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Impact of Oil Prices on Islamic Stock Prices: Evidence from Pakistan using Bootstrap ARDL Approach

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Abstract

Purpose: This research inspects the dynamic association between the oil prices and Islamic stock prices in Pakistan, an area relatively uninvestigated, regardless of the rising significance of Islamic finance.

Design/methodology/approach: The research utilizes daily data from January 2011 to April 2022. The SOR unit root assessment is employed to recognize smooth and sharp structural breaks, and the Bootstrap ARDL technique is employed to explore short- and long-run cointegration between oil prices and Islamic stock prices.

Findings: The findings divulge that certain Islamic stocks show substantial long-run cointegration with the oil prices, whereas others illustrate short-run causal associations. The outcomes highlight the non-linear and time-varying effect of the oil price fluxes on the dynamics of the Islamic stock market.

Research limitations/implications: The assessment is restricted to thirty Islamic stocks in Pakistan and does not include sectoral or regional heterogeneity, signifying a need for comprehensive future investigation.

Practical implications: The outcomes deliver valuable information for investors and policymakers by featuring the prominence of monitoring the dynamics of the oil market when articulating risk management and investment approaches in Islamic financial markets.

Originality/value: This research contributes to the inadequate empirical literature by employing innovative econometric procedures to assess the oil-Islamic stock price association in a developing market, delivering vigorous evidence that augments and complements the current study.

Keywords: Islamic stock prices, Oil prices, Bootstrap ARDL, SOR unit root, Pakistan

JEL Classification: C32, G15, G12, Q43

1. Introduction

Recently, the crude oil influence on the stock markets has been the subject of examination in numerous investigations (Bouri, 2015; Chou & Tseng, 2016; Huang, et al., 2017; Jones & Kaul, 1996; Joo & Park, 2017; Sukcharoen, et al., 2014). The influence of world oil prices on a corporation's earnings and cash flows can illustrate the economic rationale underlying the nexus between the oil and stock prices (Arouri, et al., 2012, Chang, 2020; Noman, et al., 2023). Additionally, the theory of equity valuation can demonstrate the extent to which stock prices are influenced by fluctuations in oil prices. This theory posits that stock prices represent the addition of the expected future cash flows' discounted values over specific time periods. Macroeconomic indicators, influenced by oil price shocks and discounted cash flows (such as producer and consumer confidence, investor behavior, economic growth, interest rates, income, production costs, and inflation), reflect the economic conditions (Arouri & Nguyen, 2010; Jouini, 2013).

Furthermore, numerous explorations have been conducted to explore the association between these two variables, and much of the literature has arrived at conflicting conclusions regarding the nexus between the stock and oil prices. Recently, many investigations have proposed a positive nexus between these variables (Bernanke, 2016; Cai, et al., 2017; Kang, et al., 2017; Luo & Qin, 2017). However, several investigations suggest an adverse connection between stock and oil prices (Basher, et al., 2012; Chen, 2010; Creti, et al., 2014; Fang & You, 2014; Kilian & Park, 2009; Masih, et al., 2011). Miller and Ratti (2009) investigated the relationship between these variables and found an inconclusive association. Some researchers have revealed a two-way causal linkage (Ali, et al., 2022; Bouoiyour & Selmi, 2016; Jammazi, et al., 2017; Maghyereh, et al., 2016; Uche, et al., 2022a). Meanwhile, only a limited number of researchers have observed the influence of oil prices and realized fluctuations on the returns of the stock market. Recently, researchers such as Ahmad, et al. (2018), Dutta, et al. (2017), Dutta (2018), Luo and Qin (2017), and Xiao, et al. (2018), among others, have utilized OVX as a proxy for the indicated oil price fluctuations. OVX is the initial commodity-based instability index calculated using expectations of crude oil price fluctuations over the next thirty days (Gohar, et al., 2022b, 2023a, 2023b).

Despite a vast literature on the influence of oil prices on stock market prices, the Islamic stock markets' assessment remains a comparatively new zone of investigation. Though the association between the stock markets and oil prices has been extensively investigated, investigations unambiguously concentrating on Islamic stock markets, principally in developing economies like Pakistan, remain inadequate. Given the Islamic finance's swift expansion and the likely understanding of Islamic stocks to oil price variations, it is vital to inspect this association. Consequently, this investigation intends to (1) inspect the short- and long-run nexus between Islamic stock prices and oil prices in Pakistan, (2) utilizes the Bootstrap ARDL technique for vigorous cointegration assessment, (3) employs the SOR unit root assessment to account for structural disruptions, and (4) offer understanding valuable to academics, investors, and policymakers, investors.

The Islamic finance industry is projected to grow to 3.4 trillion dollars by 2018, a significant increase from its current valuation of 1.88 trillion dollars (Islamic Finance, 2016). As a result, it has become crucial to monitor the effect of oil prices on Islamic stock market prices. Numerous investigations support the notion that the Islamic stocks are worthwhile compared to traditional stocks (Bannigidadmath & Narayan, 2016). Milly and Sultan (2012) revealed that the Islamic stocks perform better than traditional stocks throughout the economic crisis in terms of performance. Arshad and Rizvi (2013) provided empirical evidence of incomplete susceptibility to speculative shocks for Islamic stock prices (Chang, et al., 2022; Maydybura, et al., 2023).

Among the investigations that have explored the link between Islamic stock indices and oil prices, Hussin, et al. (2012, 2013) analyzed the' dynamic impact of oil prices on the stock markets of Malaysia. They discovered that, in the long term, oil prices were not co-integrated with Islamic stock returns. However, they identified a two-way causal association between the variables. Abdullah, et al. (2016) inspected the influence of South Asian economies' Islamic stock markets on the portfolio divergence in regarding to crude oil prices. They exposed that the investors could yield by including the Malaysian Islamic stock index in the investment if they held crude oil (Hashmi, et al., 2021a, 2021b, 2022; Syed, et al., 2019).

Arshad (2016) observed an association between the oil prices and the Islamic stock prices and found immediate movements between the Islamic stock markets and oscillations in oil prices. The actual economy, which serves as the basis for Islamic stock markets, is massively inclined to oil price instability, thereby directing these immediate movements. Furthermore, Badeeb and Lean (2018), predominantly in a sectoral assessment, investigated the nonlinear influence of oil price fluctuations on Islamic stocks. They identified that the Islamic stock indices display an asymmetric association with the oil price fluctuation in the short term, whereas the most Islamic sectoral stocks' reaction to oil price fluctuation exhibits an asymmetric pattern in the long term. Currently, Narayan, et al. (2019) inspected a wide variety of definite Islamic stocks and discovered that the influence of the oil price fluctuation on the Islamic stocks fluctuates across stocks. Business approaches that are approachable to oil prices yield annualized returns extending from 5.8% to 13.6%. Furthermore, Handriani, et al. (2021) gauged the influence of the oil prices, gold prices, inflation, and rupiah exchange rate on the Indonesian Islamic stock index (IISI). They revealed that the IISI is stalwartly undesirably influenced by rupiah exchange rate and inflation, whereas gold prices exercise a robust favorable influence on the IISI, and oil prices have no influence. Similarly, Khan, et al. (2022) explored the association between the achievements of Islamic and conventional indexes in the Malaysian market throughout the COVID-19 contagion. They exposed an encouraging and undesirable response in long- and short-run, respectively (Gohar, et al., 2022c; Wang, et al., 2024).

However, an inadequate number of researchers have employed the Bootstrap Autoregressive Distributed Lag (BARDL) technique in their exploration. For instance, Goh Soo Khoon, et al. (2017) applied the BARDL procedure to examine the link between GDP, FDI, and exports in definite Asian states. They compared the outcomes of the BARDL tactic with numerous cointegration assessments and discovered that while the cointegration assessments specified that only one state's progress is prejudiced by FDI (foreign direct investment), the BARDL assessment outcomes exhibited that all financial progress is influenced by FDI in both the short- and long-run. Furthermore, Wu, et al. (2020) employed BARDL to evaluate the nexus between economic growth (EC) and financial development (FD) in Asia's three major states: Japan, China, and India. They declared that the governments of India and Japan should leverage their influence to endorse FD (financial development) as a means to encourage financial development, as the economy plays a substantial part in the long-term financial expansion. The Chinese government, in contrast, should launch confident standards (Peng, et al., 2022).

Furthermore, Syed and Bouri (2022), Hashmi and Chang (2021), and Uche, et al. (2022b) investigated the Economic Policy Uncertainty (EPU)'s influence on the carbon dioxide emissions in the United States using the BARDL technique. They chose this model because it allows for differentiating the effects in the short- and long-run. The outcomes exposed that in the short run, Economic Policy Uncertainty intensifies carbon dioxide emissions, signifying that higher levels of EPU contribute to ecological degradation. In contrast, in the long run, EPU leads to a decline in carbon dioxide emissions, indicating that higher levels of EPU contribute to an improvement in the quality of the atmosphere.

