The Spill-over Effects between Oil and Gas Marketing and Exploration Firms of Pakistan Stock Exchange (PSX) KSE-100 index: During the Times of COVID-19 and Russian-Ukraine War

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Abstract

This study aims to trace the mean and volatility spillover effects between oil and gas marketing and exploration firms registered in KSE-100 index in the Pakistan Stock Exchange (PSX). Daily data of 8 firms (MGAS, PPL, PKOL, APL, HITE, HASC, PSO, and SHEL) for the period of 30th November 2019 to 30th November 2022. The whole data set is divided into two subsets, one is after COVID-19 (after 26th February2020) and the other is after the start of Russian-Ukraine war (after 24th February 2022). After that Hamao et.al (1990) uni-variate ARCH-GARCH type modeling is employed to the data in order to explore the dynamic linkages between the Marketing and Exploration firms (oil and gas) registered in KSE-100 index (PSX). The results from the data sets are indicating that there is mix movements between the oil and gas marketing and exploration firms in the KSE-100 index (PSX). The results are providing evidence there is Mean spill over from MGAS to APL, HASC, HITE, PSO, and SHEL. From PKOL to APL, HASC, HITE, PSO, and SHEL. From PPL to APL, HITE, PSO. And there is Volatility spill over from MGAS to APL, HITE, PSO and SHEL. From PKOL to APL, HITE, PSO, and SHEL. From PPL to APL, HASC, HITE, PSO, and SHEL. This linkage is developed between MGAS, PPL, and PKOL to APL, HASC, HITE, PSO, and SHEL due to the co-movements among the mentioned firms. The Augmented Dickey-Fuller Test is run on the return series and the test is insignificant in all series which is indicating that our return series are stationary at level, ARCH-LM test is run on return series and ARCH-LM test is also insignificant in all the return series means that there is no heteroskedasticity present in the return series.

Keywords: PSX Pakistan stock exchange, DER Debt-to-equity ratio, ROA Return on assets, Arch LM test: Autoregressive Conditional Heteroscedasticity Lagrange Multiplier

1. Introduction

The globe has experienced and witnessed a bad health and economic disaster in the form COVID-19 pandemic. And the markets have been towards danger due to corona virus. The first case of this disastrous pandemic was reported officially in Wuhan in the Hubei province of China on 31 December, 2019. And soon after it spread in the whole world. All the governments and economies faced severe financial and health challenges due to the pandemic. Corona virus reached Pakistan on February 26, 2020 when ministry of health officially reported first case of corona virus in Karachi, Pakistan. It would not be wrong to refer COVID-19 as a "Black Swan" event as its occurrence probability is so rare. Daily maximum cases of corona virus in Pakistan on June 14, 2020 (6825) (finance.gov.pk).

Any instability has direct impact on financial sector performance (Sulehri et al., 2020; Audi et al., 2022; Audi et al., 2023; Audi et al., 2023), as following the COVID-19, the Russian-Ukrainian war also had an impact on the stock markets and oil prices as Russia is the second-largest oil producer in the world. However, this time, the price of crude oil in the international market was much higher than it was during the COVID-19 because the lockdown that was put in place to stop the COVID-19's spread had been lifted, but the supply of crude oil in the market was insufficient to meet the quantity demanded.

This research work aims to study the spillover effects of COVID-19 and Russian-Ukraine war on the Pakistan Stock Exchange firms listed in KSE-100 index specifically for the oil and gas marketing and exploring firms, weather and also to check the spillover effects between the marketing and exploring firms during the time period of war and COVID-19. This study is being undertaken to find out what kind of effect does the above mentioned events i.e. COVID-19 and Russian-Ukraine war have on Oil and Gas marketing and exploration firms registered in KSE-100 index of Pakistan Stock Exchange (PSX).

1.1. Economic Impacts

The outbreak forces markets to stop production, shutdown industries and factories and with an increase in the cases of COVID-19 and closure and shutting of businesses, both employers and employees were effected. USA registered 35 million losses of jobs in the first two months. (finance.gov.pk) and a similar decline in economies was seen as great depression. The shut down and closure of the factories caused a decrease in demand of raw materials, and supply of final goods. Overall economic growth in Pakistan contracted to (-) 0.47% in 2019-20 when it already had weak economic growth of just 1.9 percent in the prior year. The COVID-19 further compounded long-standing challenges, especially in the industrial and services sector. However, due to the timely intervention of the government (economic stimulus package), the economy turned back to revival path. (finance.gov.pk).

1.2. Pakistan Stock Market (PSX)

In the starting days of corona virus, lockdown was implemented to stop the infection from spreading from one person to another. But as result of lockdown the Pakistan Stock Market lost on 1500 points daily on average basis (finance.gov.pk). And the shares were reduced to almost one third. The coronavirus pandemic was the primary cause of everything, but a decline in supply and demand as well as a drop in oil prices also contributed to the stock market's poor performance.

