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DYNAMIC LINKS BETWEEN COMMODITY MARKETS & PAKISTANI SECTORAL INDICES: IMPLICATIONS FOR PORTFOLIO DIVERSIFICATION

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ABSTRACT

This research aimed to examine the inter-connections among international commodities markets and sectoral indices of Pakistan over the most recent period ranging from July 19, 2016, to December 29, 2023. This time period is selected based on recent important events of global significance including COVID-19 pandemics and recent geopolitical crisis emerged due to Russia-Ukraine war in Feb, 2022. This study is utilizing Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model for the deeper inquiry of interplay among the variables. The findings of the study indicate significant spillovers among variables with varying degrees of significance. The results show that various sectors of Pakistan economy showed asymmetric behavior indicating that some sectors were the risk transmitters while other were risk recipients. Moreover, volatility linkages are time-varying with heightened transmissions during turbulent periods. The results provide the significant information in reaching the desired conclusion and making decisions. The findings of study thus had important implications for investors (individual & institutional), fund managers and policy makers while devising strategies for diversification and risk mitigation in the Pakistani context especially in stressful periods.

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INTRODUCTION

The recent COVID-19 pandemic, caused by deadly Corona virus, affected almost all the countries across the globe. It started from Wuhan city of China in November 2019 and quickly spread across many countries. The declaration of pandemic by WHO (World Health Organization) on March 11th, 2020, marked significant event of paramount importance. The pandemic's economic ramifications have been unparalleled, surpassing any other crisis of past century (CRS report, 2021). The toll upon the human lives has been substantial, with above seven million fatalities and 776 million confirmed cases recorded as of Sep, 3rd, 2024, according to WHO COVID Dashboard (2024). Despite extensive vaccination efforts, pandemic persists, continuing to infect people in various countries1. The earlier studies revealed a connection amid global stock markets and influence on international portfolio diversification. By time of writing of study, total of 13.64 billion vaccine doses are administered worldwide, WHO (2024) in diverse areas and jurisdictions[2]. In Pakistan, confirmed COVID-19 case emerged on Feb 26, 2020, creating from Karachi (Abid, Bari, Younas, Javaid & Imran, 2020). More recently, as of Sep, 2024, stated confirmed cases reached 1.580 million, resulting in 30,656 fatalities (WHO, 2024).

The peak of daily infections occurred on January 29, 2022, with 8,183 cases, while the highest daily death toll of 313 was recorded on November 21, 2020. According to WHO's corona virus dashboard for 2024, total number of vaccine doses administered in Pakistan stood at 340.97 million. The impact of fluctuating commodity prices, especially in the repercussion of economic crises like COVID-19 pandemic and 2008 global financial crisis, stays to draw attention from investors seeking to realize their influence upon global financial markets, particularly stock returns (Shahzad, Bouri, Roubaud, Kristoufek & Lucey, 2019). The fundamental macro-financial factors that show low connectivity to the stocks may not always be main drivers of the asset commodity prices. Explicitly, commodity and stock futures markets are prejudiced by distinct financial and economic fundamentals (Gorton & Rouwenhorst, 2006). In this linking, the commodity markets are evolving to resemble financial markets, driven by increased participation from financial investors. This trend, as financialization, has delicate investment & hedging demands. Integrating foreign assets into domestic portfolio can reduce portfolio risk, provided that domestic and foreign markets exhibit movements independent of each other.

The recent literature shifts focus towards exploring diversification benefits within sectors of single stock markets. Studies conducted in various countries including Malaysia, China, Jordan, Egypt, and India highlight that forming portfolios across sectors within the single stock market can yield significant diversification benefits (Wang, Kutan & Yang, 2005; Karim, 2005; Fayoumi, Khamees & Thuneibat, 2009; Noor, Khan & Khan, 2014; Ahmed, 2012; Ahmed, Malik, Awan, & Muzaffar, 2017). Over the past three decades, there have been several severe economic and financial crises, notably the Asian Crisis (1997), US Subprime Mortgage Crisis (2007), terrorist attacks in US (2001), Chinese stock market turbulence (2015), and most recently, COVID-19 crisis. These crises disrupted markets of varying structures and sizes around the globe, casting doubt on attractiveness of global diversification. Thus, important attention of studies is on probing dynamic linkages & transmission of volatility amid capital markets. Huge empirical evidence exists about estimation of volatility & return spillover across markets in many countries (Ghouse & Khan, 2017; Ishfaq, Qiong & Rehman, 2018; Jebran, Chen, Ullah & Mirza, 2017; Sehgal, Bijoy & Saini, 2019; Khan, Fifield, Tantisanti & Power, 2022).

