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Assessing conditional volatility among REITS and Stock returns; Evidence from Pakistan

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ABSTRACT

This study investigates the conditional volatility and dynamic correlations between Real Estate Investment Trusts (REITs) and stock returns in Pakistan using daily data. Given the growing significance of REITs as an asset class, understanding their volatility in relation to stock market movements is crucial for investors and policymakers. Employing the Dynamic Conditional Correlation Generalized Autoregressive Conditional Heteroscedasticity (DCC-GARCH) model, the research examines time-varying correlations between REITs and stock returns, which are influenced by market fluctuations, economic shifts, and external shocks. The findings reveal moderate short-term correlations between REITs and stock returns, which strengthen in the long term, suggesting that while REITs are not highly correlated with stock returns in the short run, they may provide a diversification benefit over a longer horizon. The study also shows that both markets exhibit volatility clustering, with stock returns showing higher volatility persistence. These insights contribute to the limited literature on REITs in emerging markets, particularly Pakistan, where only three REITs are currently listed. The results provide valuable guidance for

investors, highlighting the potential for REITs to act as a diversification tool in volatile market conditions, while also informing risk management and asset allocation strategies. Additionally, the findings can help policymakers develop regulatory frameworks to support the growth and stability of the REIT sector in Pakistan, fostering broader investor confidence and market development. This research offers a deeper understanding of the interplay between REITs and stock returns in an emerging market context, with implications for both financial institutions and regulatory bodies.
Keywords: Conditional volatility, REITS, Stock Returns, Pakistan

INTRODUCTION

The real estate sector is critical to the growth and development of any economy. It is due to the fact that it creates jobs, boosts GDP, and lead to investment opportunities. A specialized financial product called a Real Estate Investment Trust (REIT) gives investors access to real estate assets without the hassles of direct ownership. Because of their capacity to generate consistent income and diversify portfolios, REITs have become a vital asset class on a global scale in recent years. However, research on their risk and performance characteristics—particularly in relation to stock markets—remains ongoing, especially in developing nations like Pakistan.

Investors and policymakers alike must comprehend how REITs and stock markets interact. REITs are typically regarded a hedge against market volatility, given their potential for continuous income flows and their relationship to the real estate industry, which tends to perform differently from equities markets. The degree of this association, however, may differ based on economic dynamics, regulatory frameworks, and market-specific circumstances. Investigating this relationship is especially significant in Pakistan, since the REIT sector is still embryonic, with only three REITs currently listed on the stock exchange. The necessity for a thorough comprehension of their behavior in connection to wider financial markets is highlighted by their limited presence.

Volatility is a crucial component of financial market analysis due to its ability to capture the unpredictability and the risk of asset prices. Under these circumstances, conditional volatility—, which fluctuates over time in response to market dynamics—becomes a crucial area of study for scholars. The relationship between various asset classes, however, changes as market conditions do, and dynamic correlations shed light on this. This study uses the Dynamic Conditional Correlation Generalized Autoregressive Conditional Heteroscedasticity (DCC-GARCH) model, a reliable econometric method that is frequently used to examine conditional volatility and time-varying correlations, to address these issues.

This research is significant due to its potential to enhance both theoretical understanding and practical application. The findings will provide investors with insights into whether REITs serve as a diversification mechanism to reduce risks during market turbulence or if they have substantial correlations with stock market volatility. For financial institutions, comprehending these dynamics can facilitate the formulation of effective risk management strategies and the optimization of asset allocation. Moreover, the study's ramifications pertain to regulatory authorities and lawmakers. This research elucidates the significance of REITs in the financial ecosystem, thereby informing initiatives to enhance the REIT sector, which would eventually bolster economic resilience and financial stability.

LITERATURE REVIEW

Volatility is a process of change in behavior, value or investment over the time and cumulative persistence of that change to the next phase. (Vidanage, 2017) it is stated that volatility helps to predict stock returns which transmits effects to the real economy. (Schwert, 1989) also found that there is a theoretical linkage between stock returns and stock return volatility. (Poon, 1992) examine the volatility in U.K stock market. (Baillie, 1990) examine volatility in US stock market. Both of the studies measure conditional volatility over time and use GARCH models. Both the studies found positive relationship between expected returns and conditional volatility over time. GARCH-M models were used for this. In REITs, the literature examining the conditional volatility is less. (Devaney, 2012) studied a relationship between interest rates and conditional volatility of Mortgage and Equity REITs 1978-1998. The study uses GARCH-M model. Cotter and Stevenson (2006) used daily returns in multivariate GARCH framework to study the volatility linkages between Mortgage Equity and Hybrid REITs. Morelli (2002) examine the predictability of conditional volatility of macro variables on equity volatility. Morelli report a weak evidence of conditional volatility of US stock market.

