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Interdependence and Portfolio Analysis of Property Sector Real Estate Investment Trusts (REITs) in Malaysia during COVID-19

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This study examines the benefits of incorporating Malaysian Real Estate Investment Trusts (REITs) into a mixed-asset portfolio, with a focus on the periods preceding, during, and following the COVID-19 pandemic. The study utilises daily data from 1 January 2018 to 21 October 2024, sourced from the Datastream database. By utilising the Dynamic Conditional Correlation-Generalized Autoregressive Conditional Heteroskedasticity (DCC-GARCH) model, the study examines the volatility of office property REITs and retail property REITs, as well as the linkages between these assets and stocks and bonds. The findings reveal that REITs exhibit unique volatility structures and correlations with other financial assets, which vary over time. During the pandemic, retail REITs experienced higher volatility than office REITs, impacting their diversification benefits. Meanwhile, post-pandemic, office REITs demonstrated better risk-adjusted returns. The inclusion of REITs in investment portfolios consistently improved performance across different periods, underscoring their value in enhancing portfolio resilience against market disruptions. This present study offers a novel perspective on the asset allocation literature by highlighting the significance of considering property sector REITs in investment strategies that align with investors' risk appetites and market conditions.

1.0   Introduction

Businesses often find that owning commercial properties requires significant capital investment. Thus, renting becomes a more cost-effective alternative (Barkham & Park, 2011; Brounen & Eichholtz, 2005). In light of this, Real Estate Investment Trusts (REITs) provide extensive rental spaces that appeal to tenants seeking appropriate properties for their business operations (Plazzi et al., 2011; Van Nieuwerburgh, 2019). Rentals are the primary source of income for REITs, which is eventually distributed to their shareholders as dividends. Nonetheless, as REITs are traded in the stock market, their shareholders can access REITs' share price appreciation. According to Ro and Ziobrowski (2012), REITs can focus on the single property sector. For instance, retail REITs focus on retail properties such as shopping malls, while office REITs invest in office buildings (Chien & Mohd Diah, 2020). It has been documented that property sector REITs are efficient in both operating costs and agency costs, which are beneficial to REITs as a whole (Beracha et al., 2019; Feng et al., 2019).To investors, since property sector REITs have the same underlying properties, changes in market information are fully reflected in their share prices (Chen et al., 2020; Pavlov et al., 2018).

In Malaysia, there are 17 listed REITs with a market capitalisation of RM48.93 billion and an underlying portfolio property value of RM69.8 billion (Securities Commission, 2024). As observed in Table 1, REITs in Malaysia are primarily focused on the office and retail property sectors, with a few REITs also investing in industrial, warehouse, hotel, and hospital properties. This information highlights Malaysian REITs as a liquid financial asset that is comparable to stocks and bonds. Malaysian REITs are traded actively on a daily basis. According to the Securities Commission (2024), the trading volume of REITs increased significantly, rising from RM2.46 billion in 2022 to RM3.19 billion in 2023 and to RM6.28 billion in 2024. Various studies have emphasised prior shocks that can impact the volatility and linkages of REITs with other assets (Huang et al., 2016; Peng & Schulz, 2013). Notably, these factors are crucial for REITs to offer substantial diversification benefits in a daily investment portfolio that includes stocks and bonds (Anderson et al., 2023; Razak, 2023). To date, no comprehensive analysis in Malaysia has examined the volatility dynamics and correlation of property sector REITs with other financial assets, as well as their implications for portfolio management.

Table 1: List of listed Real Estate Investment Trusts (REITs) in Malaysia

No	Name of REITs	Property Sectors
1	KLCC REIT	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	Capital Land Malaysia Trust	Retail
9	Hektar REIT	Retail
10	IGB REIT	Retail
11	KIP REIT	Retail
12	Pavilion REIT	Office, Retail
13	Sentral REIT	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

The COVID-19 pandemic caused unprecedented disruptions to global financial markets, highlighting the critical significance of diversification in an investment portfolio. In line with this, traditional portfolios, which primarily consist of stocks and bonds, often fail to mitigate risks effectively during extreme market conditions, as correlations between these asset classes tend to increase during times of crisis (Le & Tran, 2021; Naik et al., 2020). On the other hand, Malaysian REITs have demonstrated potential as a diversification tool, as they were less volatile than stocks during the COVID-19 pandemic (Khrudin & Mohamad, 2023; Lee et al., 2020). Therefore, in the context of COVID-19, it can be inferred that Malaysian REITs offer diversification benefits in a mixed-asset portfolio.

This study examines the volatility and correlation that vary over time among Malaysian office property REITs, retail property REITs, stocks, and bonds in the periods preceding, during, and following the COVID-19 pandemic. The study utilised the Dynamic Conditional Correlation-Generalised Autoregressive Conditional Heteroskedasticity (DCC-GARCH) model by Engle (2002) to produce the covariance

matrix. Moreover, to understand whether Malaysian REITs offer diversification benefits to investors during these periods, the estimated covariance matrix was incorporated into the portfolio choice problem of REITs in a mixed-asset portfolio. Specifically, REITs were classified as office REITs and retail REITs, which were separately included in a portfolio. Notably, the setting allowed for assessing the performance of a portfolio of stocks and bonds, both in the presence and absence of REITs, in each subperiod.

This study claims two contributions to the existing literature. First, this study extends the prior work of Lee et al. (2020) and Khrudin & Mohamad (2023) by adopting the DCC-GARCH model to analyse the dynamics of Malaysian REITs in the periods before, during, and after the COVID-19 pandemic. The application revealed that both office and retail REITs had unique volatility structures and correlations with other financial assets in each subperiod. For instance, retail REITs exhibited higher volatility than office REITs during the COVID-19 pandemic. These differences give rise to a high correlation of retail REITs with stocks. Secondly, to evaluate the benefit of Malaysian REITs as a diversifiable asset, a previous study used a constant covariance matrix between asset returns (Jalil et al., 2015; Newell & Osmadi, 2010). Instead, the study adopted the time-varying covariance matrix for a thorough analysis in each subperiod. As a result, prior to the COVID-19 pandemic, the analysis indicated that a portfolio comprising retail REITs reported higher risk-adjusted returns than a portfolio comprising office REITs. Nonetheless, the volatility of retail REITs increased during the COVID-19 period, thereby limiting their diversification benefits. Meanwhile, following the COVID-19 pandemic, the portfolio with REITs improved, with the portfolio containing office REITs outperforming the one that includes retail REITs. After all, the inclusion of REITs accentuates the diversification benefit of including real estate assets in a portfolio of financial assets. This is particularly true for individual investors in the Malaysian market, given the dynamic linkages of REITs during unprecedented economic circumstances.

2.0   Literature Review

The literature has shed light on the similarities and differences between property sector REITs in the past. Empirical analysis indicates the presence of co-movement between

REITs and direct property, particularly in office, retail, and industrial direct real estate (Hoesli & Oikarinen, 2016; Yunus, 2019). Despite the similarity, REITs present different sensitivities to various macroeconomic factors. Notably, REITs in residential and retail sectors are vulnerable to short- and long-term interest rates, whereas office properties are neither affected by these two interest rate fluctuations (Lin et al., 2021). That is, office REITs and retail REITs are affected by the volatility and extreme return movement of the local stock markets, respectively (Demiralay & Kilincarslan, 2024). The variation in REITs within the individual property sector is due to these factors, as there are underlying differences in tenant types and lease periods (Chacon, 2023; Feng & Liu, 2023; Monden et al., 2021). As a result, each property sector REITs exhibits unique and time-varying volatility patterns (Piao et al., 2016, 2022).

Regarding COVID-19, it is reported that the pandemic has had a distinct impact on individual property sector REITs in global markets. The prices of hospitality, retail, and, to a lesser extent, office properties held by REITs declined significantly during the COVID-19 pandemic in the United States (U.S.) and European markets (Hoesli & Malle, 2022). While retail REITs are typically sensitive to the ongoing boom and bust cycles in the retail industry (Cai & Xu, 2022), their poor performance during this unprecedented situation is primarily due to the closure of retail properties and lockdown measures (Hoesli et al., 2025). The evidence can be observed in the negative relationship between daily changes in COVID-19 cases and the return of retail REITs (Milcheva, 2021). Nonetheless, office REITs are not severely affected and remain resilient, as demand for this sector is inelastic and supported by long-term lease agreements (Ling et al., 2020).

