Journal of International Trade, Logistics and Law, Vol. 11, Num. 2, 2025, 231-240

VOLATILITY DYNAMICS IN TURKISH REIT AND SECTORAL INDICES: A UNIVARIATE GARCH APPROACH

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Received: Aug 01, 2025 Accepted: Sept 21, 2025 Published: Dec 01, 2025

Abstract:
This study investigates the volatility characteristics of the Turkish REIT Index (XGYO) and major sectoral indices on Borsa Istanbul, including construction, tourism, and finance, from 2014 to 2024. The analysis uses ARIMA models for the mean and univariate GARCH(1,1) models for the variance, incorporating two key macroeconomic variables: the USD/TRY exchange rate and international gold prices. These variables are selected to capture the influence of currency fluctuations and global commodity markets on sectoral volatility. The findings reveal persistent volatility across all sectors, with macroeconomic factors being a key influence. Construction and REITs are most affected by exchange rate fluctuations due to their strong connection to the real estate market, while tourism is more impacted by gold price changes, indicating greater exposure to global uncertainty.
By focusing on sector-specific volatility instead of static measures, the study improves understanding of market behavior in emerging economies. It provides practical guidance for investors, portfolio managers, and policymakers, showing that while Turkish REITs can offer stability in diversified portfolios, their effectiveness depends on the macro-financial environment and sector-specific conditions.

Keywords:
Turkish REIT Index (XGYO); Sectoral equity indices; GARCH(1,1); Volatility dynamics; Macroeconomic variables; Emerging markets

1. Introduction
The financial markets of emerging economies display complex relationships between different asset classes, where macroeconomic trends and sector-specific shocks can significantly influence market dynamics. Understanding these linkages is essential for portfolio diversification, risk management, and evaluating financial stability.
Real Estate Investment Trusts (REITs) combine the income-generating qualities of property markets with the liquidity of stocks, offering steady income, diversification benefits, and professional management (Gazel & Münyaş, 2021). In Turkey, REITs have gained significance since their debut in the mid-1990s, influencing sectors like construction, healthcare, and tourism (Coşkun et al., 2017). The Turkish REIT Index (XGMYO) has become an essential option for portfolio diversification and market stability.
Given their exposure to both real estate fundamentals and broader financial market conditions, REITs are influenced by domestic and international macroeconomic factors. Specifically, fluctuations in the USD/TRY exchange rate and global gold prices often act as channels for external shocks, affecting sector volatility and integration. This sensitivity is more pronounced in emerging markets, where macroeconomic fluctuations can significantly affect sector relationships.
Despite extensive research on REITs in global markets, the sector-specific volatility patterns of Turkish REITs during macroeconomic shocks are still not well understood. Existing studies mainly focus on static risk measures and overlook how macroeconomic factors influence volatility across different sectors.
This study analyzes volatility in the REIT Index and five Borsa Istanbul indices: Construction (XINSA), Tourism (XTRZM), Banking (XBANK), All Shares (XTUM), and the BIST 100 (X100) for 2014 to 2024, using ARIMA for mean equations and GARCH(1,1) for variance, with exchange rate and gold prices as external regressors. Results

show that currency movements strongly affect construction and banking, while gold prices mainly influence tourism. REIT volatility is closely linked to construction, and although REITs are usually less volatile than the BIST 100, they can spike during stress periods, limiting their defensive role

2. Literature Review

The first chapter reviews literature on the volatility of Turkish REITs and sectoral indices, focusing on univariate GARCH studies related to persistence, macroeconomic sensitivity, and sectoral risk implications.

2.1. Structure, Market Role, and Regulatory Evolution of REITs

This section examines the evolution of Real Estate Investment Trust (REIT) markets and the influence of structural, regulatory, and macroeconomic factors in Turkey and internationally, providing essential background for the volatility patterns analyzed in this study.

REITs are investment companies that pool capital from multiple investors to acquire income-generating real estate, managed by professional managers (Önder, Taş, & Hepşen, 2014). They combine a property market, where rental income is the main revenue, with the liquidity of publicly traded stocks, providing diversification, steady income, and tax benefits (Fan & Wang, 2024).