The graph 1 is showing performance of KSE-100 index, a sharp decline can be seen in the start this is indicating the start of corona virus in Pakistan and we can see how the performance of KSE-100 index declined after the COVID-19.

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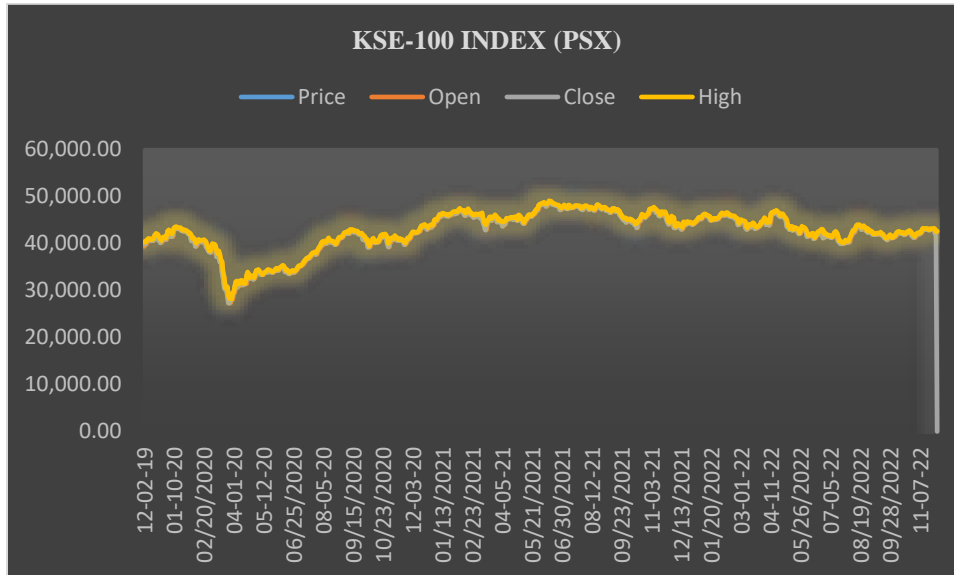[3] Department of Economics, University of Lahore, Pakistan

KSE-100 INDEX (PSX)

Figure 1

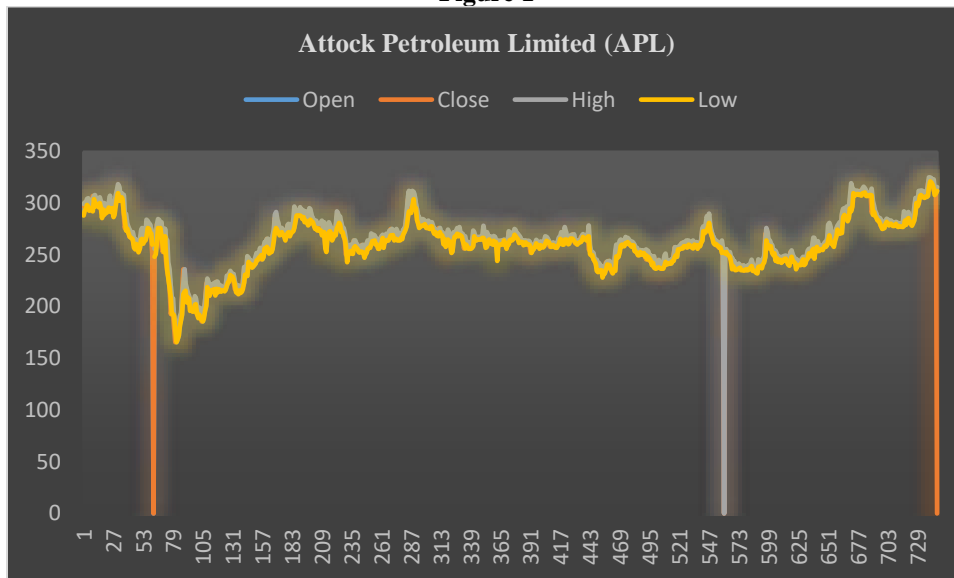## Attock Petroleum Limited (APL)

