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South African Real Estate Investment Trusts Prefer Tuesdays

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Abstract: This study examines the day-of-the-week effect on the returns of different classifications of South African REITs. Ordinary least squares regression (OLS), generalized autoregressive conditional heteroskedasticity (GARCH) (1,1) (2,1), and Kruskal–Wallis (KW) tests were performed on data obtained from the IRESS Expert database from 2013 to 2021. We found statistical differences in the day-of-the-week effects for SAREITs; the best day to invest in office REITs is Friday, for diversified REITs Thursday, and for industrial REITs Friday. Generally, Wednesday was found to be the least profitable day to invest in all REIT classifications because it had the least average daily return. Tuesdays were the most profitable days for all REIT classifications, with the highest average daily return. REITs traded the most on Fridays, while REITs traded the least on Mondays. Returns were the most volatile on Monday, while volume was the least volatile on Thursday. The KW test revealed a statistically significant difference between the median returns across days of the week. Based on the above, profitability is expressed on Tuesdays in South African REITs. By recognizing the day-of-the-week effect, investors can buy and sell South African REITs more effectively. This study, apart from being the first in the context of South African REITs, provides updated evidence of the contested calendar anomaly issues.

Keywords: day-of-the-week effect; efficient market hypothesis; market liquidity; Kruskal–Wallis; GARCH; REITs

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1. Introduction

Fama's (1970) efficient market hypothesis posits that securities prices disclose all pertinent information that market participants require to make investment decisions. Therefore, investors assume that returns on securities are consistent. Nevertheless, empirical research has uncovered several irregular patterns in stock prices and returns, including the equity premium, size effect, overreaction, discount on closed-end funds, and day-of-the-week effects. One such anomaly in returns is the day-of-the-week effect, in which returns on a particular day vary from those on other days of the week. Cross (1973) observed that returns on Mondays, the first day of the week, are the least attractive in terms of returns. This difference in returns between different days of the week has led to the coining of various terms, such as the day-of-the-week effect, weekend effect, Monday effect, and Tuesday effect, to examine the variations in stock returns on specific days (Berument and Kiymaz 2001; Mazviona et al. 2022; Khan et al. 2021; Obalade and Muzindutsi 2019). The recent literature suggests that the day-of-the-week effect is inconclusive, with some studies indicating that it has diminished or disappeared. For instance, Olson et al. (2015) claimed that such effects have been declining since the 1970s and cannot be detected in long-term data. Similarly, Trick (2018) found a moderate day-of-the-week effect in a few sectors in the United States but claimed that the overall market does not exhibit the day-of-the-week effect. Additionally, Abrahamsson and Creutz (2018) demonstrated that the OMXS30 index did not display any day-of-the-week effects.

The existing literature reveals diverse findings regarding the day-of-the-week effect in different financial markets. While some studies, such as Rossi and Gunardi (2018) and Miss et al. (2020), show a persistent effect in specific markets, others, such as Birru (2018) and Chiah and Zhong (2021), find no significant impact in other markets. Gbeda and Peprah (2018) and Akbalik and Ozkan (2017) investigate the day-of-the-week effect on the Nairobi Stock Exchange and Indonesia, respectively, while Adaramola and Adekanmbi (2020) examine the same phenomenon in Nigeria.

Paital and Panda (2018) and Chancharat et al. (2020) explored the day-of-the-week effect in India and Thailand, respectively, and discovered anomalies in market returns. Islam and Sultana (2015) observed the day-of-the-week effect in Bangladesh, and Singh et al. (2020) investigated higher returns in the emerging markets of China, India, and Brazil at the turn of the month. These findings indicate that the day-of-the-week effect is inconsistent across all financial markets, and further research is required to understand the underlying causes and implications. Thus, the existence of day-of-the-week effect rejects the efficient market hypothesis. However, evidence from developed markets suggests that this has disappeared over time. However, few studies have affirmed that it exists specifically in less-established markets. Interestingly, the day-of-the-week effect is not consistent across markets and time. Furthermore, returns from an exchange were used to capture the day-of-the-week effect. Conversely, stock liquidity is an important indicator for understanding investor behavior, which is not widely considered in the testing of the day-of-the-week effect. Stock liquidity is a condition in which a stock is traded easily, without affecting its price. This is a positive feature that investors seek when making decisions.

Traditionally, the withdrawal of liquidity from financial markets has been associated with economic crises and market instability. Historically, several stock market crashes, such as those in 1987, 1998, and 2008, have been accompanied by flights of liquidity from the market. This study investigates the day of the week effect in an emerging market, as recommended by Akbalik and Ozkan (2017) and Rossi and Gunardi (2018). Kim and Nofsinger (2008) emphasize the importance of examining financial behavior in emerging markets because of their unique political and economic dynamics. To account for the sensitivity of the day-of-the-week effect, this analysis employs three methods: ordinary least squares (OLS), generalized autoregressive conditional heteroscedasticity (GARCH) (1, 1), and the Kruskal–Wallis test. The results of this study reveal the existence of a day-of-the-week effect in South Africa, with significant evidence for its presence in the country's financial markets. Interestingly, the highest and lowest returns are observed on different days for the different market classifications. In office, diversified, and industrial REITs, Friday, Thursday, and Friday are the best days to invest, respectively, whereas Wednesdays generate the lowest returns. REITs are most actively traded on Fridays and the least traded on Mondays. Additionally, returns are most volatile on Mondays, whereas trading volume is the least volatile on Thursdays. These findings align with the results of recent studies, which have also shown variations in the day-of-the-week effect.