During the COVID-19 pandemic, Malaysian REITs outperformed the stock market, indicating that the beta of Malaysian REITs was less than one, suggesting that REITs are less volatile than stocks (Nordin et al., 2022). Using a GARCH framework, REITs demonstrated less persistence in volatility compared to other market sectors, such as property, technology, and consumer products (Khrudin & Mohamad, 2023). Furthermore, these findings highlight REITs in Malaysia, which have been revealed to be resilient to shocks in the financial market induced by the COVID-19 pandemic (Lee et al., 2020). This highlights the importance of including Malaysian REITs in a portfolio of financial assets during economic disruptions and periods of market stress.

According to investment theory, the diversification benefit of including an asset in a portfolio must consider the variance-covariance matrix between asset returns (Damianov & Elsayed, 2020). Thus, it is vital to assess the volatility of an individual asset and its correlation with the returns of another asset (Liow, 2012; Liow et al., 2009). In this regard, the application of DCC-GARCH can evaluate the time-varying volatility and correlations amongst asset returns (Case et al., 2012). Notably, various studies shed light on the diversification benefit of including REITs, which results in a portfolio with a low level of risk and improved risk-adjusted return (Anderson et al., 2023; Bernardo et al., 2023; Razak, 2023). Therefore, this study aims to contribute to the asset allocation literature involving REITs by examining their portfolio implications during the periods before, during, and after COVID-19 in Malaysia. The description of the data and the methodology used will be discussed in the following section.

3.0   Methodology

3.1   Data

The daily price indices were used for office property REITs, retail property REITs, stocks, and bonds. The Datastream office property and retail property REIT indices were employed as proxies for each property sector. Specifically, the FTSE Bursa Malaysia KLCI (FBMKLCI) price index was selected as a proxy for common stocks. Finally, the ABF Malaysian Bond Index Fund (ABFMY) was used as the proxy for bonds. The period of data used in this study spanned from 1 January 2018 until 21 October 2024. This period was considered as a whole. From then on, the data was broken down into three periods: prior to, during, and after the COVID-19 period. That is, 1 January 2018 to 17 March 2020 was set as the prior COVID-19 period. The period from 18 March 2020 to 31 March 2022 was designated as the period during COVID-19. The selection was consistent with the movement control order from 18 March 2020 (Majlis Keselamatan Negara, 2020). Finally, the period from 1 April 2022 to 21 October 2024 was selected as the period after COVID-19. The selection was in accordance with the beginning of the endemic stage of COVID-19, which reflects a controlled healthcare service system (Majlis Keselamatan Negara, 2022).

The return for each individual asset, i was calculated using the formula:

$$r_{i,t} = \ln \left(\frac{P_{i,t}}{P_{i,t-1}}\right), \qquad (1)$$

where i is the individual asset comprising office REITs, retail REITs, stocks, and bonds, respectively.

The first analysis of this study covers the modelling of the dynamics of individual assets and their covariance matrix. Secondly, the covariance matrix is incorporated into the portfolio choice problem, which consists of REITs, stocks, and bonds.

3.2 DCC-GARCH Model Specification

Following Razak (2023), the DCC-GARCH model consists of two parts. The first was the asset return that equation based on the Vector Autoregressive (VAR) model of lag (1) processes as follows:

$$r_t = \mu + \varphi_1 r_{t-1} + \varepsilon_t, \qquad (2)$$

where μ is the constant term, φ_1 as the Autoregressive (AR) term with lag of 1 in the form of a 3x3 matrix. The error term, ε_t is a 1x3 matrix that is assumed to be i.i.d and normally distributed such that, $\varepsilon_t \sim N(0, H_t)$. The subscript for each asset is excluded to simplify the representation of the equation (2).

From there onwards, the second part of the DCC-GARCH considers the equation of variance for an individual asset. From $\varepsilon_t \sim N(0, H_t)$, the covariance matrix of the error term, H_t, defined as:

$$H_t = D_t R_t D_t, \qquad (3)$$

where R_t and D_t are the conditional correlation and diagonal matrix in the form of a 3x3 matrix, respectively. From D_t, each diagonal element in is defined as $\sqrt{h_t^\tau}, \tau \in a, b, c$. This can be referred to as the standard deviation for each asset based on the univariate GARCH (1,1). That is,

$$h_t = k_i + s_i \varepsilon_{i,t-1}^2 + l_i h_{t-1}, \tag{4}$$

where k_i is the constant term, s_i is the short-run (ARCH effects), and l_i is the long-run persistent (GARCH effect) on h_t for each asset return.

There were two steps involved in estimating H_t. First, the volatility equation for each asset return was used to obtain the estimates of h_t. Second, the error term was re-expressed as $\eta_t = \frac{\varepsilon_t}{\sqrt{h_t}}$, which will be used to estimate the DCC parameters.

Consistent with Engle (2002), the dynamic conditional correlation equations were formulated as follows:

$$Q_t = (1 - \alpha - \beta)\bar{Q} + \alpha \eta_{t-1} \eta_{t-1}' + \beta Q_{t-1}, \tag{5}$$

$$R_t = Q_t^{*-1} Q_t Q_t^{*-1}, \tag{6}$$

where $\bar{Q} = E[\eta_{t-1} \eta_{t-1}']$ as a constant covariance matrix, η_t, in a 3x3 matrix, while α and β are parameters that capture past shocks and conditional covariance on the current covariance. Conditionally, the sum of parameters α and β should be close to one, $\alpha + \beta < 1$. This condition suggests the persistence of the correlation (Case et al., 2012). According to Cappiello et al. (2006), as Q_t is positive, R_t^* is a (3x3) matrix of correlation between asset returns, with ones on the diagonal and every off-diagonal element is less than one.

3.3   Mean-Variance Portfolio Optimisation

The covariance matrix from the DCC-GARCH model was used in the portfolio choice problem. Specifically, the optimisation used the objective function as formulated in equation (7). That is, the optimisation seeks to minimise the portfolio risk on each day t, subject to a required daily portfolio return, μ_0.

$$\min h_t = w_t' H_t w_t, \tag{7}$$

subject to

$$w_t' \mu = \mu_0. \tag{8}$$

And

$$w_{t,i} \geq 0, \qquad (9)$$

$$\textstyle\sum w_t = 1. \qquad (10)$$

Equation (9) represents the short-selling constraint. Lastly, equation (10) represents the budget constraint, assuming all capital is invested when optimising a portfolio.

Other than that, the costs of rebalancing in each individual asset, $c_{i,t}$ was calculated as:

$$c_{i,t} = bf \left| w_{i,t+1} - w_{i,t} \right|, \qquad (11)$$

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

$$TC_t = \sum_{i=1}^{3} c_{i,t}. \qquad (12)$$

In the mean-variance analysis, three scenarios of portfolios were hypothetically constructed where,

- Portfolio A: Stocks and bonds
- Portfolio B: Office property REITs, stocks, and bonds
- Portfolio C: Retail property REITs, stocks, and bonds

The estimation procedure was considered for four different periods, including an overall period from 1 January 2018 to 24 October 2024 and three sub-periods associated with the COVID-19 pandemic. The methodology used in this study is illustrated by the following research framework, as presented in Figure 1.
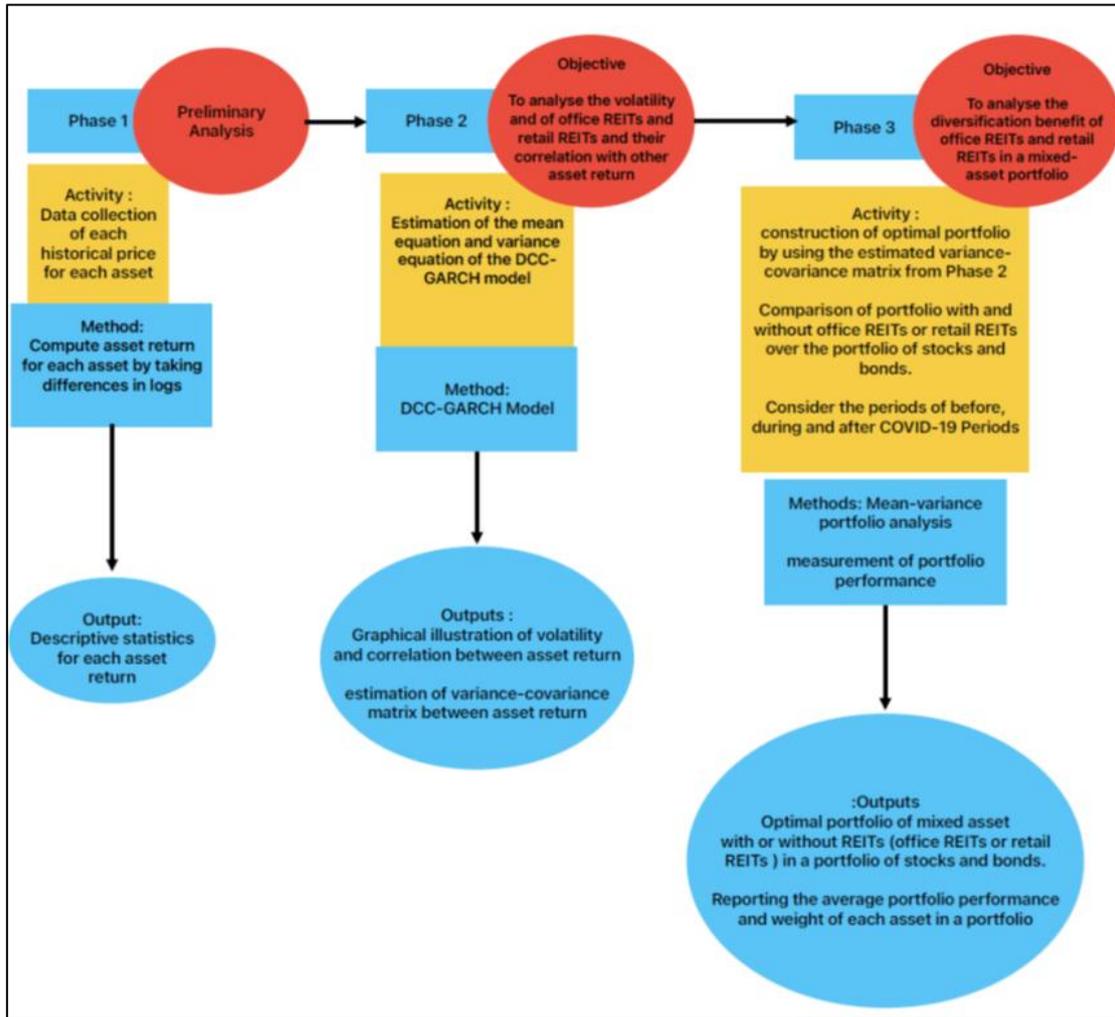
Figure 1: Research Framework

