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Navigating Uncertainty: The Multi-Method Analysis of Interest Rate Volatility and Portfolio Performance Across Developed and Emerging Markets

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Abstract: This study investigates the impact of interest rate volatility on portfolio returns across ten developed and emerging economies United States, United Kingdom, Germany, Japan, India, China, Brazil, South Africa, Mexico, and Turkey over the period 2010–2025. Utilizing a comprehensive multi-method approach, the analysis combines Fully Modified Ordinary Least Squares (FMOLS), Dynamic Ordinary Least Squares (DOLS), Autoregressive Distributed Lag (ARDL) models, Mixed-Moment Quantile Regression (MMQR), Granger causality, and System Generalized Method of Moments (GMM) to examine both long-run and short-run dynamics, heterogeneous effects across portfolios, predictive relationships, and robustness of findings. The results consistently indicate that higher interest rate volatility negatively affects portfolio returns, with stronger impacts observed in high-return portfolios. Long-run estimations (FMOLS and DOLS) confirm a persistent negative association, while ARDL models reveal both immediate and long-term adverse effects, with the error correction term highlighting a swift adjustment toward equilibrium following shocks. MMQR analysis demonstrates that the sensitivity of portfolios to interest rate volatility varies across the return distribution, emphasizing the heterogeneous nature of investor responses. Granger causality tests establish that interest rate volatility, equity allocation, and market volatility significantly predict portfolio returns, suggesting potential avenues for proactive risk management. System GMM estimations reinforce the robustness of results while addressing endogeneity and dynamic panel concerns. The study contributes to the literature by providing a cross-country, multi-method examination of interest rate volatility and portfolio performance, highlighting the role of portfolio characteristics and macroeconomic factors in mitigating adverse effects. Policy implications include the need for central banks to stabilize interest rate environments and for investors to adopt dynamic asset allocation strategies to manage risk effectively. Limitations include annual frequency data and a limited country sample, pointing to opportunities for future research on intraday dynamics, broader markets, and alternative asset classes.

Keywords: Interest rate volatility; Portfolio returns; FMOLS; DOLS; ARDL; Mixed-Moment Quantile Regression; System GMM; Developed and emerging markets; Financial risk; Asset allocation

1. Introduction

Interest rate volatility remains one of the most significant determinants of investment decisions and portfolio performance in global financial markets. Fluctuations in interest rates, driven by monetary policy shifts, macroeconomic shocks, and global financial uncertainty, influence both the cost of capital and expected returns across asset classes. Traditional finance literature emphasizes that movements in the term structure affect investor allocation between risk-free instruments, equities, and fixed-income securities (Terrell & Frazer, 1972; Vayanos & Vila, 2021). In recent years, the increasing integration of financial markets, coupled with the emergence of alternative assets such as cryptocurrencies and green bonds, has amplified the sensitivity of portfolios to interest rate fluctuations (Aharon, Umar, & Vo, 2021; Petukhina, Trimborn, Härdle, & Elendner, 2021). Understanding these dynamics is critical for both individual and institutional investors, who must navigate increasingly complex risk-return trade-offs in uncertain environments.

Existing research underscores the multifaceted impact of interest rate volatility. Lian, Ma, and Wang (2019) document that low interest rates encourage risk-taking, with investors reallocating towards higher-yield, higher-risk assets. Similarly, Hoffmann, Langfield, Pierobon, and Vuillemey (2019) illustrate that the distribution of interest rate risk varies across portfolio types, with differential exposure between equities, bonds, and alternative assets. Cross-asset interactions further complicate the picture; Antonakakis, Cunado, Filis, Gabauer, and De Gracia (2020) and Chatziantoniou, Filippidis, Filis, and Gabauer (2021) highlight that oil price and commodity market volatility amplify the effects of monetary shocks on portfolio returns. Moreover, cryptocurrency markets demonstrate high sensitivity to macro-financial conditions, particularly interest rate movements, making them both potential diversifiers and sources of systemic risk (Al Guindy, 2021; Koutmos, 2020).

Despite these insights, gaps remain in the literature. Most prior studies focus on single countries or specific asset classes, limiting the generalizability of their findings. Cross-country analyses that integrate both developed and emerging markets remain sparse, and the interaction of interest rate volatility with multi-asset portfolios, including traditional and alternative investments, is insufficiently explored (Aharon et al., 2021; Farooq, Ahmed, & Khan, 2021). Additionally, dynamic and heterogeneous effects, such as short-run adjustments versus long-run equilibrium relationships, have received limited attention. Methodological advancements, such as FMOLS, DOLS, ARDL, MMQR, Granger causality, and GMM, provide opportunities to capture these complex dynamics but have been underutilized in cross-asset and cross-country contexts. This study aims to address these gaps by examining the impact of interest rate volatility on investment portfolios across a panel of 12 countries, encompassing both developed economies (United States, United Kingdom, Germany, Japan, Canada, Australia) and emerging markets (India, China, Brazil, South Africa, Mexico, Turkey) over the period 2005–2022.

This study contributes to the literature in three key ways. First, it provides a comprehensive, cross-country assessment of how interest rate volatility affects diversified portfolios. Second, it integrates traditional and alternative assets, offering practical insights for investors seeking optimal risk management strategies. Third, it employs a rigorous methodological framework to disentangle long-term, short-term, and heterogeneous effects, enhancing theoretical understanding of portfolio responses to monetary policy shocks. Thus, the findings have important implications for investors, policymakers, and financial institutions navigating increasingly volatile global interest rate environments.

2. Literature Review

The impact of interest rate volatility on investment portfolios has garnered significant attention in financial economics due to its profound implications for asset allocation, risk management, and portfolio optimization. Terrell and Frazer (1972) pioneered early investigations into the relationship between interest rates and portfolio behavior, highlighting that fluctuations in the term structure influence investors' allocation between government securities and marketable instruments. Their study emphasized that even minor shifts in interest rates can alter portfolio composition, affecting both risk exposure and expected returns. Over the decades, this relationship has evolved, particularly with the emergence of new asset classes, such as cryptocurrencies, and the increasing complexity of global financial markets.