2. Literature Review and Hypothesis Development

2.1. Theoretical Underpinning of Differences in Day-of-the-Week Effects in REITs

Researchers have investigated irregularities in REIT returns (Mazviona et al. 2022; Letdin et al. 2019). Redman et al. (1997) examined REIT returns in the initial phase of a day-of-the-week effect study. Prior studies have revealed the existence of the January effect, the turn of the month effect, the day of the week effect, and the pre-holiday effect in REITs. Friday and Higgins (2000) found that the results for stock REITs showed that, similar to equity securities, positive returns on Mondays followed positive returns on Fridays, and negative returns on Mondays followed negative returns on Fridays. This finding is supported by recent studies (Fettouhi and Kifani 2022; Letdin et al. 2019). However, this was not observed in Malaysian REITs (MREITs) because all REIT categories exhibited a strong first-order autocorrelation trend throughout the weekend. In the realm of the real estate investment trust (REITs) market, it has been observed that the removal of negative

returns on Mondays is accompanied by an increase in the number of investors. In other words, no Monday abnormality was observed in US REITs. Previous research by Hardin et al. (2005) revealed that every trading day had positive returns, but they were significant only on Fridays (Connors et al. 2002). These findings echo those of Chan et al. (2005) and have reignited interest in the day-of-the-week anomaly. It was observed that REIT returns on Thursdays and Fridays are significantly positive, while Monday returns are only insignificantly positive in the US REITs market from 1997 to 2007 (Brounen and Ben-Hamo 2009). Prior research on the influence of REITs on the weekday effect is mostly inconclusive. Therefore, this study aims to examine the day-of-the-week influence on the South African REIT market.

This "day-of-the-week effect", which contradicts efficient market theories, has been a mystery for some time, and despite numerous explanations, no one has satisfactorily explained it. According to the efficient markets hypothesis (EMH), also known as the random walk hypothesis, current stock prices fully reflect all available information on a firm's value, and there is no opportunity to obtain excess profits (greater than the market average) by utilizing this information. In the capital market literature, the relationship between news and stock prices is referred to as "market efficiency". According to Fama, there are three levels of market efficiency: weak, semi-strong, and robust. The minimal form of the market efficiency hypothesis predicts that stock returns are serially uncorrelated and have a constant mean (EMH). Investors should not rely solely on historical price patterns as the basis for a trading rule that generates outsized returns because the market is considered weakly efficient. The market is considered semi-strongly efficient if stock prices reflect new public information immediately and strongly efficient if prices reflect all information, public, and private. According to the efficient markets theory, investors react swiftly and objectively to new information. However, De Bondt and Thaler's (1990) two well-known studies provided contradictory evidence. They found that low long-term past returns are associated with higher future returns, while high long-term past returns are associated with lower future returns (long-term reversals). The results of these studies have been widely reported in the media, with many headlines praising these "contrarian" approaches. However, these findings do not appear consistent with the EMH. Nevertheless, the long-lasting anomalies documented in the finance literature, such as the fact that stock prices appear to respond to earnings for approximately a year after they are released (Muhammad and Rahman 2010), suggest that the EMH may not be entirely accurate. Ball and Brown (1968) were the first to identify the "post-earnings-announcement drift", which has since been corroborated by numerous studies spanning numerous time periods and countries.

2.1.1. Market Liquidity

Market efficiency is promoted by liquidity, which is a key indicator of market efficiency. According to Chordia et al. (2008), liquidity plays a crucial role in enhancing market efficiency, by facilitating arbitrage. Liquidity has been found to have an impact on returns, efficiency, and investor psychology, according to several studies, which may result in a weekday effect. Li and Luo (2019) note that stock liquidity affects stock returns. In addition, liquidity rushes can lead to psychological consequences and encourage herd mentality, as per Chordia et al. (2008), who suggest that orders and liquidity in the market fulfill the presence of arbitrage. Li and Luo (2019) proposed that liquidity has a positive impact on returns. Liquid stocks are less volatile during liquidity flights and stock market crises. Switching from fewer liquid equities to more liquid equities can affect liquidity flight. The research has shown that information flow, uncertainty, liquidity, and fluctuations in oil prices can influence focused buying behavior. Market liquidity relates to the presence of a significant number of international traders and corporate mergers. As a result, a market with more players and money is more liquid and efficient. Boubaker and Raza (2017) found that investor attitudes influence stock market returns. Foreign investors tend to have a greater impact. On the other hand, Birru (2018) found no correlation between the

day-of-the-week impact and stock returns, which contradicts the findings of Huang et al. (2010). We developed our hypothesis as follows:

H_0: *Stock returns occur on different days of the week in the REIT market of South Africa.*

H_1: *Stock returns differs on different days of the week in the REIT market of South Africa.*

2.1.2. Day of the Week and Trading Volume

Variations in the day-of-the-week phenomenon have been observed to differ across different regions, as demonstrated in various studies (Gibbons and Hess 1981; Jaffe and Westerfield 1985). Lakonishok and Maberly (1990) conducted a study to explore the trading behavior of individual and institutional investors with the aim of understanding why certain days of the week have a greater impact on the NYSE than others. They discovered that, although retail revenues tend to be higher on Mondays, trading volumes are typically lower. This decrease in trading activity can be attributed to fewer institutional trades. Chan et al. (2005) revealed that the Monday effect is not statistically significant, and institutional trading appears to be more prevalent during later periods. It is possible that the limitations of retail traders' ability to analyze data and make investment decisions during normal work hours may lead to an increase in volume outside of normal work hours if retail traders dominate the cryptocurrency market. Although Birru (2018) demonstrated the expected variance in cross-sectional returns based on the day of the week, Zhang et al. (2017) evaluated the day-of-the-week anomalies in various markets using a multinational sample. Bollerslev and Domowitz (1993) examined the pattern of quote arrivals and the bid-ask spread on the Deutsche mark-dollar exchange and find that trading is consistent during the week but significantly slower on weekends. This observation is supported by Akram et al. (2008) and Kaul and Sapp (2009), who also note that foreign exchange market activity is low on weekends. If Bitcoin follows the pattern of other major currencies, there should be more gains at the beginning of the week and fewer transactions on the weekends.

The impact of launching prices on profits has been a subject of confusion for researchers, as evidenced by Rogalski's (1984) findings. Companies may choose to release negative information after the market closes on Mondays, which could explain the significant selling pressure observed on that day. According to Jain and Joh's (1988) analysis of NYSE trading volumes, Mondays had the lowest trading volume, on average, from 1979 to 1983. The weekday effect has been studied in various markets, including the US equity market, where it has been documented. Jaffe and Westerfield (1985) examined five foreign stock markets between 1950 and 1983 and found strong evidence of the weekend effect. Chang et al. (2011) analyzed 23 foreign stock markets from 1985 to 1992 and found that the Monday effect diminished in several countries. However, they only investigated the Monday effect and did not consider other effects. This anomaly has also been observed in non-equity markets, such as the foreign exchange market and the Treasury bill market (Gibbons and Hess 1981; Flannery and Protopapadakis 1988).

