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Volatility of Islamic stock market and exchange rate: Granger causality and GARCH Approach

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Abstract
This research aims to investigate the causal relationship between the Islamic stock market and the exchange rate, as well as examine the volatility of the Islamic stock index in emerging countries. The study utilized the Granger causality test to analyze the causality between the Islamic stock market and the exchange rate and employed the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model for volatility analysis and forecasting. For this research, daily time series data ranging from 2012 to 2022 from the Islamic stock indices of Malaysia, Turkey, India, Pakistan, Indonesia, and Kuwait were selected as the sample. It was observed that the stock index had an impact on the exchange rate in Malaysia, Pakistan, India, and Turkey. Conversely, the exchange rate influenced the stock index in Indonesia, Kuwait, and Turkey.

Keywords: Islamic stock; volatility; GARCH; forecasting

Introduction

In today's global economy, Islamic financing plays a crucial role in the economies of Muslim-majority countries (Aldeen, 2021; Ibrahim & Alam, 2018), offering an improved alternative mediation model over time. The Islamic finance industry has witnessed substantial growth, with an estimated annual value of $2 trillion and an expanding share in the global financial system (Paltrinieri et al., 2018). Among the key components of the Islamic financial system is the Islamic stock market index, established to foster an interest-free and profit-sharing regime (Miah & Uddin, 2017; Salman & Nawaz, 2018). These advancements in Islamic finance present new investment opportunities, particularly in developing countries.

The screening of Islamic stock indices follows specific rules of Islamic finance, such as limitations on the debt-to-equity ratio (maximum of 33 percent) and prohibitions on investments in certain industries (Alam et al., 2017; Azhar & Wulandari, 2021). Adhering to these rules and utilizing financial instruments compliant with Islamic principles enhances the resilience of the Islamic financial system, especially during economic downturns. Studies, such as conducted by Kenourgios et al. (2016), have shown that Islamic stock market indices performed well during the global financial crisis. Hkiri et al. (2017) explored the relationship between traditional and Islamic stock markets, finding that Islamic stock indices were considered a safer option during the crisis compared to traditional stock markets. However, both systems are susceptible to economic downturns, and the volatility of spillovers between them is comparable. These studies underscore the potential benefits of investing in Islamic stock indices during uncertain economic times, offering important insights for investors, policymakers, and the development of more robust financial systems.

Both conventional and Islamic stock markets are exposed to global financial conditions, including exchange rate fluctuations, due to the interconnectedness of global financial markets. Economic events and shocks in one part of the world can have ripple effects on various needs, including stocks. Exchange rates

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play a crucial role in international trade and investment flows, and fluctuations can impact trade competitiveness, attract foreign investment, and overall economic performance. Many companies listed on conventional and Islamic stock markets operate globally, engaging in international trade and investment, and are exposed to foreign currency risks. Changes in exchange rates can influence the cost of imported raw materials, export earnings, the profitability of companies with international operations, and the purchasing power of consumers, subsequently affecting a company's financial performance and share price.

Numerous studies have extensively explored the relationship between the conventional stock market and the exchange rate (Erdogan et al., 2019; Kumar & Sahu, 2018; Mohsina & Islam, 2017; Sikhosana & Aye, 2018). However, existing research on the relationship between exchange rates and the Islamic stock market has predominantly focused on examining the impact of exchange rate fluctuations on stock price volatility. Notably, limited attention has been given to investigating the two-way causal relationship between the exchange rate and the Islamic stock market, which may exhibit distinct characteristics, particularly from a risk management perspective. Consequently, this study aims to examine the bidirectional association between the exchange rate and the Islamic stock market.

In addition to exploring the relationship between these two variables, this study also endeavors to forecast the volatility of the Islamic stock market. By assuming a relationship between capital market volatility and the exchange rate within a country, the prediction of Islamic stock price volatility can serve as an early warning system for both authorities and investors.

Literature Review

The relationship between stock indices and macroeconomic conditions has been extensively researched. Previous studies have examined various macroeconomic factors that interact with stock indexes. With the establishment of Islamic stock indices, there has been a growing body of literature exploring the connections between broad macroeconomic developments and the Islamic stock market. Numerous studies have investigated the relationship between Islamic indicators and various macroeconomic factors, including industrial production, inflation rate, money supply, Treasury bills, and interest rates.