However, the previous research did not utilize the Bootstrap ARDL technique to explore the association between the oil prices and Pakistan's Islamic stock prices. We employ the Bootstrap ARDL technique within the framework of Pakistan as it delivers vigorous findings compared to earlier cointegration methods. Additionally, McNown, et al. (2018) and Gohar, et al. (2022a) established the BARDL method for noticing cointegration between variables. This tactic delivers supplementary valuations concerning the coefficients' substantial impact on lagged level regressors and offers a strong understanding of the cointegration approach's position. The Bootstrap ARDL procedure assists in addressing the feebleness of the Autoregressive Distributed Lag (ARDL) bounds assessment, like the size and power features. Furthermore, this procedure helps to eradicate the likelihood of inconclusive inferences. For more insights into the stock prices, readers may refer to Yadav (2022), TajMazinani, et al. (2022), Chang, et al. (2023), Arfaoui and Yousaf (2022), and Ravinagarajan and Sophia (2022).

This exploration advances the existing literature in four major ways. First, it proposes nation-based evidence by checking the association between Islamic stock prices and the oil prices in Pakistan, a part that remains insufficiently inspected. Second, the exploration employs SOR unit root assessment (Shahbaz, et al., 2018), seizing smooth and sharp structural disruptions frequently unheeded in standard unit root assessments. Third, it practices the Bootstrap ARDL technique (McNown, et al., 2018), offering a more energetic and steadier cointegration assessment equivalent to conventional ARDL methods. Lastly, by inspecting both short- and long-term dynamics through Bootstrap ARDL-based Granger causality, this research offers dynamic insights valuable for academics, policymakers, and investors (Gong, et al., 2023; Imane, et al., 2023).

Though numerous explorations have inspected the oil-stock price nexus throughout diverse states, limited research has been conducted on the exclusive features of Islamic stock markets, primarily in the Pakistani context (Lu, et al., 2023). Considering the swift progress of Islamic finance and its several structures (e.g., Shariah compliance), it is essential to know how oil price dynamics relate to these markets. Additionally, the application of the Bootstrap ARDL technique, which proposes vigorous inference in small samples and incapacitates conventional ARDL restrictions, enhances a novel methodological viewpoint to this assessment.

2. Literature Review

Several investigations have explored the connection between oil prices and stock prices, but only a few studies have specifically examined the nexus between Islamic stock prices and oil prices. Many of the studies in the field of Islamic finance have been qualitative in nature, such as those conducted by Obaidullah (1999), Elgari (2003), Ma'sum Billah (2003), Rosly (2005), Iqbal and Mirakhor (2011), and Archer and Karim (2007). In contrast, Hassan (2002) conducted a quantitative study. He examined the time-varying risk-return association and market efficiency of the DJIMI (Dow Jones Islamic Market Index) employing data spanning from 1996 to 2000. He concluded that the returns of DJIMI exhibited customary dispersion with good market efficiency. Nagayev, et al. (2016) discovered the durable nexus between Islamic equities and goods by employing the wavelet coherence and conditional correlation multivariate GARCH method. They discovered that Islamic equity has a long-term influence on the oil prices (Salman, et al., 2023a, 2023b).

Likewise, Abdullah, et al. (2016) scrutinized the crude oil prices' influence on the Islamic stock indices of Southeast Asian states, concentrating on investment divergence. They utilized multivariate-GARCH-DCC and the Wavelet transformation technique. The outcomes recommended that investors who take in crude oil in their portfolio can get an advantage from Malaysia's Islamic stock market index. Moreover, Hassan, et al. (2019) applied a parallel technique (Multivariate GARCH) to inspect the vacillations and nexus between the oil prices and Islamic indices of BRIC nations. They found a substantial association and uncertainty spillover between oil prices and the Islamic stock indices, but conventional stocks unveiled a sturdier association and uncertainty spillover than the Islamic stock indices throughout international upheaval (Bagadeem, et al., 2024; Mei, et al., 2024).

Additionally, Chang, et al. (2020) and Badeeb and Lean (2018) conducted an assessment on the link between the oil prices and Dow Jones Islamic Market from a sectoral viewpoint. They detected that the Islamic sectoral indices displayed varied reactions to fluctuations in the oil prices. These fluctuating responses of Islamic sectoral indices to the fluxes of oil price have been found across various times (Mishra, et al., 2019; Ftiti & Hadhri, 2019). Correspondingly, Shahzad, et al. (2018) inspected the association between oil prices and the Islamic stock markets by employing the Copula procedure. They revealed that there is an accidental influence of asymmetric risk between the Islamic stock markets and the oil prices, which considerably augmented after the international financial recession (Jin, et al., 2024).

There is an extensive literature to inspect the nexus between the oil prices and conventional stock prices (Chatziantoniou, et al., 2021; Chatziantoniou & Gabauer, 2021; Ji, et al., 2020; Sarwar, et al., 2020).

Although research on the association between oil prices and Islamic stock prices is relatively inadequate, despite its increasing significance. For illustration, Abdulkarim, et al. (2020) evaluated the causal relationship between Islamic stock markets and the oil prices in Africa. By engaging the multivariate GARCH and wavelet procedures, they revealed a modest connection between the Tunisian and Egyptian Islamic stock indexes and oil price returns. Their investigation also emphasized the importance of market diversity. Likewise, Mishra, et al. (2019) observed the multiscale link between Islamic stock indexes and oil prices by means of the quantile-on-quantile method based on wavelet assessment. Their examination concluded that oil prices' influence on the Islamic stock indexes is miscellaneous in nature.

Additionally, opposing earlier investigations, Lin and Su (2020) allied crude oil vagueness, frequently computed by the OVX (Oil Volatility Index), with the Islamic stock markets by using a quantile-on-quantile tactic. They found clear unfavorable associations between Islamic stock markets and OVX (Oil Volatility Index). This outcome is also consistent with the robust causal association documented by Ftiti and Hadhri (2019) between several Dow Jones Islamic stock market indexes, investor sentiments, economic policy ambiguity, and oil prices. In addition, Chang, et al. (2020) inspected the asymmetric link between oil prices and Islamic indexes by employing a quantile-on-quantile assessment. They revealed that the extremely favorable returns of oil are unfavorably dependent on the stimulating undesirable returns of the Islamic index, and vice versa.

Furthermore, Godil, et al. (2020) inspected by employing the Quantile Autoregressive Distributed Lag (QARDL) method to inspect how risk, ambiguity, gold prices, and crude oil prices distress Islamic and traditional stocks. Their consequences specified that oil prices receive a dissimilar response from Islamic stock prices only in bullish market states. Similarly, Abbass, et al. (2022) led the investigation to inspect the influence of international exchange rate, the gold price, interest rate, and oil price risk index on both the conventional and Islamic securities. They employed the QARDL method for their assessments. Their outcomes showed that under bearish tendencies, the oil price risk substantially influences both the conventional and Islamic securities.

Additionally, Godil, et al. (2022) carried out the investigation to scrutinize the influence of unprompted response and short- and long-term association on the Islamic and conventional stocks regarding valuable metals and energy resources, including gasoline, natural gas, crude oil, platinum, silver, and gold prices. They employed the dynamic simulated ARDL error correction approach and analyzed 18 years of data. The investigation discovered that energy resources have no substantial effect on Islamic stocks. However, gold and platinum exerted unfavorable and favorable influences on Islamic stocks in the long run. Similarly, Chkili (2022) investigated the association between the Islamic stock market and gold and oil prices, considering the distress phase from 1996 to 2020, which included the COVID-19 pandemic. The researcher employed Markov switching vector autoregressive and standard vector autoregressive approaches. The study concluded that a favorable and substantial connection existed between Islamic stock markets and oil prices throughout the turbulent phase. The absence of an adverse association between Islamic stock markets, the oil prices, and gold markets suggests that gold can serve as a place of safety during challenging market situations.

Additionally, Meo, et al. (2022) examined the influence of the pandemic, global uncertainty, and oil prices on sectoral Islamic stocks, including utilities, communication, technology, oil & gas, industrial, healthcare, and financial sectors. They applied Granger causality by utilizing wavelet analysis and quantile-on-quantile regression on quarterly data spanning from 1996 to 2020. They found that, except for the telecommunication and technology sectors, all other sectors were negatively influenced by pandemic uncertainty, global uncertainty, and oil prices. In contrast, the telecommunication and technology sectors showed a positive impact from these independent variables. Moreover, the association between these variables varied across different quantiles, indicating different responses of the economic markets based on the state of the economy. Similarly, Hassan, et al. (2022) analyzed the effect of uncertainty indices and three primary risks on Dow Jones Islamic Market World and ten important sectoral Islamic equity indices. They collected data from 2013 to 2021 and employed a quantile-on-quantile model to assess the influence. They concluded that, with respect to Geopolitical Risk (GPR), most of the Dow Jones Islamic Market Islamic and the equity indices exhibited a positive association, indicating their ability to mitigate shocks related to GPR. These protective effects were observed in the financial, oil and gas, and consumer goods segments. Additionally, even in a bearish situation, there were positive dependencies between Dow Jones Islamic Market World and industrial, healthcare, economic, and consumer goods segments, as well as severe economic policy uncertainty. This suggests limited protective advantages in the lower quantiles. On the other hand, compared to other sectors and the Dow Jones Islamic Market World, the oil & gas and basic materials sectors were able to mitigate shocks related to economic policy uncertainty due to their reliance on market conditions. However, all Islamic equity indices were negatively impacted by oil market volatility, indicating a lack of protective advantages provided by these Islamic equities.