Recent research has emphasized the dynamic and multifaceted nature of interest rate volatility. Aharon et al. (2021) investigated the spillover effects between the term structure of interest rates, bitcoin, and safe-haven currencies, demonstrating that rate fluctuations not only influence traditional assets but also digital currencies. Their study revealed that interest rate shocks can propagate across asset classes, affecting volatility and expected returns in both conventional and alternative investment vehicles. Similarly, Al Guindy (2021) found that cryptocurrency price volatility is closely linked to investor attention and macro-financial conditions, indicating that investors react sensitively to interest rate changes when allocating capital to digital assets. These findings emphasize that the modern investor's portfolio is increasingly exposed to interdependent risks driven by monetary policy and financial innovations.

Several studies have examined the macroeconomic determinants of investment risk and portfolio performance. Akbar et al. (2019) employed a Bayesian framework to analyze dynamic linkages among gold prices, stock prices, exchange rates, and interest rates in Pakistan, revealing that interest rate volatility significantly influences asset returns and portfolio allocation decisions. This aligns with Hoffmann et al. (2019), who explored the distribution of interest rate risk across financial market participants and found that exposure varies systematically across portfolios depending on asset composition and investor risk preferences. Similarly, Lian, Ma, and Wang (2019) documented that low interest rate environments encourage investors to reach for yield by reallocating towards higher-risk assets, suggesting that interest rate volatility can amplify risk-taking behavior and shape the risk-return profile of portfolios.

Interest rate fluctuations also interact with broader financial and commodity markets. Antonakakis et al. (2020) examined oil and asset class volatilities, illustrating that monetary policy shocks, including interest rate volatility, influence hedging effectiveness and investment strategies. Chatziantoniou et al. (2021) further highlighted that oil price volatility, in conjunction with macroeconomic shocks, can compound portfolio risk, emphasizing the interconnectedness of financial and commodity markets. Xiuzhen et al. (2022) reinforced this view by showing that resource price fluctuations, including oil, act as constraints for economic recovery and portfolio stability, particularly in emerging markets.

From a portfolio management perspective, the response to interest rate risk is shaped by asset-specific characteristics. Munk and Rubtsov (2014) examined portfolio optimization under stochastic interest rates and inflation ambiguity, highlighting the need for dynamic strategies that account for both expected returns and volatility. Petukhina et al. (2021) extended this framework to cryptocurrency portfolios, revealing that digital assets can offer diversification benefits but are highly sensitive to interest rate changes and macroeconomic uncertainty. Vo et al. (2019) applied deep learning techniques for socially responsible investments, showing that algorithmic portfolio optimization can effectively mitigate interest rate and market risk, particularly in multi-asset portfolios. These studies collectively suggest that investment strategies must incorporate interest rate volatility into both traditional and alternative asset allocations to achieve robust performance.

Monetary policy and macroeconomic conditions further influence portfolio decisions. Daniel et al. (2021) emphasized that monetary policy shocks, including unexpected rate changes, affect investors' income-seeking behavior, influencing their asset allocation choices. Liu and Lee (2022) explored the relationship between exchange rate fluctuations and interest rate policy, finding that currency volatility can amplify the effects of interest rate shocks on international portfolios. Camanho et al. (2022) documented the global effects of portfolio rebalancing on exchange rates, highlighting how capital flows respond dynamically to interest rate differentials. Waqas et al. (2015) similarly noted that macroeconomic volatility, including interest rate shocks, contributes to foreign portfolio investment instability in South Asian economies, underscoring the policy-relevant nature of managing interest rate exposure.

The literature also identifies risk heterogeneity and spillover effects across portfolios. Koutmos (2020) found that Bitcoin returns are affected by market risk and interest rate changes, indicating that digital assets are not isolated from conventional market dynamics. Terrell and Frazer (1972) and Vayanos and Vila (2021) emphasized that interest rate volatility affects asset prices differently depending on maturity structure, investment horizon, and risk appetite. This heterogeneity necessitates sophisticated modeling approaches, such as dynamic panel estimation, MMQR, and system GMM, to capture both time-varying and cross-sectional effects. Farooq, Ahmed, and Khan (2021) utilized a GMM approach to show that macroeconomic factors, including interest rate volatility, significantly influence firm-level investment decisions, reinforcing the importance of modeling endogeneity and dynamic relationships.

Despite extensive research, several gaps remain. While prior studies have examined the effect of interest rate volatility on individual asset classes (Aharon et al., 2021; Koutmos, 2020), limited research has integrated multiple asset types including equities, bonds, commodities, and cryptocurrencies into a single portfolio framework. Moreover, most studies focus on single-country or regional analyses, leaving cross-country heterogeneity underexplored. Similarly, the role of dynamic spillovers, risk propagation, and tail events in shaping investment portfolios remains insufficiently addressed. Integrating advanced econometric techniques, such as FMOLS, DOLS, ARDL, MMQR, and GMM, allows researchers to capture both long-run equilibrium relationships and short-run dynamic adjustments across diversified portfolios and heterogeneous market environments.

This study contributes to the literature by addressing these gaps, examining the impact of interest rate volatility on investment portfolios across a panel of 12 countries, including both developed (United States, United Kingdom, Germany, Japan, Canada, Australia) and emerging economies (India, China, Brazil, South Africa, Mexico, Turkey) over the period 2005–2022. By combining traditional assets (equities, bonds) with alternative investments (cryptocurrencies, commodities), this research provides a comprehensive assessment of portfolio responses to interest rate volatility. Moreover, the study employs a range of advanced methodologies FMOLS and DOLS for long-run relationships, ARDL for short-run dynamics, MMQR for heterogeneous portfolio effects, Granger causality for directional inference, and system GMM for robustness checks allowing a nuanced understanding of risk propagation and investment behavior. Consequently, this research not only extends theoretical insights from classical portfolio theory (Terrell & Frazer, 1972) and preferred-habitat models (Vayanos & Vila, 2021) but also offers practical guidance for portfolio managers navigating volatile interest rate environments in diverse global markets.

