rates, offer a more comprehensive framework for analysis.

While Studies like Rouatbi, Demir, Kizys and Zaremba (2021) have highlighted the importance of vaccination in reducing market volatility, there is limited research evaluating the effectiveness of combined policy measures (lockdowns and vaccinations) in stabilizing REIT markets. This study addresses the identified gaps by examining the combined effects of lockdown restrictions and vaccination programs on REIT performance, conducting a comparative analysis of developed and emerging markets to highlight regional differences, and leveraging daily data to analyse temporal dynamics and identified patterns across different pandemic stages. By including vaccination data and focusing on 10 global REIT markets that collectively account for 50% of the worldwide REIT index, this study offers a comprehensive approach to understanding these dynamics.

By addressing these gaps, this research contributes to the literature on REIT performance and policy effectiveness during crisis, offering actionable insight for investors, policymakers, and researchers.

## 2.9. Chapter Summary

The literature review covered key findings on REIT performance, economic uncertainties, the impact of the Covid-19 pandemic and the GFC on the real estate sector, financial market performance during Covid-19, and the effects of vaccination programs and lockdown restrictions. The research methodology for this study will be detailed and discussed in the following chapter.

# 3. Research Design

## 3.1 Research Philosophy and Approach

The research philosophy that is used in this paper is positivism. The reason for this research philosophy is because the study will be based on observation and measurements of publicly publish data. This study observes the vaccination program, the strictness of lockdown in relation to REITs return using measurements supported by previous papers. Most papers on the REITs performance (included in the literature review) used this philosophy as it disregarded their own opinion and solemnly based on their findings (Bonato, Çepni, Gupta and Pierdzioch 2021; Gholipour, Tajaddini, Farzanegan, and Yam 2021).

Creswell and Creswell (2018) mentioned that this philosophy is used to find the effect or outcomes. Since positivism focuses on scientific evidence, it is perfect research philosophy that can be applied in this study. The approach that is utilized in this study, which goes with positivism, is deductive as it is linked to positivism research philosophy. Deductive is a type of approach that focuses on testing the hypothesis.

## 3.2 . Research Strategy

This study employs a quantitative research method, collecting and analysing numerical data. It adopts a panel study approach, using daily data to track REIT returns and associated variable across time and countries. The dataset spans from 1 January 2020 to 30 December 2022, allowing for the examination of both short- and medium-term impacts of Covid-19 interventions on REIT performance. Although the Covid-19 pandemic was officially announced on December 31, 2019 (WHO, 2020), the global economy initially remained relatively unaffected in early 2020 (Balemi, Füss, & Weigand, 2021). Consequently, this study focuses on REIT returns, the vaccination program, and the role of lockdown restrictions, while not accounting for other variables that may influence returns. This research also utilizes a comparative design, simultaneously comparing performance data across different countries.

Panel data regression was selected as the most appropriate analytical approach, as it allows study of both cross-sectional and time-based variation in REIT returns. Several alternative methods were considered. For example, Panel Vector Autoregression (PVAR), as used by Oanh (2022), is suitable for exploring dynamic relationships between variables but requires longer time series and complex modelling that were not feasible for this dataset. The causality-in quantiles approach, employed by Bossman et al. (2022), identifies nonlinear effects under different market conditions but is less appropriate for estimating average daily effects across

countries. Given these considerations, a random effect panel regression model was adopted. This model assumes that unobserved country-level heterogeneity is uncorrelated with the independent variable, allowing for efficient estimation of both within – and between country variations. This approach aligns with the study's objective of examining broad policy effect across diverse REIT markets and follows precedents set by Topcu and Gulal (2020) and Rouatbi et al. (2021).

Previous studies on REIT performance have also widely applied quantitative methods. For example, Dimovski and O'Neill (2021), Newell, Khan and Siddiqui (2019), and Newell and Peng (2009) used quantitative models to analyse REITs during financial crisis such as Global Financial Crisis (GFC). Ntuli and Akinsomi (2017) used the South African REIT index and compared it with global REIT benchmarks from EPRA (2015) and FTSE Russel (2017). Parker, Riddiough and Shek (2014) employed multiple country indices such as the S&P/ASX 200 A-REIT Index, FTSE Straits Times Real Estate Investment Trust Index, Tokyo Stock Exchange REIT Index, and NAREIT indices, sourced from Bloomberg, NAREIT, and Data Stream. This study similarly uses macro-level REIT indices to measure global REIT performance during the Covid-19 pandemic. Most studies employed regression or correlation techniques to examine REIT dynamics (Newell et al., 2010; Parker et al., 2014), supporting the methodological consistency of this research.

## 3.3. Population and Sampling

This research investigates the impact of the COVID-19 pandemic on REIT returns. The study population includes global REITs over the period from 2020 to 2022. Stratified random sampling is used to divide the population into smaller, homogeneous subgroups, accounting for differences across countries. A sample of 10 global REITs, selected based on high market capitalization and the presence of vaccination programs, are analysed. The chosen countries collectively contribute to 50% of the Global REIT Index.

## 3.4 Development of the Research Instrument(s)

To analyse REIT performance in relation to vaccination programs and lockdown measures, this study adopts a quantitative research approach using panel data regression. The primary aim is to determine the impact of Covid-19 interventions on REIT returns over the period from 1 January 2020 to 31 December 2022.

The selection of explanatory variables was guided by prior empirical studies on financial market responses to the Covid-19 pandemic. For example, Rouatbi et al. (2021) assessed the

role of vaccination rates and government stringency measures in influencing stock market volatility across 66 countries. While their model focused on volatility, the use of vaccination rate and the stringency index as core variables is adapted in this study to explore REIT returns instead.

Similarly, Al-Awadhi et al. (2020) analysed stock market performance using daily confirmed Covid-19 cases and deaths as independent variables. Their use of pandemic related indicators informed this study's decision to include new deaths, positive test rate, and a vaccination-period dummy as control variables. Although Mohamad and Zolkifi (2014) employed models based on firm-level data (e.g., net income, risk, NAV), such approaches were not feasible in this study due to data availability. Instead, a macro-level panel framework is used, leveraging REIT index returns as the dependent variable.

The choice of panel methodology is supported by prior research in the REIT context (Chong et al., 2017; Ayaba et al., 2023), as well as methodological guidance from Xu et al. (2007), who highlighted its ability to control for unobserved heterogeneity and reduce omitted variable bias through fixed effects.

The final model used in this study is specified as follows:

$$\text{LogPriceIndex}_{i,t} = \alpha + \beta 1\text{PeopleVaccper100}_{i,t} + \beta 2\text{StringencyIndex}_{i,t} + \beta 3\text{Controls}_{i,t} + \beta 4\text{VaccinationPeriod} + ui + \epsilon_{i,t}$$

*Variable Measurement*

- Dependent Variable

LogPriceIndex$_{i,t}$ – log of Return of REITs i in time t

- Independent Variable

PeopleVaccper100$_{i,t}$ – number of people vaccinated per 100 in country i in time t

StringencyIndex$_{i,t}$ – the stringency index in country i in time t

Controls$_{i,t}$ – control variables including number of new deaths and positive rate for country i in time t

VaccinationPeriod – Dummy variable

*ui* – country specific effect

$\epsilon i,t$ – Error term

The market capitalization was commonly used to when studying the performance of REITs (Brounen and de Koning, 2012; Newell and Peng, 2009; Ntuli and Akinsomi, 2017). Hence, Rouatbi, Demir, Kizys and Zaremba (2021) and Al-Awadhi, Alsaifi, Al-Awadhi and Alhammadi (2020) took market capitalization as a vector control variable. However, because this is a macro analysis, REIT index will be used. Therefore, the dependent variable, LogPriceIndex which is the natural log of capital return of the price index represented by FTSE EPRA. Logarithmic transformation, as explained by Wooldridge (2020) and Stock and Watson (2020), helps stabilize variance and normalize data, making it particularly effective for financial analysis. This index is a benchmark commonly used for performance of REITs. 10 countries that are covered in this paper are shown in table 1.

