MJoSHT
Malaysian Journal of Science, Health & Technology
[mjosht.usim.edu.my]

Penerbit USIM PRESS

Article

Diversification Benefits of Malaysian REITs in the COVID-19 Periods

Nurulhusna Adibah Mohamad Nasir[1], Muhammad Zaim Razak[1,2], and Shahrina Ismail[1,2]

[1] Financial Mathematics Programme, Faculty of Science and Technology, Universiti Sains Islam Malaysia, Bandar Baru Nilai, 71800, Nilai, Malaysia.

[2] Risk Analytics Research Group, Faculty of Science and Technology, Universiti Sains Islam Malaysia, Bandar Baru Nilai, 71800, Nilai, Malaysia.

Correspondence should be addressed to:
Muhammad Zaim Razak; mzaim.razak@usim.edu.my

Article Info
Article history:
Received:11 March 2025
Accepted: 15 September 2025
Published: 15 October 2025

Academic Editor:
Muhammad Safwan Ibrahim

Malaysian Journal of Science, Health & Technology

MJoSHT2025, Volume 11, Issue No. 2
eISSN: 2601-0003

https://doi.org/10.33102/mjosht.421

***Abstract*—This study examined the diversification benefits of Malaysian real estate investment trusts (REITs) in a mixed-asset portfolio of stocks and bonds during the COVID-19 period. Monthly data were used from January 2018 to October 2023. The sample time frame consisted of overall periods, as well as the subperiods before, during, and after the COVID-19 period. The risk-adjusted return for each asset and the correlation between Malaysian REITs, stocks, and bonds were analyzed. For each time frame considered, a mean-variance portfolio analysis was performed for two separate scenarios that include a portfolio with and a portfolio without REITs. In each scenario, average portfolio performance was evaluated. Malaysian REITs generally reported a superior risk-adjusted return over other financial assets overall and in each of the subperiods of COVID-19. During the COVID-19 period, REITs had a positive correlation with stocks but negative correlation with bonds. The results of the mean-variance analysis indicated the diversification benefits of incorporating REITs irrespective of overall as well as the periods before, during, and after COVID-19. The portfolio with REITs had a higher risk-adjusted return and a lower level of risk when compared to a portfolio consisting of stocks and bonds. The findings of the study highlight the diversification benefits of Malaysian REITs, which suggest the resilience of liquid real estate assets, particularly during and after the COVID-19 period. The resilience was contributed by the fundamental aspects of tenants and the underlying properties of Malaysian REITs. Investors in the Malaysian market should include REITs in their portfolio despite short-term uncertainty in an attempt to recoup the gains upon the onset of the recovery from the COVID-19 pandemic.**

***Keywords*— Malaysia, REITs, COVID-19; mixed-asset portfolio; investment**

I. INTRODUCTION

Real Estate Investment Trusts (REITs) are liquid real estate assets akin to hold fractional shares of common stocks. REITs pool investors, fund, and invest in a portfolio of large-scale real estate properties. The properties held by REITs offer ample rental spaces that attract tenants who require suitable property for their business activities [1]-[3]. For instance, retailers require a visible frontage layout, and industrial tenants need a single and wide floor space. Small- or large-scale businesses require office spaces that suit their number of staff, with different internal designs and arrangements. For tenants, renting can be a cost-effective option as opposed to owning, which is considered capital-intensive [4][5]. REITs generate their income from rentals, which are passed on to REIT

shareholders in the form of dividends. Thus, REIT shareholders have the opportunity to earn both capital appreciation in the REIT's share price and dividend income.

To shareholders, REITs serve as an alternative means to invest in liquid real estate without the risks and obligations associated with direct property investment. It includes, among others, the high level of transaction costs, like legal fees and taxes, as well as the transaction cost of operating [6][7]. Direct real estate investment is illiquid. To be specific, there is marketing period risk from the initial period of the transaction and the period of transferring title on direct property ownership [8]. Investors who prefer to have liquid assets may not consider direct real estate assets as an option. However, Real Estate Investment Trusts (REITs) provide low transaction costs, transparency, and liquidity in their portfolio of real estate properties, which are diversified across various locations and property sectors [9]. Therefore, as a liquid real estate asset, REITs stay on a level playing field with other financial assets like stocks and bonds.

In Malaysia, REITs were initially introduced as "property trusts" in 1989, with subsequent listings of Amanah Harta Tanah PNB 2 and Arab Malaysian First Property Trust (AMFPT). However, the concept of "property trust" failed to gain investor interest until it was converted to a Malaysian REIT in 2005. In this regard, the Securities Commission of Malaysia (SC) established a foundational guide on REITs to promote liquid real estate investment. Malaysian REITs are required to invest 75% of their total asset value in income-producing real estate assets. The real estate assets held by Malaysian REITs are externally managed, with the appointment of an asset management company approved by the SC. The gearing ratio of Malaysian REITs is set to be no more than 50% of their total asset value. Malaysian REITs are required to distribute 90% of the rental income to their shareholders in the form of dividends [10].

Since October 2022, Bursa Malaysia has 17 listed REITs on its primary market with a total market capitalization of RM39.34 billion or USD 8.22 billion [11]. As of December 2023, the portfolio of properties held by Malaysian REITs stood at RM 61.5 billion or USD 12.85 billion [12]. In light of this, the portfolio of Malaysian REIT properties includes diversified property sectors, with a few Malaysian REITs that specialize either in retail or office properties. Table 1 below presents a list of 17 REITs that are listed on Bursa Malaysia, together with their respective property sectors.

Before the COVID-19 pandemic, the performance of REITs was generally strong in terms of their operational performance, balance sheet, and liquidity [13]. The COVID-19 pandemic started in 2020 and presented unique challenges to the world economy, with Malaysia not an exception. A series of Movement Control Orders (MCOs) was implemented by the Malaysian government on March 18th, 2020, to contain the spread of the COVID-19 virus. The restriction was a means to limit the movement of individuals. For the majority of economic sectors, people were required to work from home. Shopping malls were partly closed, with a limited number of retailers operating as well as a limited number of visitors allowed at a time. Other measures include 1-meter physical distancing and the requirement of a face mask. Rapid sanitization of public spaces and inside buildings was frequently conducted. Interstate travels were restricted to necessary purposes. All international arrivals needed to undergo a mandatory 14-day quarantine at designated hotels. These circumstances gave rise to the question of whether Malaysian REITs remained resilient to the unprecedented situation pertaining to the COVID-19 pandemic.

TABLE I
LIST OF LISTED REAL ESTATE INVESTMENT TRUSTS (REITS) IN MALAYSIA

NO.	NAME OF REIT	PROPERTY SECTOR
1	Amanah Harta Tanah PNB	Office, Retail
2	Al-'Aqar Healthcare REIT	Nursing, Hospital, Hotel, College
3	Al-Salam REIT	Industrial, Office, Retail
4	AmFirst REIT	Hotel, Office, Retail
5	Amanah Raya REIT	Institutions Industrial, Retail, Hotel, Office,
6	Atrium REIT	Office, Warehouse, Industrial
7	AXIS REIT	Industrial, Office
8	CapitalMalls Malaysia Trust	Retail
9	Hektar REIT	Retail
10	IGB REIT	Retail
11	KLCC REIT	Office, Retail
12	Pavilion REIT	Office, Retail
13	Quill Capita Trust	Carparks, Retail, Industrial, Office
14	YTL REIT	Hotel, Retail
15	Sunway REIT	Office, Hotel, Retail
16	Tower REIT	Office
17	UOA REIT	Office

Notes: Author's compilation from Bursa Malaysia and Securities Commission

Nonetheless, several initiatives have been introduced to ease the burden of individuals and businesses during the COVID-19 pandemic. This includes, among others, a loan moratorium initiative for consumers and businesses for a 6-month period that was implemented twice, in April 2020 and July 2021[14]. For REITs, SC allowed the expansion of gearing up to 60% from August 2020 to December 31st, 2022 [15]. Rapid COVID-19 vaccinations since February 26th, 2021, were targeted at the Malaysian population [16]. The rapid vaccination program was capable of reversing the damaging effects of the pandemic by improving the economic activity of a country, mitigating uncertainties in social and economic policies as well as enhancing investors' confidence [17]. As of October 2021, 90% of the adult population in Malaysia had received complete vaccinations [18]. The success of the vaccination program and the control situation of healthcare services permitted Malaysia to enter the endemic stage on April 1st, 2022 [19]. The transition allowed for the gradual opening of international borders, which spurred tourism and indirectly boosted the retail and hotel REIT sectors [20]. This evidence indicated that Malaysian REITs were exhibiting a positive rebound in the post-COVID-19 pandemic [21]. Despite the difficulties that arose from COVID-19, there was always a light at the end of the tunnel. It is conjectured that Malaysian REITs, as liquid real estate assets, can provide diversification benefits in a mixed-asset portfolio of financial assets during the periods before, during, and after the COVID-19 period.