The day-of-the-week effect in REITs is a fascinating subject of study because of the similarities between REITs and equities (Ghosh et al. 1996). In their study of the day-of-the-week effect in U.S. REITs for the years of 1970–1995, Friday and Higgins (2000) found that Mondays had a negative impact on average returns, while Wednesdays, Thursdays, and Fridays all had statistically significant positive returns, with Fridays having the largest impact in absolute terms. The authors analyzed whether returns on a particular day would be higher or lower than those on other days by examining autocorrelations between pairs of days, and their results suggest a trend that revolves around the weekend. The data indicate that, similar to other equity instruments, the weekend performance of REITs is typical. In a more recent study, Chan et al. (2005) focused on the impact of institutional investors on the Monday returns of individual REITs before and after structural changes in the early 1990s. By determining the average Monday returns for each period between 1981 and 1999 using daily NAREIT data, they sought to compare the Monday effect of the REIT market before and after 1990. Their findings reveal that the disappearance of Monday

seasonality in the U.S. REIT market coincides with the rise in institutional investors in the REIT market in the late 1990s. Additionally, the performance of REIT stocks on Mondays was found to be correlated with the percentage of REIT equities held by institutions.

2.1.3. Day of the Week and Earnings Yield

Academic research has investigated certain irregularities in the performance of real estate investment trusts (REITs). In 1997, Redman, Manakyan, and Liano were pioneers in exploring the existence of weekday bias in REIT returns. The authors highlighted various seasonal fluctuations affecting REITs, such as the January impact, turn-of-the-month effect, day-of-the-week effect, and pre-holiday effect. Furthermore, Friday and Higgins (2000) found that returns on stock REITs were positively correlated with returns on the previous Friday when they were positive and negatively correlated when they were negative. A noticeable first-order autocorrelation pattern was also observed around weekends across all the REIT categories. No anomaly was detected on Mondays in the context of U.S. real estate investment trusts (REITs), as Chan et al. (2005) discovered that the removal of negative and lower returns on Mondays was accompanied by an increase in institutional investors in the REIT market. All trading days generated positive returns, but only on Fridays were they statistically significant, as per studies conducted by Connors et al. (2002); Hardin et al. (2005); and Lenkkeri et al. (2006). These findings are consistent with those of Chan et al. (2005) and revive the discussion surrounding the day-of-the-week anomaly. According to Brounen and Ben-Hamo (2009), Thursdays had the highest returns for REITs among all weekdays from 1987 to 2007. Between 1997 and 2007, the U.S. REIT market experienced a positive day-of-week impact and VaR on Fridays, but Monday's returns were not statistically significant. Previous academic studies have produced conflicting results regarding the impact of REITs on the weekday effect, necessitating the reassessment of the day-of-the-week effect in the context of SAREITs and other emerging markets.

2.1.4. Day of the Week and PE Ratio

The price-to-earnings (P/E) ratio is a widely recognized predictor of a security's potential return on investment. According to the price ratio hypothesis (Basu 1977), investors should choose low P/E equities over high P/E stocks. The PEG ratio, which is the ratio of price-to-earnings growth, is often used as a foundation for stock recommendations and evaluating predicted rates of return by combining prices with the projections of earnings and earnings growth (Easton 2004). Studies have shown that stock returns tend to fluctuate around holidays and at the beginning and end of each month, with the day before a holiday typically having better returns than regular trade days (Ariel 1990; Cadsby and Ratner 1992). Banz (1981) found that investing in undervalued or undercapitalized enterprises can yield superior profits, which is known as the "size effect" or "small firm effect". Basu (1977) confirmed that investors in the stocks of companies with low P/E ratios had higher returns. Additionally, the research has shown that people's moods and dispositions can affect their investment decisions. Sunny days can improve people's dispositions, making them more likely to make prudent decisions (Saunders 1993). This study found that the New York Stock Exchange index is often lower on days with overcast skies, which is known as the "weather effect". The findings of Hirshleifer and Shumway (2003) also support the idea that sunshine is positively correlated with stock market returns, which is considered anomalous because it does not fit the current paradigm of the efficient market hypothesis (EMH).

2.1.5. South African REITs

Emerging economies, as identified by Das (2016), are characterized by significant short-term output and financial and economic volatility. In 2006, the diplomatic political group BRIC was established, with South Africa joining in 2011 to form the BRICS. The formation of the BRICS was based on the expectation that the economies of its member countries would rise significantly (Anuoluwapo et al. 2018). Since its inception, BRICS members have strengthened their engagement in international markets, indicating the group's expanding

power and visibility (Huidrom et al. 2016). The attractiveness of emerging economies for investors is largely due to their rapid growth, which has led to the development of REITs as a means of diversifying portfolios by investing in emerging nations' property markets (Kanaryan et al. 2015). REITs offer several advantages, including increased performance, alternative investment options to direct asset investing, and assistance in avoiding liquidity concerns (Aktan and Ozturk 2009). According to Akinsomi et al. (2016), REITs have been on the rise in South Africa because of their membership in BRICS since 2011 and the implementation of a REIT structure in 2013. Before 2013, only PLSs and PUTs were publicly listed property investment companies in South Africa. However, PUTs and PLSs were double-taxed and did not attract foreign investments. Consequently, South Africa replaced PLSs and PUTs with REITs in 2013. REITs are simpler and more tax-efficient, making them easier to compare globally. Most JSE-listed REITs were registered after South Africa launched them in 2013, and their flexibility and tax certainty have led to their preference for PUTs and PLSs (Anuoluwapo et al. 2018).