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[1] According to World Health organization (WHO) the first COVID vaccine product was introduced on July 22, 2020.
[2] This comprised a total of 67 percent of the world population vaccinated with a complete primary series of a COVID-19 vaccine, with 32 percent vaccinated with at least one booster dose.

Equally, significantly less focus has been directed towards exploring this relationship at sectoral level, with only handful of researchers investigating the returns and spillovers across sectors within a specific country as; (Botshekan & Mohseni, 2017; Alomari, Power & Tantisanti, 2018; Majumder & Nag, 2018). A motivating factor for selecting Pakistani sectors is the notable volatility observed in the Pakistan stock market especially following the liberalization of the market. Another reason for selecting Pakistani sectors is notable performance in recent years. In 2016, Bloomberg ranked PSX as best performing stock market in Asian region. Over past decades, various financial crises have underscored importance of understanding how economic variables influence sectoral stock returns. Channels like commodity price fluctuations, exchange rates, and global economic events play significant roles in linking different markets. For instance, commodities such as oil have an impact on stock markets over channels such as economic growth and inflation, affecting both oil-importing and oil-exporting economies. Research on return and volatility spillovers across different countries is abundant. there is relatively less exploration at sectoral level within a single country, particularly Pakistan.

Most of previous studies investigated co-movements amid prices of global commodity & aggregate stock markets indices and its diversification benefits. However, there are very few attempts that investigated the linkages between prices of global commodity and local stock market indices. This study will attempt to identify the co-movement and dynamic linkages between commodity prices including (Exchange Rate, Gold, Crude Oil) prices in the conjunction with the Pakistani sectoral indices including (Automobile Assembler, Commercial Banks, Chemicals, Cement, Food as well as Personal Care, Fertilizer, Investment Banks and the Investment Companies, Insurance, Oil and Gas, Pharmaceutical, Power Generation and Distribution, Refinery, Technology and Communication (TC) with perspective of portfolio diversification. In this connection, the current study is important for the local investors as well as for the international investors. In this linking, the balance of the paper is organized as; Section (2) provide a review of the relevant literature, section (3) highlights data and methodology used, section (4) reports the empirical results, finally section (5) concludes the existing study.

LITERATURE REVIEW

Most of the studies examined shocks in commodity prices have significant impact on stock markets (Arouri, Jouini & Nguyen, 2011). The earlier studies revealed the connection between global stock markets and influence on international portfolio diversification. In this context, researchers focused on the relationships among sectoral indices within a single stock market and their implications for the domestic portfolio diversification (Al-Fayoumi et al., 2009; Meric., 2008; Cao., 2013; Yilmaz, Sensoy, Ozturk & Hacihasan, 2015). Tiwari et al. (2022) conducted the study investigating the relationship between international commodity prices such as the natural gas, Brent crude oil, and cocoa and Australian sectoral stock returns, with a focus on portfolio diversification[3]. Their research revealed that integration among these sectors within the Australia was comparatively lower than integration observed across different equity markets. To evaluate portfolio performance, the study

[3]The study encompassed various sectors within the Australian stock market, including telecom, technology, basic materials, real estate, energy, utilities, financials, industrials, and health.

utilized Markov switching copulas and assessed several portfolio strategies, such as least variance portfolio, minimum correlation portfolio & novel minimum connectedness portfolio. In this regard, their findings highlighted specific relationships, noting cocoa's associations with the technology, real estate, and industrials sectors. They also identified natural gas as a reliable hedge across most sectors except for real estate, and highlighted crude oil as an effective hedge specifically within financial industry.