Nevertheless, Adekoya, et al. (2022) examined the nonlinear transmission of the return spillovers between Islamic stock prices and oil prices at the segment level. They extended Antonakakis et al.'s (2020) work by utilizing nonlinear dynamic interconnectedness estimates on the basis of a Time-varying VAR (Vector Autoregressive) technique. To identify the factors capturing this asymmetry, they conducted dynamic portfolio practices using the lowest connectedness portfolio and common hedging strategies following Broadstock, et al. (2022). The study utilized data from nine Islamic sector stocks and oil prices over a nine-year period. The results indicate that negative connectedness dominates the sample period, except during the earlier phases of the COVID-19 epidemic, suggesting that Islamic market investors were more responsive to negative news. This conclusion proposes that Islamic markets confirmed relative flexibility during the pandemic, as favorable associations were more predominant at the commencement of 2020. Furthermore, the negligible connectedness portfolio approach efficiently captures nonlinearities and offers valuable information for the management of the portfolio.

Additionally, Khan, et al. (2023) investigated the nexus between the gold prices, international policy ambiguity, oil prices, and Islamic stocks. They employed monthly data for all variables spanning from

1996 to 2018 and applied various investigative methods, including multiple and fractional wavelet coherence, continuous and discrete wavelet analysis, wavelet coherence, Granger causality assessment based on the wavelets, and a cointegration approach. Their search generated several outcomes. Firstly, they detected a favorable association between the oil prices and Islamic stocks, suggesting that vicissitudes in the oil prices have a favorable influence on Islamic stocks. Secondly, they discovered an unfavorable association between oil prices and gold prices, signifying that increases in oil prices are linked with decreases in gold prices. Thirdly, they acknowledged an unfavorable association between the Islamic stocks and gold prices due to international ambiguity, representing that augmented international ambiguity leads to drops in both Islamic stocks and gold prices. Lastly, they explored a substantial two-way causality between the variables measured, underscoring the interdependencies and feedback influences between them.

In addition, the investigation by Ahmed, et al. (2025) inspects the co-movement between stock markets, exchange rates, and oil prices in the BRICS nations by utilizing the wavelet coherency technique. The results show that the vigorous co-movements throughout the era of international unpredictability, like war between Russia and Ukraine, and the COVID-19 epidemic, where stock markets and oil prices progress together, and the exchange rates and oil prices display a conflicting association. The investigation also exposes a disconnection of oil from exchange rates and the stock markets under constant circumstances, with weaker co-movements in China related to other BRICS states. This information is critical for the decision process during financial disorder. Additionally, Ghallabi, et al. (2024) inspect non-linear risk spillovers between the Islamic stock markets and the renewable energy market formerly and during the Russia-Ukraine calamity. By employing VAR-ADCC and CoVaR approaches, the research reveals no substantial spillovers for India, Turkey, and Malaysia during the calamity, but indicates the Islamic stock market of Canada as a divergence opportunity during risky downside risk incidents. In addition, Raza Rabbani et al. (2024), by utilizing wavelet-based approaches, revealed that geopolitical risk substantially affected Composite, Islamic stocks, and Sukuk, oil, and gold during the COVID-19 and the Russia–Ukraine conflict, with Islamic assets showing higher returns and GPR and oil carrying greater risk. Furthermore, Raheem, et al. (2025) examined the association between oil shocks, decomposed into demand, supply, and risk shocks, and the return of Islamic finance by employing pooled data from Dow Jones Islamic finance indices throughout various zones. Their findings demonstrate that the shocks in oil substantially affect the returns of Islamic finance, while the anticipating power is weaker for Europe. Moreover, Harindiyah (2025) applied a quantitative time-series method (2013–2023) to scrutinize the influence of global Islamic stock indices, world oil prices, and the exchange rates on the Jakarta Islamic Index (JII). Their outcomes expose that while only exchange rates substantially influence JII in the short term, all variables — DJIJP, DJIEU, oil prices, and the exchange rates— have substantial long-term influences.

3. Data and Methodology

3.1 Data

In this thesis, we are investigating the relationship between oil prices and Islamic stock prices in Pakistan. To conduct this analysis, we have collected daily data covering the period from January 3, 2011, to April 27, 2022, resulting in a total of 2777 observations. The Islamic stock price data consists of information from thirty major firms that issue Islamic stocks, which we obtained from Investing.com. The data on oil prices is sourced from the International Financial Statistics, specifically the crude oil price, which provides a global perspective on oil prices. Additionally, we have included the interest rate as a control variable in this study. The interest rate data is also collected from the International Financial Statistics, specifically the Interest rate of deposits. Previous research (Sadorsky, 1999, 2001; Chen, et al., 1986) has emphasized the significance of interest rates in explaining stock prices, as they often have an inverse relationship. To estimate the Bootstrap ARDL approach's findings, the author utilizes Eviews software.

3.2 Methodology

3.2.1 SOR unit root estimation

Various studies have employed different unit root estimations to reveal the stationarity of the time series data. The Augmented Dickey-Fuller (ADF) unit root estimation, for instance, incorporates lagged values of the dependent variable as independent variables, effectively addressing autocorrelation issues. To complement the ADF test, the Phillips-Perron (PP) unit root estimation is also commonly employed. The PP test exhibits weaker error term dependency and accounts for various error term distributions. However, both the ADF and PP tests lack nonlinearity and structural break detection capabilities, potentially yielding misleading results. To overcome these limitations, this study employs the SOR unit root estimation introduced by Shahbaz, et al. (2018). The SOR unit root assessment identifies the integrating characteristics of variables and accommodates sharp, smooth, nonlinear, and structural breaks. By utilizing the SOR unit root estimation, this examination can effectively capture and account for both sharp and smooth structural breaks within the time series data (Shahbaz, et al., 2018). Following the methodology proposed by Leybourne, et al. (1998a), the SOR assessment requires a two-stage method:

Step 1: The genetically restricted nonlinear optimization procedure is used in the initial phase of the SOR unit root estimation. The designated technique's deterministic components are then forecasted. The residuals attained from this calculation are estimated by applying model A, model B, and model C, as shown below:

$$\text{Model A: } \hat{\varepsilon}_t = y_t - \hat{a}_1 - \hat{a}_2 F_t(\hat{y}, \hat{\tau}); \tag{1}$$

$$\text{Model B: } \hat{\varepsilon} = y_t + \hat{a}_t + \hat{\beta}_t + \hat{a}_2 F(\hat{y}, \hat{\tau}); \tag{2}$$

$$\text{Model C: } \hat{\varepsilon}_t = y_t - \hat{a}_1 - \hat{\beta}_1 t - \hat{a}_2 F_t(\hat{y}, \hat{\tau}) - \beta_2 F_t(\hat{y}, \hat{\tau}) t. \tag{3}$$

Step 2: In this step, estimation statistics of the Enders and Lee are computed. Specifically, we calculate the t-ratio linked with the Ø coefficient in the Ordinary Least Squares (OLS) regression, as proposed by Enders and Lee (2012):

$$\hat{\varepsilon}_t = \mathrm{d}(t) + \phi\varepsilon_{t-1} + v_t, \tag{4}$$

where υ_t does not have the unit root disturbance with the variance σ^2, moreover, the deterministic role of *t* is indicated by the *d*(*t*). Here, it should be highlighted that ε is inadequately dependent on an initial value that is constant. Equation (4) can be calculated directly to investigate the null hypothesis that claims the presence of non-stationarity when a functional figure of d(t) is provided. Whereas it was stated by Shahbaz, et al. (2018) that the d(t)' figure is mysterious. Therefore, when the d(t) is mistakenly determined, then any testing for $\varphi = 1$ can be uncertain. However, the estimation employed in this research is founded on the postulation that it is feasible to measure d(t) by applying the Fourier expansion:

$$d(t) = a^0 + \sum_{k=1}^{n} \alpha_{\mathrm{k}} \sin\left(\frac{2\pi kt}{T}\right) + \sum_{k=1}^{n} \beta_{\mathrm{k}} \cos\left(\frac{2\pi kt}{T}\right), n \le \frac{T}{2}, \tag{5}$$

where the observations' number is indicated by T, and in a calculation, a number of cumulative frequencies are represented by n, whereas certain frequencies are shown by k. In that condition, all values of $\alpha_k = \beta_k = 0$ conditions become a superior case when there is no nonlinear trend. It is not mentioned to employ a greater value of n because it can create the dilemma of over-fitting. Numerous researchers, such as Bierens (1997) and Davies (1987), revealed that by using the Fourier expansion method, we could obtain the smooth break's important characteristics from an unknown functional form. Furthermore, it is important to allow for gradually occurring nonlinear trends. Therefore, it is beneficial to choose a small n. In the last, the estimating equation can be expressed as follows:

$$\Delta\hat{\varepsilon}_{\mathrm{t}} = \alpha^0 + \sum_{k=1}^{n} \alpha_{\mathrm{k}} \sin\left(\frac{2\pi kt}{T}\right) + \sum_{k=1}^{n} \beta \cos\left(\frac{2\pi kt}{T}\right) + \text{Ø}\hat{\varepsilon}_{\mathrm{t}}^{\,-1} + \sum_{i=1}^{p} \varphi_{\mathrm{k}} \Delta\hat{\varepsilon}_{t-i} + \vartheta_{\mathrm{t}}. \tag{6}$$

In the estimating equation, the lag value of the dependent variables is augmented to account for any dynamics that are stationary in $\hat{\varepsilon}_t$. Simultaneously, Enders and Lee's test statistic value is represented as $s\tau_a$ in Model A, and it is applied to fabricate the $\hat{\varepsilon}_t$, when Model B is applied $s\tau_{a(\beta)}$, whereas $s\tau_{a,\beta}$ is used for Model C. While applying SOR unit root estimation, it's critical to determine if a limited number of frequency factors can imitate breaks' categories that are commonly noticed in the data of economics.