The relationship between currency exchange rates and stock market performance can be described by existing models in the literature. One such model, proposed by Dornbusch & Fischer (1980), incorporates the trade balance. According to this model, fluctuations in currency exchange rates can influence stock prices by affecting the value of exports and imports. A depreciation of the national currency boosts export demand, leading to increased stock prices and returns. Conversely, an appreciation of the domestic currency raises the cost of imported inputs, reducing sales volume, earnings, and stock prices for importers. Another model, known as the portfolio balance model, suggests that stock price fluctuations impact currency rates (Frankel, 1983). The relationship between stock prices and exchange rates is of great importance to investors.

Given the interconnectedness of global financial markets, it is inevitable that a relationship exists between currency exchange rates and stock prices. The sequence of events linking the two variables is explicable. Decreases in stock prices erode domestic investors' wealth, reducing the demand for money and leading to lower interest rates. Lower interest rates, in turn, prompt capital outflows, resulting in higher exchange rates and currency devaluation. Market efficiency refers to the extent to which market prices accurately reflect all available information. If markets are efficient, it is impossible to "beat" the market or find undervalued or overpriced stocks since all relevant information is already factored into pricing.

Erdogan et al. (2019) analyzed the relationship between the participation index 30 and economic indicators, including the industrial output index, inflation rate, real money supply, and current account deficit, from 2011 to 2019. Their long-term analysis demonstrated a negative impact of the inflation rate on the Islamic stock market index. Sikhosana & Aye (2018) examined the transmission of asymmetric volatility between real exchange rates and stock returns using South African data from 1996 to 2016. Their findings revealed short-term volatility spillover effects between the variables, operating in both directions. Negative shocks in the exchange rate significantly influenced stock market volatility, while positive shocks in stock market volatility had a substantial impact on exchange rate volatility.

After analyzing data from fourteen nations spanning from 2000 to 2016, Luqman & Kouser (2018) found a significant divergence between stock prices and currency rates. Kumar & Sahu (2018) examined Indian data from 2006 to 2015 to investigate the relationship between various macroeconomic factors and stock performance. They identified multiple macroeconomic variables that showed a connection with India's Islamic stock index over time, revealing a unidirectional causation between the currency exchange rate and the Islamic stock index of the Indian stock market.

Mohsina & Islam (2017) analyzed Indian data from 2007 to 2016 to assess the impact of several macroeconomic variables on the Islamic stock index. They found that the exchange rate was the only variable with a statistically significant negative impact on the Islamic stock market. Türsoy (2017) examined stock prices and real exchange rates from 2001 to 2016, revealing that causation operates in both directions, although the short to medium-term effect of real exchange rates on stock prices appears to be unidirectional.

Majid (2016) investigated the relationship between Islamic stock prices and macroeconomic indicators using data from 1999 to 2013. The empirical data indicated a substantial relationship between the parameters. Sui & Sun (2016) analyzed data from different time periods to estimate the spillover effect between exchange rates and stock prices of BRICS countries. They discovered a significant impact of exchange rates on short-term stock market performance, particularly during the 2007-2009 financial crisis, where a high correlation between these variables was observed.

Bahmani-oskooee & Saha (2016) examined the impact of exchange rate changes on stock prices in various countries, including the United Kingdom, Canada, Chile, Indonesia, Japan, Korea, Malaysia, and Indonesia. The analysis period varied for each country based on data availability. They concluded that exchange rate fluctuations have a non-uniform impact on stock prices. Zeren & Koç (2016) analyzed the relationship between stock indexes and currency rates using data from the United Kingdom, Japan, and Turkey from 1990 to 2013. They demonstrated a bidirectional causal relationship between the variables, particularly during times of crisis.

Jebran & Iqbal (2016) conducted a study on the volatility spillover between stock indices and currency rates in Japan, Hong Kong, China, Sri Lanka, Pakistan, and India. They found that Pakistan exhibited a more pronounced fluctuating spillover impact compared to China, Hong Kong, or Sri Lanka. In India, the volatility of stock indexes had a significant effect on currency exchange rates. However, estimating the interdependence of factors with regard to volatility in Japan was deemed challenging. Rana & Akhter (2015) analyzed data from Pakistan to investigate the relationship between various economic variables, including interest rates, currency rates, Islamic stock indexes (KMI-30), and conventional stock indexes (KSE-100), from 2008 to 2013. Their findings indicated that both traditional and Islamic stock indices benefited from paying attention to fluctuations in exchange rates.