4.0   Results and Discussion

4.1   Descriptive Statistics

The descriptive statistics for each asset return are presented in Table 2. In general, bonds and retail property REITs reported the highest return. Notably, stock and bond markets were less volatile than both office property REITs and retail property REITs. Before the pandemic, bonds reported the highest mean return of 0.00025. During the pandemic, the standard deviation of retail REITs significantly increased to 0.2725. Meanwhile, office REITs were less volatile than the retail sector. Stocks and bonds were less volatile than

REITs. After the pandemic, the standard deviation for retail REITs decreased to 0.0071. Nonetheless, office REITs were more volatile than retail REITs.

Table 2: Descriptive Statistics

Asset	Sub-period	Mean	Std. Dev	Skewness	Kurtosis
	O	-0.00004	0.0098	-0.411	8.60
Office REITs	B	-0.00023	0.0109	-0.809	13.80
	D	-0.00027	0.0099	0.000	3.60
	A	0.00030	0.0086	-0.155	2.57
	O	0.00003	0.0090	-0.124	17.57
Retail REITs	B	-0.00019	0.0103	-0.502	26.81
	D	-0.00021	0.2725	0.273	4.31
	A	0.00039	0.0071	0.281	4.65
	O	-0.00005	0.0073	-0.271	9.57
Stock	B	-0.00062	0.0069	-2.202	12.55
	D	0.00044	0.0088	0.697	6.40
	A	0.00005	0.0061	-0.300	8.47
	O	0.00016	0.0015	-0.959	22.22
Bond	B	0.00025	0.0011	-0.852	27.18
	D	0.00004	0.0018	-1.587	25.92
	A	0.00018	0.0015	0.127	6.77

Notes: This table reports descriptive statistics for each index in the overall period O, and the three sub-periods of before B, during D, and after A COVID-19 periods.

4.2   DCC-GARCH Parameter Estimates

The results of the asset return equations based on the VAR(1) processes for the DCC-GARCH model are tabulated in Tables 3 and 4. The estimated equation of the VAR(1) processes is presented by considering REITs in separate property types. The estimated regression revealed that the AR terms between lagged REITs and Bonds a_{RB} for both office and retail REITs are significant across all periods except during the pandemic. At the same time, the AR term between lagged stocks and office REITs a_{SR} is significant in the overall period. However, the relationship between lagged stocks and retail REITs is significant overall, as well as during the pre-pandemic period.

Table 3: Estimation of VAR(1) Process for Structure Consisting of Office REITs, Stock, and Bond

Sub-Period	Office REITs				Stocks				Bond			
	μ_R	a_{RR}	a_{RS}	a_{RB}	μ_S	a_{SR}	a_{SS}	a_{SB}	μ_B	a_{BR}	a_{BS}	a_{BB}
Overall	-7.5E-05	-0.197**	0.071**	0.467**	-4.2E-05	-0.00956	-0.01972	-0.0287	9.4E-05**	0.00288	0.0098**	0.429**
	(0.00022)	(0.02298)	(0.03111)	(0.1533)	(0.00017)	(0.01789)	(0.02422)	(0.1193)	(3.1E-05)	(0.00322)	(0.00436)	(0.02149)
Before	-3.9E-04	-0.115**	0.09548	1.320**	-8.0E-04**	-0.03135	0.138**	1.024**	1.7E-04**	0.00381	0.0186**	0.359**
	(0.00043)	(0.03976)	(0.06402)	(0.3913)	(0.00029)	(0.02662)	(0.04286)	(0.2619)	(4.4E-05)	(0.00406)	(0.00654)	(0.03996)
During	-3.9E-04	-0.285**	0.07288	0.0322	5.3E-04	-0.02808	-0.100**	-0.718**	4.6E-05	-0.00262	-0.00239	0.463**
	(0.00042)	(0.04236)	(0.04824)	(0.2396)	(0.00038)	(0.03828)	(0.04359)	(0.2165)	(6.4E-05)	(0.00651)	(0.00742)	(0.03684)
After	0.00025	-0.230**	0.03020	0.503**	3.8E-06	0.00635	-0.079**	0.2109	0.0001**	0.00589	0.0175**	0.386**
	(0.00032)	(0.03751)	(0.05287)	(0.2213)	(0.00024)	(0.02738)	(0.03859)	(0.1616)	(5.2E-05)	(0.00603)	(0.00850)	(0.03559)

Notes: This table reports the regression result of the asset return equation. Each value in parentheses represents the standard error, while ** denotes the 5% significance level.

Table 4: Estimation of VAR(1) Process for Structure Consisting of Retail REITs, Stock, and Bond

	Retail REITs				Stocks				Bond			
Sub-Period	μ_R	a_{RR}	a_{RS}	a_{RB}	μ_S	a_{SR}	a_{SS}	a_{SB}	μ_B	a_{BR}	a_{BS}	a_{BB}
Overall	4.4E-06	-0.168**	0.024**	0.448**	-4.1E-05	-0.0105	0.0202	-0.0265	9.4E-05**	0.0092**	0.0036	0.427**
	(0.00021)	(0.0240)	(0.0297)	(0.1417)	(0.00017)	(0.0202)	(0.0250)	(0.1194)	(3.1E-05)	(0.0036)	(0.0045)	(0.0215)
Before	-4.3E-04	-0.182**	0.249**	1.913**	-8.0E-04**	0.0172	0.120**	1.009**	1.7E-04**	0.0050	0.018**	0.357**
	(0.00040)	(0.0393)	(0.0592)	(0.3621)	(0.00029)	(0.0285)	(0.0429)	(0.2624)	(4.4E-05)	(0.0043)	(0.0065)	(0.0400)
During	-2.7E-04	-0.108**	0.0400	-0.0629	5.2E-04	-0.0594	-0.0836	-0.706**	4.7E-05	0.0007	-0.0032	0.464**
	(0.00041)	(0.0468)	(0.0499)	(0.2354)	(0.00038)	(0.0429)	(0.0458)	(0.2160)	(6.4E-05)	(0.0073)	(0.0078)	(0.0368)
After	0.00043	-0.232**	0.0351	0.3014	1.4E-05	-0.0244	-0.0702	0.2116	0.0001**	0.021**	0.0110	0.384**
	(0.00027)	(0.0395)	(0.0460)	(0.1849)	(0.00024)	(0.0345)	(0.0402)	(0.1615)	(5.2E-05)	(0.0076)	(0.0088)	(0.0354)

Notes: This table reports the regression result of the asset return equation. Each value in parentheses represents the standard error, while ** denotes the 5% significance level.