They raise capital through initial public offerings, with shares traded on exchanges, enabling investors to access real estate without the illiquidity or high costs associated with direct ownership. Regulations often require minimum dividend payouts and specific allocations to qualifying real estate assets (Coşkun et al., 2017; Coskun, 2020).

The Turkish REIT market experienced significant growth from 2008 to 2015, with total assets increasing by 518 percent, market capitalization rising by 281 percent, and the number of listed REITs growing from 14 to 31 (Coşkun et al., 2017). Regulatory flexibility, tax incentives, and greater market transparency drove this expansion. However, the sector remains vulnerable to both domestic and international shocks due to its relatively small size and limited cross-border investment.

Government interventions and tax exemptions have been essential drivers of sectoral growth, although REITs in emerging markets are often exposed to higher risk. Empirical evidence indicates that REITs' defensive properties tend to weaken during periods of financial distress as correlations with other sectors increase (Chiang et al., 2013).

While Turkish REITs operate within a framework similar to international practice, domestic investors dominate the market, making it more sensitive to local economic and political conditions, high inflation, and currency volatility.

Globally, REIT regulation typically encompasses four pillars: dividend payout mandates, corporate tax exemptions, minimum asset allocation rules, and ownership concentration limits (NAREIT, 2023; PWC, 2023). In August 2024, Turkey introduced Law No. 7524, which requires REITs and Real Estate Investment Funds to distribute at least 50 percent of net profits to retain corporate tax exemptions. This reform is expected to attract dividend-oriented investors and reduce the persistent net asset value discount (Yener Coşkun, 2019).

By the end of 2024, there were 48 REITs listed on Borsa Istanbul with a combined market capitalization of approximately 15 billion USD, representing about 4 percent of the total market. Despite this progress, Turkish REITs remain shaped by domestic conditions, including regulatory measures, inflationary pressures, and periodic financial crises.

In conclusion, although REIT markets worldwide exhibit signs of international diversification, Turkish REITs retain distinctive characteristics rooted in local market dynamics. These features should be taken into account in empirical studies of volatility to align with global research standards and to develop effective risk mitigation strategies in emerging markets.

2.2. Volatility and Correlation Modelling in Finance

Volatility measures how much the price or returns of a financial asset fluctuate over a specific period. It is calculated using statistical tools such as the standard deviation or variance of returns.

Financial markets exhibit inherent volatility and interconnectedness, requiring advanced modeling to understand asset behavior and manage risk. Real Estate Investment Trusts (REITs), with their distinctive features and sensitivity to macroeconomic conditions, demand special attention (Okoro & Ayaba, 2023). Their performance has been a long-standing focus of research, aided by the availability of high-frequency return data (Zietz et al., 2003). The growth of the REIT sector has shifted investor sentiment toward real estate securities, while increased trading

activity has introduced new volatility patterns, highlighting the need for more detailed modeling and analysis (Cotter & Stevenson, 2006).

The literature identifies several primary applications of volatility and correlation modelling:

•Risk management and VaR estimation: Conditional variance forecasts improve the accuracy of risk measures, especially when asymmetries are taken into account (Aliyev et al., 2020; Ampountolas, 2024).

•Volatility forecasting: The choice of models, such as sGARCH, EGARCH, GJR-GARCH, or FIGARCH, affects out-of-sample accuracy; in multivariate contexts, the specification shapes correlation forecasts (Aliyev et al., 2020; Laurent et al, 2010).

•Hedging and portfolio allocation: Time-varying covariances derived from multivariate GARCH models enable the estimation of dynamic hedge ratios and optimal portfolio weights (Abdullah et al., 2023; Ajayi & Kazeem, 2024).

•Spillover and connectedness analysis: Models such as BEKK, VARMA-GARCH, and Diebold–Yilmaz variance decomposition are employed to quantify directional spillovers and their dependence on market regimes (Mensi et al., 2023; Yousaf et al., 2024).

Evidence from multivariate GARCH models indicates significant cross-equation effects in Turkey, highlighting strong interconnectedness among sectoral indices (Fengler & Herwartz, 2016). Under normal market conditions, international and domestic macroeconomic variables have limited influence on Turkish REITs. However, their impact increases during periods of high volatility, with domestic shocks dominating in high volatility regimes and international factors playing a larger role during low volatility periods (Mensi et al., 2022).