Real estate investment trusts (REITs) are subject to taxation. Hybrid REITs focus on mortgages, whereas equity REITs hold income-generating assets. The Securities and Exchange Commission (SEC) mandates that REITs must have 75% of their assets invested in real estate, 75% of their gross revenue from rental income or mortgage interest, and 90% of their taxable income distributed as dividends. According to the National Association of Real Estate Investment Trusts (NAREITs), an industry's dividend rates typically provide a stable revenue stream, regardless of market conditions. The appeal of REITs as financial arrangements lies in the combination of corporate stock and finance. Smaller, less-capitalized investors may struggle to cover the costs associated with tenant renovations and leasing commissions. The performance of REITs compared with the stock market may depend on the size and maturity of the sector. After Congress created REITs in 1960, NAREITs reported significant growth in the early 1990s. Cotter and Stevenson (2006) indicate that REIT volatility has changed in response to the sector's recent expansion. Despite significant growth, the market remains dominated by small- and mid-cap companies worth approximately USD 2 billion. Studies suggest that macroeconomic variables that explain stock and bond returns also explain REIT monthly and quarterly returns and risks (Clayton and MacKinnon 2003; Loo et al. 2016). REITs combine elements of both stocks and bonds, with little or no role of physical real estate in pricing. Research on REIT returns and risks has also been conducted. Since 1992, REITs have matured, making them "more like real estate and less like stock" (Clayton and MacKinnon 2003). The declining correlation between NAREIT and S&P 500 returns and the inability of stock and bond components to explain REIT returns during the early 1990s "REITs boom" support this claim (Oikarinen et al. 2011; Block 2011; Jackson 2009; Chang et al. 2011). According to Laopodis (2009), equity and mortgage REITs exhibit similar interactions with the stock market.

According to Allen et al. (2000), real estate investment trusts (REITs) can adjust their exposure to macroeconomic variables to manage market risk. While their model suggests that equity and non-equity REITs may differ in their sensitivity to market risk, there is no evidence to suggest that asset allocation, such as that between equity and mortgage-backed securities, affects a REIT's exposure to stock markets or interest rate fluctuations. Gyourko and Nelling (1996) explored the systemic risk associated with REITs by computing asset and equity betas and using them as dependent variables in regressions, with property type composition and size as independent variables. The beta values for REIT diversification, interest rates, and market fluctuations vary, according to Allen et al. (2000). Fama and MacBeth (1973) argue that the capital asset pricing model (CAPM) does not rely on idiosyncratic risk to explain cross-sectional stock returns. However, recent studies have suggested the opposite. Malkiel and Xu (2006) found a small positive correlation between idiosyncratic risk and stock performance, while Fu (2009) found a stronger positive association between idiosyncratic volatility and GARCH models. Goyal and Santa-Clara (2003) also found a positive correlation between stock returns and idiosyncratic stock variance. In a world in which investors are forced to hold under-diversified portfolios,

Merton (1987) and Malkiel and Xu (2006) argue that idiosyncratic risk can be priced. Both the CAPM and GARCH models can assess REIT return specificity.

Investigating the returns of various types of South African real estate investment trusts (REITs) would allow inferences to be drawn regarding REITs. Investors and portfolio managers are likely to be interested in understanding the sensitivity of these categories' returns and volatility to stock market movements, as this information can help to improve the risk management of their portfolios and determine whether REITs should be used for diversification purposes. The analysis of REIT return behavior based on a time-variant model, such as GARCH, is applicable given the evolution of the REIT regime in South Africa in 2013. This analysis covers the period up to 2021 and provides useful insights into how South African REITs perform in a turbulent market environment. This paper is structured in a manner that allows for exploration of the data, development of the model, and establishment of estimation and testing strategies in Section 3. Section 4 analyzes the empirical results, and Section 5 offers concluding remarks.

3. Materials and Methods

We used the daily data of all (35) REITs from the IRESS Expert database from 2013 to 2021. A potential issue with the use of daily data is that it may mask the exact impact and help us to understand the effect of the day of the week. Cotter and Stevenson (2006) also found that the broad market appears to be more influential in the daily case. This study sought to establish whether a day-of-the-week effect exists in both return and volatility for the different categories of South African REITs. The variables and terms used in the methodology include the following.

- *Returns (%)*: The data used were the daily stock price data for office, industrial, residential, diversified, and storage REITs from January 2013 to December 2021. The return is computed as a percentage based on the closing stock prices as follows: Daily Return = (Close/open − 1) × 100.
- *Volume*: The volume measures how a given financial asset is traded in a given period of time and is useful in determining the liquidity of the REITs. The higher the volume is, the more REITs are traded.
- *EY—earnings yield*: The earnings yield is used to show how much earnings are earned for every USD invested in the company. The higher the EY, the better the performance of the asset. EY is computed by dividing the earnings per share by the stock price per share, that is, Earnings Yield = Earnings per Share/Stock Price Per Share × 100.
- *PE—price to earnings ratio*: The PE used in this study represents the value of the asset obtained by measuring the current share price relative to earnings per share (EPS). Higher PE ratios indicate that higher prices are paid, making the stock expensive. The PE is expressed by the market value per share/earnings per share.

This study employed various but relevant tests to examine the day-of-the-week effect on the returns of different classifications of South African REITs. These tests are provided in Table 1 below.

Table 1. Categories of tests.

Test	Method
Autocorrelation	Heteroskedasticity
Constant conditional variance	Generalized Autoregressive Conditional Heteroskedastic test (GARCH)
Day-of-the-week effect	Kruskal–Wallis Test

