THE DYNAMICS OF THE IMPACT OF THE COVID-19 PANDEMIC ON PAN-ASIA'S REAL ESTATE INVESTMENT TRUSTS

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ARTICLE INFO	ABSTRACT
Keywords: dynamic, Pan-Asia, REITs, COVID-19, real estate *JEL Classification:* G11, G20	This study evaluated the dynamics of Real Estate Investment Trusts (REITs) in Pan-Asian countries impacted by COVID-19. The countries comprised Malaysia, Thailand, Indonesia, Singapore, Vietnam, South Korea, Japan, China, the Philippines, and Hong Kong. The study aimed to understand how the global crisis affected the real estate industry, specifically publicly traded companies. The COVID-19 pandemic significantly impacted many industries worldwide, including real estate. It caused changes in supply and demand dynamics, disrupted business operations and affected economic activity. The pandemic has also caused a general economic slowdown, with businesses struggling and unemployment rates increasing in some countries in Asia. This in turn has led to reduced consumer spending and lower demand for all types of properties, impacting the overall performance of the Asian REITs market. This study employed techniques such as Sharpe ratio, variance ratio, and Analysis of Variance (ANOVA) to highlight the dynamics of Asian REITs towards the impact of COVID-19. The findings revealed that all Asian countries were severely impacted by COVID-19, with Japan REITs experiencing the highest drop and Taiwan REITs experiencing the lowest decline.
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1. Introduction

Generally, REITs enable investors to invest or participate in a trade involving property or income-generating real estate. These real estate assets include commercial buildings such as office buildings and shopping malls, apartments, storage facilities, hotels, and even resorts. These investment offers are made via REITs, which are trusts that predominantly buy and develop properties, not for the purpose of resale but to operate them as a component of an investment structure (Jing & Samsudin, 2018). REITs serve as crucial investment instruments that cater to the unique needs of investors and provide risk diversification. Investing in REITs has dual advantages, enabling investors to invest in commercial real estate and publicly traded equities (Rehman et al., 2022).

Investments in real estate are secured indirectly by investors via REITs that own property (developed and undeveloped) and generate income associated with real estate investment (criterion for REITs). REITs are also afforded favorable treatment regarding taxes, lower perceived risk profiles, and benefits linked to diversification within portfolio baskets and mandated dividends. As indicated by Chen et al. (2022) and Razali and Sing (2015), after the 2008 financial crisis, REITs experienced a significant rebound, primarily attributed to their higher liquidity and lower trade costs, respectively, as well as comparatively lower volatility when compared to non-REIT equities. Nevertheless, the impact of the COVID-19 pandemic that started in 2019 resulted in different dynamics,

which caused investors to move their interest to REITs very cautiously.

It is natural for investors to emphasize returns after considering associated risk levels, inflation, tax, and other applicable macroeconomic-related elements. This generally led investors to hold weak portfolios and make uninformed decisions based on misplaced expectations during unprecedented scenarios such as the COVID-19 pandemic. There needs to be more understanding of the impact of such situations on macroeconomic factors, which in turn exerts a negative influence on REIT returns. However, the mechanisms that have transpired from the pandemic to the macroeconomic factors and subsequently to returns on REITs require in-depth understanding to avoid losses in the future. It is not a question of whether or not a pandemic will occur again, but rather a question of when, as they are bound to happen. Therefore, their impact (how, what, and why) must be examined meticulously from both qualitative and quantitative perspectives.

Assessing the impact of the COVID-19 pandemic on the dynamic of REITs is crucial, particularly concerning the returns of REITs, given that the pandemic is a recognized risk factor for investments. Additionally, it is vital to consider macroeconomic factors when evaluating the level of return on investment, which can be determined by analyzing returns on a country-by-country basis. The COVID-19 pandemic has spread worldwide in several waves, with varying impacts observed in different countries (Bossman et al., 2022).

Investors often expect higher returns to balance out the greater risk associated with their investments, with riskier investments typically expected to yield a more significant risk premium. However, the COVID-19 pandemic has caught investors off-guard, leading to increased volatility in REITs worldwide. As Lansing et al. (2017) suggested, the persistent stochastic volatility of fundamental variables may contribute to the unpredictability of returns.

2. Literature review

Asian economies continued to function as the primary growth engine of the global economy. They were projected to show the most substantial growth in 2022, with a growth projection of 5% compared to 5.6% in 2017 and 5.5% in 2018. Examining the region's performance before the COVID-19 pandemic, it is revealed that, in 2016, Asian trade elements presented faster growth than global trade (although still below

global economic growth). Asian trade growth was steady until 2020 when the pandemic adversely affected economies worldwide and impacted REIT returns globally (IMF, 2022). However, from 2017 to 2021, as world trade growth slowed to below 2%, Asian trade growth decelerated only slightly, due to increased import growth driven by demand from China and India, the two largest economies in the world. During this time, trade growth accelerated for Asia up to 7.4% in 2017 and fell by 3% by 2021. It is expected to continue to gain momentum in the post-pandemic period as recovery progresses (Asian Development Bank Report 2021).