Figure 2
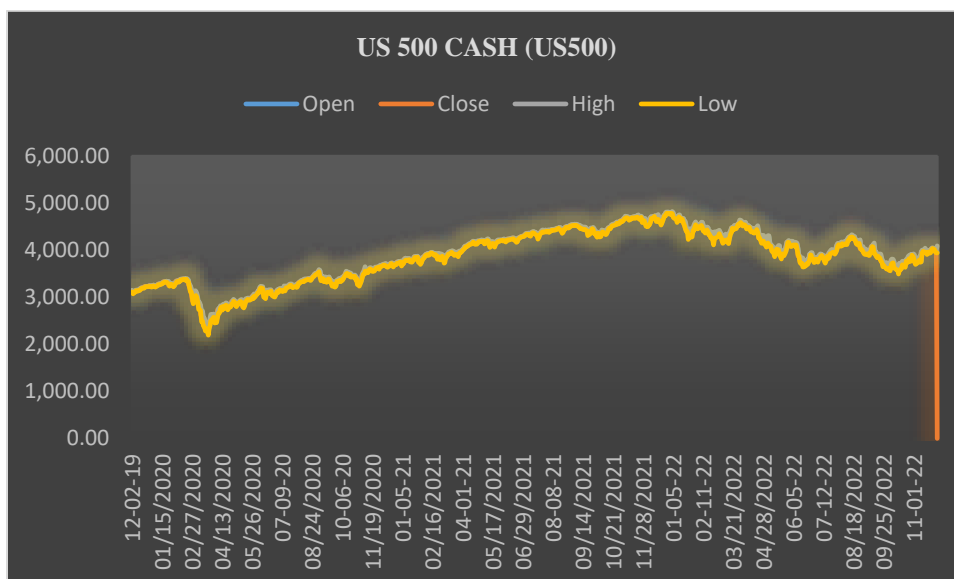
US 500 CASH (US500)

Figure 3

The graph 2 is showing the performance of Attock Petroleum Limited (APL), a firm registered in oil and gas marketing firms in KSE-100 index in the Pakistan Stock Exchange. A huge dip can has been marked in the graph that is showing the decline of the firm (APL) after the first case of corona virus (COVID-19) in Pakistan similar to the case in the KSE-100 index graph and the second line marked is the start of Russian-Ukraine war and there is a slight dip not as intense as of COVID-19 in the performance of (APL) on the Pakistan Stock Exchange (PSX).

The graph 3 is showing he trend of US500 index and we can see a sharp dip in the February 2020, i.e. the time when corona virus pandemic started to spread out.

1.3. International Stock Markets

And coming towards the international stock market, effects of corona virus on stock markets and economies, almost all the stock markets and economies faced a decline during the time period of the corona virus. The Russian-Ukraine war also had its effects but they were not as severe as the effects of the corona virus.
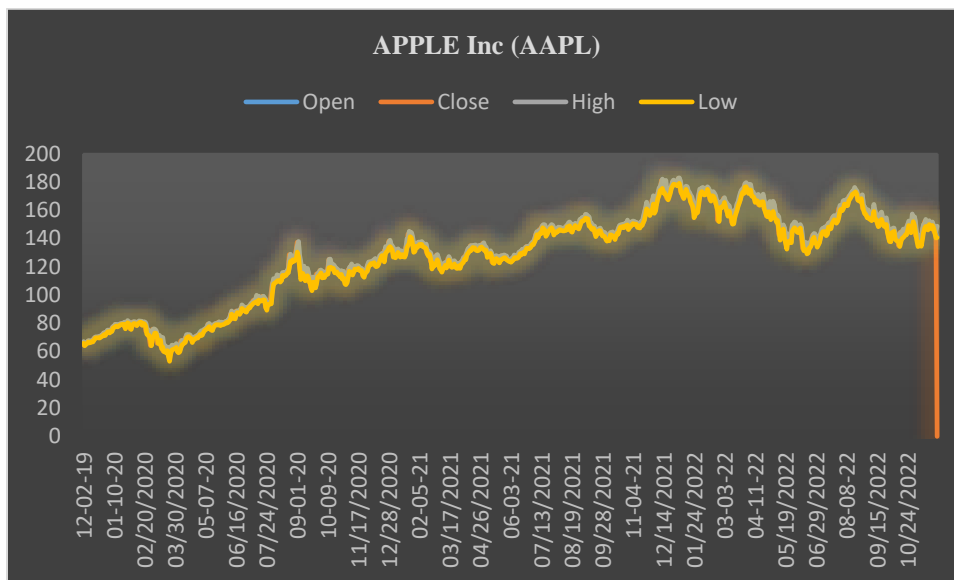

Figure 4

The above graph is of Apple (AAPL) and similar trend is also shown in this graph like the above graphs at the time of COVID-19 and a slight dip at time Russian-Ukraine war.

1.4. Problem Statement

To study the spillover effects from oil and gas exploration firms to oil and gas marketing firms registered in KSE-100 index of Pakistan Stock Exchange (PSX).

1.5. Hypothesis

H_o: there is no spillover between the selected firms.
H_1: there is spillover between the selected firms.