Chkili & Nguyen (2014) utilized data from the BRICS countries to study the relationship between currency exchange rates and stock market returns from 1997 to 2013. The results suggested that stock indexes had a significant impact on exchange rates. However, fluctuations in exchange rates did not affect the performance of stock indices. Tsagkanos & Siriopoulos (2013) examined data from the European Union and the United States and found a connection between stock prices and currency exchange rates. The study demonstrated long-term validity for the European Union, while short-term validity was observed for the United States.

Research Method

The study focuses on the stratified sampling method for several reasons. Firstly, these countries possess large and growing stock markets and offer Islamic stock indices. Secondly, they have significant and increasing Muslim populations, leading to a rising demand for Islamic investment products. Thirdly, these countries are considered representative of the Islamic stock market in Asia and the Middle East within the global economy. Lastly, these countries provide relatively more accessible and comprehensive data for analysis. By selecting these countries, the research aims to provide a representative overview of the performance and causal influence of Islamic stock indices and exchange rates in emerging markets.

The research period was chosen based on publicly available data, encompassing numerous daily observations from 2012 to 2022 for the following indices: Dow Jones Islamic Market Malaysia Index (DJIMD), Karachi Meezan 30 (KMI130), Indonesia Jakarta Composite Islamic Stock Index (JCISSI), Dow Jones Islamic Market India Index (DJIMIND), Dow Jones Islamic Market Turkey Index (DJIMTR), and Dow Jones Islamic Market Kuwait (DJIMKW). Exchange rate data relative to the US dollar was collected from investing.com, while daily stock returns were obtained from www.yahoofinance.com.

To address questions regarding the causal relationship between exchange rates and Islamic stock indexes, the study employs the Granger Causality test (Granger et al., 2000). Furthermore, the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model is utilized to assess stock indices and forecast the movement of each index. The GARCH model is suitable for analyzing volatile data characterized by heteroscedasticity. This research utilizes the GARCH model proposed by Bollerslev (1986) for analyzing returns on Islamic stock indices (S_{it}) where μ_{it} and μ_{jt} represent the averages, and ε_{it} represent the process of innovation in terms of returns on Islamic stock indexes.

$$S_{it} = \mu_{it} + \varepsilon_{it}$$
$$\varepsilon_{it} \backslash (\varepsilon_{it-1}, \varepsilon_{it-2}, \dots, s_{it-1}, S_{it-2}, \dots) \sim GED(0, \sigma_{it}^2) \quad (1)$$
$$\sigma_{it}^2 = \omega + \alpha_i \varepsilon_{it-1}^2 + \beta_i \sigma_{it-1}^2$$

Results and Discussion

The standard deviation values of Islamic stock indexes, as shown in Table 1 are higher than the averages, indicating that the data are heterogeneous. Lower standard deviation values would imply a closer association with the average, while higher values suggest wider data fluctuations or dispersion. The standard deviation can also explain the level of risk associated with each Islamic stock index. For instance, the India Islamic stock index (DJIMIND) has the highest standard deviation, indicating higher risk, but also directly proportional to the highest return value of 31.28%. In comparison, the Kuwait Islamic stock index carries the least amount of risk, while Turkey has the lowest return.

Table 1. Descriptive Statistics

Variabel	Obs.	Mean	Std. Dev	Min	Max
DJIMD	2,299	-0.0177118	0.963540	-6.2219	6.2937
KMI30	3,280	0.0655105	1.185698	-7.5324	6.3894
JKISSI	2,763	0.0251665	1.083097	-8.79	9.0729
DJIMIND	2,431	0.0507055	1.535699	-23.5461	31.2819
DJIMTR	2,417	0.0637267	1.291891	-9.9778	5.9521
DJIMKW	2,705	0.0074091	0.717079	-7.641	6.2603

The findings from the Granger causality test, presented in Table 2, indicate that the Islamic stock index has a significant impact on exchange rates in Malaysia, Pakistan, India, and Turkey. These results suggest that a significant decrease in stock prices in these countries can serve as an indicator of pessimism regarding future economic prospects, leading to a decline in exchange rates, and vice versa, potentially resulting in an overall economic downturn. Conversely, changes in exchange rates in countries such as Indonesia, Turkey, and Kuwait have an effect on stock prices. Furthermore, the findings demonstrate a two-way relationship between the exchange rate and the Islamic stock market in Turkey.