The variance equation indicated that the GARCH coefficients are statistically significant at the 5% level across all periods, except for the office REITs during the pandemic. The ARCH coefficients are also significant for office and retail REIT structures across all periods. Moreover, the ARCH and GARCH coefficients for stocks and bonds are significant across the subperiods. It is rather expected that the GARCH coefficients will be considerably larger than the ARCH coefficients. This highlights that past volatility has a more pronounced and lasting impact on current volatility compared to short-term shocks.

Table 5: Conditional Variance Estimates of Structure Consisting of Office REITs, Stocks, and Bonds

Sub-Period	Coefficients	Office REITs	Stocks	Bonds
Overall Period	k_i	3.2E-05** (1.3E-05)	1.5E-06** (7.1E-07)	4.4E-08 (4.7E-08)
	s_i	0.17** (0.04)	0.078** (0.024)	0.193** (0.077)
	l_i	0.4729** (0.151)	0.8921** (0.031)	0.8071** (0.091)
Before COVID-19	k_i	4E-05** (1.3E-05)	1.8E-06 (1.4E-06)	3E-08 (4.7E-08)
	s_i	0.27** (0.09)	0.085** (0.031)	0.201** (0.087)
	l_i	0.338** (0.12)	0.883** (0.048)	0.799** (0.133)
During COVID-19	k_i	5.9E-05 (5.1E-05)	3.2E-06 (2E-06)	3.8E-07** (1.6E-07)
	s_i	0.14** (0.04)	0.042** (0.019)	0.36** (0.11)
	l_i	0.266 (0.52)	0.904** (0.041)	0.472** (0.131)
After COVID-19	k_i	1.5E-05** (5.1E-06)	1.4E-06 (9.94E-07)	1E-08 (2.1E-08)
	s_i	0.09** (0.03)	0.09 (0.05)	0.086 (0.064)
	l_i	0.7088** (0.076)	0.8895** (0.059)	0.9135** (0.063)

Notes: This table reports the coefficients of the variance equation from the DCC-GARCH Model. Notably, k_i denotes the constant term, s_i is the ARCH effect, and l_i is the GARCH effect. Each value in parentheses represents the standard error, while ** denotes the 5% significance level.

Meanwhile, in Table 6, the sum of DCC parameters, α and β, was approximately close to one. The similar findings in each subperiod associated with COVID-19 reflect the long-run shocks affecting the correlation dynamics between asset returns. Taken together, the DCC-GARCH regression noted that sectors can be distinguished based on their ARCH and GARCH effects, as well as their conditional correlation parameters. In

essence, these circumstances indicate that each sector is unique in terms of both its conditional volatility pattern and its correlation structure with other financial assets.

Table 6: DCC Parameters for Combined Structure of Office REITs, Retail REITs, Stocks, and Bonds

Structure	Coefficients	Overall Period	Before COVID-19	During COVID-19	After COVID-19
Office REITS, Stocks & Bonds	α	0.0152 (0.0086)	0.0101 (0.011)	8.79E-09 (0.025)	0.02393 (0.014)
	β	0.858** (0.0539)	0.8088** (0.101)	0.9825** (0.046)	0.859** (0.039)
Retail REITS, Stocks & Bonds	α	0.025** (0.0076)	0.00206 (0.0042)	1.51E-08 (0.018)	0.044** (0.0204)
	β	0.867** (0.0539)	0.9848** (0.0064)	0.9673** (0.031)	0.743** (0.1009)

Notes: This table reports the conditional correlation parameters, α and β, from the DCC-GARCH Model. Each value in parentheses represents the standard error, while ** denotes the 5% significance level.

4.3   The Dynamics of Volatility and Correlations in Listed REITs during the COVID-19

The exhibits of volatility based on the DCC-GARCH model are presented in Figure 2. For each asset, the exhibits of volatility are presented, accounting for the sub-periods before, during, and after COVID-19. In particular, office REITs experienced a sharp increase in volatility during the pandemic, reaching the highest level of 0.03%. However, it fluctuated around 0.02% in the post-pandemic period. In addition, retail REITs exhibited a similar pattern, albeit with volatility significantly higher than that of office REITs during the pandemic, reaching 0.04% in mid-2020. It stabilised between 0.015% and 0.02% in the recovery period. Stock volatility also increased during the pandemic, peaking at 0.03% in mid-2020. On the other hand, bonds exhibited the lowest volatility, with only a modest increase to 0.01% during the pandemic and remained low and stable throughout the recovery period.
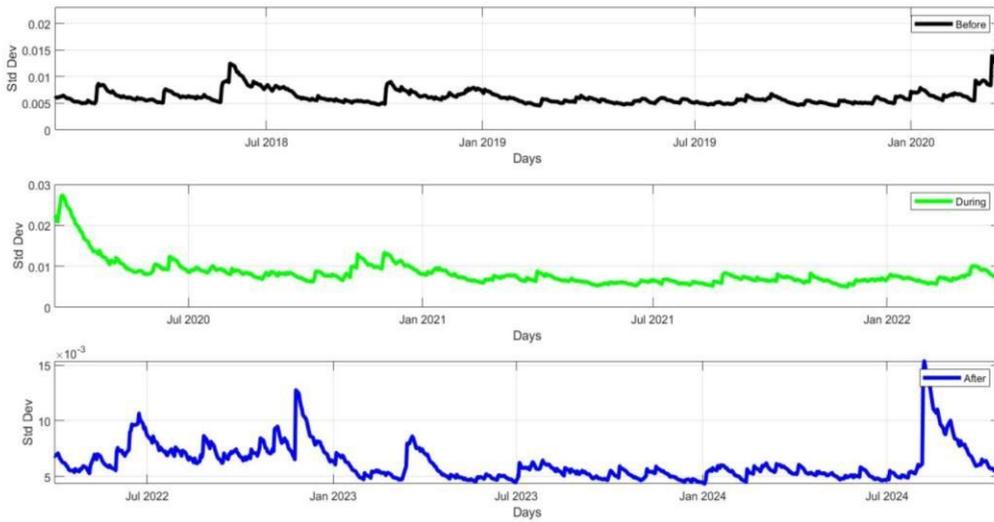
Office REITs
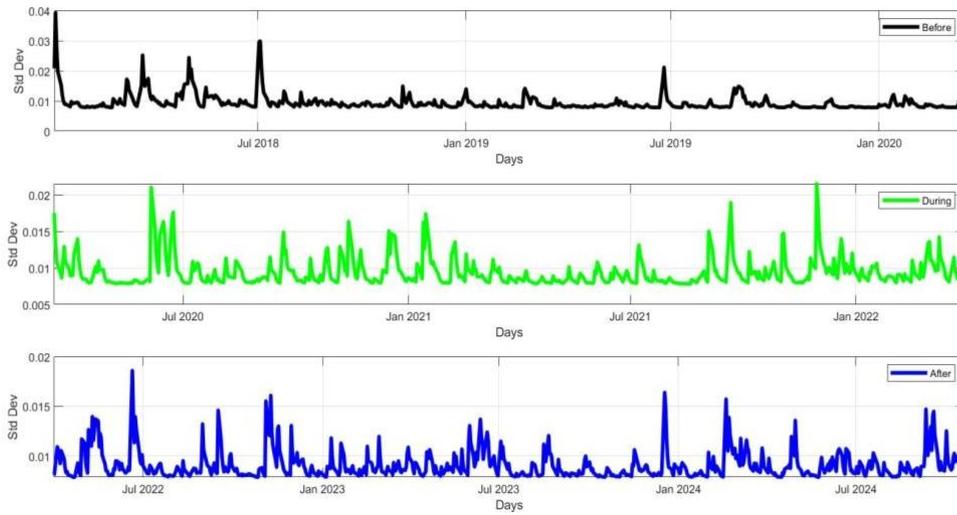
Retail REITs
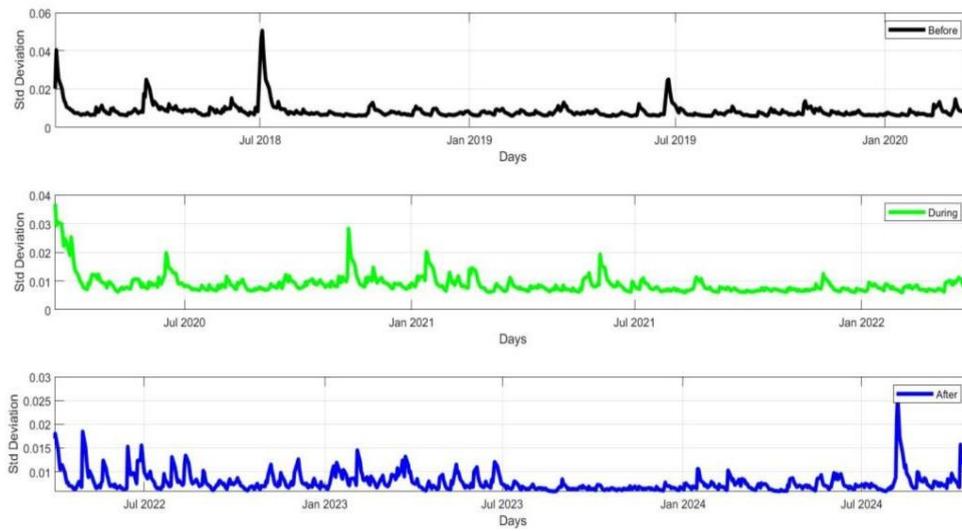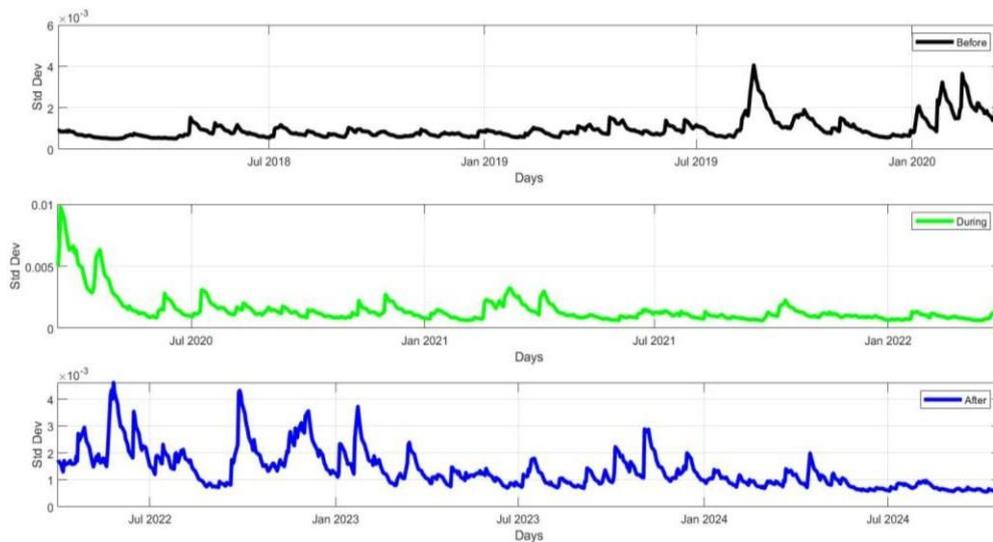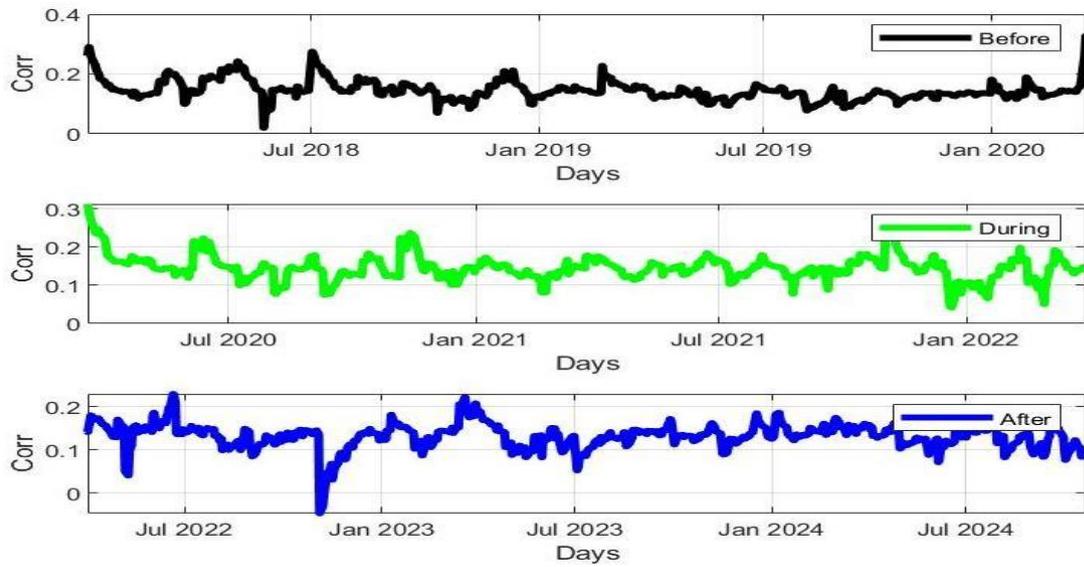
Stocks