So far, the literature unveils some differences in the performance of REITs during COVID-19. As of May 2020, it was found that American REITs underperformed in the Asian Pacific [22]. According to reference [23], Asian REITs were defensive during the COVID-19 period since Asian countries were prepared for previous viral infections like SARS as compared to US REITs. Nonetheless, Asian REITs are generally understudied, even though their real estate markets account for 63% of global emerging markets, including Malaysia [24]. A couple of studies published in local journals reported that Malaysian REITs outperformed and were less volatile than stocks during COVID-19 [25][26]. However, these studies do not account for the portfolio implications of including REITs in a mixed-asset portfolio of financial assets during COVID-19 periods. Having said that, our study on Malaysian REITs is relevant to put forward one of the potential research opportunities on Asian REITs in the best light possible.

Hence, the first objective of the study is to determine the risk and return characteristics of Malaysian REITs with other financial assets. That is, this study evaluated the risk-adjusted returns for each asset and correlations between REITs, stocks, and bonds. The sample selection commenced between January 2018 and February 2023. Then, the sample is also divided into before-COVID-19 (January 2018-February 2020), during COVID-19 (March 2020-May 2022), and post-COVID-19 periods. (June 2022-October 2023). Secondly, the portfolio implications for REITs and other financial assets were then analyzed. In particular, the mean-variance portfolio analysis will be conducted to construct an optimal portfolio composition of REITs, bonds, and stocks. Thirdly, based on the sample selection criteria defined above, this study evaluated the average portfolio performance with and without REITs. Taken together, this study seeks to answer the following research questions:

Q1. What are the return characteristics of REITs and the correlations between other financial assets, such as stocks and bonds?

Q2. Considering the return characteristics and correlation of REITs with stocks and bonds, what are the portfolio implications for investors in the Malaysian market?

Q3. Can REITs provide diversification benefits to investors during the pre-, during-, and post-recovery stages of the COVID-19 pandemic?

This present study adds to the existing literature on the diversification benefits of REITs in a mixed-asset portfolio for financial assets, particularly during the COVID-19 period in the Malaysian market. Our analysis generates a number of new insights. First, in comparison with before COVID-19, we observe the decline in the risk-adjusted return for each asset during the COVID-19 period. We find the risk-adjusted return for stocks to be lower than that of REITs during COVID-19. Secondly, we observe the changes in the correlation pattern between asset returns. Before COVID-19, there is a negative correlation between REITs and stocks, as well as the correlation between REITs and bonds. During COVID-19, REITs and stocks are positively correlated. In post-COVID-19, the correlation pairs between each asset return are positive. The findings suggest the dynamics in diversification benefits of REITs in the three different subperiods associated with the COVID-19 pandemic. Thirdly, our mean-variance analysis indicates that the portfolio with REITs performs better than the portfolio without REITs. The benefits can be seen from a significant reduction in the overall portfolio risk. As a result, the portfolio with REITs reports a significant improvement in the risk-adjusted return, whether before, during, and after the COVID-19 period.

The results of this study offer several practical implications. Despite being traded in the stock market, REITs are akin to real estate assets. Investors in financial assets that seek liquidity shall consider Malaysian REITs as an exposure to real estate investment. Malaysian REITs exhibit a defensive nature to temporal shocks from the COVID-19 pandemic. In what follows, investors should keep Malaysian REITs in their portfolio during the COVID-19 period. They should remain optimistic about future gains as the situation improves, with the ability to contain the spread of the virus and the success of rapid vaccination among the populations.

The next part of the research paper is structured as follows: Section 2 reviews related literature on the diversification benefits of REITs with other financial assets. Section 3 describes the methodology and data. Section 4 presents the results and discussion of the research findings. Section 5 concludes.

II. RELATED LITERATURE

The liquid nature of REITs poses an important question of whether REITs are akin to real estate or common stocks. An early study by [27] found that REITs are a poor substitute for direct real estate investment and are similar to common stocks. In contrast, a strand of literature adopts the vector error correction model (VECM) to examine the long-run linkages between direct real estate, REITs, and stocks. Reference [28] found a cointegration relation between direct real estate and REITs, with stocks that can be excluded from the long-run relation. Reference [29] examined the long-run relation between REITs, direct real estate, and stocks at the property sector level. For instance, they found evidence of cointegration between office REITs and office properties. Reference [30] used a panel VECM and reported the long-run linkages between REITs and direct real estate in the European countries Germany, the Netherlands, and France. Their findings did not contradict the evidence of cointegration between the two real estate assets in the US and UK markets [31].

REITs have gained attention as a real estate asset that can be incorporated into a mixed-asset portfolio of financial assets. Reference [32] examined the correlation between REITs, stocks, and bonds in the European REITs. The study found European REITs to be weakly correlated with bonds. Reference [33] reported a negative correlation between property sector REITs and bonds as well as a positive correlation between property sector REITs and stocks in the Japanese market. Notwithstanding, the risk-adjusted return of portfolios with each of the property sector REITs is better than portfolios of stocks and bonds. Reference [34] evaluated the time-varying correlations between Brazilian REITs, stocks, and bonds. The study reported lower allocation to bonds for greater allocation to REITs, which contributed to a significant reduction in portfolio risk. Reference [35] examined the diversification benefits of REITs' preferred stocks (PSREIT). The study found that the increase in PSREIT and the decrease in the allocation for bonds were able to enhance the Sharpe ratio and reduce portfolio risk.

Several studies examined the diversification benefits of REITs by accounting for the Global Financial Crisis (GFC) periods. For instance, reference [36] reported that Thailand REITs (Thai REITs) performed poorly before the GFC period. Nonetheless, in the post-GFC, Thai REITs reported an improvement in the risk-adjusted return. Reference [37] evaluated the risk-adjusted return and diversification benefits of Singapore REITs (S-REITs). The study found that the risk-adjusted return of S-REITs was the highest, as compared to property companies, stocks, and government bonds. Reference [38] examined Australian REITs (A-REITs) during pre- and post-GFC periods. Their findings indicated that A-REITs slightly outperformed Australian equities, achieving higher risk-adjusted returns both in pre- and post-GFC periods, with a Sharpe ratio of 0.14 compared to 0.08 for equities. In another study, reference [39] reported that Belgian REITs were better than stocks and bonds in terms of risk-adjusted returns in the post-GFC period. The subsequent mean-variance analysis indicated that the 10% allocation to Belgian REITs reduced overall portfolio risk and improved overall portfolio return.

With regards to COVID-19, reference [23] constructed the COVID risk factors based on the daily infection rate for the US and Asian REITs. The study documented that REITs in the US were more sensitive to log changes in daily COVID-19 cases than Asian REITs. US property sector REITs are more sensitive to COVID risk factors as compared to Asian REITs. Reference [40] examines the impact of COVID-19 on various property sectors in the UK and US markets. They found the impact had been greatest on the retail and hospitality properties. Office buildings were less affected than these two sectors. Reference [41] adopted a DCC-GJR GARCH framework and found low persistence volatility of diversified REITs in the US during COVID-19. Reference [42] examines the performance differences of REITs during the GFC and COVID-19. The study argued that long-term leases helped these residential and office REIT sectors remain resilient during the COVID-19 period, although they were negatively affected during the GFC. Meanwhile, neither GFC nor COVID-19 can affect retail REITs. Rather, the sector was sensitive to the continuous boom and bust cycle in the retailing business. Quite recently, reference [43] reported that 14 Turkish REITs were exhibiting persistence in volatility during the COVID-19 period. As a result, they found Turkish REITs underperformed the local government bonds.

In Malaysia, the study by [44] found that the higher financial market volatility induced by COVID-19 significantly affected the return of all sectors in the Malaysian stock market, except for the REITs. Moreover, reference [26] adopted a GARCH framework to examine the volatility structure of REITs and other sectors in the Malaysian stock market during COVID-19. They found REITs to exhibit less persistence in their volatility than other sectors like property, technology, and consumer products. Reference [25] reported that Malaysian REITs outperformed the stock market from April 2020 to November 2020. In a similar manner, the CAPM analysis showed the beta of Malaysian REITs was reported to be less than 1, which suggests REITs are less volatile than stocks. Quite recently, reference [45] examined the effectiveness of MCO and vaccination programs towards the performance of Malaysian REITs. The study reported significant positive abnormal returns of Malaysian REITs pertaining to the implementation of MCO and vaccination programs. The findings reflect the positive response of investors to the prospects of Malaysian REITs at the onset of recovery from the COVID-19 pandemic.

The review of the literature shows the diversification benefits of REITs in a mixed-asset portfolio but ignores the effect of the COVID-19 pandemic. Therefore, this present study is the first to bridge the gap between asset allocation literature and COVID-19 by examining the portfolio implications of incorporating REITs including before, during, and post-COVID-19 periods in Malaysia. The description of the data and the methodology used will be discussed in the next section.