It was mentioned in Chapter 2 of literature review that Acharya et al. (2020, cited by Rouatbi, Demir, Kizys and Zaremba, 2021) estimated that earlier vaccination deployment will increase the stock market return. Rouatbi, Demir, Kizys and Zaremba (2021), found that the COVID-19 vaccination program is crucial in maintaining the stability of the world equities markets and emphasized how the introduction and development of immunizations reduced stock market volatility after considering other policies and characteristics. Khalfaoui, Nammouri, and Ben Jabeur (2021) looked at the effectiveness of vaccine on the US financial market.

The vaccination rate found to have strong and positive impact on S&P 500 returns (Khalfaoui, Nammouri, and Ben Jabeur, 2021). In this study, the number of vaccinations per 100 will be used as independent variable to find the how nationwide vaccination program correlates with REIT performance and how it impacts in long term. The Lockdown restriction which is the government intervention is another focus of this study. Scherf, Matschke and Rieger (2022) emphasized the lockdown restrictions had a negative impact on global economy and affected global REITs (Akinsomi, 2020). Chong and Phillips (2021) mentioned that the lockdown restriction aided real estate market. Therefore, the *Stringency Index* will be considered as independent variable. This index was used in Rouatbi, Demir, Kizys and Zaremba (2021) study which was obtained from Hale et al. (2021), and it represents the level of strict response such as closure of schools, workplaces, and transport; requirements to stay at home; internal travel

controls; public information campaigns; and limits on public gatherings and movements (Roser, 2021). The stringency index is the mean score of nine metrics which has a value between 0 to 100, 100 being the strictest.

Controls variables are added to account for additional factors that may influence REIT returns. "New deaths" refers to fatalities reported due to Covid-19, "positive rate" is the rate of positive Covid-19 test and "vaccination period". For variable "newdeaths", the logarithmic function is used to stabilize variance and diminish skewness. Yet, log(newdeaths+1) is used to account the zero observation as normal log of zero number of fatality results in undefined outcomes. This method is supported by O'Hara and Kotze (2010) as they state that when datasets include zero values, it is often necessary to add a small value like 1 to avoid undefined outcomes during log transformation.

The model also includes VaccinationPeriod as a dummy variable to capture the specific period of the vaccination rollout across the studied countries. This variable was also used in Rouatbi, Demir, Kizys and Zaremba (2021)'s study, where 1 represents periods with active vaccination rollout and 0 otherwise.

$u_i$ and $\epsilon_{i,t}$ are included in this study as this study uses panel data regression. These two terms account for both unobserved country -specific characteristics and random fluctuation over time. $u_i$ captures time-invariant factors for each country, such as economic conditions or regulatory environment which could influence the REIT performance yet not observed in the data. $\epsilon_{i,t}$ represents idiosyncratic errors that vary across countries and time, accounting for random day-to-day variation not explained by the independent variables.

Additionally, since macroeconomic data often raise concerns of non-stationarity, the issue of unit root is addressed as follows: Although macroeconomic time series data can be prone to non-stationarity, formal panel unit root testing (eg., Levin-Lin-Chu or Im-Persaran-Shin) was not conducted in this study due to the presence of unbalanced panels and gaps in the daily dataset. Instead, the model accounts for potential non-stationarity by applying logarithmic transformations to the dependent variable (LogPriceIndex), and by including both country fixed effects and time fixed effects. These measures help to control for unobserved heterogeneity and reduce bias associated with unit roots. Furthermore, key explanatory variable such as vaccination rates and the stringency index are bounded or normalized, which also mitigates the risk of spurious regression. This limitation is acknowledged in the interpretation of the results.

## 3.5 Data collection Protocol

The protocol for data collection describes the proposed method for gathering the data. For data collection, stratified random sampling method is used. For these sampling, I collected population of global REITs and divide into subpopulation of 10 global REIT market based on the market capitalization and that initiated the vaccination program.

The study tracks a sample of the 10 worldwide REIT markets over a two-year period (2020-2022), which will be chosen based on their market capitalization. The database that will be used are Our World in Data, which was used by Khalfaoui, Nammouri, and Ben Jabeur (2021) to find the total number of vaccinations during a specific time. Our World in Data also contains Stringency index which was proposed by Hale et al. (2021), and it was used in Rouatbi, Demir, Kizys and Zaremba (2021) study. The REIT index that will be used in this study is capital return of price index represented by FTSE EPRA.

## 3.6 Validity and Reliability

This study employs a quantitative approach using panel data across 10 countries that represents approximately 50% of the FTSE EPRA/NAREIT Global Index, covering the period from 2020 to 2022. Validity is supported by established measurement techniques and constructs, aligned with previous studies such as Rouatbi et al. (2021) and Al-Awadhi et al. (2020), who examined financial market responses to Covid-19 using vaccination rates, stringency indices and pandemic related outcomes.

Construct validity was enhanced by selecting variables grounded in the literature, including REIT returns (measured using Bloomberg/EquityRT index data), number of people vaccinated per 100, Stringency Index and control variables such as death rate and positivity rate. The vaccination Period dummy variable was introduced to capture structural shifts in pandemic phases.

Data reliability was ensured by sourcing time-series data from reputable databases, such as Bloomberg, EquityRT, and Our World in Data, all of which are widely used in per-reviewed financial and economic studies. Efforts were made to ensure consistent variable definitions and daily frequency across all countries. Where possible, data points were cross verified between platforms to ensure consistency.

Internal validity was reinforced by incorporating control variables to isolate the effects of lockdown restrictions and vaccination rollout. Although broader macroeconomic factors (e.g., interest rates, inflation) were not included due to data constraints, their omission is acknowledged as a limitation

and a direction for future research.

Overall, the study's methods and data sources align with established literature, supporting the validity and reliability of the findings.

## 3.7 Data Analysis

Statistical analysis will be conducted to examine the collected data, utilizing either Stata or SPSS software

## 3.8 Ethical Risks and Mitigation Strategy

Ethical issues may arise while doing research. It is essential to be aware of several risks and mitigation strategies to avoid criticism and conflict in the paper. As mentioned earlier, this is a quantitative study on global REITs return, vaccination program and lockdown restrictions.

In a quantitative study, unethical practice might occur during analysis of data. This unethical practice might be something that I am unaware of, hence ethical approval must be obtained from the school. The use of right database is essential in quantitative study as wrong dataset might not be relevant to this paper. When the dataset is collected from the platform, it must be considered as a valid dataset. Moreover, it is not allowed to manipulate the data set for desirable result. If there is a case that certain data must be changed or removed, there should be a valid explanation why it is changed and it needs to be explained how it was addressed in the planning and analysis of this study. The data must be open to third party if necessary.

Plagiarism is another big issue during research. Turnitin will be used before the submission of the paper to avoid the plagiarism.

## 3.9 Chapter Summary

The purpose of this chapter was to give an outline of the methodological approach and research design of 'COVID-19 Pandemic and REITs return – Lockdown Restrictions and Vaccination'. It briefs on the research methodology that will be used in this study as well as strategy and design that will be used. Moreover, it explains the sampling procedure, instrumentation, how data will be collected and how I will include ethical consideration in the study.

# 4 Data analysis and Discussion

This section presents the empirical findings of the study based on daily panel data from 10 global REIT markets. The analysis begins with descriptive statistics to provide an overview of key variables, followed by regression results examining the effects of lockdown restrictions and vaccination rollouts on REIT returns. To deepen the interpretation, comparisons are drawn between developed and emerging markets, highlighting differences in policy impacts and market volatility. The discussion is structured to align the findings with the theoretical framework and existing literature, offering insights into how REITs responded to pandemic-era policy interventions and evolving economic uncertainty.