To deal with this, we use the Fourier approximation with a single frequency component that is indicated by k. α_k and β_k to illustrate the displacement and amplitude of the deterministic term's sinusoidal component. Regardless of a single frequency $k = 1$, it can allow us to have numerous smooth breaks. Founded on our three models with Fourier changes, we can articulate the unit root testing hypothesis as follows:

$$H_0 : \text{Unit Root} \qquad (Linear\ Nonstationary)$$

$$H_1 : \text{Nonlinear Stationary} \begin{pmatrix} Nonlinear\ and\ Stationary\ around \\ simultaneously\ changing\ sharp\ and\ smooth\ trend \end{pmatrix}$$

The SOR unit root estimation's critical values for Model A* developed by Shahbaz, et al. (2018) are checked in contrast to the hypothesis to check if the variables contain unit roots.

3.2.2 Bootstrap Autoregressive Distributed Lag Model

For assessing cointegration association between variables, we are employing the Bootstrap Autoregressive Distributed Lag (BARDL) cointegration method developed by McNown, et al. (2018). The uniqueness of the bootstrap ARDL model lies in its capacity to address power properties and weak size issues that arise in the conventional ARDL technique developed by Pesaran and Shin (1995) and subsequently by Pesaran, et al. (2001). Additionally, this technique enhances the power of F- and t-tests and can incorporate new estimates to supplement the traditional ARDL bounds testing technique. We need to conduct three tests without employing the Pesaran, et al. (2001) approach to determine the presence of cointegration among the variables. Pesaran, et al. (2001) propose two circumstances for recognizing cointegration: first, the error-correction terms' coefficient must be statistically significant, and second, the lagged explanatory variables' coefficients must be statistically significant. Pesaran, et al. (2001) argue that there is no need for bound tests or the critical bounds in the first condition, while the second condition requires the use of critical bounds (lower and upper bounds). In the first state, where the error correction terms' coefficients are statistically substantial, the model can be implemented if each variable is stationary at first difference I(1). It is important to note that the traditional unit root test can be challenging because of its power properties and low explanatory ability (Goh, et al., 2017). However, using newly developed test statistics and the bootstrap ARDL introduced by McNown, et al. (2018) can resolve this matter. Monte Carlo simulations have also shown that bootstrapping the critical values has better size and power characteristics. The uniqueness of the bootstrap ARDL model lies in its insensitivity to the order of variables' integration properties and its suitability for dynamic time-series approaches and small sample data (Goh, et al., 2017). Simultaneously, McNown et al. (2018) state that a major advantage of applying this technique is its capability to address the issue of inconclusive cases that arise when using the traditional ARDL model. However, considering that the values of the upper and lower critical bounds of the conventional ARDL model are based on the data producing course, all the regressors should be integrated of order zero, I(0), or integrated of order one, I(1). Additionally, critical bounds fitting for long-span data samples calculated by Pesaran, et al. (2001) can lead to indecisive outcomes (Narayan, 2005). In contrast, the BARDL model provides critical values that eliminate the possibility of inconclusive cases. Another advantage of the BARDL is its applicability to dynamic models with multiple explanatory variables. Although it may seem trivial, the critical value constraints provided by Pesaran, et al. (2001) assume the explanatory factors' strict exogeneity. However, in macroeconomic associations, strict exogeneity only holds in certain real-world situations. The conventional ARDL and BARDL models can be mathematically stated. Succeeding Goh, et al. (2017), we consider the ARDL approach with the three variables p, q, and r.

$$y_t = \sum_{i=1}^{p} a_i' y_{t-i} + \sum_{j=0}^{q} \beta_j' x_{t-j} + \sum_{k=0}^{r} \gamma_k' \, z_{t-k} + \sum_{l=1}^{s} \tau_i' \, D_{t,l} + \mu_t \,, \tag{7}$$

where y_t is explained variable (Islamic stock price in natural logarithm); $x_t$is explanatory variable (oil price in natural logarithm); $z_t$is control variable (interest rate in natural logarithm); $D_t$is dummy variable for structural breaks; α_i , β_i , γ_i, and τ_i are coefficients for lagged terms; $\mu_t$is error term assumed to be white noise with zero mean and constant variance; and p, q, r, s are optimal lag lengths selected based on information criteria.

In which time is represented by t, lags are indicated by i, j, and k (k=0,1,2…. R; j=1,2…. q; i=1,2…… p; and l = 0, 1, 2…. s), and y_t shows the dependent variable. The independent variable is indicated by x_t and z_t. The lagged explanatory variables' coefficients are exposed by β and Υ, and the $D_{t,l}$ is used to indicate the dummy variable whose coefficient is indicated by τ. In the end, the error term with finite variance and zero mean is shown by μ_t. This model's error correction form can be specified as follows:

$$\Delta y_t = \emptyset y_{t-1} + \Upsilon x_{t-1} + \psi z_{t-1} + \sum_{i=1}^{p-1} \lambda_i y_{t-i} + \sum_{j=1}^{q-1} \delta_j x_{t-j} + \sum_{k=1}^{r-1} \pi_k z_{t-k} + \sum_{i=1}^{s} \omega_i D_{t,l} + u_t \,. \tag{8}$$

In Equation (8), $\emptyset = \sum_{i=1}^{p} \alpha_i$, $\gamma = \sum_{i=1}^{q} \beta_i$, and $\psi = \sum_{i=0}^{r} \gamma_i$, and λ_i, δ_j, π_k, and ω_i are the original parameters' functions in Equation (7) associated functions. The Equation (8)'s deviation from Equation (7) is calculated by changing the levels of vector auto-regression into the form of error correction. However, by employing a constant term ($\hat{c}$), Equation (8) could be calculated in an unconditional approach that is given below:

$$\Delta y_t = \hat{c} + \widehat{\emptyset} y_{t-1} + \widehat{\Upsilon} x_{t-1} + \widehat{\psi} z_{t-1} + \sum_{i=1}^{p-1} \hat{\lambda}_i y_{t-i} + \sum_{j=1}^{q-1} \hat{\delta}_j x_{t-j} + \sum_{k=1}^{r-1} \hat{\pi}_k z_{t-k} + \sum_{i=1}^{s} \widehat{\omega}_i D_{t,l} + \hat{\mu}_t \,. \tag{9}$$

(**Note:** Consistent notation has been used throughout; all estimated coefficients are denoted with hats.)

All three null hypotheses need to be rejected to approve cointegration among y_t, x_t and z_t variables. The hypothesis could be specified as follows:

1. F_1 test that is founded on all the relevant error-correction terms (H_0: $\emptyset = \Upsilon = \psi = 0$ in contrast to H_1: any of Ø, ϒ, and ψ are dissimilar from 0),
2. F_2 test that is founded on all explanatory variable terms (H_0: $\Upsilon = \psi = 0$ in contrast to H_1: either Υ or ψ is dissimilar from 0),

3. T-test that is founded on lagged dependent variable (H_0: $\varnothing = 0$ in contrast to H_1: $\varnothing$ is dissimilar from 0).
4. It is worth noting that the bounds test's critical values for F-tests and t-tests are created in the conventional autoregressive distributed lag (ARDL) model, but estimation statistics for the F2 test on lagged explanatory variables are ignored. In comparison, all three tests' critical values can be provided using the BARDL technique presented by McNown, et al. (2018). Therefore, to get robust results, we will apply the tabulated critical values of McNown, et al. (2018). Hence, the equation for this investigation is:

$$LnSP_t = \beta_0 + \sum_{k=1}^{n1} \beta_1 \, Ln\, SP_t + \sum_{k=0}^{n2} \beta_2 \, LnOIL_t + \sum_{k=0}^{n2} \beta_3 \, LnIR_t + \gamma_1 LnSP_{t-1} + \gamma_2 LnOIL_{t-1} + \gamma_3 LnIR_{t-1} + \gamma_4 \tau D1_t + \omega. \tag{10}$$

IIn Equation (10), β_0 is used to indicate the constant term, ω is the error term, β_1 , β_2 , and β_3 shows coefficients of short-run for the variables; however, γ_1, γ_2, γ_3 indicate the coefficient of long-run for the variables, and SP_t is used to demonstrate the stock price. The oil prices and interest rate at time t is denoted with OIL_t and IR_t. The dummy variable is indicated with $D1_t$ which indicates and deals with structural change in the equation. Moreover, Ln with each variable shows that all variables are characterized by a natural logarithm.