Bonds

Figure 2: Time-Varying Volatilities of Asset Returns

The variation in the volatility patterns implies the differences in correlation with other financial assets. Thus, the exhibits of correlation in different subperiods are depicted in Figure 3. Before the pandemic, office property REITs and stocks in Malaysia were weakly correlated, with a correlation coefficient ranging from 0.1 to 0.2. Subsequently, the correlations increased moderately during the pandemic, reaching a peak of 0.3 in March 2020. After the pandemic, the correlation returned to its pre-

COVID-19 level. In contrast, the correlation between office property REITs and bonds fluctuated at an interval of -0.1 to 0.1 before COVID-19. During the pandemic, they were negatively correlated, while post-pandemic, the correlation fluctuated between 0.05 and 0.1.

Before the pandemic, the linkages between retail property REITs and stocks were moderate yet positively correlated. During the pandemic, the correlation fluctuated between 0.1 and 0.4, which is slightly higher than the correlation between office property REITs and stocks. Following the pandemic, the correlation increased, fluctuating between 0.2 and 0.4, with a peak of 0.6 in September 2024. The correlation between listed real estate and bonds for both property sectors showed a similar trend, albeit with different magnitudes. Overall, there is a limited diversification benefit between REITs and stocks, due to the high volatility of listed real estate and its correlation with stocks. Conversely, REITs and bonds demonstrate greater diversification potential due to their low correlation and the lower volatility of bonds than REITs. While these insights may not be new to international markets (Abuzayed et al., 2020; Hoesli et al., 2025; Razak, 2023), the analysis reveals the dynamics of asset allocation exercises for a portfolio comprising listed real estate, stocks, and bonds in Malaysia.
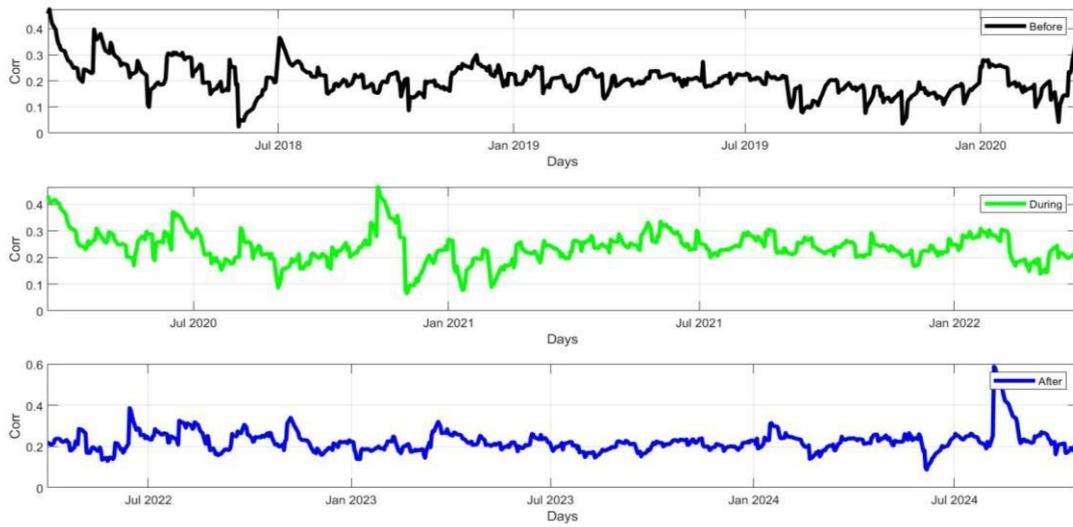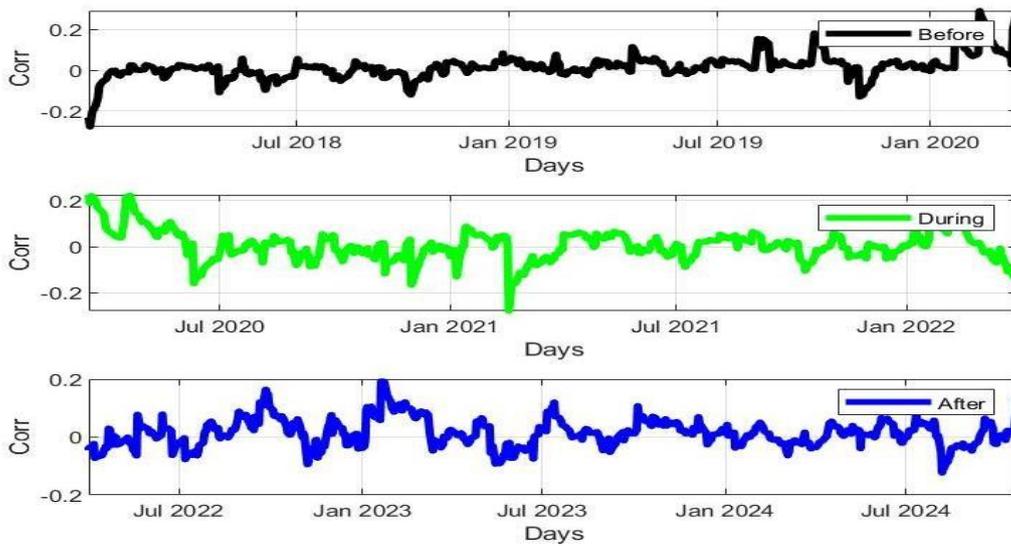
Office REITs - Stocks