Before 2001, there were no Asian REITs. They were however, active in other regions, such as the U.S. (since the 1960s), the Netherlands (since 1969), Australia (since 1971), Canada and Ghana (since 1994), Belgium and Brazil (since 1995), and Turkey and Greece (since 1999), in the form of LPTs (Listed Property Trusts). Japan was the first Asian country to establish REITs in 2001 (J-REITs), followed by South Korea, with 15 trusts listed on the Korean Stock Exchange (K-REITs). Singapore established S-REITs in 2002 and currently has 38 listed trusts on the Stock Exchange of Singapore. As of December 2021, there were over 61 REITs listed on the Osaka Stock Exchange and the Tokyo Stock Exchange, with a combined market capitalization of over USD 100 billion, paying an average dividend yield of more than 3.5%. Islamic REITs (I-REITs) were first established in Malaysia in 2005. Since then, the number of I-REITs in Malaysia has grown, with several Islamic-compliant REITs currently listed on Bursa Malaysia. I-REITs adhere to the Shariah principles, avoiding investments in industries such as gambling, tobacco, pornography, and alcohol, while complying with Islamic financial principles of profit and loss-sharing and asset-based financing. The Asian REIT markets possess unique real estate characteristics that require an in-depth understanding. The availability of improved real estate information has been further supported by understanding the dynamics of the Asian REIT markets (Newell, 2021).

The driving forces behind the expected growth of Asian REITs have been attributed to interest expressed in these REITs by two of the biggest economies in the world: China and India. The expectation of the Asian REITs market was targeted for continuous growth as Asia represented 25% of the global market. This growth was equivalent to USD 7 trillion in real estate that was investable by 2020; however, the arrival of

COVID-19 altered these projections significantly. According to APREA (2022), as of the end of 2021, the market value of the Asian REITs market was approximately USD 457 billion. The market value of Asian REITs has grown significantly over the years, reflecting the growing importance of this investment instrument in the real estate industry. Figure 1 summarizes the annual total returns of Asia ex-Japan REITs from 2010 to 2020 in terms of price return and dividend return. The analyses show that Asian REITs experienced negative and positive returns between price and dividend. The year 2012 saw the most significant price and dividend returns. During the pandemic crisis in 2020, Asian REITs began to show negative price returns and a decline in dividend returns.
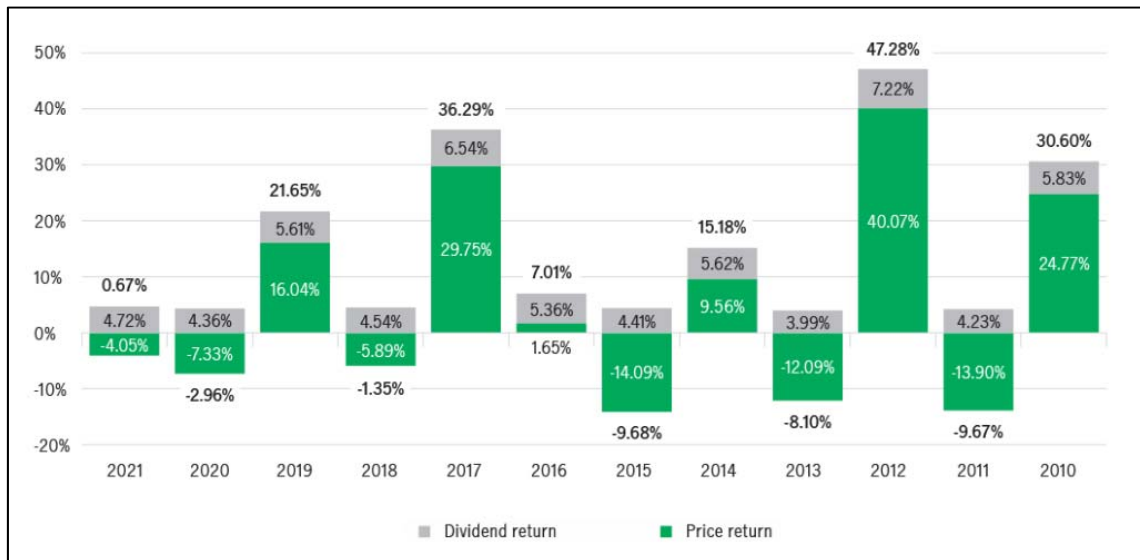

Fig. 1. Annual Total Returns of Asia Pacific ex-Japan REITs: 2010-2021 (Bloomberg, December 2021). Source: own study.

Due to COVID-19, REIT returns in other regions, such as the U.S., endured a dramatic decrease and a fat-tailed distribution with significant disparities between industries. However, Asian REIT responses varied significantly from those of REITs in many ways. Although the pandemic has spread around the globe, the earnings of companies based in Asia were less adversely impacted than those in other countries. The response of Asia and other regions to COVID-19 also revealed a significant sector-based performance discrepancy. While, in markets such as U.S., REITs exhibit significant performance variations based on the real estate sectors they specialize in, Asian REITs exhibit fewer sectoral differences.

Regarding the risk on the returns, REIT sensitivity to COVID-19 risks does not differ across sectors in Asia, but there are significant variances in the other regions. For most risk variables, like in the U.S., corporations have become more sensitive to COVID-19. In Asia, the sensitivity was low before the pandemic and mainly turned hostile during the first several months of the pandemic. This implies that Asian REITs and REITs in other regions had significantly different responses to the pandemic, which may be explained by Asia's experience with other pandemics similar to COVID-19. When the world economy experiences similar shocks, Asian REITs act as a good hedge despite the performance of their non-market being severely impacted.