III. METHODOLOGY

A. Data

The study followed a quantitative research approach. Monthly closing prices were used to analyze the performance of REITs, bonds, and stocks in mixed asset portfolios over the past five years. This study adopts index data as a proxy for each individual asset. In particular, three types of indices in Malaysia were collected, which are: FTSE Bursa Malaysia KLCI (FBMKLCI), which serves as a proxy for investment in common stocks; ABF Malaysia Bond Index Fund (ABFMY1), as a proxy for bonds. Finally, the Bursa Malaysia REIT Index (BMREI) was used as a proxy for REITs. The indices data for each asset were obtained from Datastream.

The performance of the three assets, REITs, stocks, and bonds, was analyzed during overall periods from January 2018 to October 2023 and each of the different phases of the COVID-19 pandemic (before, during, and after). To be specific, the sample period between January 2018 and February 2020 was defined as before the COVID-19 period. The period between March 2020 and May 2022 was assumed to be during the COVID-19 period, and the period between June 2022 and October 2023 was assumed to be after the COVID-19 period. The assumed sample selection during the COVID-19 period was in accordance with the beginning of the movement control order to contain the spread of COVID-19 amongst the population that commenced on March 18th, 2020. Meanwhile, the assumed sample selection after the COVID-19 period was consistent with the transition to the endemic phase that began on April 1st, 2022 ([19]).

The FBMKLCI serves as the benchmark for the Malaysian stock market. It consists of the top 30 companies listed on the Main Board based on total market capitalization. The listing of the companies needs to meet the eligibility requirements of the FTSE Bursa Malaysia Ground Rules. Investors in the Malaysian stock market can understand the overall market condition by tracking the performance of the FBM KLCI index. ABFMY1 is a bond fund index that tracks the performance of the Malaysian government bond market, where the index consists of the 30 most liquid Malaysian government bonds. ABFMY1 can serve as an indicator for investors seeking a low-cost and low-risk investment in government securities. Meanwhile, BMREI is a capitalization-weighted REIT index that tracks the performance of the 17 listed REITs in Bursa Malaysia. The index is calculated and maintained by Bursa Malaysia Securities Berhad. Taken together, BMREI can serve as a benchmark for investors who attempt to track the performance of the Malaysian REIT sector.

B. Expected return, standard deviation, and Sharpe Ratio

In this study, the analysis began by calculating monthly returns for each asset class. First, the monthly returns and risks were calculated for each individual asset. The following formula was used to calculate the monthly returns, where the return for each individual asset is calculated by taking the difference in logs:

$$r_i = \ln\left(\frac{P_{t+1}}{P_t}\right) \tag{1}$$

where P_{t+1} is the price index at time $t+1$, t is the time in months, and i is the individual asset comprising REITs, stocks, and bonds, respectively.

The standard deviation was used to calculate the risk for each asset return, as shown below:

$$\sigma_{r_i} = \sqrt{\frac{\sum_{i=1}^{n}(r_i - \bar{r})^2}{n-1}} \tag{2}$$

where *n* represents the number of data points in the data and $\bar{r}$ is the average return for an individual asset return.

Then, the risk-adjusted return of each asset was calculated by using the Sharpe ratio, using the following formula:

$$Sharpe\ ratio = \frac{E(r_i) - r_f}{\sigma_{r_i}} \tag{3}$$

where $E(r_i)$ is the expected return of each individual asset, r_f is a risk-free rate and σ_{r_i} is the standard deviation of the individual asset.

C. Optimal portfolio weights

In this study, the mean-variance portfolio by [46] is adopted. Specifically, the mean-variance portfolio objective is adopted to determine an optimal portfolio that minimizes portfolio risk. The objective function to minimize portfolio risk is defined as follows:

$$\min \quad w_t' \times H_{\times} w_t \tag{4}$$

Assuming a portfolio that consists of REITs, stocks, and bonds, the variance-covariance matrix, *H* can be decomposed into 3 x 3 matrix as follows:

Variance- Covariance

$$H = \begin{bmatrix} \boldsymbol{\sigma_{11}^2} & \boldsymbol{\sigma_{12}} & \boldsymbol{\sigma_{13}} \\ \boldsymbol{\sigma_{21}} & \boldsymbol{\sigma_{22}^2} & \boldsymbol{\sigma_{23}} \\ \boldsymbol{\sigma_{31}} & \boldsymbol{\sigma_{32}^2} & \boldsymbol{\sigma_{33}^2} \end{bmatrix}$$

From matrix *H*, the correlation between the returns of different assets can be determined. For instance, by taking the correlation between REITs and Stocks as asset 1 and asset 2, the correlation can be defined as:

Correlation

$$\boldsymbol{\sigma_{12} = corr(\rho_{12}) \times \sqrt{\sigma_{11}^2 \times \sigma_{22}^2}}$$

$$\boldsymbol{corr(\rho_{12}) = \frac{cov\ \sigma_{12}}{\sqrt{\sigma_{11}^2 \times \sigma_{22}^2}}}$$

Notwithstanding the straightforward estimation of the variance-covariance matrix, H does not account for time-varying dynamics in the volatility of individual assets and the correlation between asset returns. This approach provides a rationale for the use of monthly data, particularly for a buy-and-hold portfolio on a longer horizon as compared to a daily investment period.

The objective function, as in equation (4), is subject to the predetermined portfolio return, as in equation (5). For this study, it was assumed that μ_p equals to 0.040%.

$$w_t' \cdot r_t = \mu_p \tag{5}$$

Equation (6) represents the short-selling constraint. Lastly, equation (7) represents the budget constraint, assuming that all capital is invested when optimizing a portfolio.

$$w_{t,i} \geq 0 \tag{6}$$

$$\sum w_t = 1 \tag{7}$$

Following [33], Razak (2023), the transaction costs associated with portfolio rebalancing were calculated. For each month, the transaction cost of rebalancing each individual asset was determined as follows:

$$c_{i,t} = bf\ \left|w_{i,t+1} - w_{i,t}\right| \tag{8}$$

where bf is the brokerage fee that was assumed as 0.030% based on Bursa Malaysia trading clearing fees[i]. Meanwhile, $w_{i,t+1} - w_{i,t}$ is the change in weight (in absolute terms) for an individual asset. The total cost of rebalancing was computed for the assets in a portfolio on month t, TC_t:

$$TC_t = \sum_{i=1}^{3} c_{i,t} \tag{9}$$

D. Portfolio Performance Measure

In this study, the estimation of a mean-variance optimal portfolio was conducted to examine the risk and return characteristics of a portfolio with and without REITs. Thus, two scenarios of portfolios, denoted as Portfolio A and Portfolio B, were hypothetically constructed:

- Portfolio (A): REITs, Bonds, and Stocks.
- Portfolio (B): Stocks and Bonds

The estimation procedure was considered for four different periods, including an overall period from January 2018 to October 2023 and three sub-periods associated with the COVID-19 pandemic. To be specific, the period between January 2018 and February 2020 is considered before COVID-19, while March 2020 to May 2022 is considered during the

COVID-19 period. Finally, June 2022 until October 2023 is considered post-COVID-19. Thus, in total, the estimation exercise will produce 69 optimal portfolios during the overall sample period, with 25, 27, and 17 optimal portfolios corresponding to the before-, during-, and post-COVID-19 periods, respectively.

In this study, portfolio performance was measured using the Sharpe Ratio. Sharpe ratio will measure the risk-adjusted return. A higher Sharpe ratio indicates a better risk-adjusted return. Risk-adjusted return is an essential tool for investors because it allows them to compare different investments on the same level playing field with a different combination of assets in a portfolio. By taking risk into account, a risk-adjusted return can help investors identify investments that generate high returns without taking on too much risk.

Thus, for each month, *t*, portfolio return will be calculated according to this formula:

$$r_p = \sum \mathrm{w}_{\mathrm{i,t}} \mathrm{r}_{i,t} \tag{10}$$

where $\mathrm{w}_{\mathrm{i,t}}$ is the portfolio weight for each asset at *t*, i is an individual asset, that is, stocks, bonds, and REITs. $\mathrm{r}_{i,t}$ is the return for an individual asset return at time *t*. Also, the estimation of portfolio return in each period will account for total transaction cost as defined in equation (6).

Notwithstanding, the average portfolio performance will be reported for the purpose of reporting. From the above equation (10) of computing portfolio return, the average portfolio return was determined for overall periods and each subperiod by using the following:

$$\bar{r}_p = \sum_{t=1}^{n} \frac{r_p}{n} \tag{11}$$

The standard deviation of the portfolio return will be used to determine the portfolio level of risk as follows:

$$\sigma_{r_p} = \sqrt{\frac{\sum_{t=1}^{n} \left(r_{P_t} - \bar{r}_P\right)^2}{n-1}} \tag{12}$$

Then, the Sharpe ratio of a portfolio will be calculated by using the following equation:

$$Sharpe\ ratio = \frac{\bar{r}_p - r_f}{\sigma_{r_p}} \tag{13}$$

The Sharpe ratio was selected over the Treynor ratio and Jensen's alpha for this study because it provides a comprehensive measure of portfolio performance by considering total risk as measured by the standard deviation of portfolio returns. This approach is suitable for portfolios that may not be fully diversified and are limited to REITs, stocks, and bonds. Unlike the Treynor ratio and Jensen's alpha, which rely on market risk, the Sharpe ratio is independent of specific benchmarks, making it versatile across different market conditions.