A study found that there is a correlation between US REITs and US stocks that increases during study period May 24, 1999 through Dec 30,2005. Same results are shown according to both the DCC model and the rolling correlation. The previous literature on dynamics correlations between REITs and stocks found that REIT stock correlations generally declined during study periods. It includes Chandrashekaran (1999), Clayton and MacKinnon (2001), Conover et al. (2002), Bley and Olson (2003) and Westerheide (2006).

The REIT-stock correlations generally increase during study period during study period during January 1999 till December 2005. The studies that showed this increase are Westerheide (2006), Cotter and Stevenson (2006) and Huang and Zhong (2006). The correlation between REITs and stocks fluctuated as high as 76% and never below 59% during the pre-modern REIT era. The correlation stats to decline in August 1991 and reached as low as 30% in September 2001. Till date the correlation is on increasing trend and has never reached as high as 60%.

Chandrashekaran (1999) found that correlation dropped from 79% in 1980-1984 to 48% in 1990-1996. The researcher used monthly excess returns to compute correlation coefficient for S&P 500 for full period 1975-1996 and sub-periods 1975-1979, 1980-1984, 1985-1989 and 1990-1996. Clayton and MacKinnon (2001) examined a correlation dropped from 82% for REITs with Russell 2000 to 41%. It dropped 85% for REITs with S&P500 during 1979-1998 and 26% with S&P500 in

1992-1998. Based on daily results for the year prior to and the year following REITs' inclusion in the S&P 500, Feng et al. (2006) calculated REIT beta in relation to the S&P 500 and discovered that it increased by a statistically significant 11 percentage points, from 0.24 to 0.35. Ambrose et al. (2007) used both daily and weekly returns to compare REIT beta before and after REITs were included in the S&P 500, and they came to the same conclusion.

Using a regression that allowed for a different beta in each of six subperiods and a straightforward before-and-after comparison, Ambrose et al. also calculated the beta of REITs that were excluded from the S&P 500. In the subperiod immediately following REITs' inclusion in the S&P 500, they discovered that the beta of non-included REITs increased significantly. This increase continued after that, demonstrating a "spillover effect," in which the correlation dynamics of included REITs (higher beta due to REITs being included with non-REIT stocks in S&P 500 investors' portfolios) were transferred to non-included REITs through "overlapping categories" (higher beta due to included REITs continuing to be included with non-included REITs in the portfolios of devoted REIT investors).

The rolling correlation coefficient is another popular method for examining correlation dynamics. Bley and Olson (2003) calculated rolling 24-month correlations between the S&P 500, equity REITs, and mortgage REITs. They discovered that, during the 1972–2001 study period, both REIT series showed a generally decreasing correlation with the stock market, particularly after January 1993 (roughly the modern REIT era). Rolling 12-month correlations between U.S. and foreign stock returns, U.S. REIT returns, and foreign listed property company returns were calculated by Conover et al. (2002). They discovered that correlations increased during 12-month periods that included the 1987 stock market crash but then generally returned to their pre-crash levels. Conversely, for U.S. stocks vs. U.S. REITs, correlations generally trended downward during the January 1986–June 1995 study period.

Cotter and Stevenson's (2006) study, which employs a multivariate VAR-GARCH technique to investigate daily return and volatility connections among REIT property type sectors and between REITs and equities, is methodologically much closer to the current study. During the January 1999–June 2003 study period, Cotter & Stevenson discovered that daily conditional correlations generally trended upward, but they fluctuated greatly. Butt et al. (2010) used macroeconomic indicators to examine Pakistan's stock. The findings indicate that stock returns vary with the market, but when additional macro variables are taken into account, the fluctuation in stock returns becomes more explicable. It demonstrates how several businesses may react differently to the same economic conditions. Using conditional stock market volatility and macroeconomic volatility for Finland, Liljeblom and Stenius (1997) produce noteworthy findings that demonstrate stock market volatility as a predictor of macroeconomic prediction. Four categories of macro-variables were identified by Sabetfar et al. (2011) as having an impact on stock returns; nevertheless, there is no consistent presence of relevant determinants in Iran throughout time.