According to Boubaker and Raza (2017), the GARCH (1,1) model is considered the most efficient technique in the GARCH family for testing the day-of-week effect. In this study, various models, including OLS, GARCH (2,1), and Kruskal–Wallis tests, were

explored and utilized. OLS and GARCH (2,1) models were implemented using the SAS statistical software (9.4 M8). Previous studies have demonstrated that models that capture volatility in time-series data, such as seasonal anomalies, are better estimated using these techniques (Abrahamsson and Creutz 2018; Chancharat et al. 2020; Rossi and Gunardi 2018; Trick 2018). Boubaker and Raza (2017) argued that the day-of-the-week effect has either disappeared or shifted to different days, as suggested by previous studies. Therefore, a simple OLS and MANOVA may not account for autocorrelation and heteroscedasticity, potentially leading to spurious results. Berument and Kiymaz (2001) also contend that time-series data are subject to variation over time, making simple ordinary least squares (OLS) models inefficient for predicting results. In recent studies, Richards and Willows (2019), Miss et al. (2020), Anjum (2020), and Li et al. (2022) incorporated GARCH and its variants to test the day-of-the-week effect in time-series data. The GARCH model is widely used to account for heteroscedasticity. Engle (1982) proposed autoregressive conditional heteroskedastic (ARCH) models to allow the forecast variance of the return equation to vary systematically over time. The OLS model used to test for the day-of-the-week effect is expressed by the following equation:

$$R_t = \beta_0 + \beta_1 D_1 + \beta_2 D_2 + \beta_3 D_3 + \beta_4 D_4 + e_t \quad (1)$$

where

- Tuesday is the reference category (base period).
- D_1, D_2, D_3, and D_4 were the dummies for Monday, Wednesday, Thursday, and Friday, respectively.
- β_1, β_2, β_3, and β_4 are the coefficients (slope) of the dummy variables for the days of the week (Monday, Wednesday, Thursday, and Friday, respectively).
- The equation assumes that the returns and volume traded are the same for each day of the week, where $\beta_1 = \beta_2 = \beta_3 = \beta_4$.

4. Results

4.1. Summary Statistics

Summary statistics of Return (%), Volume, and EY in Different Years

In Table 2, the most profitable year is 2021, with an average daily return of 0.1603%, while the least profitable year is 2020 (−0.08). The REITs were traded the most in 2020 (2,669,951.70) and traded the least in 2014 (1,013,449.79). EY was the highest in 2020 (11.82) and the lowest in 2013 (−16.91), whereas for P/E, it was the highest in 2015 (84.27) and the lowest in 2020 (2.49).

Table 2. Summary statistics of return, volume, and EY in different years.

Year	Obs	Variable	Mean	Std Dev	Min	Max	Std Error	Kurtosis
2013	4485	Return %	0.02	1.69	−16.00	23.00	0.02	18.87
		Volume	1,046,297.88	2,476,056.65	0.00	455,494	36,972.55	73.73
		EY	−16.91	235.42	−2093.67	320.23	3.51	72.76
		P.E	61.51	836.67	−174.53	17,533.19	12.49	401.18
2014	5300	Return %	0.06	1.58	−13.00	50.00	0.02	197.96
		Volume	1,013,449.79	2,291,638.97	0.00	531,180	31,478.08	76.50
		EY	9.19	22.70	−0.97	320.23	0.31	176.66
		P.E	15.31	44.28	−178.40	198.07	0.60	8.07
2015	5367	Return %	0.02	2.47	−61.00	104.00	0.03	646.76
		Volume	1,501,224.52	4,233,050.31	0.00	130,729,944	57,781.34	242.31
		EY	8.03	4.58	−1.86	26.98	0.06	2.77
		P.E	84.27	374.05	−68.30	2891.48	5.10	37.40

Table 2. *Cont.*

Year	Obs	Variable	Mean	Std Dev	Min	Max	Std Error	Kurtosis
2016	6185	Return %	−0.01	2.01	−18.00	22.00	0.02	11.58
		Volume	1,509,709.45	3,425,512.82	0.00	59,465,913.00	43,556.78	41.76
		EY	7.77	5.30	−2.13	45.23	0.06	13.62
		P.E	33.65	209.14	−324.91	2790.89	2.65	103.58
2017	6972	Return %	−0.00	1.434	−20.00	17.00	0.01	13.56
		Volume	1,512,526.31	3,697,517.70	0.00	71,014,834.00	44,282.44	72.13
		EY	7.67	6.10	−7.90	48.85	0.07	10.50
		P.E	6.83	75.63	−560.81	220.42	0.90	30.80
2018	7140	Return %	−0.07	2.82	−62.00	158.00	0.03	1415.05
		Volume	1,746,105.96	4,978,443.21	0.00	233,058,082.0	58,917.52	676.91
		EY	7.70	7.82	−38.55	35.30	0.09	12.57
		P.E	15.05	15.93	−43.27	94.68	0.18	10.57
2019	7221	Return %	0.01	9.43	−87.00	762.00	0.11	5897.95
		Volume	1,519,085.99	3,658,489.88	0.00	494,100	43,052.98	39.58
		EY	8.65	20.98	−143.92	146.32	0.24	13.55
		P.E	9.71	14.66	−67.79	101.58	0.17	17.50
2020	7308	Return %	−0.08	5.93	−89.00	209.00	0.06	255.38
		Volume	2,669,951.70	9,999,916.44	0.00	4,924,638	116,976.09	875.07
		EY	11.82	38.99	−239.70	181.37	0.45	14.03
		P.E	2.49	25.02	−175.67	41.85	0.29	24.25
2021	7250	Return %	0.16	2.99	−21.00	35.00	0.03	11.62
		Volume	1,673,073.80	4,859,730.79	0.00	1,929,564	57,074.64	373.52
		EY	−0.58	43.15	−319.60	72.63	0.50	18.30
		P.E	3.40	34.34	−216.43	82.41	0.40	11.52

4.2. Time Series Plot of the Average Stock Price Returns of Monday–Friday (2013–2022) for Different REITs

From the plot in Figure 1, it can be seen that the average stock price returns of Monday–Friday during the 2013–2022 period varied across the years with highs and lows, especially during the years of 2014, 2018, and 2020.

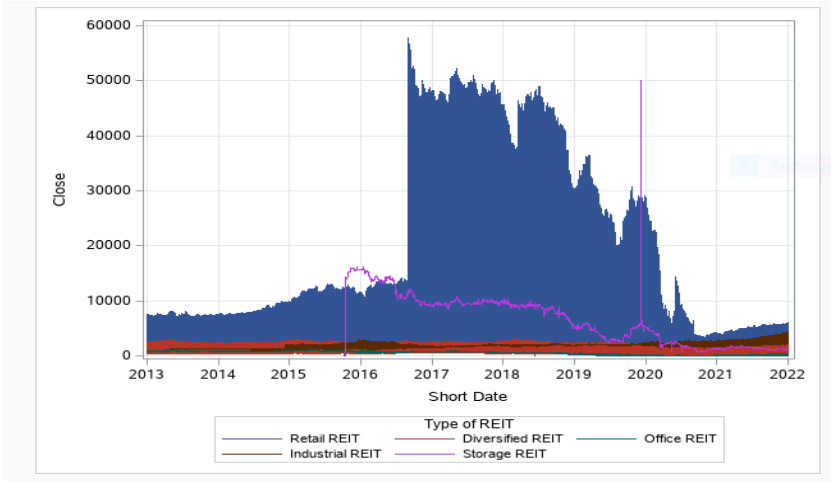

Figure 1. Time series plot of the average stock price returns of Monday–Friday (2013–2022) for different REITs.