Table 2. Granger Causality

Hypothesis	Observation	Probability
DJIMD → MYR	2298	0.0004
MYR → DJIMD		0.6198
KMI30 → PKR	3278	0.0081
PKR → KMI30		0.3366
JKISSI → IDR	2762	0.8455
IDR → JKISSI		0.0019
DJIMIND →INR	2430	0.0427
INR → DJIMIND		0.7370
DJIMTR → TRY	2416	0.0000
TRY_USD → DJIMTR		0.0006
DJIMKW → KWD	2704	0.2517
KWD → DJIMKW		0.0365

Notes: MYR is Malaysian ringgit, PKR is Pakistani rupee, IDR is Indonesian rupiah, INR is Indian rupee, TRY is Turkish lira and KWD is Kuwaiti dinar

Furthermore, all the data used in this study is stationary, and the best model was selected based on the lowest Akaike Information Criterion (AIC) value, as shown in Table 4. The final forecasting equation can be seen in equations (2)-(7). The GARCH method used for forecasting demonstrates that the constructed model effectively represents real volatility in the capital market. By considering the findings of the Granger causality test, which indicate that Islamic stock indices in Malaysia, Pakistan, India, and Turkey have an impact on exchange rates, the GARCH forecasting model can serve as an initial proxy for understanding the behavior of domestic exchange rates. The findings of this study support the existing literature on the relationship between stock market volatility and exchange rates, particularly within the context of Islamic stock markets. The studies by Chkili & Nguyen (2014) and Jebran & Iqbal (2016) further reinforce the understanding that fluctuations in stock market volatility can influence currency exchange rates.

Table 3. Stationarity

Code	ADF Statistik	Critical Value (5%)	Prob.	Results
DJIMD	-45.42245	-2.862597	0.0001	Stasioner
KMI30	-51.96708	-2.862223	0.0001	Stasioner
JKISSI	-52.03244	-2.862387	0.0001	Stasioner
DJIMND	-23.29851	-2.862530	0.0000	Stasioner
DJIMTR	-48.84052	-2.862536	0.0001	Stasioner
DJIMKW	-45.20983	-2.862409	0.0001	Stasioner

Chkili & Nguyen (2014) research on BRICS countries provides insights into the relationship between currency exchange rates and stock market returns, suggesting that changes in stock market performance can impact exchange rates. This a ligns with our research findings, which demonstrate that the relationship between Islamic stock market volatility and exchange rates is not limited to specific countries but can also extend to other developing nations. Meanwhile, Jebran & Iqbal (2016) study focusing on India supports the idea that stock market volatility affects currency exchange rates. Their findings indicate a significant impact of stock index volatility on the Indian Rupee exchange rate. This study contributes to our understanding of the relationship between stock market dynamics and exchange rates, specifically within the context of India.

Table 4. GARCH Model

Code	Model	Prob.	AIC	Heteroscedasticity		Results
				Prob. F	Prob. Chi-Square	
DJIMD	(1,0,1)	0.0000 0.0000	-6.4518	0.0000	0.0000	Heteroscedasticity
KMI30	(1,0,2)	0.0000 0.0177	-6.0430	0.0000	0.0000	Heteroscedasticity
JKISSI	(2,0,2)	0.0009 0.0002	-6.2147	0.0000	0.0000	Heteroscedasticity
DJIMND	(1,0,4)	0.0000 0.0000	-5.6389	0.0000	0.0000	Heteroscedasticity
DJIMTR	(0,0,2)	0.0172	-5.8612	0.0000	0.0000	Heteroscedasticity
DJIMKW	(1,0,5)	0.0000 0.0355	-7.0569	0.0000	0.0000	Heteroscedasticity

However, it is important to acknowledge that the relationship between stock price volatility and exchange rates may not hold universally across all countries. As discussed in the literature, there are studies that indicate no significant relationship between stock price volatility and exchange rates in certain countries. This highlights the complexity and multifaceted nature of the relationship, which can be influenced by factors such as a country's economic structure, financial market regulations, and external shocks. Given these findings, it is crucial for investors, policymakers, and financial institutions to consider the implications of stock market volatility on exchange rates in the specific countries studied. Fluctuations in the Islamic stock market can potentially have cascading effects on the exchange rates of Malaysia, India, Pakistan, and Turkey. This knowledge can inform investment decisions and risk management strategies, empowering stakeholders to navigate the financial landscape more effectively.