Leverage effects and asymmetric volatility, where adverse shocks lead to stronger volatility responses, are well documented in Turkish markets, mainly through multivariate GJR GARCH models (Aftab et al., 2019; Hölzl & Frühwirth Schnatter, 2011). This asymmetry highlights the need for models that capture nonlinear spillovers, as extreme losses in one sector can raise systemic risk.

In this study, univariate GARCH(1,1) models are applied to the Turkish REIT Index (XGYO) and key sectoral indices (XINSA, XTRZM, XBANK, XTUM, X100), incorporating USD/TRY exchange rates and international gold prices in the variance equations. This approach captures volatility persistence, short-term shocks, and the influence of external factors, providing sector-specific insights essential for portfolio risk management, asset allocation, and financial stability in emerging markets.

2.3. GARCH-Based Modelling Approaches

The Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model (Bollerslev, 1986) is widely used to model and forecast financial market volatility. Extending the ARCH model, it includes lagged conditional variances, capturing persistence and volatility clustering (Bulut, 2024)

The standard GARCH(1,1) model:

$h_t = \alpha_0 + \alpha_1 \varepsilon^2_{t-1} + \beta_1 h_{t-1}$

where:

α is a constant,

ε^2_{t-1} represents the lagged squared residual (a proxy for the magnitude of past shocks),

h_{t-1} is the lagged conditional variance,

α_1 captures the immediate impact of new information (ARCH effect),

β_1 reflects the persistence of volatility over time (GARCH effect).

Multivariate GARCH models (e.g., BEKK, DCC, orthogonal GARCH) estimate time-varying covariances, revealing how volatility spills over between assets. Asymmetric variants (e.g., GJR-GARCH, EGARCH) capture leverage effects, where adverse shocks have a larger impact than positive ones.

Different specifications suit different contexts:

•Asymmetric BEKK can better capture spillovers in equity and commodity markets (Kartsonakis-Mademlis & Dritsakis, 2020).

•AVARMA-DCC GARCH performs well for some stock indices.

•Markov Switching Multifractal models excel in long-term FX forecasts (Liu et al., 2017).

•DCC and orthogonal GARCH models adapt effectively during crises (Laurent et al., 2012).

Model choice depends on asset class, time horizon, and whether short-term precision or long-term adaptability is the priority.

2.4. The Turkish Context: REITs and Sectoral Dynamics

This section covers the development, regulation, and performance of Turkish Real Estate Investment Trusts (REITs), which have been regulated by the Capital Markets Board since 1995. By increasing transparency through independent appraisals and formalized transactions, the sector expanded rapidly from 2008 to 2015, with assets rising by 518 percent, market capitalization increasing by 281 percent, and listed REITs expanding from 14 to 31. A strong real estate market, mortgage reforms, lower interest rates, heightened investor interest, and supportive demographic trends drove this growth.

Turkish REITs benefit from corporate tax exemptions, dividend tax relief, flexible payout policies, and a low 51 percent minimum investment ratio. The absence of mandatory payouts encouraged reinvestment but caused ongoing net asset value discounts. Starting in January 2025, distributing at least 50 percent of net real estate profits will be necessary to maintain tax exemptions, aligning with global standards and potentially increasing transparency, yields, and institutional appeal.

These reforms may improve governance and attract dividend-focused investors, but could limit retained earnings. Higher payouts increase liquidity, confidence, and stability while lowering reinvestment capacity and impacting profitability, structure, valuation, and performance.

The sector's growth will hinge on balancing investor returns with sustainable capital use, managing domestic and global risks, and refining regulations to enhance stability and competitiveness, offering insights into its evolution, structure, and resilience in emerging markets.

In Turkey, Real Estate Investment Companies have been regulated since 1995, with their first public offering in 1997. Managed by the Capital Markets Board, they have improved transparency through independent appraisals and decreased unrecorded transactions. Between 2008 and 2015, assets increased by 518 percent, market capitalization by 281 percent, and listings grew from 14 to 31, reaching a 1.7 percent share of the FTSE EPRA/NAREIT Emerging Index by 2016. Growth, driven by a strong property market, mortgage reforms, investor demand, and urbanization, enhanced capital flow and liquidity, but also increased vulnerability to macroeconomic shocks due to high asset concentration.