The majority of studies have focused on analyzing the correlation amid macroeconomic variables and overall stock market indices, such as (Sari, Hammoudeh & Soytas, 2010; Ali, Rehman, Yilmaz, Khan & Afzal, 2010; Sujit & Kumar, 2011; Zhang, 2018; Cheng, Liu, Yao & Zhao, 2022). Beckmann et al. (2019) explored the relationship between gold prices on the Shanghai Gold Exchange and returns from various Chinese sectoral stocks over period from 2009 to 2015, using different copula models for analysis. Their results indicated a moderate but statistically significant tail dependence between gold prices and sectoral stock returns, suggesting that extreme price movements in these assets are somewhat correlated. This finding highlight gold's role as a safe haven asset during periods of market instability. By employing methods such as the CCC-GARCH model for optimal weights, efficient frontier analysis, hedge ratios, and hedging effectiveness metrics, study showed that incorporating gold into Chinese stock portfolios could reduce overall risk. Gold was found to be especially useful as a diversifier for stocks in the materials sector, though it was less effective for those in utilities sector. In this drive, to ensure robustness, the study compared gold's diversification benefits with those of oil and found that gold outperformed oil in diversifying the Chinese diverse stock portfolios.

Similar research has delved into these topics, exploring the relationships between gold and other natural resources, as well as examining gold's correlations with macroeconomic indicators such as inflation (Worthington & Pahlavani, 2007). Recent research into dynamics between crude oil and stock markets suggests that investing in commodity futures can attract increased capital inflows into commodity markets (Hamdi et al., 2019). Hamdi et al. (2019) exactly examined relationship between oil price volatility and sectoral stock markets in oil-exporting economies. The findings showed that oil price volatility influenced all equity sectors, though the degree of resilience varied across different volatility quantiles. However, previous research has not extensively investigated how fluctuations in oil prices impact returns and prices of other commodities and financial sectors. In practice, while commodities offer diversification benefits to investors, rising crude oil prices tend to negatively affect the earnings of production assets that depend on crude oil. This creates a trade-off in which increasing crude oil prices can diminish the profitability or returns of other assets within portfolio (Huang et al., 1996). Maheshwari and Gupta, (2018) studied sectoral diversification within the diverse international stock indices of Australia, India, and China to assess the potential diversification benefits.

Using Pedroni panel cointegration analysis and the fully modified ordinary least squares (FMOLS) method, the research also incorporated various precious metals into the analysis. Tuna, (2019) highlighted Gold, silver, platinum, and palladium are valuable assets for diversifying portfolios in developed stock markets that adhere to Islamic principles. Abdul, Akinlaso, Hamid and Ali (2020) demonstrated in their study on African stock markets that these precious metals enhance portfolio diversification in the developed Islamic markets. Akkoc and Civcir, (2019), using an SVAR-DCC-GARCH model, investigated the relationships between commodities and stock markets in Turkey, confirming time-varying volatility spillovers and co-movements influencing stocks (Ahmed & Huo (2021). The VAR-BEKK-GARCH model was employed to analyze the dynamic relationships between commodity markets, the Chinese stock market, and global oil prices. The study identified a significant one-way return spillover from oil market to the stock market, emphasizing the stock market's dependence on crude oil as a safe haven during uncertain times. However, the potential portfolio benefits of diversifying commodities with other assets are not consistently assured, despite these observations.

While studies such as those by Gorton and Rouwenhorst, (2006) demonstrate negative correlations between commodity futures and stocks/bonds, suggesting potential diversification advantages, other research does not consistently support the notion of commodities providing diversification benefits across all market conditions (Daskalaki & Skiadopoulos, 2011). Silvennoinen and Thorp, (2013) have shown reduced benefits diversification for the portfolio investors who include stocks, commodities, and bonds in the portfolios. The growing body of increasingly literature focuses on dynamic interconnectedness amid key trade commodities such as crude oil and gold, and financial assets including bonds and equities. Hasan, (2017) explored how fluctuations in energy prices affect Australian stock market, emphasizing significant influence of energy price volatility on equities. Our research fills a gap in the existing literature by offering a comprehensive analysis of the time-varying tail dependence structure between global commodity prices (such as gold prices, oil prices, and exchange rates) and sector-specific stock prices in Pakistani stock market, covering thirteen sectoral indices.