4.3. Scatter Plot of the Average Stock Price Returns of Monday–Friday (2013–2022) for Different REITs

From the scatterplot in Figure 2, it can be seen that the average stock price returns of Monday–Friday (2013–2022) for different REITs varied across the years with highs and lows, especially during the years of 2014, 2018, 2019, and 2020.

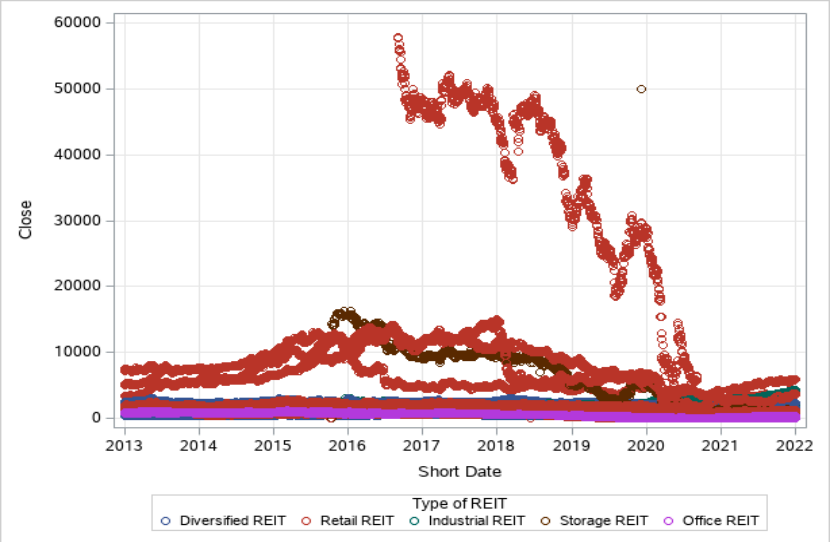

Figure 2. Scatter plot of the average stock price returns of Monday–Friday (2013–2022) for different REITs.

4.4. Testing for the Existence of the Day-of-Week Effect Using the Kruskal–Wallis (KW) Test

Tables 3 and 4 were used to test for statistically significant differences between the medians of three or more independent groups. When the normality assumption was violated, the Kruskal–Wallis test (1952) was used. As the REIT data consisted of an ordinal or continuous response variable, it was assumed that the observations were independent of one another and that the distributions had similar shapes. Consequently, a non-parametric test, the KW test, was preferred over the one-way ANOVA because it is more robust and less sensitive to outliers. The results indicate that the *p*-value of the KW test was 0.009. As the *p*-value (0.0058) was lower than the level of significance (0.05), it was concluded that the null hypothesis was rejected, and there was sufficient evidence to conclude with 95% confidence that there was a statistically significant difference in median returns across the day of the week. This finding confirms the existence of a significant day-of-the-week effect.

Table 3. Wilcoxon scores (rank sums) for the variable return (%) classified by variable day.

Day	N	Sum of Scores	Expected Under H_0	Std Dev Under H_0	Mean Score
					Average scores were used for ties.
Monday	11,082	3,133,113	3171058	1,502,802.48	28,272.09
Tuesday	11,597	3,329,159	3318423	1,528,722.37	28,707.07
Wednesday	11,528	3,268,884	3298679	1,525,319.71	28,356.04
Thursday	11,641	3,366,906	3331013	1,530,881.06	28,922.82
Friday	11,380	3,277,441	3256330	1,517,948.82	28,800.01

Notes: The table provides estimates of the Kruskal–Wallis rank test for returns. It ranks days based on the higher returns generated on each day.

Table 4. Kruskal–Wallis test.

Chi-Squared	DF	Pr > ChiSq
14.5095	4	0.0058

4.5. Post Hoc Steel–Dwass and Critchlow–Fligner Multiple Comparison Test

Typically, a post-hoc analysis of multiple treatments is conducted after a one-way test for treatment differences has yielded significant results in order to identify the specific treatment(s) that differ from the rest. In this study, the Steel–Dwass and Critchlow–Fligner procedure was applied even to index series with insignificant Kruskal-Wallis statistics. The outcomes of the SDCF procedure for the five subcategory index series are shown in Table 5. A careful examination of the *p*-values for the day-of-the-week comparison sheds further light on the results of the Kruskal–Wallis tests.

Table 5. Post hoc Steel–Dwass and Critchlow–Fligner multiple comparison test.

REITs	Days to Invest	Wilcoxon Z	DSCF Value	*p*-Value
Office REITS	Friday	2.52	3.56	0.08 *
Diversified REITS	Thursday	3.44	4.86	0.005 **
	Tuesday	2.78	3.93	0.0432 **
Industrial	Friday	3.06	4.33	0.0185 **
	Wednesday	2.54	3.60	0.0803 *
Retail REITS				
Storage REITS				

* significantly different median values at 10%, ** significantly different median values at 5%, *** significantly different median values at 1%.

Since the Kruskal–Wallis test's *p*-value (0.0058) is lower than the significance level $\alpha = 0.05$, it can be concluded with 95% confidence that there is a significant difference in the mean return percentages between at least two days of the week. As the Kruskal–Wallis test confirms the existence of a significant day-of-the-week effect, it is necessary to clarify which day(s) of the week exhibit significantly different returns. The Steel–Dwass and Critchlow–Fligner multiple comparison post-hoc procedure is useful for identifying which pairs of treatments differ significantly. Based on the results in Table 5, the best days to invest in office, diversified, and industrial REITs are Fridays, Thursdays, and Fridays, respectively. However, for retail and storage REITs, there is no significant difference in the median values, indicating a weak day-of-the-week effect.