KSE-100 index analysis was done by Sulaiman et al. (2012). Inflation reported to KSE is negligible, and domestic interests react negatively to KSE. Additionally, Akbar et al. (2012) discovered a favorable correlation between stock returns. According to Khalid et al. (2012), Pakistani stocks and variables do not move in tandem. Using the Nigeria All-Share Index and macroeconomic data, Okoli (2012) discovered that the sole factors influencing stock market volatility are exchange rate variables. Therefore, the study recommended that in order to stabilize the stock market, government policy should concentrate on the exchange rate. Tangjitprom (2012) discovered that while stock returns can be predicted by macroeconomic factors, they are less significant.

METHODOLOGY AND DATA COLLECTION

The data has been collected from Investing.com and Yahoo Finance. The time frame of the data is from 2015 to 2024 and frequency of the indices downloaded is daily. Returns were calculated from the closing prices and were used for the purpose of analysis. Dynamic Conditional correlation research technique has been applied that is most suitable keeping in view the objective of the study. For the purpose of applying DCC Garch, ARCH and GARCH tests were applied (Results are reported in the tables below). The statistical models applied for the purpose of DCC GARCH is as follows

DCC-GARCH

To forecast future volatility from historical returns, the Multivariate GARCH model, specifically Dynamic Conditional Correlation, is favored. DCC (Dynamic Conditional Correlation) accounts for time-varying effects in the computation of the correlation matrix. DCC is an extension of CCC, which stands for Constant Correlation Estimator.

The choice to employ the DCC model in our investigation was taken following meticulous evaluation of the research objectives and the characteristics of the data. The DCC model is especially pertinent for examining time-varying correlations within financial markets, a vital component for comprehending the conditional correlation between REITS and Pakistan stock market. This model was employed to reflect the dynamic and evolving linkages between asset returns in response to fluctuating in the real estate market. The DCC model presents numerous advantages that render it appropriate for our investigation. It considers time-varying correlations, facilitates the modeling of conditional volatilities, and has been extensively employed in financial econometrics to reflect the dynamic characteristics of financial markets. Its adaptability and capacity to respond to fluctuating market conditions correspond effectively with our study objectives.

DCC is a favored method for modeling dynamic correlations; yet, we acknowledge the existence of alternative econometric modeling techniques. Nonetheless, either static correlation models or conventional GARCH models may inadequately represent the dynamic character of correlations between the stock market and the real estate market indices, which is the primary emphasis of this study.

The foundational investigation will be based on the model proposed by Antonakakis et al. (2018):

$$O_t = \omega_t + \wp_t \text{ where as } \frac{\wp_t}{v_{t-1}} \sim N(0, C_t)$$
$$\wp_t = C_t^{1/2}\omega_t, \text{where } \omega_t \sim N(0,1)$$
$$C_t = D_t O_t D_t$$

Let t represent a N x 1 vector of volatilities, where N = 14; the mean vector is denoted as a 14 x 1 vector, the conditional covariance matrix is indicated by , and the diagonal matrix square root of the conditional variances is represented by = diag(). The univariate GARCH-type model is defined by C(ii,t), and the final t is the t x (N(N-1)/2 * A) matrix comprising the time-varying correlations.

However, a symmetric positive definite matrix, denoted as, is a N x N matrix defined as follows.

$$O_t = \text{diag}(q_{ii,t}^{-1/2}, \dots\dots\dots\ q_{NN,t}^{-\frac{1}{2}})Q_t = \text{diag}(q_{ii,t}^{-1/2}, \dots\dots\dots\ q_{NN,t}^{-\frac{1}{2}})$$

In the aforementioned equation, N denotes a vector of standardized residuals, and Q signifies the unconditional variance matrix. Non-negative scalar parameters satisfy the criterion of being less than 1.