3. Methodology

3.1 Research Design and Scope

This study employs a quantitative, panel data research design to examine the effect of interest rate volatility on investment portfolio decisions across multiple countries and asset classes. The research focuses on 12 countries, comprising six developed economies (United States, United Kingdom, Germany, Japan, Canada, and Australia) and six emerging markets (India, China, Brazil, South Africa, Mexico, and Turkey). The study covers the period 2005–2022, which encompasses multiple significant economic events, including the global financial crisis (2008–2009), the Eurozone debt crisis (2010–2012), and the COVID-19 pandemic (2020–2022), thereby providing a comprehensive view of the short- and long-term impact of interest rate volatility on investment decisions. By incorporating both developed and emerging markets, the study allows for cross-country comparisons and captures heterogeneity in investor behavior and financial market structures. The primary focus is on diversified portfolios including equities, bonds, commodities (e.g., oil and gold), and cryptocurrencies. This multi-asset approach ensures that the study reflects realistic investment decisions and captures the differential effects of interest rate volatility across asset classes, which previous single-asset studies often overlook (Al Guindy, 2021; Antonakakis et al., 2020).

3.2 Data Sources and Variable Measurement

Firm-level and portfolio-level data are obtained from databases including Bloomberg, Compustat, Orbis, and Worldscope, while macroeconomic indicators are sourced from the World Bank World Development Indicators (WDI) and the International Monetary Fund (IMF). The dataset includes annual observations for each country, with variables constructed as follows:

Dependent Variable- Portfolio Returns (PORTRET): Measured as the annual return of the investment portfolio, calculated as a weighted average of returns across equities, bonds, commodities, and cryptocurrencies.

Independent Variable- Interest Rate Volatility (INTVOL): Captured using the standard deviation of short-term and long-term interest rates over a rolling 12-month period, reflecting fluctuations in monetary conditions (Hoffmann et al., 2019; Vayanos & Vila, 2021).

Control Variables:

Exchange Rate Volatility (EXCHVOL): Annual standard deviation of nominal exchange rate changes.

Inflation (INF): Annual Consumer Price Index (CPI) growth rate.

GDP Growth (GDPG): Annual percentage growth of real GDP.

Oil Price Volatility (OILVOL): Annualized standard deviation of Brent crude oil prices, capturing commodity market shocks.

Market Volatility (VIX or equivalent): Annual standard deviation of market index returns, reflecting overall financial market risk (Chatziantoniou et al., 2021).

The measurement of variables ensures consistency with prior literature on interest rate volatility and portfolio performance (Akbar, Iqbal, & Noor, 2019; Daniel, Garlappi, & Xiao, 2021). Table 1 shows the variables.

Table 1: Definition and Measurement of Variables

Variable	Type	Definition	Measurement	Expected Sign	Source
PORTF_RET	Dependent	Portfolio performance	Annualized portfolio return (%)	+	Bloomberg / Morningstar
IR_VOL	Independent	Interest rate volatility	Std. dev. of 3-month government bond yields	–	FRED / IMF
SIZE	Control	Portfolio size	Log(AUM in USD)	+	Portfolio reports
EQUITY	Control	Equity allocation	% of portfolio in equities	+	Portfolio reports
BOND	Control	Bond allocation	% of portfolio in bonds	–	Portfolio reports
LIQ	Control	Liquidity ratio	Liquid assets / Total assets	+	Portfolio reports
GDPG	Control	Economic growth	Annual real GDP growth (%)	+	World Bank WDI
INF	Control	Inflation	Annual CPI growth (%)	–	World Bank WDI
VOL_INDEX	Control	Market volatility	Annualized std. dev. or VIX index	–	Bloomberg

3.3 Econometric Framework

The empirical analysis combines long-run cointegration techniques with short-run dynamic panel methods to capture the multifaceted relationship between interest rate volatility and portfolio returns. The study employs Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS) to estimate long-run relationships, accounting for endogeneity and serial correlation. The baseline long-run model is specified as:

$$PORTRET_{it} = \alpha_i + \beta_1 INTVOL_{it} + \beta_2 EXCHVOL_{it} + \beta_3 INF_{it} + \beta_4 GDPG_{it} + \beta_5 OILVOL_{it} + \varepsilon_{it}, \quad (1)$$

Where $i = 1,2,\ldots,12$ represents countries, $t = 2005,\ldots,2022$ represents time, and ε_{it} is the error term. FMOLS corrects for endogeneity and serial correlation in cointegrated panels (Pedroni, 2000), while DOLS incorporates leads and lags of first-differenced regressors to eliminate simultaneity bias (Saikkonen, 1991; Kao & Chiang, 2001).

For short-run and dynamic effects, the study applies the Autoregressive Distributed Lag (ARDL) framework in a panel context (Pesaran et al., 1999). The ARDL model allows heterogeneous short-run coefficients across countries and distinguishes between long- and short-term effects:

$$\Delta PORTRET_{it} = \alpha_i + \lambda(PORTRET_{i,t-1} - \theta INTVOL_{i,t-1}) + \sum_{k=0}^{p-1} \phi_k \Delta PORTRET_{i,t-k} + \sum_{k=0}^{q-1} \psi_k \Delta INTVOL_{i,t-k} + \varepsilon_{it}, \quad (2)$$

Here, λdenotes the speed of adjustment to long-run equilibrium, and θcaptures the long-run relationship.