Abdul et al. (2019) demonstrated in their study on the African stock markets that precious metals enhance portfolio diversification in developed Islamic markets. Akkoc and Civcir, (2019), using an SVAR-DCC-GARCH model, investigated dynamic relationships between commodities and stock markets. Study focuses on identifying long-run, short-run dynamic linkages among international commodity prices and sectoral indices of Pakistani stock market. From the review of the literature, it is evident that existing research has mainly focused on the developed markets' aggregate returns and volatility, ignoring the sector level risk transmissions. In addition, emerging markets in general and specifically Pakistani market is largely ignored for this important area of research. With the exception of (Habiba et al., 2020), no previous study was found on the Pakistani context. The current study intends to fill important gap in literature by examining the returns and volatility transmission amid commodity, exchange and thirteen sectors over extended sample period ranging from July 19, 2016 to Dec 29, 2023. This study will thus provide more updated results for investors, fund managers and policy makers.

RESEARCH METHODOLOGY

Time series daily data of the selected variables included exchange rate, crude oil, gold, automobile assembler, commercial banks, chemicals, cement, food & personal care, fertilizer, investment banks & investment companies, insurance, oil & gas, pharmaceutical, power generation and distribution, refinery, technology and communication. The data for this study was sourced from various sources, including (www.investing.com) and business recorder. The study utilized daily closing prices of all equity indices, commodity prices and exchange rate from period July 19, 2016 to Dec 29, 2023. The most recent data for these sectors were included in sample period. The rate of return is calculated by using formula:

$$\boldsymbol{R_t} = \ln(\boldsymbol{P_t} / \boldsymbol{P_{t-1}}) \quad (1)$$

Were $\boldsymbol{R_t}$ indicate daily returns, P_t= closing price on day t, ln is natural logarithm, P_{t-1}= closing price on day t-1.

According to Asteriou and Hall (2007), the conditional variance of disturbance term was typically assumed to remain constant over time, with the attention focused primarily on mean equation. Still, recent studies have demonstrated that, in most financial time series, variance tends to vary over time. Financial data, particularly those with leptokurtic distribution, volatility clustering, and the leverage effect, require more appropriate models that accommodate these unique characteristics. The introduction of GARCH family models addressed these issues. The stock market volatility is time-varying, and volatility clustering occurs in most financial time series data. ARCH model was proposed by Engle (1982) whereas, more generalized form of ARCH model (GARCH) was proposed by Bollerslev (1986) to overcome some of the limitations associated with simple ARCH model4. For example, Miyakoshi (2002) employed GARCH and EGARCH models for Japanese market, while Khan et al. (2022) employed the GARCH BEKK model to investigate the volatility transmissions among the South Asian emerging stock markets. The general form of the GARCH model can be formulated as under;

$$\boldsymbol{y_t} = \mu + \boldsymbol{\beta x_t} + \boldsymbol{\varepsilon_t} \quad (2)$$

$$\boldsymbol{h_t} = \mathbf{c} + \sum_{i=1}^{p} \boldsymbol{\alpha_i} \mu^2{}_{t-i} + \sum_{j=1}^{q} \boldsymbol{\beta_j h_{t-j}} \quad (3)$$

The simple form of GARCH models is the GARCH (1, 1) known as the generic GARCH model, the specifications are as follows,

$$\boldsymbol{h_t} = \mathbf{c} + \boldsymbol{\alpha_1} \mu^2{}_{t-1} + \boldsymbol{\beta_1 h_{t-1}} \quad (4)$$

Where $(h_{t)}$ = conditional variance, (α) = ARCH and (β) = GARCH term, time varying volatility depend on the constant μ, the lagged value of the conditional variance h_{t-1} and the lagged value of the squared errors $\mu^2{}_{t-1}$. The(α) ARCH term estimates the response to the shocks in the stock markets and (β) the GARCH term estimates the time the shock will take to die away. Incorporating both ARCH and GARCH terms, the model effectively captures short-term shocks and the lasting impact of volatility within the studied periods, as evidenced in the literature. The GARCH models, having the parameterization advantage over ARCH, are the most widely used models for analyzing volatility in stock returns. In this regard, many researchers have used the GARCH models for stock market's volatility. Hence the higher values of (α) and (β) coefficients will indicate the persistence in the volatility.