The COVID-19 pandemic significantly impacted the global REIT market, leading to a decline in returns and increased volatility. According to a report by the National Association of Real Estate Investment Trusts (NAREIT), the global REIT market had a negative return of -15.4% in the first quarter of 2020, which was the most significant decline since the Global Financial Crisis (GFC) in 2008 (NAREIT, 2021). The pandemic led to a sharp drop in demand for commercial properties such as office buildings, hotels, and retail spaces. Due to lockdowns and social distancing measures, businesses were forced to shut down or operate at reduced capacity (Chen et al., 2022).

However, the REIT market showed resilience in the latter half of 2020 and the beginning of 2021, with a strong return recovery. In the fourth quarter of 2020, the global REIT market had a return of 13.2%; in the first quarter of 2021, it had a return of 8.6% (NAREIT, 2021). This recovery was driven by the gradual

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reopening of economies and the rollout of COVID-19 vaccines, which improved investor sentiment and renewed demand for real estate properties.

The pandemic also led to changes in the global REIT market, with a shift in focus towards properties that catered to the new normal, such as data centers and logistics properties. Data centers, in particular, saw a surge in demand as businesses relied more heavily on digital infrastructure due to remote working arrangements (Knight Frank, 2021). Additionally, logistics properties benefited from the rise of e-commerce as more consumers turned to online shopping during the pandemic (Knight Frank, 2021).

A series of studies have recently been conducted to gauge the impact of the COVID-19 pandemic on stock market performances in different countries. For example, Chaudhary et al. (2020) analyzed the effect of COVID-19 on the daily return volatilities of stock markets in the top 10 GDP-based countries (including the U.S., China, Japan, Germany, India, the UK, France, Italy, Brazil, and Canada) between January 2019 and June 2020. Their findings showed a daily negative mean return for the mentioned index between January 2020 and June 2020, characterized by high volatility compared to regular periods. These markets have been observed to have a higher degree of interconnectedness post-COVID-19. Gunay and Kurtulmuş (2021) examined the financial contagion in various stock markets. Results indicated that while the time-varying correlations of Chinese and Turkish stock markets weakened between 2005 and 2019, they rose by 20% in 2020 due to the pandemic. Alber (2020) investigated the impact of COVID-19 on stock market returns in the U.S., China, France, Italy, Spain, and Germany, revealing that daily confirmed COVID-19 cases had a more significant adverse effect on stock returns in China, France, Spain, and Germany, compared to the U.S. and Italian markets.

Similarly, He et al. (2020) evaluated the impact of the COVID-19 pandemic on Asian and developed countries' stock markets using daily data. Their findings showed that the COVID-19 pandemic had a negative impact on the stock markets in China, Italy, South Korea, Spain, France, Germany, Japan, and the U.S. However, this negative impact was not limited to these groups of markets, as it also affected global financial markets.

Previous studies revealed the impact of COVID-19 on the real estate sector. Hoesli and Malle (2021) conducted a trajectory analysis of the impact of COVID-19 on commercial real estate prices in the European regime, revealing that the retail and hospitality sectors were most affected by the pandemic. Meanwhile, Ling et al. (2020) studied the effect of GeoCOVID-19 cases on commercial real estate portfolios and found an inverse relationship between the risk of GeoCOVID-19 and excess corporate real estate portfolio returns. Milcheva (2021) utilized the systemic shocks associated with COVID-19 to investigate the risk-return relationship between self-developed regional pandemic risk factors and real estate equity indices in selected Asian and U.S. markets. The study found a negative sensitivity of the Asian (U.S.) markets to COVID-19 risk factors, indicating significant heterogeneity among real estate equities in the studied regions.

NAREIT reported that commercial real estate properties, including office, retail, hotel, industrial, data centers, etc., experienced rising vacancy rates and falling rent growth in 2020, albeit with considerable variation across property types, geographic locations, and property quality. In Q3 2020, the vacancy rates for office and retail REITs increased to 10.7% and 5.0%, from 9.9% and 4.7%, respectively, in Q1 2020. However, the increase in industrial REIT vacancy rates (30 basis points) was due to the excessive supply and elevated pace of construction, despite the great demand for logistics spaces from booming e-commerce transactions. Residential REIT vacancy rates remained unchanged as people migrated from urban cores to suburbs and smaller cities due to pandemic concerns and the practice of working from home. In Q3 2020, valuation in office and retail REITs fell by 3.8% and 3.2%, respectively, compared to Q3 2019, while multi-family residential and industrial REITs steadily rose in the same quarter.

The direct impact of COVID-19 on the change in average returns across different portfolios is correlated with market risk factors. However, the similarity between Asia and countries such as the U.S. is the vital role contributed by the value of the risk loading factor, suggesting the valuation effects were controlled during the pandemic period. REITs responded to the COVID-19 risk factor sensitivity indicator more favorably in the U.S. than in Asia. The positive correlation between market risk factors and returns suggests that COVID-19 had a low-risk impact unrelated to sentiment, as shown by the unsystematic risk insignificant coefficient (Milcheva, 2022).

3. Data and Methods

The analysis of the seven Asian REIT countries will be outlined, including the data sources, the formulas used to explain the results, and the appropriate methods for conducting the analysis. Additionally, the study conditions necessitate both descriptive and inferential analysis to achieve a more accurate approximation of the predictive values.