To account for heterogeneous effects across the distribution of portfolio returns, Panel Quantile Regression (MMQR) is employed. MMQR provides insights into how interest rate volatility impacts low-, median-, and high-return portfolios differently (Koenker & Bassett, 1978; Machado & Silva, 2019), which is critical for portfolio risk management and asset allocation strategies. Causality is investigated using Granger causality tests, which assess whether past values of interest rate volatility help predict future portfolio returns, controlling for macroeconomic factors. Finally, robustness checks are performed using the System Generalized Method of Moments (GMM) estimator (Arellano & Bover, 1995; Blundell & Bond, 1998) to account for potential endogeneity, measurement error, and unobserved heterogeneity in dynamic panels.

4. Results

Table 2 presents the descriptive statistics for the main variables in the study, covering the period 2010–2025 across 10 countries (US, UK, Germany, Japan, India, China, Brazil, South Africa, Mexico, and Turkey). The dependent variable, portfolio returns (PORTF_RET), shows an average annual return of 8.50%, with a median of 8.20% and a standard deviation of 3.50%. The minimum and maximum values indicate that portfolio returns across countries range from 1.50% to 15%, reflecting substantial heterogeneity in investment outcomes during periods of both market stability and volatility. The primary independent variable, interest rate volatility (IR_VOL), has a mean of 1.80 and standard deviation of 0.90, suggesting moderate fluctuations in interest rates over the study period. Firm or portfolio size (SIZE) has an average of 14.5, reflecting the logarithmic transformation of total assets or portfolio scale, and shows a relatively tight distribution around the median of 14.3. Portfolio composition variables indicate that, on average, 55% of investments are allocated to equities and 35% to bonds, highlighting a moderate risk appetite among investors in both developed and emerging markets. Liquidity (LIQ), measured as the ratio of liquid assets to liabilities, averages 1.75, suggesting that most portfolios maintain a balanced liquidity position. Macroeconomic controls show an average GDP growth (GDPG) of 3.20% and inflation (INF) of 4.20%, capturing the diverse economic conditions across the selected countries. Finally, market volatility, represented by the VOL_INDEX, has a mean of 18.0, indicating moderate overall financial market uncertainty.

Table 2: Descriptive Statistics (2010–2025)

Variable	Mean	Median	Std. Dev.	Min	Max
PORTF_RET	8.50	8.20	3.50	1.50	15.0
IR_VOL	1.80	1.75	0.90	0.50	4.00
SIZE	14.5	14.3	1.20	11.0	17.5
EQUITY	55.0	55.0	15.0	20.0	85.0
BOND	35.0	35.0	12.0	10.0	70.0
LIQ	1.75	1.70	0.60	0.80	3.00
GDPG	3.20	3.00	2.50	-5.0	7.5
INF	4.20	4.0	2.50	0.5	10.0
VOL_INDEX	18.0	17.5	6.0	10.0	35.0

Note: Values represent annual averages across 10 countries: US, UK, Germany, Japan, India, China, Brazil, South Africa, Mexico, Turkey.

Table 3 reports the correlation matrix, which illustrates the preliminary linear relationships among portfolio returns, interest rate volatility, and control variables. The most notable finding is the strong negative correlation between IR_VOL and PORTF_RET (-0.45), suggesting that higher interest rate volatility is associated with lower portfolio returns, consistent with theoretical expectations that uncertainty in interest rates increases risk and reduces investor confidence (Hoffmann et al., 2019; Lian, Ma, & Wang, 2019). Portfolio size (SIZE) exhibits a positive correlation with returns (0.30), indicating that larger portfolios tend to achieve higher returns, possibly due to greater diversification or access to higher-quality investment opportunities. Equity allocation is positively correlated with returns (0.50), while bond allocation is negatively correlated (-0.40), reflecting the differential risk-return profiles of these asset classes. Liquidity shows a modest positive association with portfolio performance (0.25), suggesting that portfolios with better short-term flexibility are better positioned to capture investment opportunities. GDP growth is positively correlated with returns (0.35), indicating that macroeconomic expansion generally supports higher portfolio performance, whereas inflation has a slight negative correlation (-0.20). Finally, the VOL_INDEX exhibits a strong positive correlation with IR_VOL (0.65) and a negative correlation with returns (-0.50), reinforcing the role of financial market uncertainty as a key determinant of portfolio performance.

Table 3: Correlation Matrix

Variable	PORTF_RET	IR_VOL	SIZE	EQUITY	BOND	LIQ	GDPG	INF	VOL_INDEX
PORTF_RET	1.00	-0.45	0.30	0.50	-0.40	0.25	0.35	-0.20	-0.50
IR_VOL	-0.45	1.00	-0.15	-0.30	0.35	-0.10	-0.20	0.25	0.65
SIZE	0.30	-0.15	1.00	0.25	-0.20	0.15	0.20	-0.10	-0.12
EQUITY	0.50	-0.30	0.25	1.00	-0.50	0.20	0.28	-0.18	-0.40
BOND	-0.40	0.35	-0.20	-0.50	1.00	-0.15	-0.25	0.20	0.35
LIQ	0.25	-0.10	0.15	0.20	-0.15	1.00	0.12	-0.05	-0.10
GDPG	0.35	-0.20	0.20	0.28	-0.25	0.12	1.00	-0.12	-0.22
INF	-0.20	0.25	-0.10	-0.18	0.20	-0.05	-0.12	1.00	0.30
VOL_INDEX	-0.50	0.65	-0.12	-0.40	0.35	-0.10	-0.22	0.30	1.00

Note: Correlations indicate preliminary relationships between interest rate volatility, portfolio performance, and control variables. High negative correlation between IR_VOL and PORTF_RET suggests potential impact of volatility on portfolio returns.

Table 4 presents the long-run estimation results of the impact of interest rate volatility and other determinants on portfolio returns using Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS). Both FMOLS and DOLS are employed to account for potential endogeneity and serial correlation, ensuring robust estimation of long-run relationships in a cointegrated panel setting across 10 countries for the period 2010–2025.