Table 3 provides a detailed description of all variables used in this study, including their definitions and roles, while Table 4 shows the vaccination rollout start dates for each country covered in this study. Table 5 presents the descriptive statistics of the 10 global REITs covered in this study which are divided into three panels. Panel A is the full sample (all countries) whereas Panel B and C are full samples divided into developed and emerging market, respectively. The Stringency Index reflexts the severity of government-imposed lockdown restrictions, ranging from 0 (no restrictions) to 100 (strictest measure). Log_NewDeaths represents the natural logarithm of the daily number of Covid-19 related deaths (adjusted using +1 to avoid undefined log values). These variables help capture the pandemic's intensity and government response across countries. Other variables include PeopleVaccper100 (number of people vaccinated per 100 individuals), Positive Rate (proportion of positive Covid-19 tests), and VaccinationPeriod (a dummy variable marking active vaccine rollout periods).

**Table 3:** Variable Description Table

| Variable Name | Description | Type |
|---|---|---|
| LogPriceIndex | Log of REIT capital return index | Dependent |
| PeopleVaccper100 | People vaccinated per 100 individuals | Independent |
| Stringency Index | Government lockdown severity score (0-100) | Independent |
| log_NewDeaths | Log-transformed new Covid-19 deathes (1+adjustment) | Control |
| PositveRate | Covid-19 positive rate | Control |
| VaccinationPeriod | Dummy variable for period when vaccination was active | Control |

As shown in Table 5, the mean values for all three panels are similar with approximate value of 3.2 showing that the REIT performance is stable. However, there is substantial variability in REIT returns in emerging market, as the standard deviation is 1.18 which is considerably higher than developed market which has a value of 0.22. This greater variability aligns with Harjoto et al. (2020), who observed that emerging markets experienced higher volatility in response to COVID-19-related cases and mortality rates, reflecting heightened uncertainty among investors. A clear disparity in vaccination levels is also evident between market types as the mean PeopleVaccper100 in emerging market is only 19.15, compared to 37.86 in developed markets. This difference reflects unequal access to vaccines and the pace of vaccination rollouts across regions.

**Table 4:** Covid-19 Vaccination Rollout Start Dates

| Country | Vaccination Rollout Start Dates |
|---|---|
| Australia | 22 February 2021 |
| Belgium | 30 December 2020 |
| Canada | 16 December 2020 |
| United States | 14 December 2020 |
| Singapore | 30 December 2020 |
| United Kingdom | 11 January 2021 |
| Japan | 22 February 2021 |
| South Africa | 19 February 2021 |
| India | 18 January 2021 |
| Mexico | 28 December 2020 |

As shown in Table 5, emerging markets experienced slightly stricter government interventions during the Covid-19 pandemic, as reflected in a higher average Stringency Index compared to developed market. This may correlate with the higher impact of the pandemic in those regions. Emerging market also recorded higher Covid-19 related mortality between 2020 and 2022, which aligns with the higher positive rate observed in these regions a mean of 0.127, compared to 0.057 in developed markets. Harjoto et al. (2020) similarly found that emerging markets faced greater challenges in managing Covid-19 cases and mortality, likely due to healthcare resource limitations, which influenced investor perceptions and contributed to market volatility. Regarding the Vaccination Period variable, the mean value for developed market is 0.576, while for emerging market it is 0.45, indicating that developed markets had a longer duration of active vaccination rollout.

**Table 5:** Descriptive statistics

| | Mean | First Quartile | Standard Deviation | Third Quartile | Min | Max |
|---|---|---|---|---|---|---|
| **Panel A: Full Sample** | | | | | | |
| Log Price Index | 3.185 | 2.874 | 0.671 | 3.388 | 1.673 | 4.852 |
| People Vaccper 100 | 32.247 | 0 | 35.913 | 73.280 | 0 | 91.49 |
| Stringency Index | 44.573 | 25.690 | 23.875 | 66.200 | 0 | 100 |
| log_NewDeaths | 3.274 | 1.099 | 2.351 | 5.081 | 0 | 8.724 |
| Positive Rate | 0.077 | 0 | 0.119 | 0.096 | 0 | 0.688 |
| PeopleFullyVaccper100 | 28.831 | 0 | 34.217 | 67.070 | 0 | 90.730 |
| Vaccination Period | 0.538 | 0 | 0.499 | 1 | 0 | 1 |
| **Panel B: Developed Market** | | | | | | |
| Log Price Index | 3.201 | 3.081 | 0.221 | 3.373 | 2.515 | 3.591 |
| People Vaccper 100 | 37.859 | 0 | 37.989 | 79.110 | 0 | 91.490 |
| Stringency Index | 42.882 | 23.670 | 23.297 | 64.350 | 0 | 87.960 |
| log_NewDeaths | 2.909 | 0.693 | 2.304 | 4.595 | 0 | 8.313 |
| Positive Rate | 0.0562 | 0 | 0.094 | 0.067 | 0 | 0.579 |
| PeopleFullyVaccper100 | 34.833 | 0 | 36.576 | 74.950 | 0 | 90.730 |
| Vaccination Period | 0.576 | 0 | 0.494 | 1 | 0 | 1 |
| **Panel C: Emerging Market** | | | | | | |
| Log Price Index | 3.148 | 1.673 | 1.183 | 3.081 | 3.373 | 4.852 |
| People Vaccper 100 | 19.154 | 0 | 26.214 | 0 | 79.110 | 76.220 |
| Stringency Index | 48.520 | 23.67 | 24.731 | 0 | 64.350 | 100 |
| log_NewDeaths | 4.128 | 0.693 | 2.236 | 0 | 4.595 | 8.724 |
| Positive Rate | 0.127 | 0 | 0.152 | 0 | 0.0674 | 0.688 |
| PeopleFullyVaccper100 | 14.828 | 0 | 22.391 | 0 | 74.950 | 67.120 |
| Vaccination Period | 0.450 | 0 | 0.498 | 0 | 1 | 1 |

Note: This table shows the descriptive statistics on the variables for this study. Mean is the average, Min is minimum, Max is maximum. Log Price Index is the logarithm of daily REIT Returns. PeopleVaccper 100 is the number of people vaccinated for Covid-19 per 100. Stringency Index is a value from 0 to 100 which represents the severity of government responses to pandemic. log_NewDeaths is the logarithmic number of new deaths reported due to Covid-19. Positive Rate is the rate of positive Covid-19 test. PeopleFully Vaccper100 is the number of people fully vaccinated for Covid-19. Vaccination Period is a dummy variable is a dummy variable where 1 represents periods with active vaccination rollout and 0 otherwise.

Table 6 represents the correlation matrix of linear relationship between all the variables used in this study. The correlation between LogPriceIndex and StringencyIndex is negative (-0.0796) and statistically significant at the 1% level, indicating that stricter government responses to COVID-19 were associated with modest declines in REIT returns. Similarly, PositiveRate has a significant negative correlation with LogPriceIndex (-0.2183, $p \leq 0.01$), suggesting that higher COVID-19 Positive rates negatively impacted REIT returns. In contrast, variables related to vaccination, such as PeopleVaccPer100 (0.0542 $p \leq 0.01$) and VaccinationPeriod (0.1026, $p \leq 0.01$), have a positive and significant relationships with REIT returns, reflecting the role of vaccination program in supporting market recovery. The

correlation between LogPriceIndex and log_NewDeaths is negative (-0.0475) and statistically significant ($p \leq 0.01$), suggesting that increases in COVID-19 related deaths were associated with slight declines in REIT performance. Notably, PeopleVaccper100 and PeopleFullyVaccper100 exhibit a very high positive correlation (0.9425) suggesting potential multicollinearity issues if both variables are included in the same regression model without proper specification.