2. Literature Review

Amir et.al (2020) analyzed the impact of COVID-19 Pandemic on the financial performance of firms listed on the Pakistan Stock Exchange (PSX). The COVID-19 pandemic is acknowledged in this analysis as posing a significant risk to the world economy. And this current ailment spread to every nation save one. Additionally, this study examines how the COVID-19 has affected enterprises that are listed on the PSX in an effort to quantify the economic effects. The State Bank's financial statement analysis for 2019 and 2020 was used to generate the secondary data on study variables, which included information on 267 non-financial listed companies on the Pakistan Stock Exchange. The research population was 498 non-financial listed companies as on June 30, 2020. The companies were selected randomly on a non-probability basis for the sample. A total of 534 observations were made for 2 years. For this research Wilcoxon Signed Rank Test was used for data analysis using SPSS on the pattern. The study's findings suggest that both profitability and return on assets (ROA) have decreased. The COVID-19 is having a negative impact on the financial results of the businesses and corporations listed on the Pakistan Stock Exchange (PSX), as evidenced by the negative ROA. The outcome also shows a rise in the overall level of debt and the debt to equity ratio (DER).
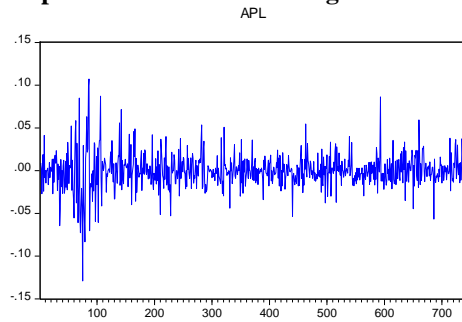
Graphs of Return Series: Figure 5

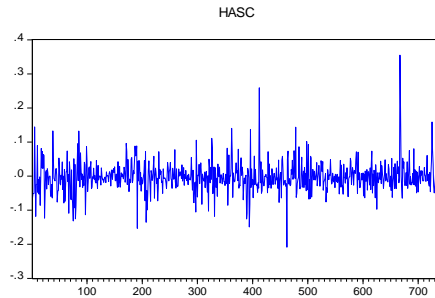APL

Figure a

HASC

Figure b

HITE

Figure c

PSO

Figure d

SHEL

Figure e

MGAS

Figure f

PPL

Figure g

PKOL

Figure h

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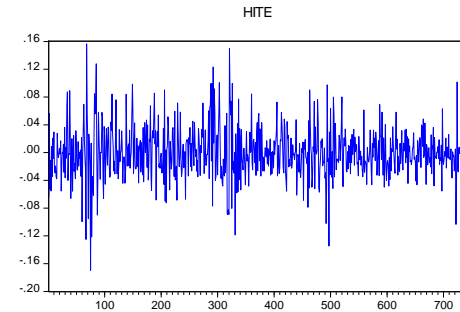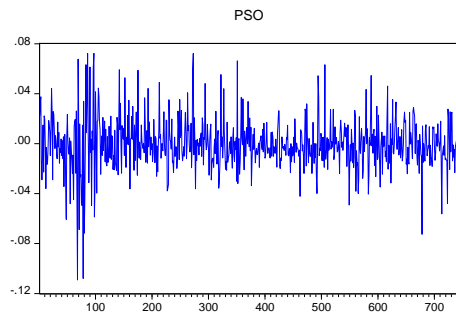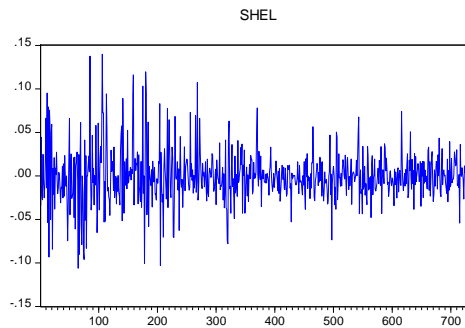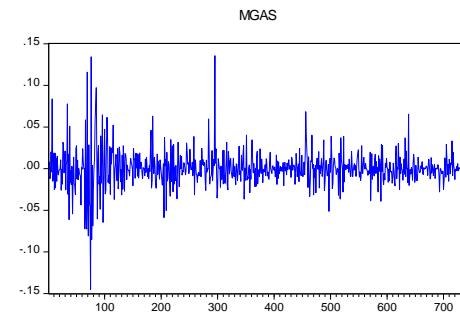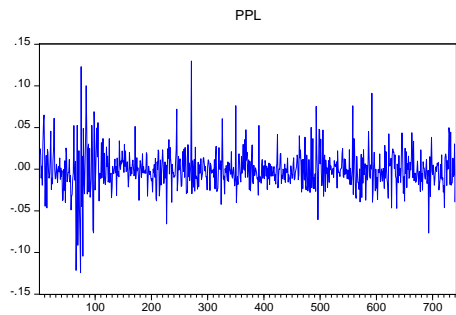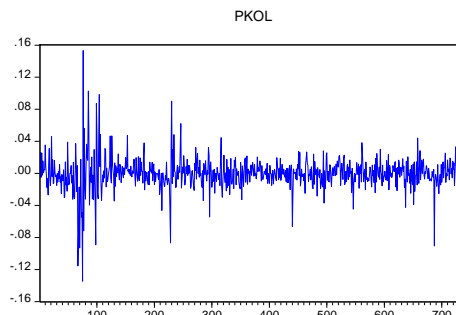
Graphs of Close Prices: Figure 6