DISCUSSION AND RESULTS

Table 1: Descriptive Statistics

	REITS	PSX
Count	2281.00	2281
Mean	12.07	43749
Standard Deviation	1.62	9973.77
Minimum	9.53	27228.80
Maximum	17.45	82074.45

Table 1 shows the descriptive statistics of the data taken for the underlying study. Mean is the average and for the REITs indices shows average value of 12.07. it is to be noted that the PSX descriptive show the closing prices of the PSX index, for which the returns were calculated in the further steps for the purpose of analysis. The deviation from mean that is Standard deviation shows 1.62 for Reits and 9973.77 for the Pakistan stock indices. Maximum and Minimum show the maximum and the minimum value in each series separately.

Table 2: ADF Test

	P-Value
REITS	2.1790727628129108e-16
PSX	0.0

Table 2 shows the results of Augmented Dickey Fuller (ADF) test that is used to check for stationarity in a time series. For REITS the p-value is very small. It indicates that the null hypothesis of the ADF test, which assumes the presence of a unit root is rejected. Therefore, this series is stationary. On the other, hand the p-value for PSX series is also zero rejecting the null hypothesis and declaring the PSX returns series stationary.

Table 3 GARCH Model for REITS: Mean Equation

	Coefficient	P-value
Garch	1.8751e-04	8.823e-266

Variance Equation:

	Coefficient	P-value
Omega	2.8209e-06	**0**
Alpha	0.1	3.008e-05
Beta	0.88	0.000

The above table shows that the GARCH coefficient in the mean equation is statistically significant, indicating the model accounts for the persistence of returns effectively. The coefficient is very small, reflecting that the direct impact of volatility on the returns is minimal but consistent. The very small value of omega indicates a low baseline level of volatility when there are no shocks or past volatility effects. Its significance suggests that this baseline variance contributes meaningfully to the overall conditional variance. The alpha coefficient measures the influence of recent shocks (lagged squared residuals) on current volatility.

A value of 0.1 means that 10% of current volatility is explained by recent shocks. The statistically significant p-value indicates that recent shocks strongly influence volatility. The beta coefficient captures the persistence of past volatility (lagged conditional variance) in the current period. A high beta value (0.88) indicates strong volatility persistence, meaning that if volatility increases, it takes time to return to normal levels. The significance of beta emphasizes the importance of past volatility in shaping current volatility.

Table 4: Model Diagnostics:

Method	**Maximum Liklihood**
Log-Liklihood	7169.87
AIC	-14331.7
BIC	-14308.8

The above table shows the model diagnostics. AIC and BIC values are used to compare different models with different numbers of parameters or specifications. The model with the lowest AIC and BIC is generally considered the best in terms of fit and simplicity. Both values are negative, as expected in likelihood-based model evaluation, with more negative values indicating a better fit.In this case, both AIC and BIC values being similar (-14331.7 and -14308.8) suggest that the model has a good balance between fit and complexity. The small difference indicates the model is not overfitting and is likely optimal for the REITs data.

Table 5 GARCH Model for PSX: Mean Equation

	Coefficient	P-value
Garch	7.7583e-04	3.039e-04
Variance Equation:		
	Coefficient	**P-value**
Omega	1.1714e-05	1.377e+06
Alpha	0.2000	7.093
Beta	0.7000	4.195e-201

The GARCH model results for the PSX series indicate significant dynamics in both the mean and variance equations. In the mean equation, the GARCH coefficient is 7.7583e-04 with a p-value of 3.039e-04, which is statistically significant. This suggests that volatility (or past market fluctuations) has a meaningful, though small, influence on the current return of the PSX series.

In the variance equation, the omega coefficient is 1.1714e-05 with an extraordinarily high p-value (1.377e+06), which is likely an error in reporting or suggests a value that doesn't carry statistical significance, possibly due to a very small variance baseline. The alpha coefficient of 0.2000 with a p-value of 7.093 indicates that 20% of the current volatility comes from past shocks to the market, which is significant and suggests a moderate response to recent market events. The beta coefficient of 0.7000 with a p-value of 4.195e-201 is highly significant, showing strong volatility persistence. This indicates that a large portion of current volatility is driven by past volatility, suggesting that volatility shocks have long-lasting effects on the PSX market.

Overall, the results show a model where volatility is driven primarily by past volatility (high beta), with past shocks contributing significantly (alpha), implying that the PSX market experiences volatility clustering, where periods of high volatility tend to be followed by more high volatility.