The methodology used in this study involved the application of three statistical tools: Sharpe ratio, variance ratio, and ANOVA. The Sharpe ratio was used to evaluate the risk-adjusted returns of the REITs, which measures the excess return earned above the risk-free rate per unit of volatility. A higher Sharpe ratio indicates a better risk-adjusted return. The variance ratio was used to test for long-term dependence in the REIT returns. The variance ratio compares the variance of the returns over different time horizons to test if they are independent and identically distributed. ANOVA was used to analyze the differences in the mean returns of REITs across different countries. ANOVA is a statistical test that examines the variation among the means of different groups to determine if there is a statistically significant difference between them. The data used in this study was obtained from publicly available sources and included monthly return data for listed property companies in seven Asian countries. The data was analyzed using the Sharpe ratio, variance ratio, and ANOVA to determine the impact of the COVID-19 pandemic on REIT performance in these countries.

The study focuses on seven Asian countries: Japan (J.P.), South Korea (K.R.), Singapore (S.G.), Hong Kong (H.K.), Malaysia (MY), Taiwan (T.W.), and Thailand (T.H.). These countries have established, emerging, and nascent REIT markets, as summarized in Table 1. Japan, Hong Kong, and Singapore have well-established REIT markets and are used as benchmarks for comparison with Malaysia, South Korea, Thailand, and Taiwan, whose markets are still emerging and nascent. The study period is from January 2017 to December 2021.

Table 1

Research data for Asian REITs

Country	Year Established	Name of REITs	Name of Stock Exchange	Number of REITs (As of Dec 2022)	Market Maturity
Japan	2001	J-REITs	Tokyo Stock Exchange and Osaka Stock Exchange	61	Established
South Korea	2001	K-REITs	Korea Stock Exchange	15	Emerging
Singapore	2002	S-REITs	Singapore Exchange Limited	38	Established
Hong Kong	2003	HK-REITs	Hong Kong Stock Exchange	12	Established
Malaysia	2004	M-REITs	Malaysia Stock Exchange	18	Emerging
Taiwan	2005	T-REITs	Taiwan Stock Exchange	7	Nascent
Thailand	2014	Thai-REITs	Stock Exchange of Thailand	43	Nascent

Source: Eikon Datastream (2022).

The performance profile is evaluated over two sub-periods in order to investigate the effects of the COVID-19 pandemic on Asian REITs. These periods are categorized into pre-Covid and during Covid periods. The following shows the length of the sub-periods:

Pre-Covid: January 2017 to February 2020
During Covid: March 2020 to December 2022

The analysis addresses the performance and differences in macroeconomic factors over these two sub-periods regarding returns, risks, and risk-adjusted returns. The changes will also be examined from the perspective of volatility dynamics and market efficiency using econometric methods. In addition, the capability and momentum of recovery of REITs post-COVID will be investigated. The findings will provide a clearer perspective on the impact of elements on the global economy, such as the effects the COVID-19 pandemic exerted on the macroeconomic factors of every country around the globe and its subsequent influence on the dynamics of the Asian REITs market.

Investors will remain cautious when dealing with high-risk investments and usually opt for lower-risk investments. In order to know which of the seven Asian countries have the highest and lowest risk, a risk-adjusted return should be calculated. However, high risk does not necessarily mean high returns. Hence, the performance of the portfolios should be examined via the utilization of the risk-adjusted returns.

The Sharpe ratio predominantly measures risk-adjusted returns or profits earned from investments. It calculates the amount of profit earned relative to the amount of risk taken. To calculate the Sharpe ratio, it is necessary to analyze the annual risk (volatility) and

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average annual return for the investment. The Sharpe ratio measures an investment's performance, with a higher ratio indicating better performance. This tool will help fulfill the second objective of this research, which is to analyze which portfolio ranks the highest and best among all. To identify changes in the investment dynamics of Asian REITs over the past five years, the pre-COVID and during-COVID periods are analyzed. The following formula is used to calculate the Sharpe ratio:

$$S = \frac{R_x - RR_f}{\sigma} \tag{1}$$

where:
S   - Sharpe ratio,
R_x - average annual return,
RR_f - real risk-free rate,
σ - average annual risk (standard deviation).

Price fluctuations or activities should reflect a random walk to achieve an efficient market. Therefore, the methodologies of Boehmer and Kelley (2009), O'Hara and Ye (2011), and Conrad, Wahal, and Xiang (2015), who used the variance ratio test to measure efficiency, are adopted for this research. They concluded that efficiency measurements using the variance ratio test are viable and applicable.

The variance ratio test established by Lo and Mackinlay (1988) indicated that in the sampling interval, the variance of the random walk increased linearly (directly proportional to and shadowing a random walk). The relationship of stock return variances over various holding periods is compared in the test. According to the hypothesis of the random walk, where there should be no significant difference, the variance ratios should be equal to one. The hypothesis of the variance ratio is shown below:

$H_0: \sigma_1^1 = \sigma_2^2$

$H_a: \sigma_1^1 \neq \sigma_2^2$

where:
H_0 - null hypothesis,
H_a - alternative hypothesis,
σ - variance.

The variance ratio test makes it possible to use stock return data that overlap, which raises the total number of observations utilized in the construction of the test statistic. This methodology also incorporates a correction for the stock return's homogeneity of variance in the test statistic. Compared to conventional serial correlation tests, these attributes boost the test's effectiveness and efficiency. The

following figure shows the difference between the two population variances.