APL

Figure a

HASC

Figure b

HITE

Figure c

PSO

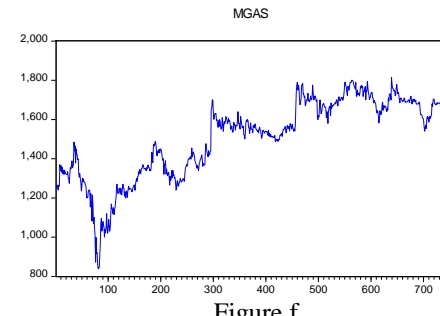

Figure d
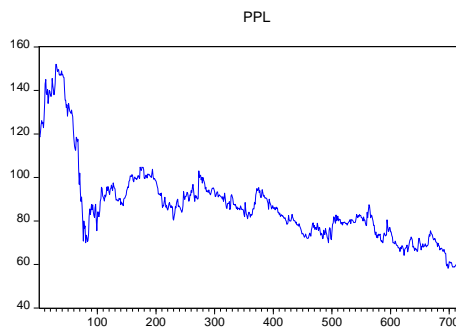
SHEL

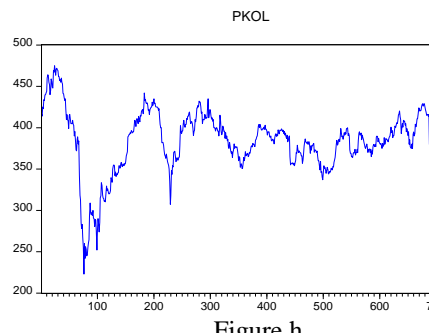

Figure e

MGAS

Figure f

PPL

Figure g

PKOL

Figure h

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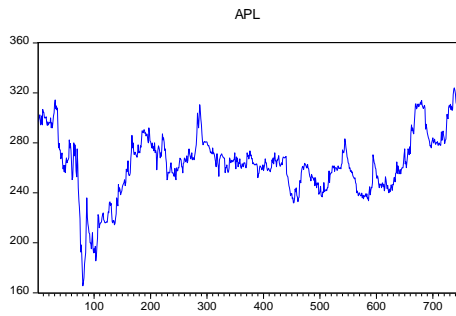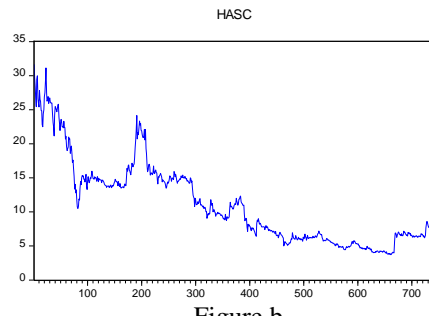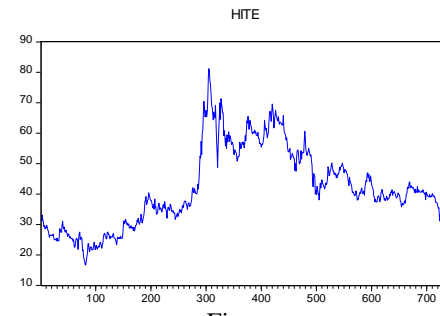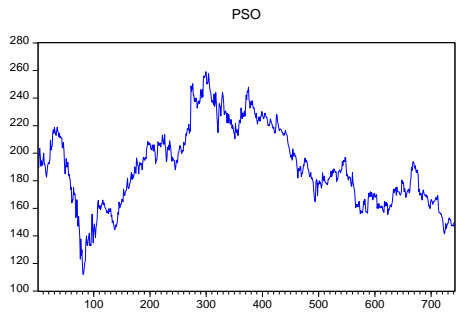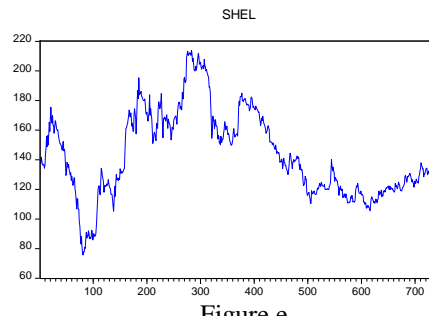
Khan and Ullah (2021) examined the post COVID-19 financial distress I Pakistan. Prediction of corporate defaults in Pakistan Stock Exchange. This study indicates that the global economy has slowed down as a result of the COVID-19 epidemic. In this study, the degree of financial hardship among the companies that trade on the Pakistan Stock Exchange (PSX) and make up the KSE 30 index was estimated. The information was gathered using the financial statements for 2019–20 and 2020–21. The data has been gathered primarily from secondary data in form of published financial statements of the KSE-30 index leading firms listed at PSX. And the test applies is Altman's Z-score. This test is used as a default prediction mechanism to anticipate the post Covid-19 defaults. And the results of Altman's Z-score test are showing a significant increase in the degree of the financial distress, which may lead to an increase in the number of corporate defaults for the firms that are registered in the Pakistan Stock Exchange.