The SOR unit root assessment was nominated as it permits for spotting both sharp & smooth structural disruptions in data, which are common in economic time series like stock prices and oil prices. Conventional unit root assessments, like ADF and PP, regularly fail to address these structural changes, leading to prejudiced outcomes. The Bootstrap ARDL method was chosen for the cointegration assessment because it delivers enhanced small-sample properties, is modified for size alterations, and efficiently tackles degenerate cases that can arise with the traditional ARDL bounds assessing technique. Given the dataset's daily nature, the comparatively small sample size in time-series econometrics, and the requirement for vigorous cointegration assessment, the Bootstrap ARDL methodology is the most suitable choice to reliably capture the short- and long-run dynamics between Islamic stock and oil prices. Though the SOR and Bootstrap ARDL techniques are comparatively more computationally exhaustive, their capability to address the economic data's intricate nature and small sample challenges makes them perfect for this investigation's objective of exactly capturing the dynamic association between the said variables in Pakistan.

3.2.3 Bootstrap ARDL-based Granger Causality Estimation

This test is directed to determine the short-run association between dependent and independent variables after assessing long-run cointegration using the BARDL approach. Assuming there is no association between the explained and independent variables after examining long-run connotation, we will employ the Granger causality test based on BARDL, which includes the lagged difference of the dependent variable. This estimation will examine whether β = 0 for equation number 07. However, if there is an association between the variables, it indicates the formation of a stationary linear combination. Therefore, short-run cointegration estimation should contain the dependent variable's lagged level and differences, which are used to test whether $\delta_j = 0$ and $\Upsilon = 0$.

4. Empirical Analysis

In this segment, we will demonstrate outcomes that we have analyzed by employing the bootstrap ARDL approach to investigate the association between the oil prices and Islamic stock prices. This chapter is divided into two segments. The first section demonstrates results, including descriptive statistics, the correlation, the unit root assessment, the bounds assessment, the bootstrap ARDL, and the Granger causality analysis. The second section discusses findings obtained from the analysis. The summary of all variables is presented in descriptive statistics in Table 1. This table has one to six columns that show Mean, Standard deviation, Skewness, Kurtosis, the Jarque-Bera, and total observations, respectively. The mean of the data indicates the data's fundamental tendency. The descriptive values are checked using the standard deviation; greater volatility reveals greater descriptive values. The data's flatness and peakiness are examined by the skewness. Whereas Jarque-Bera estimates the normality of data. The skewness's negative values show that the data is skewed to the left side, while the skewness's positive values specify that the data is skewed to the right side. While Kurtosis is employed to estimate whether the data is light-tailed or heavy-tailed, as equated to a normal distribution. The sets of data that have great kurtosis show outliers or heavy tails, whereas the data with low Kurtosis indicates that the data has light tails or insufficient outliers.

Table 1. Descriptive Statistics

Variables	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Observations
ATTOCK	167.895	68.578	1.076	3.934	636.551***	2777
AZNL	10.535	6.861	1.781	6.168	2627.953***	2777
CHERAT	77.569	51.717	0.379	2.017	178.150***	2777
CYNERGICO	12.022	5.604	1.126	3.198	591.368***	2777
DAWOOD_HER	98.402	36.129	-0.469	1.991	219.466***	2777
DG_KHAN	102.108	53.959	0.631	2.918	184.924***	2777
ENGRO_CORP	229.249	84.123	-0.619	1.834	334.786***	2777
EP_C	22.849	16.143	1.046	3.347	520.556***	2777
FAUJI	21.250	11.725	0.333	2.256	115.368***	2777
GHANDHARA	146.278	138.862	0.569	2.114	240.457***	2777
GHANI_GLOBAL	20.687	9.1966	0.620	3.017	178.066***	2777
HUB_POWER	76.521	25.251	0.009	2.278	60.357***	2777
INTER_INDUS	109.399	78.775	0.938	2.818	410.737***	2777
LUCKY	458.098	238.793	-0.034	2.151	83.886***	2777
MAPLE	38.173	27.575	0.695	2.761	229.997***	2777
MARI	763.411	569.606	0.074	1.483	268.797***	2777
MEEZAN	46.855	33.725	1.252	4.073	859.106***	2777
MILLAT	498.523	208.194	0.547	1.981	258.725***	2777

NAT_REF	311.137	166.499	1.200	3.695	723.296***	2777
NISHAT	103.977	33.508	0.044	2.265	63.416***	2777
OGDCL	157.278	49.109	0.756	3.003	264.497***	2777
PAK_ELECT	33.435	26.910	0.952	3.141	422.091***	2777
PAK_OILF	378.053	80.563	0.1485	2.791	15.267***	2777
PAK_PETRO	115.446	27.129	0.289	1.806	203.912***	2777
PIONEER_CEM	61.176	40.951	0.342	2.057	156.877***	2777
PSO	181.243	52.769	-0.515	2.037	230.116***	2777
SEARL	125.158	94.009	0.257	2.154	113.401***	2777
SUI_SG	49.864	36.629	1.292	3.948	877.124***	2777
TELE_CARD	4.135	4.249	2.409	8.174	5784.097***	2777
TREET	42.489	21.189	1.325	6.397	2148.727***	2777
IR	10.851	2.027	0.042	1.662	208.012***	2777
OIL	68.719	19.536	0.508	1.912	256.770***	2777

Note: This table shows descriptive statistics of variables that contain 2777 observations. ***, **, and * specify level of the significance at 1%, 5%, and 10%, correspondingly.

Table 1 provides a summary of descriptive statistics for daily Islamic stock index prices, interest rates, and oil prices. These statistics contain Mean, Standard Deviation, Skewness, Kurtosis, the Jarque-Bera, and Total Observations. These statistics serve as crucial initial insights into our dataset. The positive skewness values for most variables indicate a right-skewed distribution, while negative skewness values, observed in Dawood Hercules, Engro Corporation, Lucky Cement, and Pakistan

State Oil suggests left-skewed data. The positive skewness values suggest that, in general, stock prices tend to have longer tails on the right side, indicating occasional significant positive price movements. Kurtosis values indicate leptokurtic distributions for all variables, signifying heavy tails compared to a normal distribution. The leptokurtosis observed across variables highlights that these prices are prone to outliers or extreme values, which could impact risk assessment for investors and portfolio managers. The Jarque-Bera test confirms normality for all variables at a 1% significance level. The total number of observations in our research is 2777.

Table 2 presents the correlation between our independent variables, interest rate, and the oil prices, with the dependent variables, Islamic stock prices. The correlations reveal valuable insights into the relationships between these variables. Interest rates display a significant negative correlation with most Islamic stock prices, except for Pak Oilfield and Pak Petroleum, which exhibit insignificant correlations. These negative correlations imply that as interest rates rise, Islamic stock prices tend to decline, and vice versa. This is consistent with the general expectation in financial markets, where higher interest rates may lead to lower demand for stocks as investors seek higher returns from fixed-income securities. Similarly, the correlation analysis reveals a consistent negative association between the oil prices and the Islamic stock prices, with only Pak Petroleum showing a significant correlation at a 5% level. Ghani Global Holding's correlation with oil prices is deemed insignificant.

Table 2. Correlation

Variables	Interest Rate	t-statistic	Oil Prices	t-statistic
ATTOCK	-0.678	-48.576***	-0.264	-14.400***
AZNL	-0.242	-13.138***	-0.414	-23.966***
CHERAT	-0.735	-57.126***	-0.670	-47.505***
CYNERGICO	-0.643	-44.254***	-0.214	-11.517***
DAWOOD_HER	-0.634	-43.147***	-0.837	-80.510***
DG_KHAN	-0.813	-73.450***	-0.623	-41.940***
ENGRO_CORP	-0.618	-41.453***	-0.834	-79.494***
EP_C	-0.167	-8.948***	-0.523	-32.322***
FAUJI	-0.752	-60.070***	-0.684	-49.403***
GHANDHARA	-0.700	-51.571***	-0.835	-79.878***
GHANI_GLOBAL	-0.451	-26.611***	-0.026	-1.348
HUB_POWER	-0.789	-67.548***	-0.773	-64.219***
INTER_INDUS	-0.631	-42.854***	-0.716	-53.979***
LUCKY	-0.690	-50.274***	-0.732	-56.654***
MAPLE	-0.758	-61.211***	-0.670	-47.521***
MARI	-0.586	-38.049***	-0.822	-76.151***
MEEZAN	-0.359	-20.260***	-0.656	-45.740***
MILLAT	-0.528	-32.780***	-0.619	-41.469***
NAT_REF	-0.503	-30.618***	-0.054	-2.872***
NISHAT	-0.556	-35.270***	-0.543	-34.080***
OGDCL	0.270	14.751***	0.493	29.856***
PAK_ELECT	-0.762	-61.984***	-0.707	-52.686***
PAK_OILF	-0.008	-0.436	-0.155	-8.284***
PAK_PETRO	0.005	0.248	-0.046	-2.400**
PIONEER_CEM	-0.742	-58.228***	-0.628	-42.456***
PSO	-0.643	-44.273***	-0.593	-38.784***
SEARL	-0.702	-51.945***	-0.852	-85.699***
SUI_SG	-0.572	-36.766***	-0.767	-62.972***
TELE_CARD	-0.185	-9.921***	0.180	9.622***
TREET	-0.308	-17.033***	0.215	11.586***

Note: This table shows the correlation between dependent and independent variables. Negative (-) coefficient shows a negative correlation, whereas a positive coefficient shows a positive correlation between the variables. Furthermore, ***, **, and * show the significance level at 1%, 5%, and 10%, respectively.