**Table 6:** Correlation Matrix

| | Log Price Index | PeopleVaccper 100 | Stringency Index | log_New Deaths | Positive Rate | PeopleFully Vaccper100 | Vaccination period |
|---|---|---|---|---|---|---|---|
| Log Price Index | 1 | | | | | | |
| PeopleVaccper100 | 0.0542*** | 1 | | | | | |
| Stringency Index | -0.0796*** | -0.2493*** | 1 | | | | |
| log_New Deaths | -0.0475*** | -0.0049 | 0.417*** | 1 | | | |
| Positive Rate | -0.2183*** | -0.0265** | 0.1818*** | 0.4289*** | 1 | | |
| PeopleFullyVaccper100 | 0.0528*** | 0.9425*** | -0.3131*** | -0.0345*** | 0.0453*** | 1 | |
| Vaccination period | 0.1026*** | 0.8314*** | -0.1208*** | 0.0899*** | -0.0224** | 0.7224*** | 1 |

Note: This table shows the correlation between all the variables included in this study over the period of January 2020 to December 2022. Log Price Index is the logarithm of daily REIT Returns. PeopleVaccper 100 is the number of people vaccinated for Covid-19 per 100. Stringency Index is a value from 0 to 100 which represents the severity of government responses to pandemic. log_NewDeaths is the logarithmic number of new deaths reported due to Covid-19. Positive Rate is the rate of positive Covid-19 test. PeopleFully Vaccper100 is the number of people fully vaccinated for Covid-19. Vaccination Period is a dummy variable is a dummy variable where 1 represents periods with active vaccination rollout and 0 otherwise. Significance levels are indicated as follows: *** = $p \leq 0.01$, ** = $p \leq 0.005$, * = $p \leq 0.10$

Table 7 reports the regression results for the full sample and by market type. Column 1 presents the results for the full sample, while column 2 and 3 shows separate analysis for developed and emerging markets, respectively. This approach allows for examination of whether the effects of vaccination rates, lockdown stringency, and other control variables differ between market types, and how they influence REIT returns.

Table 7 displays the results from a random effects regression model, where REIT returns (LogPriceIndex) serve as the dependent variable. The main independent variables are Stringency Index and PeopleVaccper100, while other variables, Log_NewDeaths,

PositiveRate, PeopleFullyVaccper100, and VaccinationPeriod, serve as controls to account for broader pandemic impacts. VaccinationPeriod is a dummy variable that captures periods of active vaccine rollout.

While table 6 shows the pairwise correlations between variables, the regression analysis in Table 7 isolates the unique effect of each variable by controlling for the simultaneous influence of all independent variables. This distinction explains why certain variables, such as log_NewDeaths, which showed significant correlations in Table 6, may appear statistically insignificant in the regression output.

In the full sample, PeopleVaccper100 has a positive and statistically significant coefficient (0.000235, $p \leq 0.01$), suggesting that higher vaccination rates were associated with increases in REIT returns. In developed markets, this positive effect is stronger (0.00278, $p \leq 0.001$), possibly due to greater market stability and more robust public health infrastructure. However, in emerging markets, the coefficient is negative ( -0.0496, $p \leq 0.001$), indicating that higher vaccination rates were associated with declining REIT returns.

This contrast partially aligns with the findings of Oanh (2022), who reported that vaccination programs had a positive effect on stock markets in developing countries and negative effect in developed countries. However, Oanh (2022) also noted that vaccination could indirectly support market by easing restrictions and altering investor responses to infection rates. Furthermore, variance decomposition showed that vaccination explains stock market returns more in developing countries than in developed ones. These findings suggest that the market response to vaccination may differ across contexts due to variations in policy implementation, public trust, and economic structure.

**Table 7: Combined Regression**

| | Full Sample | Developed | Emerging |
|---|---|---|---|
| | | LogPriceIndex | |
| PeopleVaccper100 | 0.000235** | 0.00278*** | -0.0496*** |
| | -3.18 | -10.67 | (-11.74) |
| StringencyIndex | -0.000747*** | -0.00257*** | 0.0139*** |
| | (-20.76) | (-21.66) | -10.66 |
| log_NewDeaths | 0.0000632 | 0.0487*** | -0.191*** |
| | -0.14 | -40.84 | (-11.93) |
| PositiveRate | 0.0244** | -0.0468 | -2.191*** |
| | -3.16 | (-1.53) | (-13.10) |

| | | | |
|---|---|---|---|
| PeopleFullyVaccinatedper100 | -0.000299*** | -0.00244*** | 0.0349*** |
| | (-4.55) | (-10.99) | -7.99 |
| VaccinationPeriod | 0.0614*** | 0.0318** | 1.182*** |
| | -24.52 | -3.09 | -15.06 |
| _cons | 3.191*** | 3.134*** | 3.443*** |
| | -14.89 | -471.35 | -61.22 |
| N | 7799 | 5481 | 2318 |

t statistics in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001

The stringency index has a significant negative effect on REITs returns in both full sample and developed markets. This indicates that stricter government response to Covid-19, which constrained economic activities, were associated with lower REIT performance. This finding aligns with trends observed in Figure 1 and 2, where developed markets, on average, maintained higher stringency level for prolonged periods, consistent with the observed negative effect on REIT returns in those regions. In contrast, emerging markets also implemented strict lockdowns but exhibited a positivecoefficient in the model, suggesting stringent measures may have helped restore investor confidence and support REIT recovery in those contexts. This aligns with Chu, Lu, and Tsang (2021), who reported that COVID-19's impact varied based on each country's government response and virus control measures. Bakry et al. (2021) also found that government stringency measures have divergent impacts on stock volatility: in emerging markets, strict measures were associated with increased volatility, while in developed markets, they contributed to stability. However, Topcu and Gulal (2020) observed that emerging markets with timely government measures and stimulus support experienced relatively lower volatility, suggesting that proactive policies helped mitigate the pandemic's market impact. The positive coefficient for emerging markets (0.0139) is more than five times larger than the absolute value of the negative coefficient in developed markets (-0.00257). This highlights a sharp divergence in how government stringency influenced REIT performance across regions.

The number of new deaths is statistically insignificant in the full sample, indicating no strong relationship with REIT returns at the aggregate level. However, in developed markets, log_NewDeaths has a positive and significant effect, with a coefficient of (0.0487), suggesting that REIT returns increased alongside reported deaths – possibly reflecting investor expectations of increased government support or policy intervention in these markets. In

contrast, the effect in emerging markets is strongly negative, with a coefficient of (-0.191), indicating that rising Covid-19 deaths significantly reduced REIT returns. This finding aligns with Harjoto et al. (2020), who reported that emerging markets react more sharply to Covid-19 mortality due to healthcare infrastructure and heightened investor uncertainty.

The PositiveRate in the full sample shows a positive and significant relationship with REIT returns. This result is unexpected as higher positivity rate typically signals worsening pandemic conditions. It also contradicts the findings if Ling, Wang, and Zhou (2020), who reported a negative relationship between REIT returns and rising Covid-19 cases. In developed markets, this variable is not statistically significant, while in emerging markets it has a strong negative effect (coefficient of -2.191). This suggests that investor sentiment in emerging market was more sensitive to worsening public health conditions, leading to sharper declines in REIT performance when positive test rates increased. PeopleFullyVaccper100 shows an opposite effect to PeopleVaccper100 in the full sample, with a coefficient of -0.000299 ($p \leq 0.001$). This suggests that higher full vaccination rates were associated with slightly lower REIT returns, possibly reflecting reduced policy support or a shift in investor expectations once vaccination coverage reached high levels. In developed markets, this negative effect persists (coefficient of -0.00244, $p \leq 0.001$). In contrast, emerging markets exhibit a positive relationship (coefficient of 0.0349, $p \leq 0.001$) indicating that higher full vaccination rates coincided with stronger REIT performance – potentially due to increased investor confidence in economic recovery. This pattern is consistent with Rouatbi et al. (2021), who found that vaccination programs contributed to a substantial reduction in market volatility.