Jabeen et.al (2022) studied the COVID and World Stock Markets: A comprehensive study. According to this analysis, the COVID-19 pandemic has broken out and disrupted the global economic environment. Additionally, there was a significant loss for stock markets all around the world. Additionally, all financial organizations were forcibly compelled to lower their projected growth in 2020, the year of the COVID-19 pandemic. The current study examines how the COVID-19 epidemic has affected international stock markets. And the effect of previous and current pandemics is also checked. And the findings conclude that majority of the world stock markets have suffered trillion dollar loss. And record declined was recorded in the global stock markets. In March, 2020 there was an unusual drop in worldwide indices like, S&P 500 Index, NASDAQ, NIKKEI, SSE composite, CAC-40; DAX etc

Riaz et.al (2020) examined the Determinants of Stock Market Investors' Behavior in COVID-19: A study on Pakistan Stock Exchange. Based on the behavioral dimensions, this study investigates the impact of COVID-19 on businesspeople and the Pakistan Stock Exchange. This study was conducted to look into the factors that affected how stock market investors behaved in Pakistan during the COVID-19 outbreak. The questionnaires for this study were provided electronically to the enterprises listed on PSX, and the firms then gave the surveys to their investors. It was discovered that 167 questionnaires were 100 percent valid. The findings and conclusions of this study indicate that individual investors at the Pakistan Stock Exchange (PSX) are sufficiently confident to make investments using their knowledge and expertise under challenging circumstances in order to realize good returns on their investments. During uncertain conditions, overconfidence provides an advantageous boost for investors to wrap up unexpected and difficult activities and helps in forecasting trends. The overconfident traders underestimate the risks related to active stock investments, causing repeated losses.

Ahmed (2020) studied the impact of COVID-19 on Performance of Pakistan Stock Exchange. The objective of this study is to study the performance of the Pakistan Stock Exchange (PSX) during the period of COVID-19 pandemic. The objective of this research is to determine the response of the Pakistani stock market against the COVID-19 pandemic that how the performance of the market was influenced.COVID-19 disease has jolted the global economy and financial markets since the great depression. The data used in this study comprises of COVID-19 related positive cases, recovers, fatalities, and the closing prices of PSX-100 index. The data of the study has been obtained from two different sources. The daily closing prices of the index have been obtained from the PSX (Pakistan Stock Exchange) data portals. The information of COVID-19 cases has been obtained from the official portal of Government of Pakistan regarding COVID-19. The data of the first half of 2020 has been obtained on a daily basis from these sources. The findings of the study suggest that only COVID-19 recoveries are a strong predictor of the performance of the stock market and positive cases and fatalities have a non-significant relationship with the performance of the market.

Sohail et.al (2020) did An Exploratory Study to Check the Impact of COVID-19 on Investment Decision of Individual Investors in Emerging Stock Market. This research study aims at the purpose of finding out the factors that are affecting the investment behavior of the investors during the time of COVID-19 pandemic. Purposive sampling technique was used in the study by the researchers. To get sights from the respondents, semi-structured interviews were held with the help of electronic means. The findings of this research study shows that economic and political stability are the most considerable factors for stock selection process. The findings also demonstrate that the most significant determinants of individual investors' decisions are market and personal considerations. The study's findings also demonstrate that during COVID-19, investors cautiously invest in the market by relying on their own knowledge and broker recommendations. The findings also demonstrated that decisions regarding equality were unaffected by religious convictions, social standing, "getting rich quick" and family members' opinions.

Kalsoom et.al (2021) analyzed the Stock Market Flexibility during COVID-19 Pandemic: evidence from Pakistan. The purpose of study is to examine the impact of Corona Virus pandemic disease on the forex market, stock market, and the gold market of Pakistan. From 10 March 2020 to 16 October 2020, gold prices, stock indexes, foreign exchange rates, and daily confirmed COVID-19 instances were all collected and utilized in this study. The study analysis unveils that the stock market adversely responds to a pandemic, whereas, forex and gold markets serve as a safe haven for investors at the time of financial distress. Additionally, the authors observe the price hikes in gold and foreign currency corresponding to the number of COVID-19 positive cases.

3. Research Methodology

The data used for this study is collected of the oil and gas companies of Pakistan Stock Exchange KSE-100 index from the time period of 30th November 2019 to 30th November 2022.

3.1. Source

This data is collected from investing.com.

3.2. Type of Study

A secondary and qualitative type of study is conducted over the collected data.

3.3. Software
Eviews 10 software is used in this study.
3.4. Technique
ARCH-GARCH model is run on the collected data.

The series close price is trendy in nature and it is quite impossible to measure and estimate a robust model if the given series is trendy. To deal with the trend and stuff we use the log difference return.

$R_t = log_e (l_t / l_{t-1})$

l_t = Financial time series at level i.e. stock indices and exchange rates at the end of time t.

l_{t-1} = First lag of financial time series.