The established, emerging, and nascent REIT markets are compared so investors can enhance their portfolios and management. If the variance ratio equals one, the return follows a random walk. However, if it is less than one, it indicates that the returns are experiencing a mean reversion, while if it is more than one, it indicates that the returns are experiencing mean aversion. The formula for the variance ratio is adapted from a study conducted by Alam, Hasan, and Kadapakkam (1999), as shown below:

$$VR(q) = \frac{\sigma_c^2(q)}{\sigma_a^2(q)} \tag{2}$$

where:
VR (q)   - variance ratio at lag q,
$\sigma_c^2(q)$ - difference in returns P_t of variance of qth with the unbiased estimator of $\frac{1}{q}$,
$\sigma_a^2(q)$ - variance of the 1st difference of P_t associated with the unbiased estimator.

Whereas, the $\sigma_c^2(q)$ and $\sigma_a^2(q)$ are calculated as;:

$$\sigma_c^2(q) = \frac{1}{m}\sum_{t=q}^{nq}(P_t - P_{t-1} - q\hat{\mu})^2 \tag{3}$$

where:

$$m = q(nq - q + 1)(1 - \frac{q}{nq}) \tag{4}$$

and

$$\sigma_a^2(q) = \frac{1}{nq-1}\sum_{t=1}^{nq}(P_t - P_{t-1} - \hat{\mu})^2 \tag{5}$$

where:

$$\hat{\mu} = \frac{1}{nq}(P_{nq} - P_0) \tag{6}$$

These formulas are applied with the assumption of homoscedasticity, which allows for the formula of the standard test statistic Z as follows:

$$Z(q) = \frac{VR(q)-1}{[\phi(q)]^{1/2}} \sim N(0,1) \tag{7}$$

where:

$$\phi(q) = \frac{2(2q-1)(q-1_-)}{3q(nq)} \tag{8}$$

Meanwhile, the formula of the standard test statistic Z* for heteroscedasticity-consistent is:

$$Z*(q) = \frac{VR(q)-1}{[\phi*(q)]^{\frac{1}{2}}} \sim N(0.1) \tag{9}$$

where:

$$\phi*(q) = \sum_{j=1}^{q-1}[\frac{2(q-j)}{q}]2\delta(j) \tag{10}$$

and

$$\hat{\delta}(j) = \frac{\sum_-(t=j+1)(P_t - P_{t-1} - (\mu)^2((P_t - P_{t-1} - (\mu))}{[\sum_-(t=j+1)(P_t - P_{t-1} - (\mu)]^2} \tag{11}$$

While a positive value of Z*(q) would indicate persistence in REIT returns, a negative value would indicate mean reversion.

This research study aims to analyze the dynamics of Asian REITs by conducting econometric analyses, such as the Sharpe and variance ratios. The research focuses on seven Asian countries, including Japan, South Korea, Singapore, Hong Kong, Malaysia, Taiwan, and Thailand, to evaluate their established, emerging, and nascent REIT markets. The study examines the effects of COVID-19 on Asian REITs' Performance, volatility, and efficiency and analyses the relationship between macroeconomic conditions and Asian REIT returns. The research also investigates the volatile connectedness between the researched countries. Descriptive analysis and econometric modeling will provide a comprehensive overview of the behavioral aspects of data surface analysis, total return analysis, Sharpe ratio, and variance ratio testing. The research findings will contribute to a better understanding of the Asian REIT market and its performance in a crisis.

4. Findings

The Sharpe ratio is an assessment that presents a comparative estimate of the return on an investment associated with risk. The mathematical expression is based on insight into excess returns over specific periods, potentially indicating higher volatility and risk. The numerator of the Sharpe ratio presents the difference over a specific period in realized or expected returns, based on benchmarks such as risk-free rates of return. Table 2 to Table 4 show the three different periods to indicate the whole study period (January 2017 to December 2022) and the time during the pandemic (January 2020 to December 2022).

The Sharpe ratio measures the risk-adjusted return of an investment, where a higher ratio indicates a better performance. Table 2 presents the Sharpe ratio analysis versus the whole period. The findings indicate Taiwan (T.W.) has the highest Sharpe ratio of 0.321, followed by Singapore (S.G.) at 0.432 and Japan (J.P.) at 0.304. Meanwhile, Malaysia (MY) has a negative Sharpe ratio of -0.221, indicating poor performance relative to the risk taken. In terms of annual return, Japan (J.P.) has the highest return at 5.04%, followed by Singapore (S.G.) at 4.32% and Taiwan (T.W.) at 2.01%. On the other hand, Thailand (T.H.) has the lowest return at -2.31%. In terms of annual risk, South Korea (K.R.) has the highest risk at 16.82%, followed by Thailand (T.H.) at 12.42% and Malaysia (MY) at 11.26%. Meanwhile, Taiwan (T.W.) has the lowest risk at 6.30%. Taiwan (T.W.) has the highest rank based on its Sharpe ratio, return, and risk, while Malaysia (MY) has the lowest rank.

Table 2

Sharpe Ratio Analysis of Asian REITs: January 2017 to December 2022

Country	Annual Return	Annual Risk	Risk/Return Ratio	Sharpe Ratio	Rank
JP	5.04%	18.10%	2.17	0.304	3
KR	0.28%	16.82%	52.36	0.003	5
SG	4.32%	14.41%	4.21	0.432	2
HKG	1.21%	12.35%	11.23	0.065	4
MY	-1.32%	11.26%	-4.99	-0.221	7
TW	2.01%	6.30%	2.98	0.321	1
TH	-2.31%	12.42%	-6.34	-0.164	6

Source: own study.