4.6. OLS and GARCH Model: Model Selection

The model chosen was a regression with the vector autoregressive model. To test the presence of the day-of-the-week effect in both the return and volatility equations, all equations were estimated jointly using the full information maximum likelihood estimation technique. The type of model chosen is the arch process order (1,0)—GARCH process order (2,1), with a representation type of dynamic A regression vector model based on the selection of a dependent variable (return (%)) and independent variables (returnLagged (r_{t-1}, D_1(dummyMonday), D_2(dummyTuesday), D_3(dummyWednesday), and D_4(dummyThursday). Tuesdays were used as the reference categories. The Akaike information criterion (AIC) was used to select the best GARCH model fit for the data. The model with the lowest AIC was selected, as shown in Tables 6 and 7.

Table 6. Model selection.

Type of Model	ARX(1,0)-GARCH(2,1)
Estimation Method	Maximum Likelihood Estimation
Representation Type	DCC

Table 7. Information criteria.

AICC	150,948.10
HQC	150,981.50
AIC	150,948.10
SBC	151,055.50
FPEC	19.37

To perform the Lagrange multiplier autoregressive conditional heteroskedastic test suggested by Engle (1982) using 12 lags, the squared residuals were regressed using the square of the error terms on the first 12 lags. A single lag for daily returns (r_{t-1} representing the returns of the previous day) was added to the model to capture the linear dependency because it is important to use the model to estimate seasonal anomalies and capture volatility in time-series data.

4.7. OLS Model Parameter Estimates on REITs' Returns

The OLS estimation results in Table 8 show evidence of autoregressive conditional heteroskedasticity in squared variances. Therefore, the conditional variance of the return equation was modeled as a GARCH (2,1) process, and the return equation was re-estimated jointly with the conditional variance equation. From the analysis, it can be observed that the constant is not statistically significant, as it has a *p*-value greater than the level of significance ($\alpha = 0.05$). The slope of the coefficients indicates that, for every unit increment in the lag of returns, the conditional mean for returns (%) decreases by 0.035. Additionally, the conditional mean for returns (%) on Monday, Tuesday, Wednesday, and Thursday are higher than those on Friday by 0.026, 0.024, 0.133, and 0.030, respectively.

Table 8. OLS model parameter estimates on REITs' returns.

Parameter	Estimate	Standard Error	t Value	Pr > |t|	Explanation of Variable
Constant	0.03	0.01	1.91	0.05	1
B_0	−0.13	0.005	−26.67	0.0001	Coefficient for Lagged Return ((%) (r_{t-1}) (t))
β_1	0.02	0.02	1.01	0.31	Coefficient for Dummy Variable Monday (t)
B_2	0.02	0.02	0.95	0.34	Coefficient for Dummy Variable Tuesday (t)
B_3	0.13	0.02	5.24	0.0001	Coefficient for Dummy Variable Wednesday (t)
β_4	0.03	0.02	1.18	0.23	Coefficient for Dummy Variable Thursday (t)

The statistical significance of the slope for the lag of return and Wednesday was determined to be 0.0001 and 0.0001, respectively, whereas the *p*-values for the slopes of Monday, Tuesday, and Thursday were not significant at 0.31, 0.34, and 0.23, respectively. However, the results indicate a significant difference in the conditional average returns between Fridays and Mondays. Table 8 reveals that all the t-statistics for the estimated parameters are statistically different for each day of the week. This finding suggests that the average daily returns for listed REITs on the Johannesburg Stock Exchange are independent of the days of the week. Consequently, Tuesday appears to be the most profitable day for investing in South African REITs.

The equation is provided below:

$$\text{Returns} = -0.03509 + -0.13898r_{t-1} + 0.02630M + 0.02436T + 0.13345W + 0.03070T \quad (2)$$

4.8. Incorporating the GARCH Variance Model into the OLS Equation

The analysis of time-series data is often complicated by variations over time, which can lead to inaccurate and inefficient results when using traditional methods, such as ordinary least squares (OLS) and multivariate analysis of variance (MANOVA). To overcome these limitations, researchers have turned to more advanced techniques. such as generalized autoregressive conditional heteroskedasticity (GARCH). In general, the use of GARCH

in analyzing market indices has shown significant results in both the mean and variance equations, similar to those obtained from simpler GARCH models. Additionally, the day-of-the-week effect was found to be significant, with coefficients for Friday, Thursday, and Monday being positively significant at the conventional level for office, diversified, and industrial REITs, respectively. This finding is consistent with previous research by Jadevicius and Lee (2017), who documented greater returns on Tuesdays than on other days of the week. To further specify the findings of this study, the coefficients for the dummies representing the days of the week were incorporated into the GARCH variance equation, as shown in Table 9. The constant in the mean equation was used to regress returns, providing a measure of the DOW effect in the conditional mean. The GARCH process is estimated using the following method:

$$\begin{array}{l} \sigma_t^2 = \omega + \sum_{i=1}^{p} \alpha_i \epsilon_{t-1}^2 + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2 \\ where\ \omega > 0,\ \alpha_i \geq 0,\ \beta_j \geq 0,\ and\ \sum_{i=1}^{p} \alpha i + \sum_{j=1}^{q} \beta_j < 1. \end{array} \quad (3)$$

A further explanation is as follows:

- $\omega > 0$ is a constant term that ensures a positive baseline volatility.
- $\alpha_i \geq 0$ and $\beta_j \geq 0$ are coefficients that determine the impact of past squared errors and past conditional variances, respectively.
- $\sum_{i}^{p} = {}_1\ \alpha_i + \sum_{j}^{q} = {}_1\ \beta_j < 1$ ensures that the model remains stationary.