ARCH (q) model

Mean Equation

$R_t = \alpha_0 + \beta X_t + \varepsilon_t$

Variance Equation

$\sigma_t^2 = \theta_0 + \sum_{i=1}^{q} \epsilon_{t-1}^2$

GARCH (p q) model

Mean Equation

$R_t = \alpha_0 + \beta X_t + \varepsilon$

Variance Equation

$\sigma_t^2 = \theta_0 + \sum_{i=1}^{q} \theta_I \varepsilon_{t-1}^2 + \sum_{i=1}^{p} \varphi_j \sigma_{t-1}^2$

4. Results and Interpretations
4.1. Results of Augmented Dickey-Fuller Test

Table 1

APL	
P-Value	0.0000

The P-Value of return series of APL is 0.0000 in the Augmented Dickey-Fuller Test and H_1 is accepted and H_0 is rejected and the return series of APL is stationary at level.

Table 2

HASC	
P-Value	0.0000

The P-Value of return series of HASC is 0.0000 in the Augmented Dickey-Fuller Test and H_1 is accepted and H_0 is rejected and the return series of HASC is stationary at level.

Table 3

*HITE	
P-Value	0.0000

The P-Value of return series of HITE is 0.0000 in the Augmented Dickey-Fuller Test and H_1 is accepted and H_0 is rejected and the return series of HITE is stationary at level.

Table 4

PSO	
P-Value	0.0000

The P-Value of return series of PSO is 0.0000 in the Augmented Dickey-Fuller Test and H_1 is accepted and H_0 is rejected and the return series of PSO is stationary at level.

Table 5

SHEL	
P-Value	0.0000

The P-Value of return series of SHEL is 0.0000 in the Augmented Dickey-Fuller Test and H_1 is accepted and H_0 is rejected and the return series of SHEL is stationary at level.

Table 6

MGAS	
P-Value	0.0000

The P-Value of return series of MGAS is 0.0000 in the Augmented Dickey-Fuller Test and H_1 is accepted and H_0 is rejected and the return series of MGAS is stationary at level.

Table 7

PKOL	
P-Value	0.0000

The P-Value of return series of PKOL is 0.0000 in the Augmented Dickey-Fuller Test and H_1 is accepted and H_0 is rejected and the return series of PKOL is stationary at level.

Table 8

PPL	
P-Value	0.0000

The P-Value of return series of PPL is 0.0000 in the Augmented Dickey-Fuller Test and H_1 is accepted and H_0 is rejected and the return series of PPL is stationary at level.

Table 9

MGAS_2	
P-Value	0.0000

The P-Value of square of return series of MGAS that is MGAS_2 is 0.0000 in the Augmented Dickey-Fuller Test and H_1 is accepted and H_0 is rejected and the square of return series of MGAS that is PKOL_2 is stationary at level.

Table 10

PKOL_2	
P-Value	0.0001

The P-Value of square of return series of PKOL that is PKOL_2 is 0.0001 in the Augmented Dickey-Fuller Test and H_1 is accepted and H_0 is rejected and the square of return series of PKOL that is PKOL_2 is stationary at level.

Table 11

PPL_2	
P-Value	0.0000

The P-Value of square of return series of PPL that is PPL_2 is 0.0000 in the Augmented Dickey-Fuller Test and H_1 is accepted and H_0 is rejected and the square of return series of PPL that is PPL_2 is stationary at level.

Table 12

FROM MGAS TO APL			
	Variable	Coefficient	P-Value
Mean Equation	MGAS	0.2030	0.0000
Variance Equation	MGAS_2	0.1235	0.0001

4.2. Results of ARCH-GARCH MODEL

As we can see return series of MGAS is significant in Mean Equation of return series of APL with a P-value of 0.0000 which is smaller than 0.05 at 5 percent significance which means H_1 will be accepted and H_0 will be rejected and in Variance Equation of

return series of APL, MGAS_2 which is square of return series of MGAS is significant with a P-value of 0.0002 which is smaller than 0.05 at 5 percent significance level which means H_1 will be accepted and H_0 will be rejected. So, as both are significant we can say that there is Mean spillover and Volatility spillover from MGAS to APL. The Value of R^2 is 0.086509.

Table 13

	Variable	Coefficient	P-Value
FROM MGAS TO HASC			
Mean Equation	MGAS	0.4382	0.0000
Variance Equation	MGAS_2	0.2223	0.0698

As we can see return series of MGAS is significant in Mean Equation of return series of HASC with a P-value of 0.0000 which is smaller than 0.05 at 5 percent significance which means H_1 will be accepted and H_0 will be rejected and in Variance Equation of return series of HASC, MGAS_2 which is square of return series of MGAS is not significant with a P-value of 0.0698 which is greater than 0.05 at 5 percent significance level which means H_0 will be accepted and H_1 will be rejected. So after seeing the P-values in the Mean Equation and Variance Equation, we can say that there is Mean spillover from MGAS to HASC but in Variance Equation MGAS_2 is not significant and there is no Volatility spillover from MGAS to HASC. The value of R^2 is 0.031809.