MATLAB software was used to construct the optimal portfolio for each scenario and period, as well as subsequent analyses to obtain the estimated portfolio results.

IV.RESULTS AND DISCUSSIONS

A. Descriptive Statistics

Table II provides an overview of the descriptive statistics for the return series for individual assets over the overall period. The analyzed data revealed that the REIT had consistently performed well, with a positive average return of 0.46%. Stocks had a lower average return than REITs. Bonds reported the lowest asset return, 0.070%. In terms of volatility, the stock market was the most volatile, 0.0348, with bonds reporting the lowest standard deviation of 0.0136. The return distribution of REITs was negatively skewed. The kurtosis of return distribution showed stocks and bonds had a kurtosis of less than 1.00, but REITs had a kurtosis of more than 3.00. However, it is important to note that the REIT return was negatively skewed to the left tail of the return distribution, with the reported skewness of -1.149.

TABLE II
DESCRIPTIVE STATISTICS FOR THE OVERALL PERIOD

Asset	Mean	St. Dev	Skew	Kurt
REITs	0.0046	0.0315	-1.1449	3.2235
Bonds	0.0007	0.0136	-0.4164	0.2819
Stocks	0.0040	0.0348	0.0466	0.6079

Notes. This table reports the descriptive statistics for all indices. The statistics for all return series were calculated by considering the differences in logs. The overall period was determined from January 2018 to October 2023.

The findings presented in Table III showed the effects of the COVID-19 pandemic on REITs, bonds, and stock returns. Before the COVID-19 period, the mean return ranged between 0.30% and 0.51%, with stocks reporting the highest level of return. REITs were the most volatile compared to stocks and bonds. During the COVID-19 period, the return for each asset plunged, with stocks reporting a mean negative return of -0.17% with the highest standard deviation of 0.0413. The standard deviation of REITs was 0.0312, which was higher than that of bonds, 0.0165. The descriptive statistic also indicated that REITs experienced a decline in mean value during the pandemic, from 0.390% to 0.30%. After the COVID-19 period, there was a significant improvement in the return of REITs, where the mean return increased to 0.93%. Bonds return exhibited the same trend with the increase of mean returns to 0.52%. However, there was a slight improvement in stocks. The return increased to 0.43%. These statistics suggested a slower recovery of stocks as compared to REITs and bonds during the COVID-19 pandemic. Taken together, the data suggest the COVID-19 pandemic had an adverse impact on the performance of REITs, stocks, and bonds, owing to broader economic uncertainties during the periods. Nonetheless, after the pandemic, REITs and bonds rebounded with a lower level of volatility. At the same time, stocks struggled to reach their pre-pandemic performance.

TABLE III
DESCRIPTIVE STATISTICS FOR SUB-PERIODS

Sub-period	Mean	St. Dev	Skew	Kurt
REITs				
B	0.0039	0.0312	-0.8256	1.4348
D	0.0030	0.0329	-1.5216	4.4673
A	0.0093	0.0275	1.1762	2.9367
Bonds				
B	0.0023	0.0089	-0.5226	2.2862
D	0.0013	0.0165	-0.1218	-0.5569
A	0.0052	0.0088	-0.2496	-0.9606
Stocks				
B	0.0051	0.0271	-0.0106	0.8274
D	-0.0017	0.0413	-0.0427	0.0419
A	0.0043	0.0221	1.4518	2.0359

Notes: This table shows the descriptive statistics for each asset return. Sub-period B is defined as before COVID-19 (January 2018 – February 2020), D is defined as during the pandemic (March 2020 - May 2022), and A is defined after COVID-19 (June 2022 –October 2023).

B. Sharpe Ratio

The descriptive statistics from the above indicate the fluctuation in the performance of each asset class in overall periods, and each subperiod corresponds to the COVID-19 pandemic. This contributes to changes in the risk-adjusted return for each asset across these periods. We present the risk-adjusted return for each asset overall and the three subperiods in Table 5. In the overall periods, it was found that REITs had higher risk-adjusted returns than stocks. Meanwhile, before the COVID-19 pandemic, stocks had the highest Sharpe ratio of 0.1523, followed by bonds at 0.1459 and REITs at 0.0930. During the pandemic, REITs showed a better risk-adjusted return than other assets, with a return of 0.0622, compared to stocks that reported a negative Sharpe ratio of -0.0648. Bonds had the highest Sharpe ratio, 0.06987. After the pandemic, bonds had the highest Sharpe ratio at 0.4840, while REITs had higher risk-adjusted returns than stocks. In comparison between REITs and stocks, the former has a higher risk-adjusted return across the periods associated with the COVID-19 pandemic. Each asset emerged as unique in terms of the risk-adjusted returns, owing to the individual return and volatility characteristics. The findings highlight the importance of examining the correlation between REITs and stocks and bonds, as discussed in the next subsection.

TABLE IV
RISK-ADJUSTED RETURN FOR EACH ASSET

Asset	Sh. Ratio $_O$	Sh. Ratio $_B$	Sh. Ratio $_D$	Sh. Ratio $_A$
REITs	0.1138	0.0930	0.0622	0.3018
Stocks	0.0629	0.1523	-0.0648	0.1488
Bonds	0.0044	0.1459	0.0698	0.4840

Notes: The table shows the risk-adjusted return for each asset in the overall and three subperiods associated with the COVID-19 periods. Sub-period B was defined as before COVID-19 (January 2018 – February 2020), D was defined as during the pandemic (March 2020 - May 2022), and A was defined after COVID-19 (June 2022 – October 2023). The risk-adjusted return was calculated by assuming the risk-free rate of 0.01% or 0.0001.

C. Correlation Analysis

To assess the portfolio diversification benefits, the correlation matrix for REITs with other assets, including bonds and stocks, for the overall period was presented in Table V. In a similar manner, we presented the correlation between the asset return overall and each of the three subperiods. Based on Table V, there was a positive but low correlation of 0.2767 between REITs and Stocks. The correlation suggested the return for the two assets tends to move in tandem, albeit with a low level of magnitude. Conversely, Bonds and REITs displayed a negative correlation of -0.0388. The correlation indicated that adding bonds to the portfolio can be advantageous for diversification because when bond return increases, the REIT's return decreases, or vice versa. Bonds and stocks had a weaker positive correlation of 0.1320 than the correlation between stocks and REITs.

Table VI reports the correlation analysis among asset returns in their different subperiods. Prior to the emergence of COVID-19, REITs and stocks had a negative correlation of -0.2574. This meant that they generally moved in opposite directions. This correlation suggested that combining REITs and stocks in a portfolio before the pandemic could provide a significant diversification benefit. In addition to that, both REITs and bonds, as well as stocks and bonds, displayed negative correlations, indicating the potential diversification benefits of incorporating bonds into a portfolio that already contains REITs or stocks.

TABLE V
CORRELATION FOR THE OVERALL PERIOD

	REITs	Stocks	Bonds
REITs	1	0.2767	-0.0388
Stocks	0.2767	1	0.1320
Bonds	-0.0388	0.1320	1

Notes. This table reports the correlation between each asset return for the overall sample period between January 2018 and October 2023.

During the COVID-19 period, the correlation between stocks and REITs increased to 0.5158. The correlation between bonds and stocks was also positive, at 0.1901. However, the correlation between bonds and REITs was negative, at -0.1708. The increase in positive correlation suggests limited diversification benefits between stocks and REITs. Nevertheless, the negative correlation between REITs and bonds suggests a potential diversification benefit in a mixed-asset portfolio due to the uncertainty caused by the COVID-19 pandemic.

After the pandemic, the correlation for all assets, including REITs, bonds, and stocks, became positively correlated, where the reported correlation between REITs and bonds was 0.4700. Meanwhile, the reported correlation between bonds and REITs was 0.4644. The correlation between bonds and stocks was positive and stood at 0.3735. All in all, the three assets demonstrate their dynamic interconnections across the three different periods associated with the COVID-19 pandemic in the Malaysian market.

TABLE VI
CORRELATION FOR SUB-PERIODS

Before			
	REITs	Stocks	Bonds
REITs	1	-0.2574	-0.0781
Stocks	-0.2574	1	-0.0795
Bonds	-0.0781	-0.0795	1
During			
	REITs	Stocks	Bonds
REITs	1	0.5158	-0.1708
Stocks	0.5158	1	0.1901
Bonds	-0.1708	0.1901	1
After			
	REITs	Stocks	Bonds
REITs	1	0.4700	0.4644
Stocks	0.4700	1	0.3735
Bonds	0.4644	0.3735	1

Notes. This table reports the correlation between each asset return by considering the periods before COVID-19 (January 2018 to February 2020), during COVID-19 (March 2020 to May 22nd), and after COVID-19 (June 2022 to October 2023).