Table 6: Model Diagnostics:

Method	Maximum Likelihood
Log-Liklihood	7286.05
AIC	-14564.1
BIC	-14541.2

The above table shows the model diagnostics. The Log-Likelihood of 7286.05 indicates that the model provides a good fit to the data, with higher values suggesting that the model effectively explains the observed returns. The AIC of -14564.1 and BIC of -14541.2 are both negative, which is typical for likelihood-based criteria, and they suggest that the model is well-optimized. The AIC penalizes model complexity, so the negative value indicates that the model balances fit and simplicity effectively. Similarly, the BIC, which also includes a stronger penalty for the number of parameters, reinforces that the model avoids overfitting while explaining the data well. When comparing models, the one with the lowest AIC and BIC would generally be considered the best, as it achieves a good fit with minimal complexity.

Table 7: DCC results

	Theta 1	**Theta 2**
Dynamic Conditional Correlation	0.29937111	0.43104276

The above table shows The Dynamic Conditional Correlation (DCC) values of 0.29937111 for Theta 1 and 0.43104276 for Theta 2 indicate the time-varying correlation between the two assets or series being analyzed. Theta 1 represents the short-term correlation, while Theta 2 captures the long-term correlation dynamics. The value of 0.29937111 for Theta 1 suggests a moderate level of short-term correlation between the series, indicating some co-movement in the short run but not a very strong relationship. In contrast, the value of 0.43104276 for Theta 2 indicates a stronger long-term correlation, suggesting that over a longer horizon, the two series exhibit a more significant relationship. Together, these values show that while the two series may not be highly correlated in the short term, their relationship becomes more pronounced over time.