Table 3

Sharpe Ratio Analysis of Asian REITs Pre-COVID: January 2020 to February 2022

Country	Annual Return	Annual Risk	Risk/Return Ratio	Sharpe Ratio	Rank
JP	7.45%	8.52%	1.14	0.874	2
KR	-2.87%	14.61%	-5.1	-0.230	7
SG	8.33%	8.41%	1.01	0.934	1
HK	8.66%	11.77%	1.36	0.696	3
MY	0.87%	8.79%	10.07	0.028	5

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TW	-0.06%	8.23%	-142.69	-0.032	6
TH	2.94%	6.42%	2.18	0.378	4

Source: own study.

Table 4

Sharpe Ratio Analysis of Asian REITs during COVID: March 2020 to December 2022

Country	Annual Return	Annual Risk	Risk/Return Ratio	Sharpe Ratio	Rank
JP	-0.94%	25.11%	-23.08	-0.053	4
KR	6.79%	22.38%	2.69	0.243	2
SG	-1.28%	25.76%	-4.63	-0.041	3
HK	-13.14%	22.22%	-1.65	-0.632	7
MY	-4.21%	12.96%	-2.52	-0.490	5
TW	8.20%	4.31%	0.82	1.432	1
TH	-11.33%	21.31%	-2.94	-0.892	6

Source: own study.

Based on the Sharpe ratio analysis of Asian REITs during Pre-COVID from January 2020 to February 2022, it is clear that Singapore (S.G.) had the highest Sharpe ratio at 0.934, indicating a better risk-adjusted return compared to the other countries. Japan (J.P.) also had a high Sharpe ratio of 0.874, ranking second. However, the Sharpe ratio for all countries decreased compared to the pre-COVID period, indicating that the COVID-19 pandemic negatively impacted the risk-adjusted returns of the Asian REITs market. In terms of annual returns, Singapore (S.G.), Hong Kong (H.K.), and Japan (J.P.) had the highest returns, with 8.33%, 8.66%, and 7.45%, respectively. On the other hand, South Korea (K.R.) had the lowest annual return at -2.87%. From the point of annual risk, South Korea (K.R.) had the highest risk at 14.61%, followed by Hong Kong (H.K.) at 11.77%. Taiwan (T.W.) had the lowest annual risk at 8.23%. Overall, it can be concluded that the performance of the Asian REITs market during the COVID-19 pandemic was mixed, with some countries performing better than others. Singapore (S.G.) had the highest risk-adjusted return and annual return, while South Korea (K.R.) had the lowest annual return and highest annual risk. The findings focus on the performance of the Asian REITs market, which suggests that research on REITs' unique characteristics and dynamics could be relevant. Previous research on REIT pricing, risk, and diversification could provide insights into the factors influencing the performance of different countries' REIT markets during the pandemic (Hoesli & McGregor, 2000; Hoesli & Malle, 2021). Furthermore, the findings mentioned that Singapore, Japan, Hong Kong, South Korea, and Taiwan all had different levels of risk-adjusted return, annual return, and annual risk. Research on the unique characteristics and dynamics of each of these countries' real estate markets could provide insights into why their REIT markets performed differently during the pandemic (Lim & Jiang, 2014; Bossman et al., 2022).

ANOVA Test

It is essential to consider joint and individual tests while analyzing the data. Focusing on multiple tests may result in the null hypothesis being over-rejected. In the joint test, the null hypothesis is rejected if the p-value is less than 0.05 (alpha). The study results show that before the COVID-19 pandemic, the returns of REITs in Taiwan and Thailand followed the random walk theory, while other countries did not. The returns of J-REITs, K-REITs, S-REITs, HK-REITs, and M-REITs were rejected, whereas T-REITs and Thai-REITs were accepted. However, during the pandemic, the returns of all countries followed the random walk theory.

The findings suggest that before the COVID-19 pandemic, the returns of REITs in Taiwan and Thailand were consistent with the random walk theory, which implies that their prices follow a pattern of random fluctuations and cannot be predicted based on past prices. However, the returns of REITs in other countries did not follow the random walk theory, which suggests that their prices were influenced by factors other than random fluctuations, such as external economic and financial conditions. During the COVID-19 pandemic, the returns of all countries followed the random walk theory. This could be because the pandemic created significant disruptions in the global

economy, leading to unpredictable and volatile market conditions.