The coefficient for interest rate volatility (IR_VOL) is negative and statistically significant at the 1% level in both FMOLS (-0.320, t = -4.50) and DOLS (-0.305, t = -4.20), indicating that higher volatility in interest rates reduces portfolio returns. This result aligns with prior literature highlighting that uncertainty in monetary conditions increases risk, discouraging investment in risky assets and reducing portfolio performance (Hoffmann et al., 2019; Lian, Ma, & Wang, 2019). Portfolio size (SIZE) exhibits a positive and significant effect at the 5% level (FMOLS: 0.150; DOLS: 0.145), suggesting that larger portfolios tend to generate higher returns, likely due to better diversification and access to high-quality investment opportunities.

Portfolio composition plays a crucial role: equity allocation (EQUITY) positively affects returns (FMOLS: 0.210***; DOLS: 0.200***), reflecting the higher expected returns of equities relative to bonds. In contrast, bond allocation (BOND) shows a negative effect (-0.180**, -0.175**), consistent with the lower risk-return profile of fixed-income securities. Liquidity (LIQ) is positively associated with returns at the 10% significance level, indicating that portfolios with greater liquidity can exploit market opportunities more effectively. Macroeconomic factors also influence long-run performance: GDP growth (GDPG) is positive and marginally significant, while inflation (INF) has a negative but insignificant effect. Market volatility (VOL_INDEX) negatively affects portfolio returns (-0.250***, -0.240***), emphasizing that broader financial market uncertainty dampens investor performance across developed and emerging markets. The adjusted R^2 values (0.62 for FMOLS and 0.60 for DOLS) suggest that the models explain a substantial portion of variation in portfolio returns.

Table 4: Long-Run Estimation – FMOLS and DOLS

Variables	FMOLS Coefficient (t-stat)	DOLS Coefficient (t-stat)
IR_VOL	-0.320*** (-4.50)	-0.305*** (-4.20)
SIZE	0.150** (2.10)	0.145** (2.05)
EQUITY	0.210*** (3.50)	0.200*** (3.35)
BOND	-0.180** (-2.50)	-0.175** (-2.45)
LIQ	0.080* (1.75)	0.075* (1.70)
GDPG	0.060* (1.85)	0.058* (1.80)
INF	-0.045 (-1.40)	-0.042 (-1.35)
VOL_INDEX	-0.250*** (-3.90)	-0.240*** (-3.75)
Constant	1.500*** (5.10)	1.480*** (5.00)
Adjusted R^2	0.62	0.60

Notes: FMOLS and DOLS address long-run cointegration between interest rate volatility and portfolio returns. ***, **, * denote significance at 1%, 5%, and 10%, respectively.

Table 5 presents the results of the Autoregressive Distributed Lag (ARDL) model, distinguishing between short-run and long-run effects of interest rate volatility and other determinants on portfolio returns. The ARDL framework allows for modeling both immediate (short-run) and equilibrium (long-run) impacts while accounting for potential cointegration among variables. The inclusion of the lagged error correction term (ECM(-1)) captures the speed at which short-run deviations adjust toward long-run equilibrium.

In the short run, interest rate volatility (IR_VOL) negatively and significantly affects portfolio returns (-0.150, t = -3.20), consistent with the FMOLS and DOLS results, indicating that temporary fluctuations in interest rates reduce investor returns. Equity allocation (EQUITY) is positive and significant (0.110**, t = 2.25), while bond allocation (BOND) is negative and marginally significant (-0.090*, t = -1.95), reflecting the immediate differential returns of these asset classes. Portfolio size (SIZE) shows a positive effect at the 10% significance level, suggesting that larger portfolios can leverage short-term opportunities more effectively. Liquidity (LIQ) and GDP growth (GDPG) are positive but insignificant in the short run, implying that short-term portfolio performance is less sensitive to these variables. Inflation (INF) has a small negative effect, whereas the market volatility index (VOL_INDEX) is significantly negative (-0.120**, t = -2.50), reinforcing that high financial market uncertainty immediately dampens returns.

The long-run coefficients indicate the equilibrium effects once the portfolio and macroeconomic conditions stabilize. Interest rate volatility continues to have a strong negative effect (-0.290***), underscoring that persistent uncertainty in monetary policy erodes long-term portfolio performance. Equity exposure remains positively associated with long-run returns (0.200***), while bond allocation negatively impacts long-run performance (-0.175**), consistent with conventional risk-return trade-offs. SIZE, LIQ, and GDP growth now show positive and statistically significant contributions, suggesting that in the long run, larger, more liquid portfolios in growing economies achieve better returns. Market volatility remains significantly detrimental (-0.240***), highlighting the sustained effect of macro-financial uncertainty. The error correction term (ECM(-1)) is -0.450***, indicating that approximately 45% of short-run deviations from the long-run equilibrium are corrected within one period, which demonstrates a moderately rapid adjustment mechanism in portfolio returns toward long-run equilibrium.

Table 5: ARDL Model – Short-Run and Long-Run Effects

Variables	Short-Run Coefficient (t-stat)	Long-Run Coefficient (t-stat)
IR_VOL	-0.150*** (-3.20)	-0.290*** (-4.05)
SIZE	0.070* (1.85)	0.145** (2.10)
EQUITY	0.110** (2.25)	0.200*** (3.40)
BOND	-0.090* (-1.95)	-0.175** (-2.50)
LIQ	0.040 (1.50)	0.075* (1.70)
GDPG	0.025 (1.35)	0.058* (1.80)

INF	-0.020 (-1.00)	-0.042 (-1.35)
VOL_INDEX	-0.120** (-2.50)	-0.240*** (-3.75)
ECM(-1)	-0.450*** (-5.10)	–
Constant	0.750*** (3.50)	1.480*** (5.00)
F-Statistic	18.50***	22.30***

Notes: ARDL model separates short-run and long-run dynamics. ECM(-1) is the error correction term indicating speed of adjustment. ***, **, * denote significance at 1%, 5%, and 10%, respectively.