Table 3 reports the outcomes of the unit root assessments, which are crucial for assessing data stationarity. The Augmented Dickey-Fuller (ADF) test was directed at both the level and first difference. The ADF assessment at the level indicates that none of the variables are stationary. In other words, they fail to reject the null hypothesis of non-stationarity. However, when applying the ADF test at the first difference, all variables become stationary. This indicates that they are integrated of order one, denoted as I(1).

Table 3. Unit Root Test

Variables	ADF at Level	ADF at First Difference
ATTOCK	-2.132	-46.327***
AZNL	-1.684	-50.393***
CHERAT	-1.992	-44.897***
CYNERGICO	-1.640	-50.073***
DAWOOD_HER	-1.743	-44.550***
DG_KHAN	-1.752	-47.485***
ENGRO_CORP	-1.466	-37.985***
EP_C	0.244	-49.990***
FAUJI	-1.767	-48.551***
GHANDHARA	-1.207	-44.510***
GHANI_GLOBAL	-2.037	-46.439***
HUB_POWER	-1.975	-50.045***
INTER_INDUS	-1.053	-45.622***
LUCKY	-2.149	-45.988***
MAPLE	-2.177	-46.930***
MARI	-1.079	-42.049***
MEEZAN	-1.032	-64.044***
MILLAT	-0.996	-46.720***
NAT_REF	-1.776	-25.154***
NISHAT	-1.870	-46.931***
OGDCL	-1.075	-48.149***
PAK_ELECT	-1.177	-45.367***
PAK_OILF	-2.519	-47.614***
PAK_PETRO	-1.829	-47.798***
PIONEER_CEM	-1.793	-46.186***
PSO	-1.898	-61.142***
SEARL	-1.878	-38.712***
SUI_SG	-1.207	-46.804***
TELE_CARD	-0.880	-52.577***
TREET	-1.799	-43.794***
IR	-1.722	-43.918***
OIL	-1.497	-36.698***

Note: This table demonstrates findings of the ADF unit root test to explore the stationarity of data. These are outcomes of the ADF unit root at the level and first difference. These values are negative, but when they are interpreted, their absolute value is counted instead of the negative value. Moreover, the ***, **, and * indicates level of significance at 1%, 5%, and 10%, correspondingly.

Table 4 shows the outcomes of the SOR unit root test. To estimate the robustness of unit root investigations, we have employed SOR unit root estimation that considers the sharp and smooth structural breaks. In this table, t-statistic values are presented with frequency. The critical value for Model A is shown in the table, which shows the critical value for the t-statistic. It shows that if the t-statistic is greater than the critical value provided by Shahbaz, et al. (2018) in Table 2, then it is integrated with order zero I (0) or one I (1).

The results indicate that several variables, including Attock, Cherat, Dawood Hercules, Fauji Cement, Ghandhara Industries, Ghani Global Holdings, International Industries, Maple, Oil and Gas Development, Pak Petroleum, and Pakistan State Oil, are stationary at the 1% significance level, demonstrating a stationary relationship with oil prices. However, other variables exhibit different levels of significance.

Table 4. SOR Unit Root Test

				Critical Values	
Variables	t-statistic	Frequency	1%	5%	10%
ATTOCK	-5.827***	2	-4.997	-4.48	-4.192
AZNL	-4.546**	3	-5.029	-4.484	-4.172
CHERAT	-6.249***	2	-4.997	-4.48	-4.192
CYNERGICO	-4.022*	1	-4.807	-4.281	-4.007
DAWOOD_HER	-5.854***	4	-4.995	-4.419	-4.094
DG_KHAN	-4.144*	1	-4.807	-4.281	-4.007
ENGRO_CORP	-3.702	3	-5.029	-4.484	-4.172
EP_C	-4.451**	3	-5.029	-4.484	-4.172
FAUJI	-5.540***	1	-4.807	-4.281	-4.007
GHANDHARA	-7.414***	3	-5.029	-4.484	-4.172
GHANI_GLOBAL	-5.811***	1	-4.807	-4.281	-4.007
HUB_POWER	-4.508**	1	-4.807	-4.281	-4.007
INTER_INDUS	-6.635***	1	-4.807	-4.281	-4.007
LUCKY	-2.443	3	-5.029	-4.484	-4.172
MAPLE	-5.008***	2	-4.997	-4.48	-4.192
MARI	-2.056	3	-5.029	-4.484	-4.172
MEEZAN	-1.986	2	-4.997	-4.48	-4.192
MILLAT	-4.351**	1	-4.807	-4.281	-4.007
NAT_REF	-2.428	2	-4.997	-4.48	-4.192
NISHAT	-4.693**	1	-4.807	-4.281	-4.007
OGDCL	-5.492***	2	-4.997	-4.48	-4.192
PAK_ELECT	-2.790	1	-4.807	-4.281	-4.007
PAK_OILF	-4.540**	2	-4.997	-4.48	-4.192
PAK_PETRO	-5.001***	2	-4.997	-4.48	-4.192
PIONEER_CEM	-2.137	2	-4.997	-4.48	-4.192
PSO	-5.507***	2	-4.997	-4.48	-4.192
SEARL	-2.307	3	-5.029	-4.484	-4.172
SUI_SG	-4.402**	1	-4.807	-4.281	-4.007
TELE_CARD	-3.183	1	-4.807	-4.281	-4.007
TREET	-2.851	3	-5.029	-4.484	-4.172
IR	-4.183*	3	-5.029	-4.484	-4.172
OIL	-4.652**	2	-4.997	-4.48	-4.192

Note: This table shows findings of the SOR unit root test. The frequency and critical values are generated by the SOR unit root test, which shows the number of frequencies and the significance of the unit root test, respectively. Moreover, the ***, **, and * indicates level of significance at 1%, 5%, and 10%, correspondingly.

Table 5 presents the outcomes of the bounds test, which determines the cointegration between the explained and independent variables. The outcomes show that Attock, Ghandhara Industries, International Industries, Meezan, Pak Oilfield, and Treet exhibit a significant cointegration with oil prices. Ghandhara Industries demonstrates the strongest relationship, significant at a 1% level. Attock, International Industries, and Pak Oilfield also display a significant relationship, albeit at a 5% significance level. Meezan and Treet show a long-run association with oil prices at a 10% significance level. The confirmation of cointegration between the oil prices and specific Islamic stock prices implies that changes in oil prices can have lasting effects on certain stocks. For investors, this means that monitoring oil price movements is crucial when holding these stocks. If oil prices exhibit a sustained upward trend, it could have positive implications for these Islamic stocks. Conversely, a decline in oil prices may adversely affect them. These findings align with previous research (Badeeb & Lean, 2018; Chang, et al.,2020; Ftiti & Hadhri, 2019; Hussin, et al., 2013; Narayan, et al., 2019). These previous investigations suggest that there is co-integration between the oil prices and Islamic stock prices. Cynergico, Maple, National Refinery, Nishat, and Sui Southern Gas have inconclusive results, indicating that their cointegration with oil prices is uncertain. However, the remaining variables demonstrate no cointegration with oil prices.

Table 5. Bounds Test

Variables	F-Statistic	Conclusion
ATTOCK	4.737**	Long-run Relationship
AZNL	2.374	No Long-run Relationship
CHERAT	2.497	No Long-run Relationship
CYNERGICO	2.969	Inconclusive
DAWOOD_HER	1.549	No Long-run Relationship
DG_KHAN	2.233	No Long-run Relationship
ENGRO_CORP	1.327	No Long-run Relationship
EP_C	1.618	No Long-run Relationship
FAUJI	1.382	No Long-run Relationship
GHANDHARA	5.482***	Long-run Relationship
GHANI_GLOBAL	2.130	No Long-run Relationship
HUB_POWER	1.912	No Long-run Relationship
INTER_INDUS	3.889**	Long-run Relationship
LUCKY	2.391	No Long-run Relationship
MAPLE	3.199	Inconclusive
MARI	2.159	No Long-run Relationship
MEEZAN	3.497*	Long-run Relationship
MILLAT	2.284	No Long-run Relationship
NAT_REF	3.234	Inconclusive
NISHAT	2.678	Inconclusive
OGDCL	0.961	No Long-run Relationship
PAK_ELECT	1.216	No Long-run Relationship

PAK_OILF	3.970**	Long-run Relationship
PAK_PETRO	1.084	No Long-run Relationship
PIONEER_CEM	1.610	No Long-run Relationship
PSO	2.497371	No Long-run Relationship
SEARL	2.493	No Long-run Relationship
SUI_SG	3.302	Inconclusive
TELE_CARD	0.491	No Long-run Relationship
TREET	3.391*	Long-run Relationship
Critical Values		
Significance Level	Lower Values	Upper Values
10%	2.63	3.35
5%	3.1	3.87
1%	4.13	5

Note: The critical values are provided by bounds test. They show the significant long-run relationship at 1%, 5% and 10% significance level. Furthermore ***, **, and * specifies level of significance at 1%, 5%, and 10%, correspondingly.