$$DJIMND\sigma_t^2 = 2.06E-06 + 0.0772\varepsilon_{t-1}^2 + 0.1144\varepsilon_{t-2}^2 + 0.0629\varepsilon_{t-3}^2 - 0.463\sigma_{t-1}^2 + 0.285\sigma_{t-2}^2 + 0.911\sigma_{t-3}^2 \quad (2)$$

$$KMI30\sigma_t^2 = 5.59E-06 + 0.1341\varepsilon_{t-1}^2 + 1.0621\sigma_{t-1}^2 - 0.6694\sigma_{t-2}^2 + 0.4352\sigma_{t-3}^2 \quad (3)$$

$$JKISSI\sigma_t^2 = 7.67E-06 + 0.1117\varepsilon_{t-1}^2 + 0.0171\varepsilon_{t-2}^2 + 0.1191\varepsilon_{t-3}^2 + 0.5293\sigma_{t-1}^2 - 0.6614\sigma_{t-2}^2 + 0.815\sigma_{t-3}^2 \quad (4)$$

$$DJIMIND\sigma_t^2 = 1.38E-05 + 0.2655\varepsilon_{t-1}^2 + 0.4859\sigma_{t-1}^2 - 0.463\sigma_{t-2}^2 + 0.7251\sigma_{t-3}^2 \quad (5)$$

$$DJIMTR\sigma_t^2 = 1.38E-05 + 0.092\varepsilon_{t-1}^2 + 0.0973\varepsilon_{t-2}^2 - 0.1241\sigma_{t-1}^2 + 0.8563\sigma_{t-2}^2 \quad (6)$$

$$DJIMKW\sigma_t^2 = 2.93E-06 + 0.0992\varepsilon_{t-1}^2 + 0.0408\varepsilon_{t-2}^2 + 0.7998\sigma_{t-1}^2 \quad (7)$$