Turkey's REIT framework has provided tax exemptions on corporate income and dividends, a low investment threshold, and no mandatory payout, supporting reinvestment but contributing to persistent NAV discounts. From January 2025, TREITs must distribute at least 50 percent of real estate profits to keep tax benefits, with undistributed earnings taxed at 30 percent. This aligns with global norms and may attract dividend-focused investors, but could affect capital structure and valuations. Higher payouts may strengthen confidence, liquidity, and price stability. However, the sector still lags global benchmarks and remains vulnerable to local volatility, underscoring the need for greater transparency, wider investor reach, and broader asset diversification.

2.5. Market Structure and Performance Metrics

Turkish REITs (TREITs) have traditionally maintained diversified portfolios, though recent years show increased specialization in industrial storage, residential, and hotels (Yener Coskun, 2019; Coşkun et al., 2017).

•Diversified TREITs dominate in assets and market cap, delivering strong excess returns, especially post–global financial crisis.

•Residential TREITs hold a significant market share but show high sensitivity to housing price movements.

•Retail TREITs exhibit low-risk, low-return profiles with smaller NAV discounts.

•Office and Specialized TREITs face the steepest NAV discounts.

Between 2008 and 2015, regulatory reforms and favorable macroeconomic conditions expanded Turkish REITs from 14 to 31 listings, growing assets from TL 5 billion to TL 30 billion and enhancing market depth. However, high asset concentration and liquidity constraints limit resilience and competitiveness, with performance driven more by profitability ratios than liquidity measures, reflecting firm commitments to fixed real estate holdings.

3. Methodology

This chapter outlines the methodology for analyzing the volatility dynamics of the Turkish Real Estate Investment Trust Index (XGYO) and selected Borsa Istanbul sectoral indices using univariate GARCH(1,1) models. The models identify sector-specific volatility persistence, short-term shocks, and responses to key macroeconomic variables, specifically the USD/TRY exchange rate and international gold prices, to examine how external factors influence

sectoral interconnections. The chapter details model specification, parameter estimation procedures, and diagnostic tests, followed by results that assess volatility persistence and macroeconomic sensitivity across sectors under different market conditions.

3.1. Research Objective and Analytical Framework

This study investigates the volatility of the Turkish Real Estate Investment Trust Index (XGYO) and major Borsa Istanbul sector indices using ARIMA-GARCH(1,1) models. It assesses volatility persistence, short-term shocks, and the influence of macroeconomic factors, specifically the USD/TRY exchange rate and international gold prices, on sector volatility. Separate models are applied to each index to capture sector sensitivities, including macroeconomic variables in the variance equations to evaluate systemic risk. The GARCH(1,1) framework is selected for its effectiveness in modeling time-varying volatility in emerging markets, although parameters may require adjustment for regime shifts. While multivariate models can capture interconnectedness, single-index GARCH models are suitable given data limitations and market conditions. Results indicate that macroeconomic shocks impact sectors differently, emphasizing the importance of dynamic, regime-aware modeling for accurate risk assessment and portfolio management.

This study uses daily closing prices from January 1, 2014, to December 31, 2024, for eight financial and macroeconomic variables:

Code	Description
XGYMO	BIST REIT Index (Real Estate Investment Trusts)
XTRZM	BIST Tourism Sector Index
XINSA	BIST Construction Sector Index
XBANK	BIST Banking Sector Index
X100	BIST 100 Index
XTUM	BIST All Shares Index
GAU	International Gold Price (TRY equivalent)
USD	USD/TRY Exchange Rate

All series were converted to logarithmic returns to stabilize variance and ensure scale compatibility. Data were sourced from Borsa Istanbul, the Central Bank of the Republic of Turkey (CBRT), and Refinitiv Eikon.