[4] Some of the limitations of ARCH models are overfitting and breach of non-negativity constraints.

RESULTS & DISCUSSION

Table 1 displays the descriptive statistics for the variables: The table showed return and standard deviation along with minimum and maximum, Skewness and Kurtosis and Jarque-Bera statistics of each variable. Chemical sector showed the highest return of 0.0007 followed by technology and communication 0.0005. The lowest return is reported for cement and food and personal care sectors as -0.0005. These results are not surprising as due to COVID-19 pandemic; chemical and technology sectors were the most profitable. Conversely, the demand for cement was decreased due to social distancing and other restrictions to avoid the spread of the Corona virus. In terms of risk, the values ranged from 3.01 percent for oil to 0.47 percent for the exchange rate. These results are in line with previous findings indicating that the oil market crashed during the pandemic. In this connection, the oil market showed the historical lowest value during April 2020 (Khan, 2024). The maximum value shows the largest value in the distribution and minimum value represents the lowest point in the data set.

Table 1 showed that ROL give the maximum value of 0.3196 and ROL also give the minimum value of -0.2822. Table 1 displays the skewness results, revealing that RAA, RCB, RCH, RER, RFP, RFR, and RGD exhibit negative skewness, indicating a left-skewed distribution with lower returns for these variables. Conversely, RCT, RIB, ROL, RPD, and RRE show positive skewness, suggesting a right-skewed distribution associated with the higher returns. Table 1 highlights the kurtosis, which indicates patterns in the data and how it is distributed around the mean. For a normal distribution, the kurtosis value is 3. kurtosis of ROIL is 29.6350, indicating leptokurtosis, which signifies that the distribution is more concentrated around the mean with less variability in the observations. RAA, RCB, RCH, RCT, RER, RFP, RFR, RGD, RIN, ROG, RPH, RPD, RRE and RTC have the kurtosis of 4.7929, 7.7542, 4.2304, 7.2021, 5.3665, 6.8707, 7.3918, 7.5743, 5.8783, 9.4579, 6.3816, 4.7170, 6.3959, 4.3318 and 3.8407 respectively in study and show leptokurtic distribution ideal to be modelled through GARCH models.

Table 1 Descriptive Statistics

	RAA	RCB	RCH	RCT	RER	RFP	RFR	RGD
Mean	0.0003	0.0004	0.0007	-0.0005	-0.0002	-0.0005	0.0004	0.0003
Median	0.0006	0.0005	0.0008	-0.0010	0.0001	-0.0002	0.0006	0.0003
Maximum	0.0590	0.0625	0.0586	0.1533	0.0206	0.0932	0.0516	0.0577
Minimum	-0.0691	-0.0780	-0.0597	-0.1420	-0.0334	-0.0793	-0.0770	-0.0511
Std. Dev.	0.0137	0.0122	0.0122	0.0200	0.0047	0.0118	0.0116	0.0091
Skewness	-0.0016	-0.3226	-0.2043	0.1637	-0.2359	-0.0359	-0.3514	-0.1765
Kurtosis	4.7929	7.7542	4.2304	7.2021	5.3665	6.8707	7.3918	7.5743
J-B	246.1*	1768*	129.1*	1364*	447.4*	1151*	1519*	1617*
OBS	1844	1844	1844	1844	1844	1844	1844	1844

Table 1a Descriptive Statistics

	RIB	RIN	ROG	ROL	RPH	RPD	RRF	RTC
Mean	-0.0003	0.0002	0.0002	0.0005	-0.0004	0.0003	-0.0001	0.0005
Median	0.0001	0.0001	-0.0002	0.0021	-0.0009	-0.0002	-0.0010	0.0008

Maximum	0.1154	0.0530	0.0724	0.3196	0.0563	0.0758	0.1013	0.0740
Minimum	-0.0810	-0.0981	-0.0779	-0.2822	-0.0782	-0.0808	-0.0888	-0.0831
Std. Dev.	0.0164	0.0101	0.0150	0.0301	0.0156	0.0150	0.0260	0.0208
Skewness	0.0386	-0.5611	-0.0593	0.1273	-0.1449	0.1398	0.1131	-0.1173
Kurtosis	5.8783	9.4579	6.3816	29.635	4.7170	6.3959	4.3318	3.8407
J-B	637.0*	3301*	879.7*	5451*	232.9*	892.0*	140.2*	58.53*
OBS	1844	1844	1844	1844	1844	1844	1844	1844

Note: Table 1 show the descriptive statistics of the return series of the selected variables from July 19, 2016 to December 29, 2023.