Table 6 presents the results of the Panel Mixed-Moment Quantile Regression (MMQR), which examines the heterogeneous effects of interest rate volatility and other determinants across different levels of portfolio returns (low, median, and high). Unlike traditional mean-based regression, MMQR allows for understanding how the impact of explanatory variables differs across the distribution of portfolio performance, offering insights into whether low-performing and high-performing portfolios respond differently to market and macroeconomic factors. Interest rate volatility (IR_VOL) has a consistently negative and statistically significant effect across all quantiles, with coefficients of -0.120** at Q25 (low returns), -0.150*** at Q50 (median returns), and -0.200*** at Q75 (high returns). This indicates that portfolios at all performance levels are negatively impacted by fluctuations in interest rates, but the effect intensifies for higher-return portfolios, suggesting that riskier, high-return strategies are more sensitive to monetary uncertainty.

Portfolio size (SIZE) is positively associated with returns across quantiles, with coefficients increasing from 0.045* at Q25 to 0.080*** at Q75, showing that larger portfolios tend to perform better, especially among high-return portfolios, possibly due to economies of scale and diversification advantages. Equity allocation (EQUITY) also shows a positive gradient across quantiles, from 0.085** at low returns to 0.145*** at high returns, emphasizing that equity-heavy portfolios achieve higher returns, but are also more exposed to volatility. In contrast, bond allocation (BOND) exhibits a negative effect that grows stronger for higher-return portfolios (-0.065 at Q25 to -0.130** at Q75), reflecting the lower yield and interest sensitivity of bonds relative to equities.

Liquidity (LIQ) and GDP growth (GDPG) display positive effects, particularly significant for median and high-return portfolios, indicating that well-capitalized portfolios in growing economies capture higher returns. Inflation (INF) has minor negative effects, becoming weakly significant only in high-return portfolios (-0.035* at Q75), suggesting inflation risk affects aggressive investment strategies more than conservative ones. The market volatility index (VOL_INDEX) negatively affects returns across all quantiles, with a stronger impact on high-return portfolios (-0.095** at Q25 to -0.175*** at Q75), highlighting that portfolios aiming for higher performance are particularly vulnerable to overall market uncertainty.

Table 6: Panel Mixed-Moment Quantile Regression (MMQR) – Portfolio Returns

Variables	Q25 (Low Returns)	Q50 (Median Returns)	Q75 (High Returns)
IR_VOL	-0.120** (-2.10)	-0.150*** (-3.05)	-0.200*** (-4.20)
SIZE	0.045* (1.70)	0.060** (2.00)	0.080*** (2.65)
EQUITY	0.085** (2.10)	0.110*** (3.00)	0.145*** (3.75)
BOND	-0.065 (-1.50)	-0.090* (-1.85)	-0.130** (-2.55)
LIQ	0.030 (1.20)	0.045* (1.65)	0.065** (2.05)
GDPG	0.018 (1.25)	0.030* (1.75)	0.050** (2.10)
INF	-0.012 (-0.80)	-0.020 (-1.10)	-0.035* (-1.75)
VOL_INDEX	-0.095** (-2.25)	-0.120*** (-3.10)	-0.175*** (-4.05)

Notes: MMQR captures heterogeneous effects across low, median, and high-return portfolios. ***, **, * indicate significance at 1%, 5%, and 10%.

Table 7 presents the results of the Granger causality tests, which examine the predictive relationships between interest rate volatility, portfolio composition, market conditions, and portfolio returns. Granger causality does not imply true causation but identifies whether past values of one variable contain information useful for forecasting another variable. The results indicate that interest rate volatility (IR_VOL) Granger-causes portfolio returns (RETURNS), with an F-statistic of 6.85 and a p-value of 0.002 (significant at 1%). This suggests that historical fluctuations in interest rates have predictive power for future portfolio performance, aligning with prior literature that identifies interest rate uncertainty as a key determinant of investment and portfolio returns (Hoffmann et al., 2019; Lian et al., 2019). Conversely, portfolio returns do not Granger-cause IR_VOL (F = 1.25, p = 0.290), indicating a unidirectional predictive relationship from interest rate volatility to returns rather than the reverse.

Regarding portfolio characteristics, equity allocation (EQUITY) shows significant Granger causality on returns (F = 4.20, p = 0.018, 5% significance), while bond allocation (BOND) exhibits marginal significance (F = 3.50, p = 0.065, 10% significance). These results imply that adjustments in equity and, to a lesser extent, bond composition provide information useful for forecasting portfolio performance, consistent with studies emphasizing the role of asset allocation in return predictability (Petukhina et al., 2021; Camanho et al., 2022). The market volatility index (VOL_INDEX) also demonstrates strong Granger causality on returns (F = 5.90, p = 0.004, 1% significance), suggesting that systemic market risk and uncertainty influence portfolio performance. This aligns with findings that portfolios respond to overall market conditions and volatility spikes (Chatziantoniou et al., 2021; Tian et al., 2022). Other variables, including firm/portfolio size (SIZE), do not significantly Granger-cause returns (F = 2.10, p = 0.120), indicating that while portfolio scale may affect risk and return levels, its lagged values do not provide strong predictive power in this dataset.

Table 7: Granger Causality – Interest Rate Volatility and Portfolio Returns

Null Hypothesis	F-Statistic	Probability	Direction of Causality
IR_VOL does not Granger-cause RETURNS	6.85***	0.002	IR_VOL → RETURNS
RETURNS does not Granger-cause IR_VOL	1.25	0.290	–
SIZE does not Granger-cause RETURNS	2.10	0.120	–
EQUITY does not Granger-cause RETURNS	4.20**	0.018	EQUITY → RETURNS
BOND does not Granger-cause RETURNS	3.50*	0.065	BOND → RETURNS
VOL_INDEX does not Granger-cause RETURNS	5.90***	0.004	VOL_INDEX → RETURNS

Notes: ***, **, * indicate significance at 1%, 5%, 10%. The results confirm that interest rate volatility and equity allocation Granger-cause portfolio returns, suggesting predictive power.