Rationale for Variable Selection

This section examines how exchange rate changes and gold price movements transmit external shocks to Turkish markets, shaping sector volatility and linkages. The USD/TRY rate signals currency risk tied to external debt, current account deficits, and global capital flows, strongly affecting import-reliant sectors such as real estate, banking, and construction. Gold prices act as a safe haven in global uncertainty, influencing asset allocation and liquidity, with tourism particularly sensitive to shifts in investor sentiment. USD_LOG captures domestic monetary stress, while GAU_LOG reflects global risk aversion, together revealing complementary volatility channels. Evidence shows exchange rate shocks have broader impacts in Turkey than in developed markets, with two-way spillovers in finance and sector-specific sensitivities elsewhere. These results stress the need for tailored risk assessments, hedging strategies, and sector-focused volatility models, alongside macroprudential policies to mitigate currency shock effects and systemic risk.

3.2. Modelling Framework

The methodology follows a two-stage process:

1. Mean Equation – ARIMA Specification

Each return series is modeled using an ARIMA(p,d,q) model selected based on the Augmented Dickey-Fuller test, autocorrelation checks, and information criteria. For example, XGYMO fits ARIMA(3,3), and XTRZM fits ARIMA(1,1). This process removes autocorrelation in the mean, ensuring that residuals are suitable for volatility modeling.

2. Variance Equation – GARCH(1,1) Specification

The residuals are modelled using the GARCH(1,1) framework:

$\sigma 2t = \omega + \alpha\varepsilon 2t\text{-}1 + \beta\sigma 2t\text{-}1 + \delta 1USD\_LOG\ t + \delta 2GAU\_LOG\ t$

Where α captures short-term shock effects (ARCH) and β measures volatility persistence. Macroeconomic regressors USD_LOG and GAU_LOG are included in the variance equations to capture sectoral responses to external shocks in real time.

4. Empirical Results

4.1. Introduction

This chapter presents GARCH(1,1) results for Turkish sector indices and the BIST 100, using baseline, USD, and gold models to assess volatility persistence, macroeconomic shock transmission, and sector-specific risk in the equity market.

4.2. General Observations Across Models

Across all sectors, the GARCH (1,1) results indicate high volatility persistence (0.68–0.89) and significant short-term effects from recent shocks. Incorporating USD_LOG and GAU_LOG improves the model fit and demonstrates that external financial conditions greatly influence volatility in Turkish equities.

4.3. Sector-Specific Results

4.3.1. Real Estate Investment Trusts (XGMO)

Model	ARCH (α_1)	GARCH (β_1)	USD_LOG	GAU_LOG
Base	0.1796	0.682	—	—
+USD_LOG	0.1748	0.6868	0.0002	—
+GAU_LOG	0.1684	0.6884	—	0.001

The REIT sector demonstrates strong persistence of volatility. Both macro variables are significant and positive, indicating that lira depreciation and increased global risk aversion elevate REIT volatility, reflecting their capital-intensive nature and sensitivity to exchange rates. Gold's role as a safe haven signals investor anxiety that influences REIT valuations.

4.3.2. Tourism Sector (XTRZM)

Model	ARCH (α_1)	GARCH (β_1)	USD_LOG	GAU_LOG
Base	0.1365	0.7966	—	—
+USD_LOG	0.1329	0.8055	0.0003	—
+GAU_LOG	0.1335	0.7856	—	0.0016

Tourism sector volatility is driven mainly by gold price movements, indicating greater sensitivity to global risk sentiment than to exchange rates. Rising gold prices, signaling global uncertainty, often coincide with weaker tourism demand and higher volatility.

4.3.3. BIST All Shares Index (XTUM)

Model	ARCH (α_1)	GARCH (β_1)	USD_LOG	GAU_LOG
Base	0.096	0.84	—	—
+USD_LOG	0.0961	0.8815	0.0001	—
+GAU_LOG	0.0962	0.8427	—	0.001

As a market-wide proxy, XTUM shows persistent systemic volatility and significant sensitivity to both macro variables, confirming the broad impact of external shocks on total market risk.

4.3.4. BIST 100 Index (X100)

Model	ARCH (α_1)	GARCH (β_1)	USD_LOG	GAU_LOG
Base	0.1499	0.5999	—	—
+USD_LOG	0.0587	0.6612	0.0002	—
+GAU_LOG	0.0626	0.6036	—	0.001

BIST 100 volatility is highly responsive to external risk, with slightly lower persistence. Adding USD_LOG reduces the ARCH term, indicating that exchange rate effects absorb part of the shocks, consistent with large-cap integration into macro fundamentals.