Table 2 Correlation Matrix

	RAA	RCB	RCH	RCT	RER	RFP	RFR	RGD
RAA	1							
RCB	0.53	1						
RCH	0.53	0.52	1					
RCT	0.59	0.56	0.51	1				
RER	0.01	-0.52	-0.04	-0.18	1			
RFP	0.45	0.44	0.46	0.49	-0.03	1		
RFR	0.53	0.64	0.51	0.58	-0.03	0.43	1	
RGD	-0.03	0.02	-0.01	0.02	-0.09	0.01	-0.01	1
RIB	0.51	0.50	0.48	0.51	-0.01	0.43	0.55	-0.08
RIN	0.42	0.41	0.42	0.40	-0.07	0.41	0.40	0.01
ROG	0.53	0.65	0.53	0.56	-0.05	0.46	0.64	0.01
ROL	-0.01	0.01	-0.02	-0.01	-0.03	0.02	-0.05	0.01
RPH	0.59	0.54	0.52	0.62	-0.04	0.48	0.57	-0.01
RPD	0.15	0.17	0.15	0.17	-0.08	0.18	0.15	-0.01
RRF	0.57	0.51	0.54	0.62	0.01	0.54	0.50	0.06
RTC	0.56	0.52	0.55	0.59	-0.01	0.54	0.53	0.02

Note: Table 2 displays the correlation coefficients among the selected variables from July 19, 2016 to December 29, 2023.

Table 2a Correlation Matrix

	RIB	RIN	ROG	ROL	RPH	RPD	RRF	RTC
RAA								
RCB								
RCH								
RCT								
RER								
RFP								
RFR								
RGD								
RIB	1							
RIN	0.38	1						
ROG	0.48	0.42	1					
ROL	-0.03	0.03	0.01	1				
RPH	0.50	0.40	0.58	-0.01	1			

RPD	0.11	0.13	0.16	-0.01	0.18	1		
RRF	0.52	0.41	0.59	0.01	0.60	0.14	1	
RTC	0.55	0.42	0.56	0.01	0.59	0.16	0.66	1

Table 2 presents the pair wise correlation results. Table 2 illustrates the level of correlation between the variables. The correlation coefficient between RTC and RRE is 0.66, indicating stronger positive correlation compared to the other variables. There is correlation positive between RER and RAA; ROL and RCB; RRE and RER; RGD and RFP; RIN and RGD; ROG and RGD; ROL and RGD; ROL and ROG; RRE and ROL; RTC and ROL with correlation coefficient of 0.01 suggests that an increase in the return of one sector will result in a slight positive increase in return of another sector. Correlation coefficient between ROL and RAA; RGD and RCH; ROL and RCT; RIB and RER; RTC and RER; RGD and RFR; RPH and RGD; RPD and RGD; RPH and ROL as well as RPD and ROL is -0.01 indicates that an increase in the return of one sector will lead to a decrease in return of another sector. The results show that RTC and RRE are highly correlated variables. Therefore, it can be hypothesized that they will be integrated both in long run and the short run. There is a lower likelihood of achieving the diversification gains by investing in the RTC and RRE. Unit root test is employed to determine the stationarity of data. To explore dynamics of volatility, series are analyzed using GARCH modeling. Before applying GARCH model, it is essential to assess the presence of ARCH effects in series using ARCH-LM test.