Office REITs - Bonds
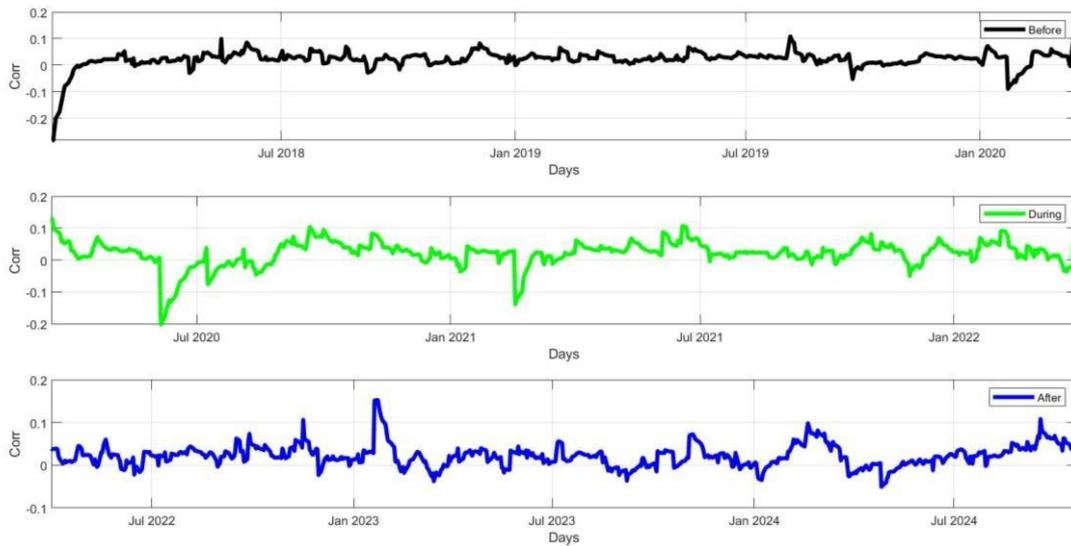
Retail REITs - Stocks

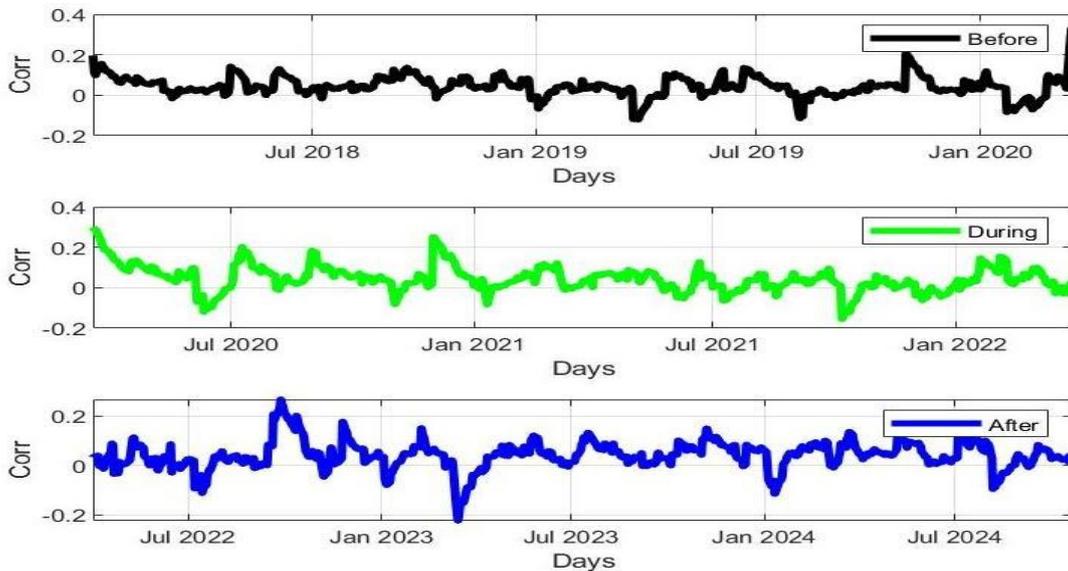**Retail REITs – Bonds**

Stock - Bonds

Figure 3: Dynamic Correlations Between Asset Returns

4.4   Portfolio Diversification

The variance-covariance matrix implied by DCC-GARCH was then incorporated into mean-variance portfolio analysis, both before, during, and after the COVID-19 period. That is, an optimal portfolio was produced on a day-to-day basis through estimates of asset returns for each asset, r_t, and the variance-covariance matrix of H_t. For each day, the portfolio return was assumed to be 0.0019% based on the FBMKLCI average return during the overall period. Furthermore, short-selling and budget constraints were considered in the optimisation process. The transaction cost was also determined, owing to an absolute change in the weight of each asset each day. Correspondingly, three hypothetical portfolios were created, denoted as Portfolio A, B, and C. In particular, Portfolio A served as the reference portfolio, which did not include a listed real estate asset. Conversely, the office property and retail property REITs were included in portfolios B and C, respectively. The portfolio analysis was conducted from January 2018 to October 2024. The analyses were broken down into three distinct sub-periods: before COVID-19 (January 2018 to March 2020), during COVID-19 (March 2020 to March 2022), and after COVID-19 (April 2022 to October 2024).

Against this backdrop, the average allocation in each asset and the performance of each portfolio are tabulated in Table 7. During the overall period, Portfolio A reported an average weight of 25.33% in stocks and 74.67% in bonds. In addition, Portfolio A generated an average return and standard deviation of 0.45% and 0.36%, respectively. The risk-adjusted return based on the Sharpe ratio was 0.4019. Meanwhile, Portfolio B, which includes office REITs, stocks, and bonds, reported 18.31% weight to stocks and 66.27% weight to bonds. The remaining 15.42% of the weight was allocated to office REITs. Portfolio B reported a Sharpe ratio of 0.7817, higher than Portfolio A. At the same time, Portfolio C, composed of retail REITs, stocks, and bonds, had a return similar to that of Portfolio B, yet with slightly higher volatility, at 0.31%. Overall, Portfolio C has a Sharpe ratio of 0.7343. Before the pandemic, Portfolio A reported a risk-adjusted return of 0.4732. Portfolio B, with 14% allocation to office property REITs, had a Sharpe ratio of 0.7238. Portfolio C, which includes a 16% allocation to retail property REITs, posted the highest Sharpe ratio of 0.7818. It had better risk-adjusted performance than Portfolio B. While Portfolio B had a higher bond allocation of 67.91%, Portfolio C reported a lower standard deviation of 0.16% compared to Portfolio B's at 0.17%.

During the pandemic, the portfolio without listed REITs reported a return of 0.14% and 0.24%, respectively. In particular, Portfolio B, which added a 15% allocation to office property REITs, generated portfolio returns of 0.20% and a Sharpe ratio of 0.7613. Portfolio C, which included 14% of retail REITs, had the highest return of 0.21%. However, their Sharpe ratio of 0.6701 was lower than that of Portfolio B, due to a higher standard deviation of 0.20%. Nonetheless, during the pandemic, portfolios with listed real estate (either office or retail properties) outperformed the reference portfolio. Following the pandemic, Portfolio A experienced improvement, reporting a higher return of 0.16% with a Sharpe ratio of 0.41978, compared to the period of the COVID-19 pandemic. Portfolio B, with 17% allocation to office REITs, reported average return and standard deviation of 0.26% and 0.17%, respectively. Portfolio C had a 16% allocation to retail REITs, reported a portfolio return of 0.24%, and a standard deviation of 0.18%. Thus, the portfolio with office REITs reported a higher risk-adjusted return of 0.8540 than the portfolio with retail REITs.