DCC-GARCH (1,1) Variance Model Equation:

$$\sigma_t^2 = \omega + \alpha_1 \epsilon_{t-1}^2 + \alpha_2 \epsilon_{t-2}^2 + \alpha_3 \epsilon_{t-3}^2 + \alpha_4 \epsilon_{t-4}^2 + \alpha_5 M + \alpha_6 T + \alpha_7 W + \alpha_8 Th \quad (4)$$

where

- $\omega = 0.11028$ is the constant term representing the baseline volatility.
- $\alpha_1 = 0.07845$, $\alpha_2 = 0.79069$, $\alpha_3 = 0.12854$, and $\alpha_4 = 0.02630$ are the coefficients for the past squared errors.
- $\alpha_5 = 0.02436$, $\alpha_6 = 0.13345$, $\alpha_7 = 0.03070$, and $\alpha_8 = 0.0$ are the coefficients for the additional variables M, T, W, and Th, respectively.
- M—Monday, T—Tuesday, W—Wednesday, and Th—Thursday.

Table 9. GARCH (2,1) model parameter estimates on REITs' returns.

Parameter	Estimate	Standard Error	t Value	Pr > |t|
DCCA[1]	0.100	0.000		
DCCB[2]	0.100	0.000		
GCHC1_1[3]	0.110	0.005	21.700	0.0001
ARCH1_1_1[4]	0.078	0.002	34.010	0.0001
GCH1_1_1	0.790	0.030	25.750	0.0001
GCH2_1_1	0.128	0.028	4.470	0.0001

Notes: The table displays the statistics for GARCH (2, 1) for the mean equation only. In each row, the coefficients, t-statistics, and significance level are presented.

In this paper, we are interested in the joint significance of (1) α1, and β1 for each of the series and (2) the joint conditional correlation parameter significance of DCCA and DCCB (corresponding to a and b in the equation Qt = bQt − 1) because:

1. This analysis assessed whether the GARCH(2, 1) model was suitable for a given series. If α1 and β1 are jointly insignificant, it suggests that using a constant conditional variance might be preferable to using GARCH(1, 1).
2. Similarly, we examined the joint significance of DCCA and DCCB to evaluate the suitability of the dynamic conditional correlation (DCC) model for the system of series. If DCCA and DCCB are jointly insignificant, it indicates that employing a constant conditional correlation model might be more appropriate than employing DCC(1, 1).

In this case, μ represents the intercept of the conditional mean model (εt = μt + at) and α0 denotes the intercept of the GARCH(1, 1) model. Based on the results, all the α1 and β1 coefficients are statistically significant for every exchange rate, at least at the 10 percent significance level. Furthermore, the conditional correlation parameters DCCA and DCCB were statistically significant at the 1 percent significance level.

5. Conclusions

Significant disparities in the returns and traded volumes of real estate investment trusts (REITs) exist on different days in all markets. In the majority of these markets, Monday was the day with the least trade. Based on the analysis, it was concluded that Friday was the optimal day to invest in office REITs, Thursday for diversified REITs, and Friday for industrial REITs. Nevertheless, for retail and storage REITs, no substantial differences in median values were observed, indicating a weak day-of-the-week effect. The day-of-week effect is a calendar anomaly characterized by the occurrence of relatively high or low returns on certain days of the week as opposed to others. This phenomenon is fascinating because of the relationship between the day of the week and the magnitude of the returns associated with that particular day. The day-of-the-week effect was first recognized in the US market as the Monday effect, which is characterized by lower or negative returns on Mondays and higher or positive returns on Fridays.

Tuesdays were found to be the most profitable days to invest in South African REITs, a finding that is consistent with those of Jadevicius and Lee (2017). These researchers documented evidence of greater returns on Tuesdays than on the other days of the week in their study. However, other studies have identified different patterns in different markets and over different periods. For instance, Onyuma (2009) and Mokua (2003) found that Monday produces the lowest negative returns and Friday produces the largest positive returns, using regression analysis and data on prices and adjusted returns from the NSE 20 index in Kenya between 1980 and 2006. Nishat and Mustafa (2002) also noted that the day-of-the-week effect changed with the settlement era. Various factors, such as statistical errors, changes in volatility, settlement methods, and the recurrence of unfavorable news at specific times, can impact these findings. Furthermore, investor strategies in response to this news can result in different patterns.

The primary goal of this study was to assess whether the day-of-week effect still exists, utilizing daily return data for South African real estate investment trusts (REITs) belonging to various categories, including office, diversified, industrial, retail, and storage REITs. In addition to examining the day-of-week effect on returns, this study also analyzed the symmetry of volatility in trading volumes across the week. The sample period spanned from 1 August 2013 to 31 December 2021. Three models were employed to investigate the impact of weekdays and market liquidity on the return series of SA REIT categories. The first model used a simple ordinary least squares (OLS) regression with five dummy variables to identify the weekday effect in a linear regression context. Furthermore, the study also utilized non-parametric tests, which were classified into two types. For all days of the week, the second model employed the OLS's mean equation and variance equation of the generalized autoregressive conditional heteroskedasticity (GARCH-M)-M model. In the variance equation, this study examined how vulnerability varies according to the day of the week.

Investing in South African real estate investment trusts (REITs) on specific days of the week can have varying results, with Fridays, Thursdays, and Fridays being the best days for office, diversified, and industrial REITs, respectively, in terms of statistical significance in changes in variances. Conversely, Wednesday was the least profitable day, with the lowest daily average return, whereas Tuesday was the most profitable day, with the highest daily average return. Moreover, the highest number of REITs was traded on Friday, whereas the lowest number was traded on Monday. The day of the week also affects return volatility, with Monday showing the highest level of volume volatility and Thursday showing the highest level. These findings differ from those of previous studies

(Poterba and Weisbenner 2001; Basher and Sadorsky 2006) in this field, which might be due to the use of updated models and a different sample period. Understanding stock return and volatility patterns can help investors to make more informed investment decisions and estimate the associated risk and returns for any given day. The news can also influence stock returns, which can affect investment decisions.

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Notes

1 Dynamic conditional correlation analysis—DCC(1,1)—denotes the parameters of the dynamic conditional correlation A.

2 Dynamic conditional correlation analysis—DCC (1,1)—denotes the parameters of the dynamic conditional correlation B.

3 GCHC(1,1) is the diagonal element of the GARCH component.

4 ARCH 1,1 (autoregressive conditionally heteroscedastic) model is a model for the variance of a time series.

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