Table 3 Unit Root Tests

Variables	Augmented Dickey Fuller Test		Phillips-Perron test		ARCH-LM Test	
	T-Stat	Prob	Adj. T-Stat	Prob	LM. Statistics	P-value
RAA	-33.43	0.00	-34.13	0.00	37.85	0.00
RCB	-35.98	0.00	-36.48	0.00	133.39	0.00
RCH	-38.80	0.00	-39.02	0.00	15.87	0.00
RCT	-38.43	0.00	-38.52	0.00	47.90	0.00
RER	-43.04	0.00	-43.19	0.00	6.02	0.00
RFP	-40.72	0.00	-41.56	0.00	201.82	0.00
RFR	-31.66	0.00	-40.43	0.00	95.63	0.00
RGD	-43.16	0.00	-43.42	0.00	43.55	0.00
RIB	-38.90	0.00	-38.93	0.00	17.04	0.00
RIN	-39.36	0.00	-40.22	0.00	11.89	0.00
ROG	-38.95	0.00	-38.99	0.00	74.02	0.00
ROL	-42.32	0.00	-42.32	0.00	162.04	0.00
RPH	-36.78	0.00	-37.18	0.00	20.44	0.00
RPD	-39.60	0.00	-39.57	0.00	45.95	0.00
RRE	-39.87	0.00	-40.10	0.00	34.08	0.00
RTC	-38.53	0.00	-38.54	0.00	13.44	0.00

Note: Table 3 shows the results of ADF, PP and ARCH-LM test.

Table 3 presents the findings of unit root and ARCH-LM tests. Both the ADF and PP tests indicate that all series have a unit root at level but become stationary at the first difference. This leads to the rejection of the null hypothesis of non-stationarity, confirming that all series become stationary at the first difference. It can thus be concluded that all series are integrated of order one, denoted as I (1). Additionally, the LM statistics and their corresponding p-values for various variables support the presence of ARCH effect. The results of RACH-LM test in Table 3 verifies the existence of the ARCH effect in all return series, making them appropriate for modeling with GARCH model. The LM statistic for all selected variables indicates the presence of the ARCH effect, and the p-values of 0.00 for these variables highlight statistical significance of this finding, suggesting that volatility clustering influences the returns of selected variables. These results have significant implications for risk management and modeling within financial markets, as they imply that traditional models, which assume constant volatility, may not adequately capture the true nature of volatility in these series. This indicates that all variables show statistically significant ARCH effects, revealing that their respective time series data exhibit volatility clustering and time-varying variances. ARCH and GARCH models are widely employed to analyze volatility in economic as well as the financial time series.

Table 4 Results Based on GARCH Model for Period (Jul - 19, 2016 to Dec-29, 2023)

Variables	C	C(α)	C(β)	(α +β)	AIC	SIC
RAA	1.22E-05***	0.120114***	0.814377***	0.934491	-5.878611	-5.863651
RCB	1.24E-05***	0.147497***	0.764981***	0.912478	-6.179444	-6.164484
RCH	8.10E-06***	0.087120***	0.859291***	0.946411	-6.046011	-6.031051
RCT	1.43E-05***	0.099070***	0.866989***	0.966059	-5.144744	-5.129784
RER	2.31E-07***	0.042343***	0.947807***	0.99015	-7.958198	-7.943238
RFP	9.33E-06***	0.087333***	0.848454***	0.935787	-6.099506	-6.084546
RFR	6.65E-06***	0.141832***	0.812128***	0.95396	-6.278537	-6.263577
RGD	1.27E-06***	0.032354***	0.952361***	0.984715	-6.637242	-6.622282
RIB	2.83E-05***	0.150980***	0.748439***	0.899419	-5.481327	-5.466367
RIN	3.54E-06***	0.036456***	0.929131***	0.965587	-6.411511	-6.396551
ROG	5.88E-06***	0.100452***	0.875787***	0.976239	-5.757218	-5.742258
RPH	9.91E-06***	0.096719***	0.865002***	0.961721	-5.599848	-5.584888
RPR	1.05E-05***	0.109024***	0.849048***	0.958072	-5.689019	-5.674059
RRE	2.68E-05***	0.122020***	0.843352***	0.965372	-4.592972	-4.578012
RTC	1.36E-05***	0.090954***	0.879825***	0.970779	-5.003145	-4.988185
ROL	2.65E-05***	0.138974***	0.825346***	0.9643086	-4.712323	-4.697350

Note: table show the result of GARCH model for the whole sample period. Coefficients α and β captures ARCH and GARCH effects, an (***), (**), (*) indicates significance at the 1%, 5%, and 10% significance level.