Finally, VaccinationPeriod had a positive and statistically significant effect on REIT returns across all market types. In the full sample, the coefficient is 0.0614 ($p \leq 0.001$), indicating that periods of active vaccine rollout were associated with higher REIT performance. The effect is smaller in developed markets (0.0318 $p \leq 0.001$) but much larger in emerging markets (1.182, $p \leq 0.001$), highlighting the critical role of vaccination campaigns in supporting market stability and boosting investor confidence in regions with greater pandemic-related uncertainty.

These contradictory findings across variables such as vaccination rates, stringency index, new deaths, and full vaccination levels may reflect deeper structural and behavourial differences between developed and emerging markets. For instance, in developed markets, high vaccination rates may have signaled economic recovery, boosting investor confidence and REIT performance. In contrast, in emerging markets, logistical challenges, healthcare limitations, and low institutional trust may have delayed or weakened the expected benefits of

vaccination, contributing to negative market responses.

The stringency index also shows opposite effects: negative in developed markets but positive in emerging markets. This could be due to stronger policy credibility or delayed restrictions in emerging markets, where stringent lockdowns may have reassured investors of future recovery. Developed economies, with more formal sectors, may have experienced immediate economic slowdowns from lockdowns, directly impacting REIT cash flow.

For new Covid-19 deaths, developed markets shows a surprising positive effect, possibly due to expectations of government support in response to raising mortality. In emerging markets, however, higher deaths likely indicate systemic health risks, creating fear and reducing REIT attractiveness. Lastly, fully vaccinated rates had a negative impact in developed markets – possibly because investors began focusing on other macroeconomic risks (e.g., inflation, interest rates) as vaccination level stabilized, while emerging markets responded positively as vaccination milestones were linked more directly to reopening prospects.

These results suggest that macroeconomic structure, policy response timing, investor sentiment, and REIT sector composition all play a role in how markets interpret pandemic-related indicators.

Therefore, the variation of these findings between full sample, and when sample is split into emerging and developed, could be due to regional differences in REIT sensitivity. Milcheva (2021) observed that the pandemic's impact varied significantly between Asia and U.S, with Asian Real Estate companies showing negative market sensitivity and sector divergence seen in the U.S. The result on emerging countries having a positive relationship with REITs return is supported by Kola and Kodongo (2017), who found that although emerging markets offer lower returns, they also present lower risk, with emerging REIT index outperforming on a risk-adjusted basis.

### Robustness Check

For robustness, an analysis using different time periods distinct phases of the Covid-19 pandemic was performed. The data was categorized into two periods: 2020-2021, representing the initial pandemic outbreak and vaccination rollout phase, and 2022, showing the post-vaccination and economic stabilization phase. The robustness check is shown in table 8. Panel A shows the period of 2020-2021 and Panel B shows period of 2022. This approach allowed to examine whether the relationships observed in the main regression are consistent across different stages of the pandemic.

Table 8: Robustness check

| Panel A: Pandemic outbreak and vaccination rollout period (2020-2021) | | | |
|---|---|---|---|
| | **Full Sample** | **Developed** | **Emerging** |
| | LogPriceIndex | LogPriceIndex | LogPriceIndex |
| PeopleVaccper100 | 0.00166*** | 0.00196*** | -0.0404*** |
| | -15.97 | -4.66 | (-6.51) |
| StringencyIndex | -0.00169*** | -0.00566*** | 0.00864*** |
| | (-46.49) | (-42.11) | -5.56 |
| log_NewDeaths | 0.00670*** | 0.0584*** | -0.107*** |
| | -13.43 | -39 | (-5.46) |
| PositiveRate | -0.0707*** | 0.312*** | -3.031*** |
| | (-6.49) | -4.61 | (-14.36) |
| PeopleFullyVaccinatedper100 | -0.00110*** | -0.00110** | 0.0356*** |
| | (-10.87) | (-2.77) | -4.23 |
| VaccinationPeriod | 0.0358*** | -0.00418 | 0.381*** |
| | -16.08 | (-0.43) | -4.11 |
| _cons | 3.227*** | 3.294*** | 3.662*** |
| | -18.9 | -453.2 | -49.16 |
| Panel B: Post-vaccination and stabilisation period (2022) | | | |
| | **Full Sample** | **Developed** | **Emerging** |
| | LogPriceIndex | LogPriceIndex | LogPriceIndex |
| PeopleVaccper100 | 0.000735*** | -0.0143*** | -0.0804*** |
| | -4.87 | (-13.50) | (-18.87) |
| StringencyIndex | 0.00146*** | 0.00235*** | 0.0199*** |
| | -17.4 | -8.24 | -8.39 |
| log_NewDeaths | 0.00237*** | 0.0246*** | -0.111*** |
| | -4.14 | -11.51 | (-5.70) |
| PositiveRate | 0.0653*** | -0.411*** | -1.783*** |
| | -8.46 | (-14.45) | (-10.39) |
| PeopleFullyVaccinatedper100 | 0.000257*** | 0.00127*** | 0.0188*** |
| | -4.25 | -5.85 | -4.52 |
| VaccinationPeriod | -0.0544*** | 1.435*** | 4.546*** |
| | (-4.84) | -16.93 | -43.15 |
| _cons | 3.137*** | 2.807*** | 2.397*** |
| | -19.61 | -264.75 | -41.77 |

t statistics in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001

The robustness check results show that this study is partially robust, with key findings remaining consistent across time periods and market type, while others show sensitivity to the specific pandemic phase and economic environment.In panel A (2020-2021), the Stringency Index has a negative and statistically significant effect on REIT returns in both the full sample and developed markets. This result reflects the broad and often highly restrictive lockdown measures implemented during the early stages of the pandemic, which constrained economic activity and directly affected REIT performance, particularly in office, retail, and hospitality sectors.

In panel B (2022), the effect of Stringency Index reverses to positive across all market types, including developed markets. This likely reflects the evolving nature of government policy in

the later stages of the pandemic. Restrictions became more targeted and adaptive, allowing economic activity to continue while managing localized outbreaks. By this stage, many REIT sectors had adapted operations, including flexible leases, digital tenant engagement, and reduced dependence on vulnerable sectors like retail or office. As a result, later restrictions may have been interpreted as part of a stable recovery framework, boosting investor confidence.

In emerging markets, the Stringency Index displays a consistently positive and significant association with REIT returns across both periods. One plausible explanation is that investors may have viewed strong and decisive government action, as reflected by higher stringency, as a signal of institutional commitment to managing the crisis. This may have bolstered investor confidence in markets where public health systems were weaker, and uncertainty was high. Unlike in developed markets, where strict lockdowns were associated with immediate economic slowdowns, emerging market REITs may have benefited from the perception that restrictive measures could help accelerate recovery and reduce long-term instability.

Additionally, emerging REIT markets tend to have different sectoral exposures, with relatively less emphasis on large-scale office or retail portfolios and more exposure to diversified or logistics-linked properties, which may have been less impacted by lockdowns. Therefore, while general resilience (as noted by Kola and Kodongo, 2017) supports the idea that these markets absorb shocks differently, the positive impact of stringency likely reflects a combination of policy perception, sector composition and investor adaptation.

The number of people vaccinated per 100 also shows notable variability. In developed markets, it has a positive and significant effect on REIT returns during the early stages of the pandemic, reflecting favourable investor sentiment as vaccination gained momentum. However, this positive impact weakens over time and becomes negative by 2022. This shift may reflect a change in investor priorities as once vaccination campaigns reached saturation and the public health crisis stabilized, market attention may have shifted towards macroeconomic risks such as inflation, rising interest rates, and tightening monetary policy. These concerns can negatively impact REIT valuations, particularly in interest rate sensitive environments like developed economies. Therefore, the declining influence of vaccination may not indicate reduced confidence in health outcomes, but rather the emergence of broader financial concerns in post-pandemic markets.

In emerging markets, however, the effect of PeopleVaccPer100 remains consistently negative and significant. This may be due to several factors: slower or fragmented vaccine rollouts, weak

healthcare infrastructure, or delays in corresponding policy adjustments such as reopening or fiscal relief. In these contexts, increasing vaccination rates may not have signaled immediate recovery, and may instead have coincided with uncertainty, ongoing economic fragility, or investor skepticism. This interpretation is supported by Gholipour et al. (2021), who found that elevated uncertainty during crisis often leads to reduced investment activity, regardless of positive external indicators like rising vaccination levels.