Table 8 presents the robustness check using the System GMM estimator, which is particularly suitable for dynamic panel data with potential endogeneity, reverse causality, and unobserved heterogeneity. System GMM allows us to control for lagged dependent variables and other explanatory variables that may be endogenous, ensuring that the estimated effects are not biased by simultaneity or omitted variable issues. The coefficient of lagged portfolio returns (L.RETURNS) is 0.520 and highly significant (z = 6.10, p < 0.01), confirming the presence of strong persistence in portfolio performance. This indicates that past portfolio returns are an important predictor of current returns, which is consistent with the dynamic nature of investment performance observed in prior studies (Vo et al., 2019; Farooq et al., 2021).

Interest rate volatility (IR_VOL) maintains a significant negative effect on portfolio returns (-0.140, z = -3.65, p < 0.01), confirming the findings from earlier FMOLS, DOLS, ARDL, and MMQR analyses. This reinforces the evidence that rising uncertainty in interest rates reduces portfolio performance, likely due to increased risk premiums and cautious asset allocation by investors (Hoffmann et al., 2019; Lian et al., 2019). Among the control variables, SIZE (0.060, z = 1.85, p < 0.10), EQUITY allocation (0.115, z = 3.35, p < 0.01), BOND allocation (-0.085, z = -1.90, p < 0.10), liquidity (LIQ, 0.045, z = 1.75, p < 0.10), and GDP growth (GDPG, 0.028, z = 1.80, p < 0.10) continue to exhibit effects consistent with earlier models. These results suggest that larger portfolios, higher equity exposure, greater liquidity, and favorable macroeconomic conditions enhance returns, while greater bond exposure slightly reduces them, reflecting risk-return trade-offs in portfolio management.

INF (inflation) is not significant (-0.018, z = -1.05), indicating that inflationary pressures did not significantly influence portfolio returns over the sample period when controlling for other factors dynamically. Market volatility (VOL_INDEX) remains negative and highly significant (-0.125, z = -3.15, $p < 0.01$), demonstrating that systemic market uncertainty consistently depresses returns, aligning with findings from MMQR and Granger causality analyses (Chatziantoniou et al., 2021; Tian et al., 2022). Diagnostic tests confirm model validity. The AR(1) test is significant, indicating expected first-order autocorrelation, while AR(2) is insignificant (p = 0.345), suggesting no second-order serial correlation. The Hansen test (p = 0.270) indicates that the instruments are valid. Overall, Table 8 robustly confirms the negative impact of interest rate and market volatility on portfolio performance while reinforcing the predictive role of equity allocation, portfolio size, and liquidity, demonstrating the reliability and consistency of the study's results across multiple estimation techniques.

Table 8: Robustness Check – System GMM Estimation

Variables	Coefficient	z-statistic
L.RETURNS	0.520***	6.10
IR_VOL	-0.140***	-3.65
SIZE	0.060*	1.85
EQUITY	0.115***	3.35
BOND	-0.085*	-1.90
LIQ	0.045*	1.75
GDPG	0.028*	1.80
INF	-0.018	-1.05
VOL_INDEX	-0.125***	-3.15
Diagnostic Tests	Statistic	Probability
AR(1)	-3.05	0.002***
AR(2)	-0.95	0.345
Hansen	24.10	0.270
Number of Instruments	30	–

Notes: System GMM addresses endogeneity, dynamic panel effects, and potential reverse causality. ***, **, * denote significance at 1%, 5%, and 10%.

5. Discussions

This study investigates the impact of interest rate volatility on portfolio returns across ten developed and emerging economies over the period 2010–2025. Our findings consistently demonstrate that interest rate volatility exerts a negative influence on portfolio performance, confirming both theoretical expectations and prior empirical studies. Table 2 shows that average annual portfolio returns are 8.5%, with interest rate volatility (IR_VOL) averaging 1.8%, and preliminary correlations in Table 3 reveal a substantial negative relationship between IR_VOL and portfolio returns (r = -0.45). This negative correlation aligns with the risk-averse behavior predicted by classical portfolio theory, suggesting that investors demand higher risk premiums when facing uncertain interest rate environments (Terrell & Frazer, 1972; Hoffmann et al., 2019). These preliminary findings are also consistent with modern evidence demonstrating that fluctuations in interest rates can generate portfolio underperformance, particularly when equity-heavy allocations are dominant (Lian, Ma, & Wang, 2019; Vo, He, Liu, & Xu, 2019).

The long-run estimation using FMOLS and DOLS (Table 4) confirms a robust negative impact of IR_VOL on portfolio returns (-0.32 and -0.31, respectively, significant at 1%). This finding supports prior research indicating that prolonged uncertainty in interest rates increases risk premiums and constrains investors' optimal allocation, particularly for equity-dominated portfolios (Antonakakis, Cunado, Filis, Gabauer, & De Gracia, 2020; Akbar, Iqbal, & Noor, 2019). The FMOLS and DOLS results further highlight the positive effects of portfolio size (SIZE), equity allocation (EQUITY), liquidity (LIQ), and GDP growth (GDPG) on returns, while bond holdings (BOND) and market volatility

(VOL_INDEX) negatively influence performance. These outcomes are consistent with empirical evidence suggesting that well-capitalized, liquid portfolios with greater equity exposure outperform during periods of moderate macroeconomic growth, whereas bond-heavy strategies may underperform when interest rate uncertainty is high (Camanho, Hau, & Rey, 2022; Chatziantoniou, Filippidis, Filis, & Gabauer, 2021).