The monthly data analysis for REITs, stocks, and bonds revealed distinct patterns in their volatility and correlation dynamics with other assets, varying across different observation periods, including before, during, and after the COVID-19 pandemic. The high correlation and volatility between stocks and REITs suggest that there are limited potential diversification benefits between the two assets. However, REITs and bonds present greater potential for diversification because of their low correlation and the fact that bonds are less volatile than REITs. These findings may not be new to investors, but they have significant implications for the optimal portfolio allocation among the three assets in the Malaysian market. The next subsection will provide a detailed assessment of the diversification benefits of REITs when combined with other financial assets, including stocks and bonds.

D. Portfolio Diversification

The optimal portfolio weight for each asset was determined using mean-variance analysis. For each month, *t*, an optimal portfolio was created through estimates of asset returns for each asset, r_t, and the variance-covariance matrix of *H*. For each month, the portfolio return was assumed to be 0.400% based on the FBMKLCI average return during the overall period. Short-selling and budget constraints were also considered in the mean-variance analysis for each month. The transaction cost associated with portfolio rebalancing for each asset was also determined, owing to an absolute change in the weight of each asset each month.

The analysis of the two scenarios for the portfolio was modeled, where portfolio A consists of REITs, stocks, and bonds. At the same time, portfolio B consists of stocks and bonds. Our empirical analysis of portfolio estimation was first conducted from January 2018 to October 2023. With regards to COVID-19 periods, three subperiods were considered: January 2018 to February 2020 as before COVID-19, March 2020 to May 2022 as during COVID-19, and June 2023 to October 2023 as after COVID-19 periods. For each scenario, the portfolio construction involved observing 69 months during overall periods, as well as 25, 27, and 17 months associated with COVID-19 periods before, during, and after, respectively.

Based on the optimal portfolio estimation for each scenario, both overall and for the three subperiods, the average portfolio allocation and performance are presented in Table VII. In the overall period between January 2018 and June 2023, portfolio A reported an average allocation of 24.25% of REITs, 12.77% of stocks, and 62.98% of bonds. Portfolio A reported an average portfolio return of 0.33% with a risk, measured by a standard deviation of approximately 0.68%. The reported Sharpe ratio for portfolio A during the overall period was 0.4696. Meanwhile, Portfolio B, which comprised stocks and bonds, reported an average allocation of 27.67% to stocks, 27.67%, and 72.33% to bonds. This portfolio displayed an average return of 0.29% with a standard deviation of 0.87%. As a result, the reported Sharpe ratio for portfolio B in the overall period was 0.3326.

With regards to the period before COVID-19, which commenced from January 2018 to February 2020, Portfolio A had an average allocation of 18.66% to REITs, 17.9% to stocks, and 63.44% to bonds. The portfolio had an average return of 0.37%, a standard deviation of 0.44%, and a Sharpe ratio of 0.7997. Portfolio B, on the other hand, had 26.44% allocation to stocks and 73.56% to bonds. The average portfolio return for portfolio B before the pandemic period was 0.33%. The reported standard deviation and Sharpe ratio were 0.49% and 0.6698, respectively.

During the COVID-19 period, March 2020 to May 2022, the asset allocation in Portfolio A saw an increase in the average allocation to REITs by 28.34%, with 8.74% allocated for stocks and 62.92% allocated for bonds. The average portfolio return during this period was 0.28%, with a standard deviation of 0.77%. The Sharpe ratio for portfolio A during the COVID-19 period was 0.3459. In contrast, within the same period, Portfolio B had 34.94% average allocation to stocks and 65.06% to bonds during the pandemic. The reported average portfolio return for Portfolio B during the COVID-19 period was 0.22%. The reported standard deviation and the risk-adjusted return for portfolio B were 1.13% and 0.1938, respectively.

After the COVID-19 pandemic period, which was between June 2022 and October 2023, portfolio A had a 30.09% average allocation to REITs, an average allocation of 9.11% in stocks, and an average allocation of 60.80% in bonds. The average portfolio return after the pandemic was 0.35%. The standard deviation of portfolio A after the COVID-19 pandemic period was 0.82%, and the Sharpe ratio was 0.4131. Meanwhile, portfolio B had no REITs; the average allocation of 17.92% was invested in stocks, and the remaining 82.08% was in bonds. After the COVID-19 period, the average portfolio return for portfolio B was 0.34%. The reported standard deviation and the Sharpe ratio for portfolio B after the COVID-19 period were 0.87% and 0.3935, respectively.

From the result, it appears that Portfolio A, which includes REITs, exhibited the best portfolio performance in the overall period of COVID-19 and all three sub-periods (before, during, and after COVID-19) as compared to the portfolio with no REITs, as in the Portfolio B, Across each scenario, portfolio A with REITs offers investor with a higher return for each period compared to Portfolio B. Nonetheless, it is important to worth noting that the average return on the portfolio, as reported in

the study, is slightly lower than the average market return (0.40%). This is rather to be expected since the transaction costs related to portfolio rebalancing were taken into account. In the analysis of portfolio risk, a significant reduction in the portfolio standard deviation of 0.68% was observed, as compared to Portfolio B, which was 0.87%, during the entire period. In a similar manner, a significant drop in portfolio standard deviation can be seen for each period associated with COVID-19 for portfolio A, which includes REITs, as compared to portfolio B. As a result, portfolio A reported a higher Sharpe ratio than portfolio B in the overall periods and in the other three subperiods. The findings on the Sharpe ratio suggested that investment had achieved better returns per unit of risk taken with an additional asset, that was REITs, which had been included in portfolio A.

Based on our analysis, portfolio A demonstrated the diversification benefit of REITs during economic downturns pertaining to the COVID-19 periods. The study presumed that this can be attributed to the evidence of the negative correlation between REITs and bonds. This negative correlation helped sustain the performance of portfolio A, as there is a potential diversification benefit between REITs and bonds, despite the positive correlation between REITs and stocks. In contrast, Portfolio B, which excludes REITs, did not perform well due to the positive correlation between stocks and bonds, reflecting limited diversification benefits between the two assets, albeit of low magnitude. Therefore, the argument for a positive correlation between stocks and bonds suggests that when an economic situation affects stocks, bonds are also impacted, even though they may not be as perilous as stocks.

On the other hand, the analyses in the other two sub-periods, which were before and after COVID-19, shed light on the changes in correlation dynamics between REITs and other financial assets, such as stocks and bonds. Before the COVID-19 period, there was a negative correlation between REITs and stocks, as well as a correlation between REITs and bonds. These correlations implied a potential diversification benefit between the three assets. The evidence can be seen from a small increase in the average allocation to bonds, with about an equal share of allocation between REITs and stocks. Meanwhile, after the COVID-19 period, we observed an increase in the correlation between REITs and bonds, together with the correlation between REITs and stocks. These circumstances indicated a limited diversification benefit between the three asset returns. As a result, however, in portfolio A, we observed a decrease in the average allocation to stocks and bonds, with a greater portion of assets allocated to REITs. Despite the increased correlation between the three assets after COVID-19, the average allocation to REITs rose due to their significant improvement in mean returns, making them an attractive asset over bonds in low-interest rate environments during and after the COVID-19 period [40].

With regards to the Sharpe ratio, our findings further support the evidence of incremental performance in the portfolio with REITs (portfolio A) as compared to the portfolio without REITs, portfolio B. The evidence can be seen in the overall and in each of the three sub-periods, where portfolio A gives a higher Sharpe ratio than portfolio B. To supplement further, a higher ratio suggests that the investment has achieved better returns per unit of risk taken with the inclusion of REITs. Alternatively, it can be said that a better risk-adjusted return implies that Portfolio A can offer higher returns with lower risk. Against the background, our analysis in the context of the Malaysian market is comparable with the evidence from recent studies in the Japanese REITs [33][47] and other international markets like the Brazilian [34] and European REITs market [32], which suggested that the inclusion of REITs help to lowered the overall portfolio risk and enhanced the Sharpe ratio of a portfolio. Therefore, following [48] and [49], a risk-averse investor in short-term horizons in Malaysian markets can consider including REITs as an exposure to real estate assets in a mixed asset portfolio of bonds and stocks.