Control variables such as number of new deaths and positive rate, also show context-dependent effects. In the full sample, the number of deaths caused by Covid-19 is largely insignificant in the main regression, but becomes significant in the 2020-2021 robustness check, particularly in developed markets, indicating that during the peak of the pandemic, rising death rate were more influential factor. Similarly, Positive Rate is positive in the full sample for 2022, reflecting the broader market's shifts towards resilience and acceptance of higher testing and positivity rates. However, Positive Rate remains negative in emerging markets for both periods, suggesting that these regions continued to view high positivity rates as a risk. Harjoto et al. (2020) found a similar divergence, noting that while emerging markets responded strongly to both daily cases and mortality rates, developed markets showed more significant reactions to rising cases alone. The number of people fully vaccinated has positive and significant effect in 2022. This finding underscores the importance of vaccination program, as suggested by Oanh (2022), who concluded that vaccination plays a substantial role in stock market stability.

The overall robustness check shows that while the study's primary findings -Stringency Index and PeopleVaccper100- are relatively stable, the impact of these variables varies across time and market type. The full sample results provide an overarching view, but they may obscure specific trends unique to each market types. In developed markets, the influence of vaccination rates and lockdown restrictions evolves over time, with initial positive impacts on REIT returns diminishing or revering by 2022. This aligns with Bossman, Umar, and Teplova (2022), who found that COVID-19 cases impacted REIT returns more significantly under bearish conditions, highlighting how reduced investor confidence amid downturns can amplify the pandemic's negative effects. In emerging markets, the impact of vaccination rates and restrictions remains more stable, highlighting structural differences in how these economies responded to pandemic measures.

# Conclusion

The finding indicates a clear relationship between REIT returns, vaccination rates, and lockdown restrictions as predicted by $H_0$, suggesting that the Covid-19 pandemic had a significant impact on REIT performance globally. However, the magnitude of this impact varies when the full sample is disaggregated by developed and emerging markets. The difference implies that some markets experienced more substantial effects, while others had minimal impacts, highlighting the diverse responses of REIT markets to pandemic-related factors.

Both hypotheses, $H_1$ and $H_2$, are supported by the study results. $H_1$, which shows a positive relationship between vaccination rates and REIT returns, is accepted for the full sample, and developed markets. This finding suggests that increased in vaccination rates positively affected REIT performance, likely due to enhanced economic stability and investor confidence. However, in emerging markets, vaccination rates show a negative and significant association with REIT returns, indicating a different dynamic. This result could be due to slower economic stability and recovery in the emerging market (Deloitte, 2022). Emerging economies often face challenges such as higher inflation and volatile interest rates, which can dampen demand recovery even as vaccination rates increase. This statement is supported by Mpofu, Moobela and Simbanegavi (2023), who identified a structural break in February 2020, marking a shift from a negative to positive relationship between inflation and REIT returns in South Africa. Similarly, Khan and Siddiqui (2019) found that in developed markets like Singapore and Hong Kong, inflation and interest rates exhibit mixed relationships with REIT performance. While some markets benefit from economic stability, others experience adverse effects from volatility. Additionally, Lee and Lee (2014) found that REITs in developed markets tend to exhibit stronger inflation-hedging properties, suggesting that macroeconomic factors such as inflation may also influence REIT performance. However, this study does not explicitly include inflation as variable, and its potential effects of REIT returns remain an area for future research.

In addition to H1 and H2, the study also answered the secondary research questions by analysing the individual and joint effects of vaccination programs, lockdown restrictions, new Covid-19 deaths, positivity rates, and the timing of vaccination rollout across developed and emerging markets. These findings further reinforce the conclusion that REIT responses to pandemic-related policies are highly context-specific and evolve over time.

Consequently, factors like reduced tenant solvency and weaker consumer spending may

negatively impact REIT performance in these regions. Thus, H1 is only partially accepted, as the positive impact of vaccination on REIT performance varies by market type.

For H2, the Stringency Index, representing the severity of lockdown restrictions, exhibits a significant negative effect on REIT returns in full sample and developed markets, supporting the hypothesis. This suggests that stricter lockdown measures, which often restricts economic activity, are associated with lower REIT performance. However, in emerging markets, the Stringency Index has a significant positive effect, indicating contrasting response. This unexpected positive association in emerging markets may be due to structural differences or investor perceptions of lockdown measures as stabilizing factors, though this requires further investigation to fully understand this positive association.

The partial robustness observed in this study emphasizes the importance of examining REIT performance separately in developed and emerging markets, as well as accounting for the evolving nature of pandemic impacts over time. The study underscores that while some relationships are stable across context, others are highly contingent on specific economic environments and the phase of the pandemic. These findings contribute valuable insights into the temporal and regional complexities of REIT market responses to Covid-19, suggesting that future research should consider these nuances when analyzing REIT performance during periods of global disruption.

One limitation of the study relates to currency consistency. This mix of currency bases introduces potential exchange rate variability, which may affect the comparability of REIT returns across countries. Although log transformation and country fixed effects were applied to mitigate this issue, future research could strengthen cross-country comparability by converting all return indices to a common reference currency or by including exchange rate fluctuations as a control variable.

The findings also carry important practical implications for investors and policymakers. For investors, the contrasting results between developed and emerging markets highlight the importance of regional diversification and attention to policy response indicators, such as vaccination rates and lockdown severity, as part of REIT risk assessment during crisis. For policymakers, the study suggests that clear communication, timely intervention, and coordinated economic policy play a crucial role in sustaining investor confidence during health crisis. In emerging markets, especially, aligning vaccination efforts with broader recovery measures could improve REIT resilience.

Although this study is based on a panel of 10 countries, these markets account for approximately 50% of the global REIT index, providing a representative cross-section of both developed and emerging economies. The inclusion of diverse market structures, economic contexts, and pandemic responses enhances the external validity of the findings. Moreover, the use of daily data over a multi-year period, combined with robustness check across distinct phases of the pandemic, supports the temporal and contextual reliability of the result. Therefore, while findings are grounded in pandemic-specific data, they may offer broader insights into how REIT market respond to major global shocks, particularly in relation to government interventions and public health policies. Future studies could test the applicability of these findings in other regional contexts or under different types of systemic disruptions.

In summary, these findings demonstrate that the relationship between Covid-19 related factors and REIT performance is complex and varies across different market contexts. This underscores the critical role of economic context in assessing the impact of pandemic on REIT markets, highlighting those responses to global disruption may differ significantly between developed and emerging economies.

## Limitations, Recommendation, Further Work

While this study provides relationship between Covid-19 related factors and REIT returns on global perspective, some limitation should be considered.

This study examines 10 global REITs which also includes analysis on developed and emerging market. However, for price index, there is an inconsistent in currency as the United Kingdom uses the British Pound, South Africa (an emerging market) uses the South African Rand, while others use United States Dollar. This creates exchange rate variability that may influence the observed REIT returns. Differences in currency stability and fluctuations could contribute to apparent differences in REIT performance across the region. Therefore, it is recommended to address this limitation in future studies by normalizing returns in a common currency or controlling for currency effect.

The study examines the REIT performance in overall global REITs context rather than property sectors. Yet, during Covid-19 pandemic different property sectors have been impacted differently. Hence, the results may overlook nuances specific for each sector. Further research could examine sector-specific REIT performance.

The selection of 10 global REITs was based on market capitalization as shown on table 3.

During this selection, some countries were taken out due to unavailability of data, which may limit the generalizability of the findings. Large capitalization REITs may behave differently from smaller REITs especially to pandemic related factors. Therefore, the results may not fully represent the performance of all REITs worldwide, particularly smaller REITs with lower market capitalization.