Figure 1: Heat Map of Correlation between REITS and PSX

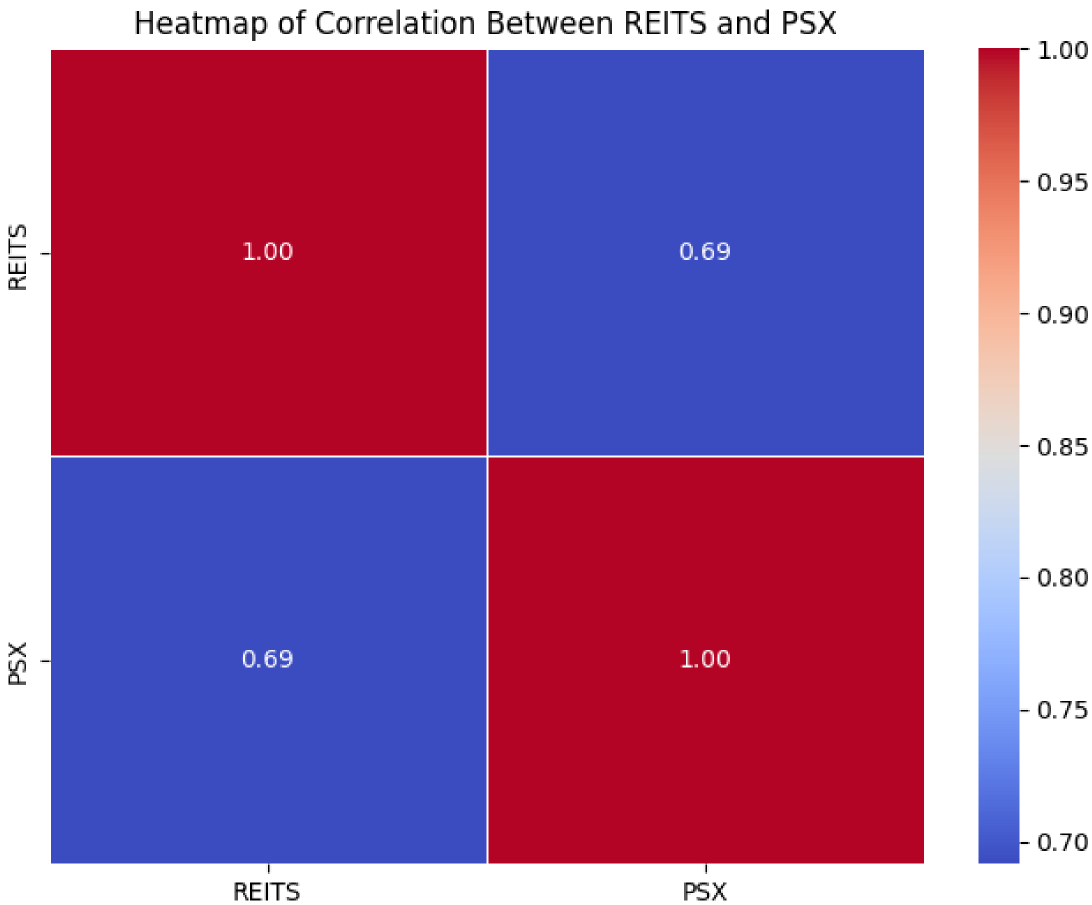
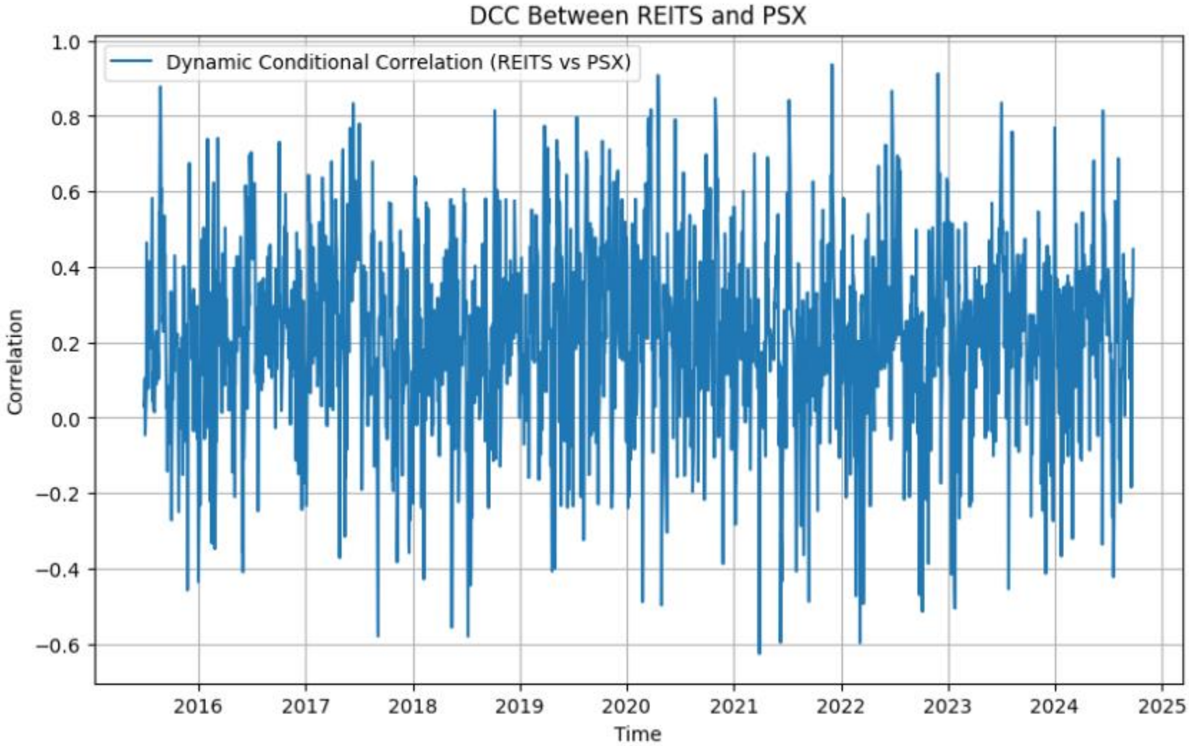