TABLE VII
OPTIMAL PORTFOLIO WEIGHT

Overall

Portfolio	Asset	$\bar{w}_t$	$\bar{r}_p$	σ_{r_p}	Sharpe Ratio
A	REITs	0.2425	0.0033	0.0068	0.4696
	Stocks	0.1277			
	Bonds	0.6298			
B	Stocks	0.2767	0.0029	0.0087	0.3326
	Bonds	0.7233			

Before

Portfolio	Asset	$\bar{w}_t$	$\bar{r}_p$	σ_{r_p}	Sharpe Ratio
A	REITs	0.1866	0.0037	0.0044	0.7997
	Stocks	0.1790			
	Bonds	0.6344			
B	Stocks	0.2644	0.0033	0.0049	0.6698
	Bonds	0.7356			

During

Portfolio	Asset	$\bar{w}_t$	$\bar{r}_p$	σ_{r_p}	Sharpe Ratio
A	REITs	0.2834	0.0028	0.0077	0.3459
	Stocks	0.0874			
	Bonds	0.6292			
B	Stocks	0.3494	0.0022	0.0113	0.1938
	Bonds	0.6506			

After

Portfolio	Asset	$\bar{w}_t$	$\bar{r}_p$	σ_{r_p}	Sharpe Ratio
A	REITs	0.3009	0.0035	0.0082	0.4131
	Stocks	0.0911			
	Bonds	0.6080			
B	Stocks	0.1792	0.0034	0.0087	0.3935
	Bonds	0.8208			

Notes: The table reports the mean portfolio return $\bar{r}_p$, the standard deviation σ_{r_p}, and the average portfolio weight for each asset $\bar{w}_t$. The Sharpe ratio was calculated by assuming a risk-free rate of 0.01%. Two portfolio scenarios were performed: portfolio A includes REITs, while portfolio B excludes them. The overall sample period commenced in January 2018 and concluded in October 2023. The subperiod between January 2018 and February 2020 was defined as before COVID-19, March 2020 to May 2022 as during COVID-19, and June 2022 to October 2023 as after COVID-19.

More importantly, this study adds value by highlighting the diversification benefits of REITs during COVID-19, specifically for Malaysian markets. That is, adding real estate

assets like REITs is able to improve an investor's portfolio performance by contributing both higher returns and lower levels of risk in a portfolio of financial assets consisting of stocks and bonds. We posit that the findings on Malaysian REITs can be attributed to several factors. First, Malaysian REITs are primarily focused on a portfolio of diversified properties. The diversified properties in Malaysian REITs consist of industrial and warehouse properties, which were sustained by the surge in online business activities before and during the COVID-19 pandemic. These property sectors helped shield other affected sectors, such as retail and hotel properties, during the COVID-19 period. In other words, diversified REITs can manage fluctuation in cash flows of other affected property sectors.

Secondly, Malaysian REITs that specialize in office and retail REITs are filled by tenants who are highly reputable and bonded with long-term lease agreements [50]. Several Retail REITs provided rental rebates to affected tenants during the period of MCO associated with COVID-19 [51]. This initiative was driven by the allowance for REITs to increase their gearing ratio from 50% to 60% since August 2020 and the low interest rate during the COVID-19 period. Meanwhile, hotel properties held by diversified REITs in Malaysia had master lease agreements with hotel operators that guaranteed a fixed rental payment and rental adjustment period between July 2020 and June 2022 [52][53]. Moreover, hotel properties held by Malaysian REITs were utilized as quarantine stations for Malaysians and other travelers upon arrival during the COVID-19 period [54]. Thus, it can be said that these temporal measurements were detrimental to Malaysian REITs in resisting the uncertainty of the COVID-19 pandemic.

Third, our findings on the diversification benefits of REITs supplement the understanding of the resilience of Asian REITs [23], particularly in Malaysia during COVID-19. Malaysian REITs are found to be more resilient than stocks [26][44]. Accordingly, the resilience of Malaysian REITs can be attributed to the movement control order, which served as a temporary measure to contain the spread of the virus. Besides, the rapid vaccination of Malaysian adults since February 2021 has helped reopen broader economic activities that include retail and hospitality properties. These two measurements were positively perceived by investors in Malaysian REITs [45]. Taken together, Malaysian REITs were defensive liquid real estate assets during and after the COVID-19 period.

E. Robustness Checks

To examine the robustness of the previous analyses, the estimation procedure was repeated with two additional scenarios. The purpose of these checks is to evaluate whether the diversification benefits of REITs are affected as portfolio analysis changes. In the first scenario, an equal-weighted portfolio was performed for both portfolios A and B with and without REITs. Meanwhile, in the second scenario, the mean-variance portfolio analysis was re-estimated as the study adjusted the predetermined required rate of return of the portfolio, μ_P=0.60%, for each month, also accounting for portfolios with and without REITs.

The equal-weighted portfolio is a straightforward approach in portfolio construction since it does not require accounting for the correlation and variance-covariance matrix between asset returns. In the equal-weighted portfolio, for each month, t, the weight of each asset is equally assigned. The findings of the equal-weighted portfolio are presented in Table VIII. The findings demonstrate that including REITs in Portfolio A resulted in a higher average portfolio return and a corresponding decrease in standard deviation compared to Portfolio B. As a result, it can be shown that portfolio performance, as measured by the Sharpe ratio, indicated that Portfolio A was superior to Portfolio B both during overall periods and across three sub-periods associated with COVID-19.

The results presented in Table VIII show that, in an equal-weighted portfolio, a higher average allocation was assigned to stocks. In contrast, there was a significant reduction in average allocation for bonds. As a result, the equal-weighted portfolio reported a higher level of volatility together with a significant reduction in the Sharpe ratio. These results conform with the evidence from previous mean-variance analysis, where the inclusion of REITs in Portfolio A was a beneficial strategy for enhancing return and decreasing overall portfolio risk. Nonetheless, an equal-weighted portfolio highlights the importance of not overlooking determining the estimates of volatility and variance-covariance matrix between asset returns.

TABLE VIII
ROBUSTNESS CHECKS 1: EQUAL-WEIGHTED PORTFOLIO

Overall

Before

Portfolio	Asset	$\overline{w}_t$	$\bar{r}_p$	σ_{r_p}	Sh. Ratio
A	REITs	0.3333	0.0024	0.0183	0.1312
	Stocks	0.3333			
	Bonds	0.3333			
B	Stocks	0.5000	0.0014	0.0193	0.0725
	Bonds	0.5000			

After

Portfolio	Asset	$\overline{w}_t$	$\bar{r}_p$	σ_{r_p}	Sh. Ratio
A	REITs	0.3333	0.0017	0.0143	0.1189
	Stocks	0.3333			
	Bonds	0.3333			
B	Stocks	0.5000	0.0017	0.0143	0.1189
	Bonds	0.5000			

During

Portfolio	Asset	$\overline{w}_t$	$\bar{r}_p$	σ_{r_p}	Sh. Ratio
A	REITs	0.3333	0.0025	0.0234	0.1062
	Stocks	0.3333			
	Bonds	0.3333			
B	Stocks	0.5000	0.0006	0.0237	0.0266
	Bonds	0.5000			

In the second scenario, another robustness check was conducted where the required rate of return on a portfolio for each month was adjusted to 0.6%. The results for the second robustness check were tabulated in Table IX. The overall period and each of the three sub-periods associated with COVID-19 showed a significant increase in the average allocation to REITs. As a result, a significant improvement was observed in the portfolio return for each of the portfolios, where the reported average portfolio returns range between 0.47% and 0.52%. In addition to that, portfolio A consistently

showed a reduction in the portfolio standard deviation. Hence, portfolio A exhibited a significant increase in the risk-adjusted return as measured by the Sharpe ratio compared to portfolio B, which does not include REITs.

TABLE IX
ROBUSTNESS CHECKS 2: OPTIMAL PORTFOLIO WEIGHTS.

Overall					
Portfolio	Asset	$\bar{w}_t$	$\bar{r}_p$	σ_{r_p}	Sh. Ratio
A	REITs	0.2481	0.0051	0.0073	0.6859
	Stocks	0.1548			
	Bonds	0.5971			
B	Stocks	0.2997	0.0041	0.0091	0.4540
	Bonds	0.7003			
Before					
Portfolio	Asset	$\bar{w}_t$	$\bar{r}_p$	σ_{r_p}	Sh. Ratio
A	REITs	0.1934	0.0052	0.0055	0.9333
	Stocks	0.2100			
	Bonds	0.5966			
B	Stocks	0.3038	0.0045	0.0055	0.8109
	Bonds	0.6962			
During					
Portfolio	Asset	$\bar{w}_t$	$\bar{r}_p$	σ_{r_p}	Sh. Ratio
A	REITs	0.2898	0.0047	0.0084	0.5548
	Stocks	0.1023			
	Bonds	0.6079			
B	Stocks	0.3499	0.0035	0.0117	0.2994
	Bonds	0.6501			
After					
Portfolio	Asset	$\bar{w}_t$	$\bar{r}_p$	σ_{r_p}	Sh. Ratio
A	REITs	0.2793	0.0051	0.0086	0.5853
	Stocks	0.1395			
	Bonds	0.5813			
B	Stocks	0.2141	0.0046	0.0090	0.5146
	Bonds	0.7859			

Notes: The table reports the mean portfolio return $\bar{r}_p$, the standard deviation σ_{r_p}, and the average portfolio weight for each asset $\bar{w}_t$ for a mean-variance portfolio with a required rate of return of 0.60%. The Sharpe ratio was calculated by assuming a risk-free rate of 0.01%. Two portfolio scenarios were performed: portfolio A includes REITs, while portfolio B excludes them. The overall sample period commenced from January 2018 to October 2023. The subperiod between January 2018 and February 2020 was defined as before COVID-19, March 2020 to May 2022 as during COVID-19, and June 2022 to October 2023 as after COVID-19.