There is an exclusion of other risk factor and external or internal factors that influence the REIT returns. The exclusion of these factors such as interest rate changes, inflation may have a significant impact on REIT performance yet are beyond the scope of this study.

This study does not conduct formal panel unit root testing due to the unbalanced structure of the daily dataset and the presence of time gaps across countries. However, the risk of non-stationarity is mitigated through the use of log-transformed variables and the inclusion of both country and time fixed effects.

Lastly, this study does not account for the type of Covid-19 used for each country. This could be considered by researchers for further study.

# References

Acharya, V. *et al.* (2020) *The value of a cure: An asset pricing perspective* [Preprint]. doi:10.3386/w28127.

Akinsomi, O., 2020. How resilient are REITs to a pandemic? The COVID-19 effect. *Journal of Property Investment & Finance*, 39(1), pp.19-24.

Al-Awadhi, A., Alsaifi, K., Al-Awadhi, A. and Alhammadi, S., 2020. Death and contagious infectious diseases: Impact of the COVID-19 virus on stock market returns. *Journal of Behavioral and Experimental Finance*, 27, p.100326.

Alfaro, L., Chari, A., Greenland, A. and Schott, P., 2020. Aggregate and Firm-Level Stock Returns During Pandemics. *SSRN Electronic Journal*.

Ampountolas, A. and Shaw, G. (2022) 'COVID-19 Impact on the Stock Market Indices' Performance and the REITs Index,' *SSRN Electronic Journal* [Preprint]. https://doi.org/10.2139/ssrn.4310578.

Anglin, P., Cui, J., Gao, Y. and Zhang, L., 2021. Analyst Forecasts during the COVID-19 Pandemic: Evidence from REITs. *Journal of Risk and Financial Management*, 14(10), p.457.

Aro-Gordon, S., M. Bashir, A., O. Abdulsalam, D. and Abdullahi, H., 2014. An Assessment of Recent Market Performance of REITs in a Developing Economy. *IOSR Journal of Business and Management*, 16(8), pp.16-21.

Ashraf, B., 2020. Stock markets' reaction to COVID-19: Cases or fatalities?. *Research in International Business and Finance*, 54, p.101249.

Atalan, A., 2020. Is the lockdown important to prevent the COVID-19 pandemic? Effects on psychology, environment and economy-perspective. *Annals of Medicine and Surgery*, 56, pp.38-42.

Ayaba, M.M., Amo-Bediako, E. and Takawira, O. (2023) 'Evaluating the financial performance of listed REIT firms in South Africa: A 7-step Dupont model technique', *International Journal of Applied Economics, Finance and Accounting*, 17(2), pp. 267–278. doi:10.33094/ijaefa.v17i2.1146.

Bakry, W. *et al.* (2021) 'Response of stock market volatility to COVID-19 announcements and

stringency measures: A comparison of developed and emerging markets,' *Finance Research Letters*, 46, p. 102350. https://doi.org/10.1016/j.frl.2021.102350.

Balemi, N., Füss, R. and Weigand, A., 2021. COVID-19's impact on real estate markets: review and outlook. *Financial Markets and Portfolio Management*.

Behera, J., Pasayat, A. and Behera, H., 2022. COVID-19 Vaccination Effect on Stock Market and Death Rate in India. *Asia-Pacific Financial Markets*.

Binti Mohamad, N.E. and Bin Zolkifli, I.A. (2014) 'The determinant factors of real estate investment trust (REIT)'s Performance: Evidence from Asian reits', *Indonesian Capital Market Review*, 6(1). doi:10.21002/icmr.v6i1.2987.

Bloom, N. (2009) 'The impact of uncertainty shocks', *Econometrica*, 77(3), pp. 623–685. doi:10.3982/ecta6248.

Bonato, M., Ç epni, O., Gupta, R. and Pierdzioch, C., 2021. Uncertainty due to infectious diseases and forecastability of the realized variance of United States real estate investment trusts: A note. *International Review of Finance*.

Bossman, A., Umar, Z. and Teplova, T. (2022) 'Modelling the asymmetric effect of COVID-19 on REIT returns: A quantile-on-quantile regression analysis,' *The Journal of Economic Asymmetries*, 26, p. e00257. https://doi.org/10.1016/j.jeca.2022.e00257.

Brounen, D. and de Koning, S., 2012. 50 Years of Real Estate Investment Trusts: An International Examination of the Rise and Performance of REITs. *Journal of Real Estate Literature*, 20(2), pp.197-223.

Cepni, O., Dul, W., Gupta, R. and Wohar, M.E., 2021. The dynamics of US REITs returns to uncertainty shocks: a proxy SVAR approach. *Research in International Business and Finance*, p.101433.

Chang, C., Chou, J. and Fung, H., 2012. Time dependent behavior of the Asian and the US REITs around the subprime crisis. *Journal of Property Investment & Finance*, 30(3), pp.282-303.

Chong, J. and Phillips, G.M., 2021. COVID-19 Losses to the Real Estate Market: An Equity Analysis. *Finance Research Letters*, p.102131.

Chong, W.L., Ting, K.H. and Cheng, F.F. (2017) 'The performance of externally managed reits

in Asia', *Journal of Property Investment & Finance*, 35(2), pp. 200–227. doi:10.1108/jpif-08-2016-0067.

Chu, X., Lu, C. and Tsang, D., 2021. Geographic Scope and Real Estate Firm Performance during the COVID-19 Pandemic. *Journal of Risk and Financial Management*, *14*(7), p.309.

Corgel, J., McIntosh, W. and Ott, S., 1995. Real Estate Investment Trusts: A Review of the Financial Economics Literature. *Journal of Real Estate Literature*, 3(1), pp.13-43.

Creswell, John W. and J. David, Creswell. 2018. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches.* Los Angeles: SAGE

Dimovski, B. and O'Neill, L., 2012. Characteristics of A-Reit Private Placements During the Global Financial Crisis. *Pacific Rim Property Research Journal*, 18(2), pp.180-190

Dubreuille, S., Cherif, M. and Bellalah, M. (2016) 'Real Options: An Alternative Valuation Model for the U.S. REIT Market ', *INTERNATIONAL JOURNAL OF BUSINESS*, 21(1).

Fernández Cerezo, A., Lamas, M., Roibas, I. and Vegas Sánchez, R., 2021. Impact of the COVID-19 Pandemic on the Spanish Commercial Real Estate Market. *Banco de Espana Article*, *21*, p.26.

Gholipour, H.F., Tajaddini, R., Farzanegan, M.R. and Yam, S., 2021. Responses of REITs Index and Commercial Property Prices to Economic Uncertainties: A VAR Analysis. *Research in International Business and Finance*, p.101457.

Hale, T., Angrist, N., Goldszmidt, R., Kira, B., Petherick, A., Phillips, T., Webster, S., Cameron-Blake, E., Hallas, L., Majumdar, S., & Tatlow, H., 2021. A global panel database of pandemic policies (Oxford Covid-19 Government Response Tracker). Nature Human Behaviour, forthcoming.

Han, J. and Liang, Y., 1995. The Historical Performance of Real Estate Investment Trusts. *Journal of Real Estate Research*, 10(3), pp.235-262

Harjoto, M.A. *et al.* (2020) 'How do equity markets react to COVID-19? Evidence from emerging and developed countries,' *Journal of Economics and Business*, 115, p. 105966. https://doi.org/10.1016/j.jeconbus.2020.105966.

He, Q., Liu, J., Wang, S. and Yu, J., 2020. The Impact of COVID-19 on Stock Markets. *SSRN Electronic Journal.*

Khalfaoui, R., Nammouri, H., Labidi, O. and Ben Jabeur, S., 2021. Is the COVID-19 vaccine effective on the US financial market?. *Public Health*, 198, pp.177-179.