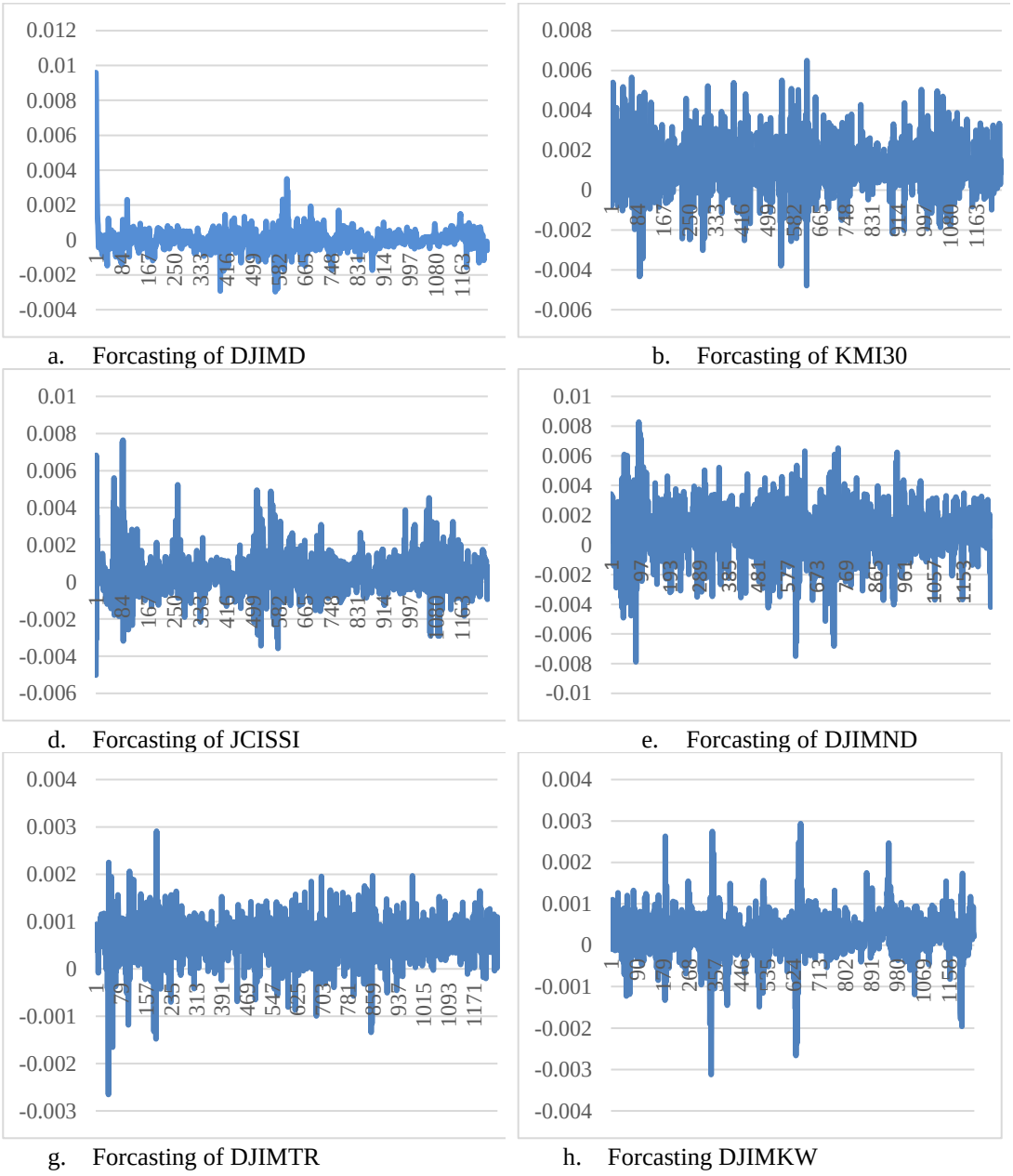

Figure 1. Volatility based on GARCH model

Based on the GARCH model presented in equations (2)-(7) and the observations depicted in Figure 1, this study draws the following conclusions: a) The Dow Jones Islamic Market Malaysia Index (DJIMD) exhibits low volatility with infrequent occurrences of large explosions; b) The Karachi Meezan 30 (KMI130) demonstrates high volatility with a high intensity of significant explosions; c) The Indonesia Jakarta Composite Islamic Stock Index (JCISSI) displays relatively low volatility with frequent instances of large explosions; d) The Dow Jones Islamic Market India Index (DJIMIND) shows high volatility with occasional bursts of significant volatility; e) The Dow Jones Islamic Market Turkey Index (DJIMTR) experiences relatively high volatility with occasional large bursts of volatility; f) The Dow Jones Islamic Market Kuwait (DJIMKW) is characterized by considerable volatility and frequent occurrences of large

volatility explosions. Based on this analysis, the study concludes that there is no relationship between the level of volatility and the impact of the exchange rate on the rate of return in the Islamic stock market.

Moreover, the findings of this study have broader implications for policymakers. Understanding the relationship between stock market volatility and exchange rates can aid in formulating appropriate monetary and fiscal policies to effectively manage exchange rate fluctuations. By monitoring the dynamics of the stock market and its potential impact on exchange rates, policymakers can implement measures to maintain stability and mitigate the adverse effects of excessive volatility. However, it is essential to acknowledge the limitations of this study. The analysis focuses on a specific set of countries, and the findings may not be generalizable to other countries or regions. Additionally, this study does not consider other macroeconomic factors or external shocks that can influence exchange rates. Future research should aim to expand the scope by including a wider range of countries, longer time periods, and additional variables to provide a more comprehensive understanding of the relationship between stock market volatility and exchange rates in the context of Islamic stock markets.

Conclusion, Suggestions and Limitations

This study makes a valuable contribution to the existing literature by providing empirical evidence supporting the relationship between Islamic stock market volatility and exchange rates in Malaysia, India, Pakistan, and Turkey. The findings suggest that changes in the Islamic stock market can have a cascading effect on the exchange rates of the countries examined. However, it is important to acknowledge that the relationship between stock price volatility and exchange rates may not hold universally in all countries, as indicated by studies showing no significant relationship in certain contexts. For investors, understanding this relationship can aid in assessing and managing the risks associated with currency fluctuations. Similarly, policymakers need to consider the impact of stock market dynamics on exchange rates when formulating monetary and fiscal policies. By incorporating this relationship into policy decisions, policymakers can implement measures to mitigate the adverse effects of excessive volatility and maintain exchange rate stability.

Despite the valuable insights gained from this study, it is crucial to acknowledge several limitations. Firstly, the analysis focuses on a limited number of countries, and caution should be exercised when generalizing the findings to other countries or regions. Additionally, this study does not account for other macroeconomic factors or external shocks that can influence exchange rates. Future research should aim to include a broader range of countries, extend the analysis to longer time periods, and incorporate additional variables to develop a more comprehensive understanding of the relationship between stock market volatility and exchange rates in the context of Islamic stock markets. By addressing these limitations, future research can enhance our understanding of this complex relationship and provide more robust insights.

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