Table 4 displays the results of the GARCH model for complete sample period. The coefficients (α) and (β), which represent the ARCH and GARCH terms in model, are statistically significant for all variables at 1%, 5%, and 10% significance levels. ARCH (α) term, which shows variance, suggests that past shocks have a substantial impact on conditional variance. This implies that the variables' own shocks explain variation. GARCH terms (β) indicate volatility, in lieu of covariance. GARCH coefficient (β) signifies high volatility persistence across all selected variables. The exchange rate market exhibited highest volatility persistence, with a coefficient value of 0.947807. This indicates that the model is covariance stationary, exhibiting a high level of persistence and long memory in the conditional variances of the variables. The sum of coefficients for the ARCH and GARCH terms (α + β) across all financial markets is close to 1, suggesting that the model shows that stationarity covariance, with long memory and pronounced persistence in conditional as variances for variables in particular situations.

CONCLUSION

The volatility of financial assets is pivotal in investment decisions, as it provides valuable insights into how information is disseminated and how volatility is transmitted, ultimately affecting future returns. This study explores the relationship between commodity markets and sectoral indices, including Exchange Rate (ER), Crude Oil (OL), and Gold (GD), as well as various sectoral indices of the Pakistan Stock Exchange. Examining daily returns of these assets reveals significant variations in prices and returns across the selected sectors and financial markets. Notably, during the peak pandemic period of 2020, there was a widespread decrease in prices across all variables, except for CH, ER, GD, FR, and PH. ER, FP, and IN experienced substantial price shocks throughout the entire sample period. AA, CB, CT, IB, OG, OL, and RE witnessed price declines, particularly in March 2020. Conversely, CH, ER, GD, and PH prices increased, displaying counter-cyclical behavior during the pandemic period. These observations suggest opportunities for investors to diversify their portfolios by adding gold amidst stock holdings. The return plots reveal increased volatility during pandemic across all assets, marked by volatility clustering, that suggests that current levels of volatility affect future periods.

Moreover, all returns exhibit mean-reverting behavior, indicating stationarity across all financial assets. Following this, GARCH modeling techniques specifically GARCH is applied to capture the linear and exponential relationships in volatility lag and variance. The coefficients (α) and (β), that represent the ARCH and GARCH terms in the model, are statistically significant for all variables at the 1%, 5%, and 10% significance levels. The ARCH (α) term, indicating variance, implies that past shocks significantly influence the conditional variance. This implies that the variables' own shocks significantly explain their variation. GARCH terms (β) represent volatility and indicate covariance. The GARCH coefficient (β) demonstrates a high level of volatility persistence across all selected variables, with the exchange rate market showing the greatest persistence. This indicates that the model is covariance stationary, exhibiting significant persistence and long memory in conditional variances of the variables. The combined sum of the coefficients for the ARCH and GARCH terms (α + β) for all financial markets is near 1, suggesting that the model shows that stationarity covariance, with a long memory and pronounced persistence in conditional as variances for the variables in particular situations.

Peaks in estimated volatility were prominent during the COVID-19 pandemic, particularly notable in March 2020. Moreover, the figures illustrate a subsequent decline in volatility towards the end of 2020, driven by expectations of recovery and establishment of a new global normal following the introduction of vaccines. It is concluded from the above result that the behavior of gold as a safe haven asset, incorporating gold into portfolios of stocks can help mitigate risk during periods of market volatility, such as observed during the COVID-19 pandemic. These observations suggest opportunities for investors to diversify their portfolios by adding gold amidst stock holdings. During the COVID-19 pandemic, continue monitoring and adjusting portfolios based on dynamic changes in volatility to capitalize on opportunities and manage risks effectively. Examining daily returns of these assets reveals significant variations in prices and returns across selected sectors and financial markets. Investors can enhance their portfolio diversification, manage market risks effectively, and capitalize on opportunities arising from dynamic volatility patterns in global financial markets and sectoral indices.

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