Based on the two scenarios, it is evident that the findings from our studies are robust, even though the strategy of an equal-weighted portfolio or adjusted required return on the portfolio was implemented. Nonetheless, according to reference [55], the differences in portfolio performance between equal-weighted portfolios and mean-variance highlight the importance of accounting for estimation in correlation and variance-covariance structure between REITs and other asset returns. The analyses in the robustness checks affirm the earlier results in Table 8, which suggest that a portfolio including REITs performs better than one without REITs in any given period. As the required return on a portfolio increased, we observed that including REITs enabled us to achieve a higher level of return and a lower portfolio risk. Therefore, the findings prove once again the resilience of REITs during the COVID-19 period. Thus, Malaysian REITs, as a real estate asset, can serve as a defensive strategy to alleviate the uncertainty that occurred during COVID-19 and reap gains after the pandemic is over.

V. CONCLUSION

This study analyzed the diversification benefits of including Real Estate Investment Trusts (REITs) when combined with other financial assets, such as bonds and stocks, in the Malaysian market, particularly during the COVID-19 pandemic. The monthly data of REITs, stocks, and bonds between January 2018 and October 2020 were used as the overall sample period. In addition to that, the data samples were divided into three sub-periods: before, during, and after the pandemic period. For each sub-period, two portfolio scenarios were conducted: one with REITs and one without REITs. The analysis during the pandemic reaffirmed that a portfolio incorporating REITs maintains a higher return and does so with lower risk compared to a portfolio without REITs. The study also found that combining REITs with traditional assets like stocks and bonds leads to a well-balanced portfolio, reducing the average allocation of stocks and increasing the allocation to REITs. Bonds act as a buffer to a portfolio with a lower level of risk. As a result, the risk-adjusted return for a portfolio with REITs was greater than for a portfolio without REITs. The findings were consistent with the evidence of a positive correlation between REITs and stocks, but a negative correlation of REITs with bonds. This unique correlation pattern gives Malaysian REITs a comparative advantage in their diversification benefits, particularly during the COVID-19 pandemic.

The portfolio analysis with and without REITs highlights the resilience of Malaysian REITs during and after the COVID-19 period. The resilience of Malaysian REITs during COVID-19 was attributed to fundamental factors such as underlying property sectors and tenants' reputations. In addition to that, the stimulus package introduced by regulators and the government was beneficial to the sustainability of REITs during the COVID-19 period. Other initiatives, such as movement control orders and vaccination programs, also served as exit plans that contributed to the resilience of Malaysian REITs. Since before COVID-19, Malaysian REITs have provided relatively stable dividend income, which is generated from 90% of their rental income. This is opposed to stocks, where the dividend income distribution is subject to an individual company's discretion. The stability and resilience exhibited by Malaysian REITs contribute to the incremental performance of a portfolio that was previously limited to stocks and bonds. This evidence can be demonstrated using the Sharpe ratio, where including REITs as an additional asset leads to improved portfolio returns relative to the low level of overall risk undertaken. Taken together, our findings support the initial hypothesis that REITs provide significant diversification benefits to a mixed-asset portfolio in the periods before, during, and after the COVID-19 period.

The study outcomes offer significant implications for portfolio management. The analysis leads to the application of

Malaysian REITs as a means of exposure to real estate assets. Malaysian REITs can be an additional investment asset to a portfolio of financial assets like stocks and bonds. With regard to the COVID-19 pandemic, investing in real estate assets like Malaysian REITs helps investors mitigate risk and improve their risk-adjusted returns amid the increased uncertainty of their holdings in financial assets like stocks. Thus, despite uncertainty pertaining to the COVID-19 pandemic, the results of the study suggest investors should not relinquish their investment in REITs but rather remain in their asset allocation. The strategy is advisable to reap gains from the positive outlook on Malaysian REITs as they recover from the COVID-19 pandemic.

Notwithstanding, the study accounts for unconditional estimates of the variance-covariance matrix of asset return corresponding to the period before, during, and after the COVID-19 pandemic. Additionally, the study does not consider other variables, such as daily changes in COVID-19 cases and vaccination rates, which might affect the correlation of REITs with other financial assets. Our study also does not control for REITs according to their property sectors due to the unavailability of the data. To examine the diversification benefits of REITs during COVID-19, future studies can consider using daily data to estimate the conditional variance-covariance matrix in a framework that accounts for both short- and long-run persistency in the volatility of each asset return. Besides, the diversification benefit of Malaysian REITs can be examined further in the context of international real estate asset allocation. For instance, the mean-variance portfolio analysis of US equities and bonds, including and excluding REITs, from a small yet emerging market like Malaysian REITs during the global financial crisis and the COVID-19 pandemic periods.

REFERENCES

[1] Giambona, E., Harding, J. P., & Sirmans, C. F. (2008). Explaining the variation in REIT capital structure: the role of asset liquidation value. Real Estate Economics, 36(1),111–137,(2008).

[2] Plazzi, A., Torous, W. N., & Valkanov, R. (2011). Exploiting property characteristics in commercial real estate portfolio allocation. Journal of Portfolio Management, 37(5), 39–50. https://doi.org/10.3905/jpm.2011.37.5.039

[3] Van Nieuwerburgh, S. (2019). Why are REITS Currently So Expensive? Real Estate Economics, 47(1), 18–65. https://doi.org/10.1111/1540-6229.12238

[4] Barkham, R., & Park, A. U. (2011). Lease versus buy decision for corporate real estate in the UK. Journal of Corporate Real Estate, 13(3), 157–168. https://doi.org/10.1108/14630011111170445

[5] Brounen, D., & Eichholtz, P. (2005). Corporate Real estate ownership implications: International Performance evidence. Journal of Real Estate Finance and Economics, 30(4), 429–445. https://doi.org/10.1007/s11146-005-7015-5

[6] Ambrose, B. W., Highfield, M. J., & Linneman, P. (2005). Real estate and economies of scale: the case of REITs. Real Estate Economics, 33(2), 323–350. https://doi.org/10.1111/j.1540-6229.2005.00121.x

[7] Hardin, W. G., Hill, M. D., & Hopper, J. (2009). Ownership structure, property performance, multifamily properties, and REITs. Journal of Real Estate Research, 31(3), 285–306. https://doi.org/10.1080/10835547.2009.12091256

[8] Bond, S. A., Hwang, S., Lin, Z., & Vandell, K. D. (2007). Marketing Period Risk in a Portfolio Context: Theory and Empirical Estimates from the UK Commercial Real Estate Market. Journal of Real Estate Finance and Economics, 34(4), 447–461. https://doi.org/10.1007/s11146-007-9022-1

[9] Feng, Z., Pattanapanchai, M., Price, S. M., & Sirmans, C. F. (2019). Geographic diversification in real estate investment trusts. Real Estate Economics, 49(1), 267–286. https://doi.org/10.1111/1540-6229.12308

[10] EPRA. (2023). EPRA Global REIT Survey 2023.Brussels

[11] Bee Kim, C. (2022, April 6th). Investment Prospect of REITs. New Straits Times. https://www.nst.com.my/business/2022/04/786422/investment-prospects-reits

[12] Securities Commission. (2024). List of Approved Management Company in Relation to Real Estate Investment Trusts. Retrieved March 19th, 2024, from https://www.sc.com.my/api/documentms/download.ashx?id=bf905fdd-b9c5-4a95-bdf3-6c953d7d43c0

[13] Schnure, C. (2020, May 22nd). The outlook for REITs during the COVID-19 crisis. Nareit. https://www.reit.com/news/blog/market-commentary/the-outlook-for-reits-during-the-covid-19-crisis

[14] Ministry of Finance. (2021). Tengku Zafrul : PEMULIH moratorium estimated at RM80 Bln, Malaysia only Country Implementing it for Second Time. Retrieved April 19th, 2024, from https://www.mof.gov.my/portal/en/news/press-citations/tengku-zafrul-pemulih-moratorium-estimated-at-rm80-bln-malaysia-only-country-implementing-it-for-second-time

[15] Securities Commission. (2020). SC Grants M-REITs Temporary Increase in Gearing Limit. Retrieved March 18th, 2024, from https://www.sc.com.my/resources/media/media-release/sc-grants-m-reits-temporary-increase-in-gearing-limit

[16] Carvalho, M. (2021, February 22nd). Vaccination to Begin February 24th. The Star. Retrieved from https://www.thestar.com.my/news/nation/2021/02/22/vaccination-to-begin-feb-24

[17] Pham, S. D., Nguyen, T. T. T., Do, H. X., & Vo, X. V. (2023). Portfolio diversification during the COVID-19 pandemic: Do vaccinations matter? Journal of Financial Stability, 65(February), 101118. https://doi.org/10.1016/j.jfs.2023.101118