The portfolio analysis of REITs in Malaysia during the COVID-19 period revealed several key insights. First, the inclusion of office property or retail property REITs generates a portfolio with a low-risk level. The evidence can be observed based on the improvement in the Sharpe ratio. It reflects that the investor has been rewarded by incorporating listed REITs (either office properties or retail properties) into their portfolio. Furthermore, the findings are robust across the periods. The analysis confirms that the evidence listed indicates REITs contribute to incremental performance for a mixed-asset portfolio of financial assets, which include stocks and bonds (Anderson et al., 2023; Bernardo et al., 2023; Razak, 2023). In addition, the findings support the notion that REITs should be construed as real estate assets rather than common stocks (Hoesli & Oikarinen, 2012, 2016, 2021). Hence, property sector REITs in Malaysia can serve as a substitute for direct property investment, including office and retail properties.

Secondly, using the DCC-GARCH appraises the dynamics of each property sector REITs in Malaysia. That is, both office property and retail property REITs have discernible volatility patterns and correlation dynamics with stocks and bonds. Irrespective of the COVID-19 period, the volatility of retail REITs is higher than that of office REITs. Following Abuzayed et al. (2020), the high level of volatility of retail REITs gives rise to a high correlation with stocks. Notably, the result of this study is not contradictory to the underlying fundamental differences between office property and retail property REITs. In particular, there are a few tenants of office property REITs that large firms and corporations typically concentrate on. The concentrated tenants contribute to operating efficiency for REITs, which in turn translates to increased profitability and reduced uncertainty in their cash flows compared to tenants from widespread companies (Chacon, 2023; Feng & Liu, 2023; Lu-Andrews, 2017). However, the tenants of retail property REITs are extensive, comprising both large and small retailers, although the large retailers are primarily highly reputable companies (Tee et al., 2023). Typically, retailers' income is daily, and thus, their rental payment is dependent on their sales performance (Kariya et al., 2023; Monden et al., 2021).

Third, the COVID-19 pandemic exacerbated the differences between retail property and office property REITs. Despite both REITs' results in better performance

for a portfolio of stocks and bonds, the portfolio with retail property REITs reported a higher level of risk compared to the portfolio with office property REITs. Hence, the portfolio with retail REITs reported a low risk-adjusted return. The findings are consistent with the uncertainty from retailers, in such a way that retail REITs had to provide rebates to affected tenants during the lockdown imposed by the Malaysian government (Lee, 2020). However, office REITs were not severely affected as the retail sector, despite the work-from-home policy, had been implemented by businesses during COVID-19 (Isa et al., 2024). Instead, the work-from-home policy allowed these businesses to maintain continuous productivity during unprecedented circumstances. Taken together, property sector REITs, either office or retail, provide a greater choice for individual investors to invest in real estate assets, which was limited to residential properties before this. Nonetheless, in Malaysian REITs, the office sector is more resilient than the retail sector during the COVID-19 pandemic. Therefore, it can be suggested that individual investors consider REITs according to their risk appetite. That is, risk-averse investors should consider office REITs, while high-risk takers should consider retail REITs.

Table 7: Optimal Portfolio Performance

Sub-Period	Portfolio	A	B	C
Overall Period	$\bar{w}$ Reit	-	0.1542	0.1533
	$\bar{w}$ Stock	0.2533	0.1831	0.1709
	$\bar{w}$ Bond	0.7467	0.6627	0.6757
	$\tilde{r}p$	0.0045	0.0067	0.0067
	$\sigma(rp)$	0.0036	0.0029	0.0031
	Sharpe Ratio	0.4019	0.7817	0.7343
Before COVID-19	$\bar{w}$ Reit	-	0.1397	0.1614
	$\bar{w}$ Stock	0.2558	0.1812	0.1828
	$\bar{w}$ Bond	0.7442	0.6791	0.6558
	$\tilde{r}p$	0.0015	0.0021	0.0022
	$\sigma(rp)$	0.0017	0.0017	0.0016
	Sharpe Ratio	0.4732	0.7238	0.7818
During COVID-19	$\bar{w}$ Reit	-	0.1466	0.1363
	$\bar{w}$ Stock	0.2354	0.1799	0.1497
	$\bar{w}$ Bond	0.7646	0.6735	0.714

Sub-Period	Portfolio	A	B	C
	$\tilde{r}_p$	0.0014	0.0020	0.0021
	$\sigma(r_p)$	0.0024	0.0016	0.0019
	Sharpe Ratio	0.3435	0.7613	0.6701
After COVID-19	$\bar{w}$ Reit	-	0.1735	0.1601
	$\bar{w}$ Stock	0.2654	0.1867	0.1769
	$\bar{w}$ Bond	0.7346	0.6398	0.6629
	$\tilde{r}_p$	0.0016	0.0026	0.0024
	$\sigma(r_p)$	0.0020	0.0017	0.0018
	Sharpe Ratio	0.4198	0.8540	0.7643

Notes: The table reports the portfolio return, risk, and the weight of each asset, $\tilde{r}_p, \sigma(r_p)$ and $\bar{w}$ respectively. Portfolio A is a portfolio without REITs, while Portfolio B and Portfolio C include office REITs and retail REITs, respectively.

5.0   Conclusion and Future Research

This research analysed the riskiness of office property REITs and retail property REITs in Malaysia and their interdependence with stocks and bonds during COVID-19. The daily data from January 2018 and October 2024 were used, which were then divided into three sub-periods: before, during, and after the COVID-19 period. The interdependence of REITs was analysed further in the context of the portfolio optimisation problem. In essence, for each sub-period, the portfolio analyses were conducted under three scenarios: one without REITs and two with either office REITs or retail REITs, respectively. The exhibits of volatility revealed that Malaysian REITs were not identical to one another since the magnitude of volatility varied across sectors. Specifically, retail property REITs were discovered to be more volatile compared to office property REITs. These dynamics have a significant impact on the linkages between REITs and other asset returns that fluctuate over time. The analysis reported that portfolios containing listed real estate investment trusts (REITs) outperformed a portfolio of financial assets. The results were consistent with the initial hypothesis that Malaysian REITs provide a significant diversification benefit to a portfolio. In particular, during the pandemic, portfolios, including those with REITs, achieved higher returns with lower risk compared to those without REITs.

The study also discovered that integrating REITs with traditional assets creates a balanced portfolio by reducing the allocation to common stocks and increasing the room for listed REITs in a portfolio. Bonds serve as a buffer, lowering the overall risk of the portfolio. Consequently, the risk-adjusted return for the portfolio with office REITs was superior to those with retail REITs and without REITs, respectively. The study's findings have significant implications, highlighting Malaysian REITs as a liquid form of real estate assets across various sectors. In other words, Malaysian REITs are comparable to stocks and bonds, which can be invested in on a daily basis. In this context, the study provides practical recommendations for individual investors, taking into account the riskiness of each type of REIT and its linkages with other investable assets. Hence, this approach can be viewed as a risk assessment prior to investing in Malaysian REITs, especially during a distressed economic situation. Above all, the study significantly extends the portfolio implication literature by affirming the resilience of REITs in the Malaysian market, specifically during the COVID-19 period. The study is limited to retail property and office property REITs, and a six-year study period is chosen due to data availability. Thus, future research could include diversified property REITs as another asset class within REITs. Moreover, future studies can utilise the spanning test to investigate whether REITs enhance a portfolio that previously consisted of stocks and bonds. Nonetheless, the study offers valuable insights into understanding the dynamics and diversification benefits of both office and retail REITs, which enable investors to make informed decisions based on their risk appetite.

Conflict of Interest Statement: The authors have no competing interests to declare that are relevant to the content of this study.