Furthermore, the z-score in the individual test indicates the relationship between the returned value and the mean group of values that are either above or below the mean for the four periods tested. After calculating the mean and standard deviation, the z-score is calculated to determine its position on the distribution curve, ranging from -3 (far left) to +3 (far right). For Japan, the pre-COVID z-score fell further to the left compared to during COVID. For South Korea, the z-score pre-COVID showed that it was not normally distributed during the first quarter as it skewed way to the left. However, during COVID, returns were more normally distributed. Singapore's z-score is similar to Japan's, falling further to the left pre-COVID than during COVID. In Hong Kong, the z-score pre-COVID also fell more to the left than during COVID, but the sub-periods for Hong Kong REITs exhibited almost similar distribution. For Malaysia, the z-score pre-COVID and during COVID showed almost similar distribution. The z-score for Taiwan pre-COVID fell more to the left, especially in the first quarter than during COVID. Finally, Thailand exhibited the best normal distribution among all the countries pre-COVID and during COVID. The z-score results from the individual tests provide insights into the distribution of the returns for each country during the pre-COVID and COVID periods. The z-score ranges from -3 to +3 and represents the number of standard deviations that the observed value deviates from the mean value. The findings suggest that the distribution of returns varied across countries and the pre-COVID and COVID periods. In Japan, South Korea, and Singapore, the z-score was higher to the left pre-COVID than during COVID, indicating that returns were less normally distributed before the pandemic. In Hong Kong and Malaysia, the z-score was also higher to the left pre-COVID than during COVID. However, the sub-periods for Hong Kong REITs exhibited almost a similar distribution. In Taiwan, the z-score was more to the left pre-COVID compared to during COVID, especially in the first quarter. However, Thailand exhibited the best normal distribution among all the countries pre-COVID and during COVID, indicating that returns were more customarily distributed and followed the random walk theory. Overall, the z-score results provide insights into the distribution of returns for each country and the impact of the COVID-19 pandemic on the distribution of returns.

The variance ratio was tested to determine if the two sub-periods had the same variance. According to the variance hypothesis, if the variances are equal, the null hypothesis is accepted; if they are not, the null hypothesis is rejected (alternative hypothesis). Based on the results, all countries had equal variance before and during COVID, meaning they all accepted the null hypothesis. This ANOVA variance test showed that the returns of all countries pre-COVID and during COVID followed the null hypothesis, indicating no significant differences in monthly returns. The returns of REITs in all countries followed the martingale process of the null hypothesis, indicating efficient REIT markets. In economics and related fields, the martingale process is viewed as significant because it suggests that, with the available data, the only reliable indicator of future values for a time series is its present value. The alternative hypothesis is a stationary non-martingale process. In this test, an Ordinary Least Square (OLS) estimator's asymptotic covariance matrix estimate is considered heteroskedasticity-robust if it overlaps asymptotically to the actual value, despite the variance of the regression's errors not being constant. It is possible to fit a model with heteroskedastic residuals by using standard errors consistent with heteroskedasticity.

The findings of the variance ratio test indicate that all countries had equal variance before and during the COVID-19 pandemic, which means that there were no significant differences in the monthly returns. This implies that the impact of the pandemic on the volatility of REIT markets was not statistically significant across different countries. Moreover, the ANOVA variance test results showed that all countries' returns followed the null hypothesis, indicating that the REIT markets were efficient. The findings suggest that the returns of REITs in all countries followed the martingale process of the null hypothesis, which implies that the only reliable indicator of future values for a time series is its present value. This has significant implications for economics and related fields, suggesting that past trends and patterns cannot be used to predict future trends with certainty.

Additionally, the results suggest that the OLS estimator's asymptotic covariance matrix estimate is heteroskedasticity-robust, which means that the test results are reliable and not influenced by the non-constant variance of the regression's errors. This implies that the model used in the test is robust and can be used to analyze the data accurately. Overall, the findings suggest that the REIT markets were

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efficient, and the impact of the COVID-19 pandemic on the volatility of the markets was not statistically significant across different countries. Table 5 summarizes the ANOVA variance test for Asian REITs over the pre-COVID and during the COVID periods.

Table5

The ANOVA Variance Test

Countries	Pre-COVID-19				During COVID-19			
	Joint Tests	Value	df	Probability	Joint Tests	Value	df	Probability
Japan	Max |z| (at period 2)*	2.93405	36	0.0214	Max |z| (at period 4)*int Tests	1.263532	24	0.7381
South Korea	Max |z| (at period 2)*	3.59305	36	0.0022	Max |z| (at period 4)*int Tests	1.780422	24	0.4024
Singapore	Max |z| (at period 2)*	3.19304	36	0.0241	Max |z| (at period 4)*int Tests	1.590211	24	0.5024
Hong Kong	Max |z| (at period 2)*	2.64920	36	0.0530	Max |z| (at period 4)*int Tests	2.424242	24	0.0804
Malaysia	Max |z| (at period 2)*	2.89321	36	0.0314	Max |z| (at period 4)*int Tests	2.393041	24	0.1342
Taiwan	Max |z| (at period 2)*	2.31041	36	0.0942	Max |z| (at period 4)*int Tests	1.894212	24	0.4301
Thailand	Max |z| (at period 2)*	1.71940	36	0.3783	Max |z| (at period 4)*int Tests	2.09313	24	0.2302

Source: own study.

Previous studies have also used similar techniques. This study employs ANOVA to examine the effects of COVID-19 on the Performance of Asian REITs across various sectors. The authors observe that the pandemic has adversely impacted the REIT market's overall performance, with the industrial and office sectors being hit the hardest. Additionally, the study reveals that REITs in Japan, Singapore, and Hong Kong during the pandemic performed better than those in other countries. Authors conducted another study using ANOVA to analyze the impact of COVID-19 on REIT markets in six Asian countries. The authors found that the pandemic adversely affected all REIT markets, with Singapore and Japan experiencing the most significant declines. The study also shows that the office and retail sectors have been the most affected.