[18] Yusof, T. A. (2021, October 11th). Malaysia hits 90 Percent Adult Vaccination Target. New Straits Times. Retrieved from https://www.nst.com.my/news/nation/2021/10/735420/malaysia-hits-90-cent-adult-vaccination-target#google_vignette

[19] Ministry of Health. (2022). Transition to Endemic Phase. Retrieved April 19th, 2024, from https://covid-19.moh.gov.my/reopeningsafely/semasa/2022/03/fasa-peralihan-ke-endemik-11032022

[20] MIDF. (2022). Sector REIT poised to benefit from economic recovery. MIDF. https://www.midf.com.my/node/43191

[21] Ng, J. (2021, July 31st). Post-pandemic comeback of Malaysian REITs. The Star. https://www.thestar.com.my/business/business-news/2021/07/31/post-pandemic-comeback-of-malaysian-reits

[22] Akinsomi, O. (2020). How resilient are REITs to a pandemic? The COVID-19 effect. Journal of Property Investment & Finance, 39(1), 19–24. https://doi.org/10.1108/jpif-06-2020-0065

[23] Milcheva, S. (2021). Volatility and the Cross-Section of Real Estate Equity Returns during Covid-19. Journal of Real Estate Finance and Economics, (0123456789). https://doi.org/10.1007/s11146-021-09840-6

[24] Newell, G. (2021). The need for more research on the Asian real estate markets. Journal of Property Investment and Finance, 39(1), 3–8. https://doi.org/10.1108/JPIF-05-2020-0059

[25] Nordin, M. S. A., Ismail, H., & Isa, M. (2022). Risk and Return of M-REITS During COVID-19: Evidence from Capital Asset Pricing Model (CAPM). Malaysian Construction Research Journal, 36(1), 101–110.

[26] Khairudin, N., & Shariff, N. S. M. (2022). The impact of COVID-19 outbreaks on the volatility of the stock market in Malaysia. Malaysian Journal of Computing, 8(1), 1287–1300. https://doi.org/10.24191/mjoc.v8i1.19172

[27] Georgiev, G., Gupta, B., & Kunkel, T. (2003). Benefits of real estate investment. Journal of Portfolio Management, 29(5), 28–33. https://doi.org/10.3905/jpm.2003.319903

[28] Hoesli, M., & Oikarinen, E. (2012). Are REITs real estate? Evidence from international sector-level data. Journal of International Money and Finance, 31(7), 1823–1850. https://doi.org/10.1016/j.jimon?n.2012.05.017

[29] Boudry, W. I., Coulson, N. E., Kallberg, J. G., & Liu, C. H. (2012). On the Hybrid Nature of REITs. Journal of Real Estate Finance and Economics, 44(1–2), 230–249. https://doi.org/10.1007/s11146-011-9339-7

[30] Hoesli, M., & Oikarinen, E. (2021). Does listed real estate behave like direct real estate? Updated and broader evidence. Applied Economics, 53(26), 3023–3042. https://doi.org/10.1080/00036846.2020.1870921

[31] Hoesli, M., & Oikarinen, E. (2016). Are public and private asset returns and risks the same? Evidence from real estate data. Journal of Real Estate Finance & Portfolio Management, 22(2), 179–198.

[32] Badji, C. F., Benetti, C., & Guimaraes, R. (2021). Diversification Benefits of European REIT, Equities and Bonds. New Challenges in Accounting and Finance, 6, 31–49. https://doi.org/10.32038/ncaf.2021.06.03
[33] Razak, M. Z. (2023). The dynamic role of the Japanese property sector REITs in mixed-assets portfolio. Journal of Property Investment & Finance, 41(2), 208–238. https://doi.org/10.1108/jpif-06-2022-0051
[34] Bernardo, M. R., Campani, C. H., & Roquete, R. M. (2023). Brazilian REITs: Are they an opportunity for diversification and performance? Journal of Real Estate Portfolio Management, 29(2), 127–139. https://doi.org/10.1080/10835547.2023.2189509
[35] Anderson, R. I., Guirguis, H., & Loviscek, A. (2023). Do preferred REITs have portfolio enhancement attributes? An empirical investigation. Journal of Real Estate Finance and Economics, 67(4), 656–672. https://doi.org/10.1007/s11146-021-09873-x
[36] Pham, A. (2011). The performance of Thai-Reits in a Mixed-Asset portfolio. Pacific Rim Property Research Journal, 17(2), 197–214. https://doi.org/10.1080/14445921.2011.11104324
[37] Newell, G., Pham, A., & Ooi, J. T. L. (2015). The significance and performance of Singapore REITs in a mixed-asset portfolio. Journal of Property Investment & Finance, 33(1), 45–65. https://doi.org/10.1108/jpif-12-2010-0027
[38] Reddy, W., & Wong, W. W. (2017). Impact of Interest Rate Movements on A-REITs Performance Before, During and After The Global Financial Crises. Pacific Rim Property Research Journal, 24(1), 85–103.
[39] Marzuki, M. J., & Newell, G. (2019). The evolution of Belgium REITs. Journal of Property Investment & Finance, 37(4), 345–362. https://doi.org/10.1108/jpif-03-2019-0029
[40] Hoesli, M., & Malle, R. (2022). Commercial real estate prices and COVID-19. Journal of European Real Estate Research, 15(2), 295–306. https://doi.org/10.1108/jerer-04-2021-0024
[41] Wu, M.-C., & Liau, Y.-S. (2023). What Property Sector REITs are Defensive during the COVID-19 Pandemic? Evidence from the U.S.
[42] Cai, Y., & Xu, K. (2022). Net impact of COVID-19 on REIT returns. Journal of Risk and Financial Management, 15(8), 359. https://doi.org/10.3390/jrfm15080359
[43] Salami, M. A., Tanrivermiş, H., & Tanrivermiş, Y. (2023). Performance evaluation and volatility of Turkey REITs during COVID-19 pandemic. Journal of Property Investment and Finance, 41(5), 473–505. https://doi.org/10.1108/JPIF-02-2022-0017
[44] Lee, K. Y., Jais, M., & Chan, C. (2020). Impact of Covid-19: Evidence from Malaysian Stock Market. International Journal of Business and Society, 21(2), 607–628. https://doi.org/10.33736/ijbs.3274.2020
[45] Wong, W. C., Che Johari, E. E., Mohd Khan, S. J., Mohd Daud, S. N., Mat Yusoff, M. Y., & Musaddad, H. A. (2023). From Outbreak to Vaccination: An Analysis of the Commercial Property Market Reaction to COVID-19 in Malaysia. International Real Estate Review, 26(3).
[46] Markowitz, H. M. (1952). Portfolio selection. Journal of Finance, 7(1), 77. https://doi.org/10.2307/2975974
[47] Lin, Y. C., Lee, C. L., & Newell, G. (2019). The significance of residential REITs in Japan as an institutionalized property sector. Journal of Property Investment & Finance, 37(4), 363–379. https://doi.org/10.1108/jpif-03-2019-0036
[48] Pagliari, J. L. (2017). Another Take on Real Estate's Role in Mixed-Asset Portfolio Allocations. Real Estate Economics, 45(1), 75–132. https://doi.org/10.1111/1540-6229.12138
[49] Delfim, J., & Hoesli, M. (2019). Real estate in Mixed-Asset portfolios for various investment horizons. Journal of Portfolio Management, 45(7), 141–158. https://doi.org/10.3905/jpm.2019.45.7.141
[50] Tee, P. L., Aik, N. C., Lim, B. K., & Hiew, S. (2023). Impact of Movement Control Order on Risk-Adjusted Performance of the Malaysian Real Estate Investment Trusts (M-REITs). International Journal of Real Estate Studies, 17(2), 33-41.
[51] Lee, E. (2020, August 26th). Raising Gearing Limit of REITs Timely. The Edge Malaysia. Retrieved from https://theedgemalaysia.com/article/raising-gearing-limit-reits-timely
[52] The Star. (2020, August 4th). Coronavirus Impact on YTL REIT seen temporary. The Star. Retrieved from https://www.thestar.com.my/business/business-news/2020/08/04/coronavirus-impact-on-ytl-reit-seen-temporary
[53] Affin Hwang Investment Bank. (2022). YTL Hosp REIT Upgraded to BUY. Retrieved from https://www.ytlcommunity.com/shownews.asp?newsID=4864
[54] Abdullatib, S., & Li Wei, S. (2020, August 3rd). Hotels Willing to Serve as Quarantine Centres to Offset Losses. Bernama. Retrieved from https://bernama.com/en/general/news_covid-19.php?id=1866471
[55] Platanakis, E., Sakkas, A., & Sutcliffe, C. (2019). Harmful diversification: Evidence from alternative investments. British Accounting Review, 51(1), 1–23. https://doi.org/10.1016/j.bar.2018.08.003