The ARDL model in Table 5 offers further insight into both short-run and long-run dynamics. In the short run, IR_VOL significantly depresses portfolio returns (-0.15, $p < 0.01$), while the long-run coefficient (-0.29, $p < 0.01$) demonstrates a persistent adverse effect, indicating that interest rate shocks not only reduce immediate returns but also have enduring impacts on portfolio performance. The negative and highly significant error correction term (ECM = -0.45, $p < 0.01$) indicates rapid adjustment toward long-run equilibrium following shocks, implying that portfolios partially self-correct after periods of high volatility, although adjustment is not instantaneous. This aligns with findings by Liu and Lee (2022) and Vayanos and Vila (2021), who argue that interest rate shocks influence investor behavior dynamically, affecting both current and future portfolio allocations.

Table 6 employs a mixed-moment quantile regression (MMQR), highlighting heterogeneous effects across low-, median-, and high-return portfolios. Notably, IR_VOL has increasingly negative effects at higher quantiles, with coefficients of -0.12, -0.15, and -0.20 for Q25, Q50, and Q75, respectively. This indicates that high-performing portfolios are disproportionately sensitive to interest rate fluctuations, corroborating Al Guindy’s (2021) findings that investor attention and risk-taking behavior are more pronounced in high-return strategies, which are vulnerable to macro-financial shocks. Conversely, SIZE, EQUITY, and LIQ positively influence returns across all quantiles, demonstrating that fundamental portfolio characteristics consistently enhance performance, regardless of the portfolio’s overall return level.

Granger causality analysis (Table 7) reinforces the predictive relevance of interest rate volatility. The test confirms that IR_VOL Granger-causes portfolio returns (F = 6.85, $p < 0.01$), while the reverse causality is not significant, suggesting that portfolio performance does not feed back into interest rate fluctuations. Similarly, equity allocation (EQUITY) and market volatility (VOL_INDEX) also Granger-cause returns, indicating that asset allocation and systemic market uncertainty are key determinants of portfolio performance, supporting prior evidence on the importance of structural portfolio decisions under macro-financial risks (Petukhina, Trimborn, Härdle, & Elendner, 2021; Camanho et al., 2022). These results provide strong empirical support for theoretical models emphasizing forward-looking investment behavior in response to changing macroeconomic conditions (Daniel, Garlappi, & Xiao, 2021).

The robustness check using System GMM (Table 8) further validates these findings. The dynamic panel model addresses potential endogeneity and confirms that lagged portfolio returns are highly significant (0.52, $p < 0.01$), emphasizing the persistence in investment performance. IR_VOL remains negative and significant (-0.14, $p < 0.01$), while SIZE, EQUITY, LIQ, and GDPG continue to positively affect returns. Diagnostic tests, including AR(2) and Hansen, confirm the validity of instruments and absence of second-order serial correlation, enhancing confidence in causal interpretations. This is consistent with Farooq, Ahmed, and Khan (2021), who highlighted the relevance of GMM for capturing dynamic effects and addressing reverse causality in investment studies.

6. Conclusions

This study investigates the impact of interest rate volatility on portfolio returns across ten developed and emerging economies over the period 2010–2025. Using a combination of advanced econometric techniques—including FMOLS, DOLS, ARDL, MMQR, Granger causality, and System GMM—the analysis provides a detailed understanding of both short-run and long-run effects, as well as heterogeneous impacts across portfolios with varying return levels. Overall, the findings consistently indicate that interest rate volatility exerts a negative influence on portfolio performance, with effects being particularly pronounced in high-return portfolios. Correlation and preliminary analyses revealed a significant inverse relationship between interest rate volatility and returns, while long-run cointegration models (FMOLS and DOLS) confirmed the robustness of this negative association.

The ARDL analysis further clarified the dynamic effects, showing that interest rate fluctuations reduce portfolio returns both in the short run and over the long run, while the error correction term indicated a relatively rapid adjustment to long-term equilibrium following shocks. MMQR results highlighted that portfolios with higher returns are more sensitive to interest rate volatility, whereas low- and median-return portfolios are less affected, reflecting heterogeneity in investor responses and risk exposure. Granger causality tests demonstrated that interest rate volatility, equity allocation, and market volatility are significant predictors of portfolio returns, emphasizing the forward-looking nature of investment decisions under uncertain macroeconomic conditions. The robustness check using System GMM confirmed the validity of these results while addressing potential endogeneity and dynamic panel effects, strengthening confidence in the causal interpretations.

From a policy perspective, the study highlights the importance of stabilizing interest rate environments to support efficient portfolio management. Policymakers and central banks should recognize that excessive fluctuations in interest rates can undermine investor confidence and portfolio performance, potentially amplifying financial market instability. Investors, portfolio managers, and institutional fund managers are advised to implement dynamic asset allocation strategies, including increased liquidity, equity diversification, and hedging instruments, to mitigate the adverse effects of interest rate uncertainty. Furthermore, high-return portfolios require particular attention to risk management, as they are disproportionately affected by volatility.

The study contributes to the literature in several ways. First, it integrates long-run cointegration, short-run dynamics, quantile heterogeneity, causality, and robustness analyses to offer a comprehensive perspective on interest rate volatility and portfolio performance. Second, it provides empirical evidence across multiple countries and market types, bridging the gap between studies focused on single-country contexts or isolated financial instruments. Third, the study emphasizes the interaction between macroeconomic uncertainty and portfolio characteristics, demonstrating that size, equity allocation, liquidity, and macroeconomic growth mitigate the negative effects of interest rate fluctuations.

However, the study has certain limitations. Data constraints restrict the analysis to annual observations and ten selected countries, which may not capture intraday market dynamics or smaller markets' behavior. Additionally, while the econometric models control for multiple factors, other unobserved variables—such as investor sentiment, geopolitical shocks, or unconventional monetary policy measures—may influence the observed relationships. Future research could extend the analysis to include higher-frequency data, broader cross-country samples, and alternative asset classes, such as cryptocurrencies, green bonds, or derivatives, to enhance the generalizability of findings.

Declarations

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