Similarly, Guhathakurta et al. (2020) studied the impact of COVID-19 on REITs across Asia, utilizing ANOVA to analyze the effects on the Performance of REITs across various sectors. The authors discovered that the pandemic negatively impacted the performance of all REIT markets, with the hospitality and retail sectors being the most affected. The study also found that REITs in Singapore and Japan were the most impacted. The findings from this study align with research by Ling et al. (2020), which examined the geopolitical risk of the COVID-19 pandemic and the impact on REIT returns in the United States, which differed significantly from returns in Europe and Asia in various economic conditions. The differences were attributed to the purpose of a REIT, the spatial distribution of its properties, and the relationship between these two variables mainly contributed to the returns of REITs. Besides that, it was found that there was a positive relationship between the geopolitical risk and the returns on healthcare and technology REITs. In contrast, there was a negative relationship between the risk and the returns on residential, retail, and office. This study observed that the countries examined (Japan, South Korea, Singapore, Hong Kong, Malaysia, Taiwan, and Thailand) consisted of healthcare REITs that performed exceptionally well during the pandemic, while REITs associated with other industries performed poorly.

This study's findings are also in alignment with Milcheva's (2022) conclusions regarding how the virus affected the relationship between risk and return in established Asian REIT markets, such as Japan, Singapore, Hong Kong and China, and the U.S. The study discovered a drastic rise in unsystematic and market risks while the average REIT returns fell significantly. In Asian markets, there were fewer differences in REIT returns compared to U.S. markets, with significant differences in REIT returns amongst the different types of properties. In addition, office REITs in Asia and retail REITs in the U.S. showed the lowest performance.

Another study, by Periola-Fetunsin (2021), revealed similar findings where there was high connectedness among Asian REIT markets during the COVID-19 pandemic, with Japan and Singapore being net transmitters of volatility spill-overs. Uncertainty due to

infectious diseases significantly drives all connectedness measures in mean and variance, except for total spillovers. The study concluded that infectious diseases have a significant influence on financial markets.

5. Conclusion

The study analyzed the Performance of Asian REITs throughout the pre-COVID period and during the COVID-19 pandemic and found that Singapore had the highest risk-adjusted and annual returns. In contrast, South Korea had the lowest annual return and highest annual risk. The variance ratio test showed no significant differences in monthly returns before and during the pandemic, indicating that the impact of the pandemic on the volatility of REIT markets was not statistically significant across different countries. The results of the ANOVA variance test also showed that the returns of all countries followed the null hypothesis, indicating efficient REIT markets, with the returns following the martingale process of the null hypothesis. Finally, the OLS estimator's asymptotic covariance matrix estimate was heteroskedasticity-robust, making the test results reliable and the model robust for data analysis. Overall, the findings suggest that the REIT markets were efficient, and the impact of the COVID-19 pandemic on the volatility of the markets was not statistically significant across different countries.

The COVID-19 pandemic impacted every aspect of life, individually and economically, globally. Most market sectors were negatively affected, especially tourism. Other severely impacted markets included the construction industry, agriculture, food and beverage industries, and even the property market and associated investments, including income-generating REITs. The COVID-19 pandemic resulted in a global health panic, and the subsequent actions implemented by governments triggered an economic slowdown that differed from other economic crises, such as the Asian Financial Crisis (AFC) from 1997 to 1998 and the GFC from 2007 to 2008. COVID-19 limited travel restrictions, not just cross-borders but also within countries. It has severely impacted businesses, primarily commercial real estate such as office and retail properties. Consequently, it led to cutbacks and postponements in rent collection. For instance, the impact of travel restrictions was devastating for hotels, motels, and retail properties. The requirement for landlords to provide additional rental provisions and extend rental payments resulted

in the sharing of income disruption risks with tenants, which contributed to an increase in systematic risk for residential and retail REITs. REIT businesses rely heavily on their rental collection. At the same time, generating at least 75% of their gross revenue from rent collected from real estate properties is legally compulsory.

In addition, REITs must pay at least 90% of their net income (or 95% before 2000) to shareholders as dividends. This condition may significantly raise debt financing and decrease retained earnings without the advantage of tax deductions. In the short term, the decrease in cash flow had an impact on how dividends were paid out and how debt was paid down. Substantial adjustments in capitalization rates, discount rates, and projected cash flows significantly impacted the fair value of real estate properties. Among the reasons identified for the poor performance of Asian REITs during the pandemic in 2020, were increasing vacancy rates and declining rent growth. These were observed in commercial properties such as industrial, retail, offices, hotels and motels, and data centers. However, there was significant diversification among property classifications, regions, and characteristics of properties. Due to the high requirement for logistical spaces from the rising e-commerce operations, industrial REIT vacancy rates increased significantly due to the rapid pace of construction and abundant supply.

The COVID-19 pandemic significantly impacted global markets, including the Asian REITs market. The study discussed in this summary highlights the Performance of Asian REITs during the pandemic and found that Singapore had the highest risk-adjusted and annual returns. In contrast, South Korea had the lowest annual return and highest annual risk. However, the variance ratio test showed that the impact of the pandemic on the volatility of REIT markets was not statistically significant across different countries, indicating efficient REIT markets. The pandemic impacted the rental collection and dividend pay-outs of REITs, and the fair value of real estate properties was significantly impacted. The poor performance of Asian REITs during the pandemic was attributed to increasing vacancy rates and declining rent growth in commercial properties. However, there was significant diversification among property classifications, regions, and characteristics of properties.

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