The Bootstrap ARDL approach's estimates are revealed in Table 6. The estimation includes F-statistic and t-statistic for dependents and independents. This model also provides the critical values for F-statistics, T-statistics for a dependent variable, interest rate, and oil prices that are indicated as F*, T-Dep*, T-IR*, and T-Oil* at 1%, 5%, and 10% significance levels. But the critical values that are presented in this table are at a 10% significance level. Thus, if the value of any of the estimations is higher than the critical value, then it is considered significant at a 10% significance level. This approach also informs about two degenerate cases that were generated during the performance of the ARDL approach. Those two degenerate cases are: Degenerate Case#01, which arises when the F-statistic and t-statistic of the lagged independent variable are substantial, but the t-statistic of the explained variable is negligible. Degenerate Case#02 befalls when the F-statistic and t-statistic of the lagged dependent variable are significant, but the t-statistic of the lagged independent variable is insignificant.

Table 6. Bootstrap ARDL Estimates

Variables	F	F^*	Dep-t	Dep-t^*	T-IR	T-IR^*	T-OIL	T-OIL^*	Conclusion
ATTOCK	4.738*	3.102	-4.149*	-2.99	14.157*	4.409	4.572*	3.984	Coint
ANZL	2.374	3.302	-2.605	-2.833	0.255	4.426	2.591	3.947	NI
CHERAT	2.497	3.592	-2.507	-2.675	2.866	4.152	0.052	3.414	NI
CYNERGICO	2.97*	2.881	-3.253*	-2.682	8.779*	3.683	3.712*	3.51	Coint
DAWOOD_HER	1.549	2.946	-2.367	-2.501	0.235	4.055	2.127	3.337	NI
DG_KHAN	2.233	2.982	-2.721	-2.783	5.382*	4.032	0.152	4.031	NI
ENGRO_CORP	1.327	3.102	-2.01	-2.628	0.651	4.01	1.02	3.183	NI
EP_C	1.618	3.36	0.358	-2.585	3.995*	3.22	0.623	3.487	NI
FAUJI	1.382	3.087	-1.636	-2.786	1.493	3.918	0.256	3.605	NI
GHANDHARA	5.482*	3.498	-3.754*	-2.662	13.429*	4.633	3.105	3.096	Coint
GHANI_GLOBAL	2.13	2.936	-2.804	-2.906	4.06	4.456	3.096	3.835	NI
HUB_POWER	1.912	3.082	-2.281	-2.465	3.303	3.878	0.053	3.965	NI

INTER_INDUS	3.839*	3.171	-3.217*	-3.064	8.585*	4.509	1.287	3.624	D2
LUCKY	2.391	3.698	-2.117	-2.539	1.784	4.004	0.001	3.374	NI
MAPLE	3.211	3.369	-2.371	-2.456	5.306*	3.792	1.229	3.266	NI
MARI	2.16	4.397	-1.182	-2.19	2.004	3.926	0.002	3.612	NI
MEEZAN	3.497	6.048	0.269	-1.903	2.946	3.387	3.396*	3.022	NI
MILLAT	2.284	3.47	-1.84	-2.857	5.998*	4.719	0.154	3.595	NI
NAT_REF	3.234*	3.133	-3.221*	-2.871	8.444*	4.085	4.512*	3.836	Coint
NISHAT	2.678	2.983	-2.51	-2.787	7.254*	4.514	0.87	4.216	NI
OGDCL	0.962	3.174	-1.271	-2.82	1.597	3.707	2.383	3.926	NI
PAK_ELECT	1.216	3.067	-1.377	-2.776	3.053	4.474	0.739	3.764	NI
PAK_OILF	3.873*	3.535	-2.423	-2.533	5.629*	5.325	7.829*	4.58	D1
PAK_PETRO	1.084	3.026	-1.348	-2.808	2.02	4.168	1.456	4.112	NI
PIONEER_CEM	1.61	3.214	-2.009	-2.716	1.334	3.715	0	3.785	NI
PSO	2.497	2.925	-2.962*	-2.831	4.741	4.397	0.073	4.025	NI
SEARL	2.493	4.04	-1.857	-2.408	1.979	3.54	0.13	3.095	NI
SUI_SG	3.302*	2.934	-2.887*	-2.75	10.634*	4.545	0.061	3.431	D2
TELE_CARD	0.491	3.031	-1.094	-2.841	0.542	4.227	0.302	3.831	NI
TREET	3.391*	3.104	-3.425*	-2.951	8.73*	4.464	8.792*	4.046	Coin

Note: The table shows the result of Bootstrap ARDL. The F, T-Dep, T-IR, and T-Oil show the F-statistics, t-statistics of the dependent variable, t-statistic of interest rate, and t-statistic of oil, respectively. The F*, T-Dep*, T-IR*, and T-Oil* indicate critical values for significance at a 10% significance level that are generated by the bootstrap approach. Coint, NI, D1, and D2 indicate Cointegration, No-cointegration, Degenerate Case#1, and Degenerate Case#2, respectively.

Table 6 provides estimates from the Bootstrap ARDL approach, offering F-statistics and t-statistics for the explained and independent variables. The results demonstrate that Attock, Cynergico, Ghandhara, National Refinery, and Treet have cointegration with oil prices at a 10% significance level. The existence of significant cointegration between certain Islamic stocks and the oil prices suggests that these stocks are not only influenced by short-term price fluctuations but also by the broader trends in oil markets. This suggests that investors in these stocks should consider oil market dynamics as part of their investment strategy. These outcomes are steady with prior investigation (Abdulkarim, et al., 2020; Godil, et al., 2020; Hanif, 2020; Hadhri, 2021; Khan, et al., 2023; Lin & Su, 2020; Miller & Ratti, 2009; Mongi, 2019; Raza, et al., 2016), which states that there is cointegration between the oil prices and Islamic stock prices. However, Pak Oilfield indicates a degenerate case #01, implying that it exhibits cointegration with lagged independent variables but not with the dependent variable. International Industries and Sui Southern Gas indicate a degenerate case #02, suggesting the opposite relationship.

For the remaining variables, no long-run nexus between explained and independent variables is observed in multiple investigations (Akoum, et al., 2012; Hassan, et al., 2019; Mubarok, et al., 2020; Ullah, et al., 2019), which suggests that there is no co-integration between the Islamic stock prices and oil prices.

Table 7 outlines the outcomes of the short-run causality analyses between the dependent variables, interest rates, and oil prices. Firstly, we find no short-run causality from the explained variables to interest rates, indicating no directional causality in this direction. Secondly, interest rates demonstrate short-run causality on several dependent variables at varying significance levels, suggesting a unidirectional influence from interest rates to the dependent variables. The identification of short-run causal relationships between interest rates and some dependent variables underscores the sensitivity of these Islamic stocks to changes in interest rates. This information is valuable for investors looking to manage short-term risks.

Table 7. Bootstrap ARDL-based Granger Causality

Variables	**Interest Rate**		**OIL**	
ATTOCK	ATTOCK-IR	IR-ATTOCK	ATTOCK-OIL	OIL-ATTOCK
	0.577	5.157***	0.265	0.599
ANZL	ANZL-IR	IR-ANZL	ANZL-OIL	OIL-ANZL
	0.478	5.091***	0.221	0.272
CHERAT	CHERAT-IR	IR-CHERAT	CHERAT-OIL	OIL-CHERAT
	0.004	4.126**	1.909	1.375
CYNERGICO	CYNERGICO-IR	IR-CYNERGICO	CYNERGICO-OIL	OIL-CYNERGICO
	0.776	2.383*	1.078	0.084
DAWOOD_HER	DAWOOD_HER-IR	IR-DAWOOD_HER	DAWOOD_HER-OIL	OIL-DAWOOD_HER
	0.744	0.342	8.916***	2.527
DG_KHAN	DG_KHAN-IR	IR-DG_KHAN	DG_KHAN-OIL	DG_KHAN-OIL
	1.004	3.071**	2.256	0.129
ENGRO_CORP	ENGRO_CORP-IR	IR-ENGRO_CORP	ENGRO_CORP-OIL	OIL-ENGRO_CORP
	0.112	0.704	6.355***	3.063**
EP_C	EP_C-IR	IR-EP_C	EP_C-OIL	OIL-EP_C
	1.910	3.179**	0.399	0.351
FAUJI	FAUJI-IR	IR-FAUJI	FAUJI-OIL	OIL-FAUJI
	0.794	1.393	3.526**	0.133
GHANDHARA	GHANDHARA-IR	IR-GHANDHARA	GHANDHARA-OIL	OIL-GHANDHARA
	0.355	8.018***	4.584**	3.299**
GHANI_GLOBAL	GHANI_GLOBAL-IR	IR-GHANI_GLOBAL	GHANI_GLOBAL-OIL	OIL-GHANI_GLOBAL
	0.009	0.801	0.394	0.811
HUB_POWER	HUB_POWER-IR	IR-HUB_POWER	HUB_POWER-OIL	OIL-HUB_POWER
	2.058	1.765	5.453***	0.589
INTER_INDUS	INTER_INDUS-IR	IR-INTER_INDUS	INTER_INDUS-OIL	OIL-INTER_INDUS
	1.376	6.299***	1.573	3.649**
LUCKY	LUCKY-IR	IR-LUCKY	LUCKY-OIL	OIL-LUCKY
	0.274	1.588	3.044**	0.151
MAPLE	MAPLE-IR	IR-MAPLE	MAPLE-OIL	OIL-MAPLE
	0.526	3.289**	2.547*	0.962
MARI	MARI-IR	IR-MARI	MARI-OIL	OIL-MARI
	0.088	1.261	3.809**	0.737
MEEZAN	MEEZAN-IR	IR-MEEZAN	MEEZAN-OIL	OIL-MEEZAN
	0.986	1.179	0.924	0.436
MILLAT	MILLAT-IR	IR-MILLAT	MILLAT-OIL	OIL-MILLAT