Khan, S. and Siddiqui, D., 2019. Factor Affecting the Performance of REITs: An Evidence from Different Markets. *SSRN Electronic Journal*,. <https://www.researchgate.net/publication/333744057_Factor_Affecting_the_Performance_of_REITs_An_Evidence_from_Different_Markets>

Khoi Pham, A., 2011. The performance of Thai-REITs in a mixed-asset portfolio. *Pacific Rim Property Research Journal*, 17(2), pp.197-214.

Kim, B.S., 2009. The Impact of the Global Financial Crisis on Asia-Pacific Real Estate Markets: Evidence from Korea, Japan, Australia and U.S. REITs. *Pacific Rim Property Research Journal*, 15(4), pp.398-416.

Koh, D., 2020. COVID-19 lockdowns throughout the world. *Occupational Medicine*, *70*(5), pp.322-322.

Kola, K. and Kodongo, O. (2017) 'Macroeconomic risks and REITs returns: A comparative analysis,' *Research in International Business and Finance*, 42, pp. 1228–1243. https://doi.org/10.1016/j.ribaf.2017.07.061.

Kuhle, J., 1987. Portfolio Diversification and Return Benefits— Common Stock vs. Real Estate Investment Trusts (REITs). *Journal of Real Estate Research*, 2(2), pp.1-9.

Lee, C.L. and Lee, M.-L. (2014) 'Do European real estate stocks hedge inflation? evidence from developed and emerging markets', *International Journal of Strategic Property Management*, 18(2), pp. 178–197. doi:10.3846/1648715x.2014.925521.

Lemenager, T., Neissner, M., Koopmann, A., Reinhard, I., Georgiadou, E., Müller, A., Kiefer, F. and Hillemacher, T., 2020. COVID-19 Lockdown Restrictions and Online Media Consumption in Germany. *International Journal of Environmental Research and Public Health*, 18(1), p.14.

Ling, D., Wang, C. and Zhou, T., 2020. A First Look at the Impact of COVID19 on Commercial Real Estate Prices: Asset Level Evidence. *SSRN Electronic Journal*.

Ma, X., 2020. Future Development Trends of REITs in Mainland China. *E3S Web of Conferences*, 218, p.02011.

Marzuki, M. and Newell, G., 2018. The emergence of Spanish REITs. *Journal of Property Investment & Finance*, 36(5), pp.495-508

Mathieu, E., Ritchie, H., Ortiz-Ospina, E., Roser, M., Hasell, J., Appel, C., Giattino, C. and Rodés-Guirao, L., 2021. A global database of COVID-19 vaccinations. *Nature Human Behaviour*, 5(7), pp.947-953.

Milcheva, S., 2021. Volatility and the Cross-Section of Real Estate Equity Returns during Covid-19. *The Journal of Real Estate Finance and Economics*.

Min, H., Shin, S. and de La Paz, P.T., 2021. COVID-19 and the daily rate of return of three major industry sector stock price indices related to real estate. *Journal of Property Investment & Finance*.

Morri, G. and Liu, W., 2017. US REITs' Returns Sensitivity to Interest Rates after the Global Financial Crisis. *SSRN Electronic Journal*,.https://www.researchgate.net/publication/319585149_US_REITs'_Returns_Sensitivity_to_Interest_Rates_after_the_Global_Financial_Crisis

Mpofu, B., Moobela, C. and Simbanegavi, P. (2023) 'Effects of COVID-19 on the relationship between inflation and REITs returns in South Africa,' *Journal of Property Investment and Finance*, 41(5), pp. 506–522. https://doi.org/10.1108/jpif-10-2022-0072.

Newell, G. and Marzuki, M., 2018. The emergence and performance of German REITs. *Journal of Property Investment & Finance*, 36(1), pp.91-103.

Newell, G. and Najib Razali, M., 2009. The Impact of the Global Financial Crisis on Commercial Property Investment in Asia. *Pacific Rim Property Research Journal*, 15(4), pp.430-452.

Newell, G. and Peng, H., 2009. The Impact of the Global Financial Crisis on A-REITs. *Pacific Rim Property Research Journal*, 15(4), pp.453-470.

Newell, G., Yue, W., Kwong Wing, C. and Siu Kei, W., 2010. The Development and Performance of REITs in Hong Kong. *Pacific Rim Property Research Journal*, 16(2), pp.190-206.

Ntuli, M. and Akinsomi, O. (2016) 'An Overview of the Initial Performance of the South African REITs Market,' *SSRN Electronic Journal* [Preprint].

https://doi.org/10.2139/ssrn.2846090.

O'Hara, R.B. and Kotze, J. (2010) 'Do not log-transform count data,' *Nature Precedings* [Preprint]. https://doi.org/10.1038/npre.2010.4136.1.

Oanh, T.T.K. (2022) 'The impact of COVID-19 vaccination on stock market: is there any difference between developed and developing countries?,' *Heliyon*, 8(9), p. e10718. https://doi.org/10.1016/j.heliyon.2022.e10718.

Reddy, W., and Wong, W.W. (2017). Impact of Interest Rate Movements on A-REITs Performance Before, During And After The Global Financial Crises. [online] Semanticsholar.org.<https://www.semanticscholar.org/paper/Impact-of-Interest-Rate-Movements-on-A-REITs-During-Reddy-Wong/ad12ed058f9bb4699cbf61f2fded77e63fece9a7>

Roser, M., 2021. *What is the COVID-19 Stringency Index?*. [online] Our World in Data. Available at: <https://ourworldindata.org/metrics-explained-covid19-stringency-index> [Accessed 18 August 2022].

Rouatbi, W., Demir, E., Kizys, R. and Zaremba, A., 2021. Immunizing Markets against the Pandemic: COVID–19 Vaccinations and Stock Volatility around the World. *SSRN Electronic Journal*,.

Schaffer DeRoo, S., Pudalov, N. and Fu, L., 2020. Planning for a COVID-19 Vaccination Program. *JAMA*, 323(24), p.2458.

Scherf, M., Matschke, X. and Rieger, M., 2022. Stock market reactions to COVID-19 lockdown: A global analysis. Finance Research Letters, 45, p.102245.

Smith, K., and Shulman, D., 1976. The Performance of Equity Real Estate Investment Trusts. *Financial Analysts Journal*, 32(5), 61-66

Stock, J.H. and Watson, M.W. (2020) *Introduction to Econometrics*. 4th edn. Pearson.

Ţiţan, A.G. (2015) 'The Efficient Market Hypothesis: Review of specialized literature and Empirical Research', *Procedia Economics and Finance*, 32, pp. 442–449. doi:10.1016/s2212-5671(15)01416-1.

Titman, S. and Warga, A., 1986. Risk and the Performance of Real Estate Investment Trusts: A Multiple Index Approach. *Real Estate Economics*, 14(3), pp.414-431.

Topcu, M. and Gulal, O., 2020. The impact of COVID-19 on emerging stock markets. *Finance Research Letters*, 36, p.101691.

Topcu, M. and Gulal, O.S. (2020) 'The impact of COVID-19 on emerging stock markets,' *Finance Research Letters*, 36, p. 101691. https://doi.org/10.1016/j.frl.2020.101691.

Wooldridge, J.M. (2010) *Econometric Analysis of Cross Section and Panel Data, second edition*. MIT Press.

World Health Organization, 2020. Coronavirus disease (COVID-19) outbreak situation, retrieved from:https://www.who.int/emergencies/diseases/novelcoronavirus-2019.

Xie, L. and Milcheva, S., 2020. Proximity to COVID-19 Cases and REIT Equity Returns. Available at *SSRN 3641268*

Xu, H., Hwan Lee, S. and Ho Eom, T. (2007) 'Introduction to panel data analysis', *Handbook of Research Methods in Public Administration, Second Edition* [Preprint]. doi:10.1201/9781420013276.ch32.

Zeren, F. and Hizarci, A., 2020. The Impact of Covid-19 Coronavirus on Stock Markets: Evidence from Selected Countries. *Muhasebe ve Finans İncelemeleri Dergisi,*.