4.3.5. Banking Sector (XBANK)

Model	ARCH (α_1)	GARCH (β_1)	USD_LOG	GAU_LOG
Base	0.0739	0.8889	—	—
+USD_LOG	0.0594	0.8863	0.0003	—
+GAU_LOG	0.0559	0.8398	—	0.001

The banking sector exhibits the highest volatility persistence, with intense sensitivity to USD_LOG due to foreign currency exposure and policy risk. Gold also affects volatility, but to a lesser extent.

4.3.6. Construction Sector (XINSA)

Model	ARCH (α_1)	GARCH (β_1)	USD_LOG	GAU_LOG
Base	0.103	0.8631	—	—
+USD_LOG	0.0928	0.8673	0.0003	—
+GAU_LOG	0.0783	0.8387	—	0.0017

Volatility in the construction sector is heavily influenced by both macro variables, with gold showing the highest coefficient (0.0017). This can be attributed to the sector's dependence on commodity-linked inputs and interest-rate-sensitive financing. The high GARCH term confirms the slow dissipation of shocks, consistent with infrastructure and housing cycle dynamics.

4.4. Comparative Sectoral Insights

Most Persistent Volatility: XBANK (GARCH ≈ 0.89)
Strongest USD Sensitivity: XGYMO, XBANK, XINSA
Strongest Gold Sensitivity: XTRZM, XINSA, XGYMO
Broadest Macro Factor Effect: XTUM and X100 (both USD_LOG and GAU_LOG significant)
Relatively Isolated from USD: XTRZM (tourism is less currency-dependent)

These patterns suggest that exchange rate volatility disproportionately affects finance, construction, and real estate, while global risk sentiment (via gold) affects investor confidence and demand-sensitive sectors such as tourism.

3.5. Interpretation of Results

3.5.1. Volatility Persistence and Market Efficiency

GARCH coefficients (0.60–0.89) show high persistence, typical of emerging markets with structural rigidities and lower efficiency. Persistence is highest in banking, followed by tourism and construction.

3.5.2. Macroeconomic Factors

USD_LOG and GAU_LOG both significantly impact volatility, with currency depreciation increasing systemic risk for REITs, banks, and construction, while gold prices, which reflect global uncertainty, mainly influence tourism and, to a lesser extent, REITs and construction.

3.5.3. Sectoral Vulnerability Profiles

REITs: High sensitivity to USD and gold due to FX-linked liabilities and exposure to global sentiment
Tourism: Strong gold sensitivity linked to demand-side shocks
All Shares: Broad exposure to both USD and gold
Bist 100: Moderate exposure, partly insulated by diversification
Banking: Very high USD sensitivity due to currency mismatches
Construction: High exposure to USD and gold from imported material costs and investment sentiment shifts
Sector differences reflect distinct financial structures, operational dependencies, and investor bases, underscoring the need for tailored portfolio strategies in emerging markets.

5. Conclusion

This study examined the interactions between the Turkish Real Estate Investment Trust (REIT) Index and major Borsa Istanbul sector indices, including construction, tourism, and finance, while considering the effects of the USD/TRY exchange rate and international gold prices from 2014 to 2024. Using ARIMA models followed by GARCH(1,1) estimation with external macroeconomic variables, it explored volatility persistence, short-term shocks, and macroeconomic sensitivities. Results show that REITs respond differently to macroeconomic factors than other sectors, with currency fluctuations impacting construction and banking the most, and gold prices influencing tourism. Correlations and volatilities vary over time, increasing during market stress, which reduces REITs' stabilizing role during crises but enhances their defensive qualities during stable periods. The findings align with international evidence that diversification benefits decrease during downturns and highlight the impact of recent regulatory changes on market integration. Limitations include data constraints, a focus on one market, and the absence of asymmetry modeling. Future research should explore cross-country analysis, higher frequency data, and more advanced GARCH models incorporating additional macroeconomic factors. The results provide practical insights for investors, portfolio managers, and policymakers in risk management, asset allocation, and strengthening regulatory frameworks.

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