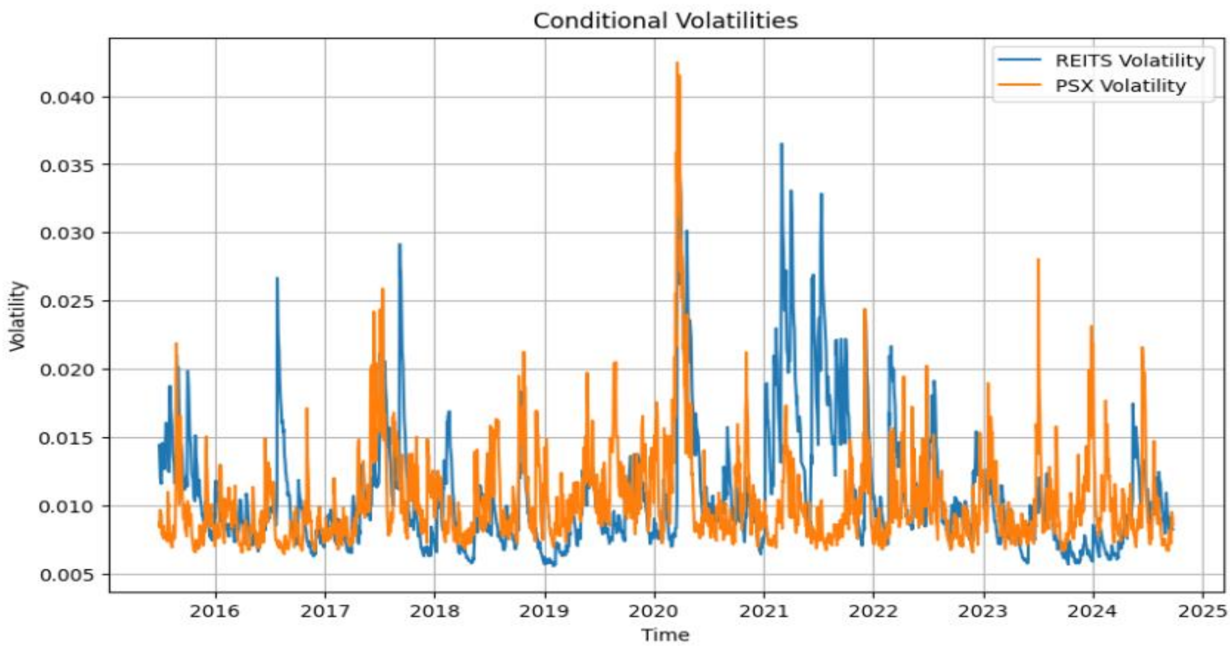
Figure 1, shows the correlation between the two series that is REITS and PSX, which is 0.69 indicating moderate positive correlation between the two series.

Figure 2: DCC between REITS and PSX



The above figure shows the conditional volatility results for both series. The above graph clearly shows that during the period from 2016 to 2024, a number of times the correlation has gone beyond 80% positive, showing positive direction of relationship and strength and the timevaryingness between the two series suggesting limited diversification benefits as both might be experiencing similar risks.

Figure 3: Conditional Volatilities between REITS and PSX



The above figure shows the conditional volatilities in two series. Volatility measures the magnitude of fluctuations in the series. It provides the time varying estimates of volatility. The above graph clearly shows that PSX and REITS both have conditional volatility spikes during the period selected for the purpose of the study. These spikes often correspond to events like market crashes specifically the time of 2020 was when the economy was struggling with Covid. High volatility indicate higher risk and uncertainty in that time period. Further, as both markets show spikes at the same time indicating both markets reacted similarly to external shocks.

CONCLUSION

In conclusion, this study has thoroughly assessed the conditional volatility between Real Estate Investment Trusts (REITs) and stock returns in Pakistan, utilizing advanced econometric models, including the GARCH framework. The findings reveal significant volatility dynamics, highlighting how both REITs and stock returns exhibit considerable interdependence, with past shocks influencing current volatility in both markets. The results show that while REITs and stock returns display volatility clustering, the degree of persistence is more pronounced in the stock market, suggesting that stock returns experience longer-lasting volatility shocks. Furthermore, the DCC-GARCH model indicates moderate short-term correlation between the two markets, which strengthens over the long term. These findings offer valuable insights for investors and policymakers in understanding the volatility spillovers between REITs and the broader stock market, providing a basis for more informed decision-making in terms of portfolio management and risk assessment. Overall, this study contributes to the literature by exploring the conditional volatility dynamics of Pakistan's emerging markets, filling a gap in the understanding of the interplay between these two important asset classes. However, the study is limited by the availability of data for REITs in Pakistan, and model assumptions such as the normality of returns could affect the results. Future research could incorporate more granular data or alternative modeling techniques for a deeper understanding. Policymakers should focus on enhancing market transparency and infrastructure to reduce volatility and mitigate systemic risks. By understanding the relationship between REITs and stock returns, effective policies can be designed to foster investor confidence and stability in both markets.

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