References

Abuzayed, B., Al-Fayoumi, N., & Bouri, E. (2020). Co-movement across european stock and real estate markets. *International Review of Economics & Finance*, *69*, 189–208. https://doi.org/10.1016/j.iref.2020.05.010

Anderson, R. I., Guirguis, H., & Loviscek, A. L. (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

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

Beracha, E., Feng, Z., & Hardin, W. G. (2019). REIT operational efficiency and shareholder value. *Journal of Real Estate Finance & Economics*, *41*(4), 513–553. https://doi.org/10.22300/0896-5803.41.4.513

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

Brounen, D., & Eichholtz, P. M. A. (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

Cai, Y., & Xu, K. (2022). Net Impact of COVID-19 on REIT Returns. *Journal of Risk and Financial Management*, *15*(8). https://doi.org/10.3390/jrfm15080359

Cappiello, L., Engle, R. F., & Sheppard, K. (2006). Asymmetric dynamics in the correlations of global equity and bond returns. *Journal of Financial Econometrics*, *4*(4), 537–572. https://doi.org/10.1093/jjfinec/nbl005

Case, B., Yang, Y., & Yildirim, Y. (2012). Dynamic correlations among asset classes: REIT and stock returns. *Journal of Real Estate Finance and Economics*, *44*(3), 298–318. https://doi.org/10.1007/s11146-010-9239-2

Chacon, R. G. (2023). Tenant concentration in REITs. *Journal of Real Estate Finance and Economics*, *66*(3), 636–679. https://doi.org/10.1007/s11146-021-09829-1

Chen, H., Harrison, D. M., & Khoshnoud, M. (2020). Investors' limited attention: evidence from REITs. *Journal of Real Estate Finance and Economics*, *61*(3), 408–442. https://doi.org/10.1007/s11146-018-9667-y

Chien, T. C., & Mohd Diah, M. L. (2020). Diversification benefits in malaysia real estate investment trusts (M-REITs): Analysis by property types. *Research in Management of Technology and Business*, *1*(1), 699–713. https://doi.org/10.30880/rmtb

Damianov, D. S., & Elsayed, A. H. (2020). Does Bitcoin add value to global industry portfolios? *Economics Letters*, *191*(0), 1–13. https://doi.org/10.1016/j.econlet.2019.108935

Demiralay, S., & Kilincarslan, E. (2024). Uncertainty measures and sector-specific reits in a regime-switching environment. *Journal of Real Estate Finance and Economics*. https://doi.org/10.1007/s11146-022-09898-w

Engle, R. (2002). Dynamic conditional correlation: A simple class of multivariate generalised autoregressive conditional heteroskedasticity models. *Journal of Financial Econometrics*, *20*(3), 339–350.

Feng, Z., & Liu, P. (2023). Introducing "focused firms": implications from reit prime operating revenue. *Journal of Real Estate Finance and Economics*, *67*(3), 545–578. https://doi.org/10.1007/s11146-021-09850-4

Feng, Z., Pattanapanchai, M., Price, S. M. K., & Sirmans, C. F. (2019). Geographic diversification in real estate investment trusts. *Real Estate Economics*, 1–20. https://doi.org/10.1111/1540-6229.12308

Hoesli, M., Johner, L., & Kraiouchkina, J. (2025). The volatility of listed real estate in europe and portfolio implications. *Journal of Real Estate Research*, *47*(2), 240-278.

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

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

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.

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

Huang, M. C., Wu, C. C., Liu, S. M., & Wu, C. C. (2016). Facts or fates of investors' losses during crises? Evidence from REIT-stock volatility and tail dependence structures. *International Review of Economics and Finance*, *42*, 54–71. https://doi.org/10.1016/j.iref.2015.10.046

Isa, A. A., Razali, M. N., Azmi, F. A., Daud, S. Z., Mohsin, A., Ismail, A., & Lokman, M. A. (2024). Covid-19 impact to retail, hospitality, and office space in MALAYSIA. *Real Estate Management and Valuation*, *32*(1), 84–94. https://doi.org/10.2478/remav-2024-0008

Jalil, R. A., Ali, H. M., Razali, N., Lee, J., & Yim, M. (2015). Optimal portfolio allocation of Malaysian real estate investment trusts during economic downturn. *International Journal of Real Estate Studies*, *9*(2), 1–15.

Kariya, T., Takada, H., & Yamamura, Y. (2023). Tenant Portfolio Selection for Managing a Shopping Center. *International Real EstateReview*, *26*(2), 143–171.

Khrudin, K. N., & Mohamad Shariff, N. S. (2023). 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

Le, T. P. T. D., & Tran, H. L. M. (2021). The contagion effect from U.S. Stock Market to the Vietnamese and the Philippine stock markets: The Evidence of DCC – GARCH Model. *Journal of Asian Finance, Economics and Business*, *8*(2), 759–770. https://doi.org/10.13106/jafeb.2021.vol8.no2.0759

Lee, E. (2020, 26 August). Raising gearing limit of REITs timely. *The Edge Malaysia*. https://theedgemalaysia.com/article/raising-gearing-limit-reits-timely

Lee, K. Y.-M., Jais, M. J., & Chan, C.-W. (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

Lin, Y. C., Lee, C. L., & Newell, G. (2021). Varying interest rate sensitivity of different property sectors: cross-country evidence from REITs. *Journal of Property Investment and Finance*, *40*(1), 68–98. https://doi.org/10.1108/JPIF-09-2020-0099

Ling, D. C., Wang, C., & Zhou, T. (2020). A first look at the impact of COVID-19 on commercial real estate prices: Asset-level evidence. *Review of Asset Pricing Studies*, *10*(4), 669–704. https://doi.org/10.1093/rapstu/raaa014

Liow, K. H. (2012). Co-movements and correlations across asian securitised real estate and stock markets. *Real Estate Economics*, *40*(1), 97–129. https://doi.org/10.1111/j.1540-6229.2011.00314.x

Liow, K. H., Ho, K. H. D., Ibrahim, M. F., & Chen, Z. (2009). Correlation and volatility dynamics in international real estate securities markets. *Journal of Real Estate Finance and Economics*. https://doi.org/10.1007/s11146-008-9108-4

Lu-Andrews, R. (2017). Tenant quality and REIT liquidity management. *Journal of Real Estate Finance and Economics*, *54*(3), 272–296. https://doi.org/10.1007/s11146-016-9575-y

Majlis Keselamatan Negara. (2020). *FAQ Perintah Kawalan Pergerakan (PKP)*.

Majlis Keselamatan Negara. (2022). *Fasa Peralihan ke Endemik*. Kementerian Kesihatan Malaysia.

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

Monden, A., Takashima, K., & Zennyo, Y. (2021). Revenue-sharing contracts under demand uncertainty in shopping center. *Real Estate Economics*, *49*(2), 556–573.

Naik, N., Mohan, B. R., & Jha, R. A. (2020). GARCH Model Identification for Stock Crises Events. *Procedia Computer Science*, *171*, 1742–1749. https://doi.org/10.1016/j.procs.2020.04.187

Newell, G., & Osmadi, A. (2010). The development and preliminary performance analysis of islamic REITs in Malaysia. *Journal of Property Research*, *26*(4).

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.

Pavlov, A., Steiner, E., & Wachter, S. (2018). The consequences of REIT index membership for return patterns. *Real Estate Economics*, *46*(1), 210–250. https://doi.org/10.1111/1540-6229.12202

Peng, L., & Schulz, R. (2013). Does the diversification potential of securitised real estate vary over time and should investors care? *Journal of Real Estate Finance and Economics*, *47*(310–340). https://doi.org/10.1007/s11146-011-9357-5

Piao, X., Mei, B., & Xue, Y. (2016). Comparing the financial performance of timber REITs and other REITs. *Forest Policy and Economics*, *72*, 115–121. https://doi.org/10.1016/j.forpol.2016.06.022

Piao, X., Yao, W., & Mei, B. (2022). On the risk of novel specialized REITs. *Journal of Real Estate Portfolio Management*, *28*(1), 33–47. https://doi.org/10.1080/10835547.2021.2008095

Plazzi, A., Torous, W., & 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

Razak, M. Z. (2023). The dynamic role of the Japanese property sector REITs in mixed-assets portfolio. *Journal of Property Investment and Finance*, *41*(2), 208–238. https://doi.org/10.1108/JPIF-06-2022-0051

Ro, S., & Ziobrowski, A. J. (2011). Does focus really matter? Specialised vs. Diversified REITs. *Journal of Real Estate Finance and Economics*, *42*(1), 68–83. https://doi.org/10.1007/s11146-009-9189-8

Ro, S., & Ziobrowski, A. J. (2012). Wealth effects of REIT property-type focus changes: Evidence from property transactions and joint ventures. *Journal of Property Research*, *29*(3), 177–199. https://doi.org/10.1080/09599916.2012.703222

Securities Commission. (2024). *List of Listed Real Estate Investment Trusts*. Securities Commissions. https://www.sc.com.my/api/documentms/download.ashx?id=bf905fdd-b9c5-4a95-bdf3-6c953d7d43c0

Securities Commissions. (2024). *Real Estate Investment Trust Statistics*.

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. https://doi.org/10.11113/intrest.v17n2.287

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

Yunus, N. (2019). Dynamic linkages among U.S. real estate sectors before and after the housing crisis. *Journal of Real Estate Finance and Economics*, *58*(2), 264–289. https://doi.org/10.1007/s11146-017-9639-7