	2.148	4.746***	0.643	1.022
NAT_REF	NAT_REF-IR	IR-NAT_REF	NAT_REF-OIL	OIL-NAT_REF
	1.209	4.637***	0.643	1.158
NISHAT	NISHAT-IR	IR-NISHAT	NISHAT-OIL	OIL-NISHAT
	1.109	3.426**	2.733*	0.100
OGDCL	OGDCL-IR	IR-OGDCL	OGDCL-OIL	OIL-OGDCL
	0.686	0.354	1.412	5.643***
PAK_ELECT	PAK_ELECT-IR	IR-PAK_ELECT	PAK_ELECT-OIL	OIL-PAK_ELECT
	0.672	1.393	4.058**	0.132
PAK_OILF	PAK_OILF-IR	IR-PAK_OILF	PAK_OILF-OIL	OIL-PAK_OILF
	6.506	1.409	0.039	2.910*
PAK_PETRO	PAK_PETRO-IR	IR-PAK_PETRO	PAK_PETRO-OIL	OIL-PAK_PETRO
	0.821	0.995	2.259	3.155**
PIONEER_CEM	PIONEER_CEM-IR	IR-PIONEER_CEM	PIONEER_CEM-OIL	OIL-PIONEER_CEM
	0.319	1.413	1.366	0.247
PSO	PSO-IR	IR-PSO	PSO-OIL	OIL-PSO
	0.520	3.525**	1.105	0.823
SEARL	SEARL-IR	IR-SEARL	SEARL-OIL	OIL-SEARL
	0.079	1.533	6.520***	0.375
SUI_SG	SUI_SG-IR	IR-SUI_SG	SUI_SG-OIL	OIL-SUI_SG
	0.784	5.853***	7.651***	1.563
TELE_CARD	TELE_CARD-IR	IR-TELE_CARD	TELE_CARD-OIL	OIL-TELE_CARD
	0.281	0.202	1.290	0.005
TREET	TREET-IR	IR-TREET	TREET-OIL	OIL-TREET
	0.036	0.615	1.569	0.689

Note: This table shows short-run causality between variables, where the causality is either bidirectional or unidirectional. Additionally, ‘‘*’’ shows how much the causality is significant, where ***, **, and * specify the level of significance at 1%, 5%, and 10%, respectively.

Thirdly, we observe short-run causality from several dependent variables to oil prices, with varying levels of significance. Finally, oil prices display short-run causality on some dependent variables, again with differing significance levels. Additionally, the short-run causality between certain dependent variables and oil prices highlights the potential impact of oil price movements on these stocks in the short term, offering valuable information for traders and investors with shorter investment horizons. These results highlight the complex interplay between these variables in the short run, with bidirectional causality observed in some cases. These findings are supported by the results of various investigations (Hussin et al., 2012; Mongi, 2019), which advocate that there is short-run causality between the Islamic stock oil prices.

In conclusion, this discussion chapter has presented a comprehensive analysis of the relationships between daily Islamic stock index prices, interest rates, and oil prices. The findings, derived from descriptive statistics, correlation analysis, unit root assessments, bounds tests, and short-run causality analyses, deliver valuable information on the dynamics of these financial and economic variables.

The descriptive statistics unveiled that Islamic stock prices generally exhibit right-skewed distributions with leptokurtic characteristics, indicating occasional significant positive price movements and the presence of outliers. Furthermore, the Jarque-Bera test confirmed normality for all variables, laying a solid foundation for the succeeding assessment. The correlation analysis demonstrated that interest rates display a significant negative correlation with most Islamic stock prices, suggesting that as interest rates rise, stock prices tend to decrease. Similarly, oil prices consistently exhibited a negative association with Islamic stock prices, implying that changes in oil prices can influence stock prices.

The unit root assessments established that all the variables are integrated of order one, indicating they are non-stationary at the level but stationary at the first difference. Additionally, the SOR unit root test further corroborated the stationary association between certain Islamic stocks and oil prices. The bounds test identified cointegration between specific Islamic stocks and oil prices, signifying that fluctuations in oil prices can have a lasting influence on these stocks. This information holds crucial importance for investors, emphasizing the necessity of considering oil market dynamics when holding these stocks.

The Bootstrap ARDL approach reaffirmed the occurrence of significant cointegration between certain Islamic stocks and oil prices, underscoring the importance of factoring in broader oil market trends in investment strategies. The short-run causality analyses unveiled intricate interplays between the variables, with bidirectional causality observed in some instances. This highlights the sensitivity of Islamic stocks to short-term fluctuations in interest rates and oil prices, offering valuable information for investors and traders.

5. Conclusion

This investigation investigates the association between the oil prices and Islamic stock prices in Pakistan, by employing data from January 2011 to April 2022. Whereas oil price variations characteristically have substantial consequences for international economies, this investigation precisely probes into their influence on an Islamic stock prices subset. The outcomes divulge that the oil prices have a mixed influence on stock prices; some businesses experience a favorable influence, whereas others confront unfavorable consequences. More prominently, the investigation unearths cointegration between oil prices and the stock prices for numerous businesses, including Attock, Ghandhara, International Industries, Meezan, Pak Oilfield, and Treet. By utilizing the BARDL approach, we recognize substantial cointegration at a significance level of 10% for these businesses, offering robust empirical evidence of long-term associations between the oil prices and the stock returns.

Furthermore, the Granger causality assessments expose that three businesses—Dawood Hercules, Engro Corporation, and Ghandhara—display bidirectional short-run causality with the oil prices, signifying a shared linkage between stock prices and oil price activities. This outcome is mostly pertinent for market contributors and investors looking to comprehend the dynamic connections between the energy prices and the performance of the stock market.

Although these outcomes offer valuable information on the association between the oil prices and the Islamic stock prices in Pakistan, they also indicate numerous avenues for additional investigation. Future investigations could increase the assessment by including an extensive range of businesses, other segments, or other states to assess the generalizability of these outcomes throughout various economies. Besides, discovering the explicit aspects that drive the various responses among businesses to the oil price variations could deliver deeper insights into sectoral resilience and susceptibilities.

From a policy viewpoint, the outcomes emphasize the requirement for a further nuanced method in managing the consequences of the oil price unpredictability. Policymakers should ponder these associations when articulating financial policies, mainly in unindustrialized markets where fluctuations in oil prices can have substantial ripple effects on financial stability and market assurance. Given the detected cointegration and causality, policymakers may benefit from integrating the oil price movements into macroeconomic approaches to better forecast market behavior and develop approaches to alleviate the unfavorable influence of oil price shocks.

The uniqueness of this investigation lies in its BARDL approach's application to assess the connection between oil prices and Islamic stock prices, a part that has not been broadly inspected in Pakistan's context. By addressing this gap, this investigation contributes to the increasing literature on energy price influences in developing markets and delivers a basis for future investigation that can further inspect the intricate dynamics of oil price instability and its influences on monetary markets.

6. Research Implications & Policy Recommendations

The study suggests that policymakers in emerging Islamic economies like Pakistan should closely monitor oil price fluctuations, especially given the strong long-run cointegration observed between the oil prices and the stock prices of companies such as Attock, Ghandhara, and Treet. Designing hedging instruments and promoting diversified investment portfolios can help mitigate risks arising from oil market volatility. Moreover, enhancing transparency and strengthening risk management frameworks within Islamic financial institutions are crucial to improving market resilience, particularly for sectors with significant exposure to energy price shocks. For investors, understanding the sensitivity of specific Islamic stocks to the oil price movements, as evidenced by the bidirectional short-run causality in companies like Dawood Hercules and Engro Corporation, is essential for constructing more resilient and informed portfolios. These findings also highlight the need for sector-specific monitoring and risk assessment strategies. Finally, researchers are encouraged to further explore sectoral dynamics, differences between the Islamic and conventional markets, and the moderating role of global uncertainty using high-frequency and post-COVID-19 data.

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