Table 14

	Variable	Coefficient	P-Value
FROM MGAS TO HITE			
Mean Equation	MGAS	0.5173	0.0000
Variance Equation	MGAS_2	0.1767	0.0076

As we can see return series of MGAS is significant in Mean Equation of return series of HITE with a P-value of 0.0000 which is smaller than 0.05 at 5 percent significance which means H_1 will be accepted and H_0 will be rejected and in Variance Equation of return series of HITE, MGAS_2 which is square of return series of MGAS is significant with a P-value of 0.0076 which is smaller than 0.05 at 5 percent significance level which means H_1 will be accepted and H_0 will be rejected. So, as both are significant we can say that there is Mean spillover and Volatility spillover from MGAS to HITE. The value of R^2 is 0.096601.

Table 15

	Variable	Coefficient	P-Value
FROM MGAS TO PSO			
Mean Equation	MGAS	0.1134	0.0098
Variance Equation	MGAS_2	0.0424	0.0011

As we can see return series of MGAS is significant in Mean Equation of return series of PSO with a P-value of 0.0098 which is smaller than 0.05 at 5 percent significance which means H_1 will be accepted and H_0 will be rejected and in Variance Equation of return series of PSO, MGAS_2 which is square of return series of MGAS is significant with a P-value of 0.0011 which is smaller than 0.05 at 5 percent significance level which means H_1 will be accepted and H_0 will be rejected. So, as both are significant we can say that there is Mean spillover and Volatility spillover from MGAS to PSO. The value of R^2 is 0.204058.

Table 16

	Variable	Coefficient	P-Value
FROM MGAS TO SHEL			
Mean Equation	MGAS	0.3693	0.0000
Variance Equation	MGAS_2	0.1471	0.0011

As we can see return series of MGAS is significant in Mean Equation of return series of SHEL with a P-value of 0.0000 which is smaller than 0.05 at 5 percent significance which means H_1 will be accepted and H_0 will be rejected and in Variance Equation of return series of SHEL, MGAS_2 which is square of return series of MGAS is significant with a P-value of 0.0001 which is smaller than 0.05 at 5 percent significance level which means H_1 will be accepted and H_0 will be rejected. So, as both are significant we can say that there is Mean spillover and Volatility spillover from MGAS to SHEL. The value of R^2 is 0.1016611.
As we can see return series of PKOL is significant in Mean Equation of return series of APL with a P-value of 0.0000 which is smaller than 0.05 at 5 percent significance which means H_1 will be accepted and H_0 will be rejected and in Variance Equation of

return series of APL, PKOL_2 which is square of return series of PKOL is significant with a P-value of 0.0002 which is smaller than 0.05 at 5 percent significance level which means H_1 will be accepted and H_0 will be rejected. So, as both are significant we can say that there is Mean spillover and Volatility spillover from PKOL to APL. The value of R^2 is 0.126851.

Table 17

	Variable	Coefficient	P-Value
	FROM PKOL TO APL		
Mean Equation	PKOL	0.2932	0.0000
Variance Equation	PKOL_2	0.1681	0.0000

Table 18

	Variable	Coefficient	P-Value
	FROM PKOL TO HASC		
Mean Equation	PKOL	0.6711	0.0000
Variance Equation	PKOL_2	0.0234	0.6859

As we can see return series of PKOL is significant in Mean Equation of return series of HASC with a P-value of 0.0000 which is smaller than 0.05 at 5 percent significance which means H_1 will be accepted and H_0 will be rejected and in Variance Equation of return series of HASC, PKOL_2 which is square of return series of PKOL is not significant with a P-value of 0.6859 which is greater than 0.05 at 5 percent significance level which means H_0 will be accepted and H_1 will be rejected. So after seeing the P-values in the Mean Equation and Variance Equation, we can say that there is Mean spillover from PKOL to HASC but in Variance Equation PKOl_2 is not significant and there is no Volatility spillover from PKOL to HASC. The value of R^2 is 0.0924.

Table 19

	Variable	Coefficient	P-Value
	FROM PKOL TO HITE		
Mean Equation	PKOL	0.5474	0.0000
Variance Equation	PKOL_2	0.1253	0.0105

As we can see return series of PKOL is significant in Mean Equation of return series of HITE with a P-value of 0.0000 which is smaller than 0.05 at 5 percent significance which means H_1 will be accepted and H_0 will be rejected and in Variance Equation of return series of HITE, PKOL_2 which is square of return series of PKOL is significant with a P-value of 0.0105 which is smaller than 0.05 at 5 percent significance level which means H_1 will be accepted and H_0 will be rejected. So, as both are significant we can say that there is Mean spillover and Volatility spillover from PKOL to HITE. The value of R^2 is 0.120270.

As we can see return series of PKOL is significant in Mean Equation of return series of PSO with a P-value of 0.0000 which is smaller than 0.05 at 5 percent significance which means H_1 will be accepted and H_0 will be rejected and in Variance Equation of return series of PSO, PKOL_2 which is square of return series of PKOL is significant with a P-value of 0.003 which is smaller than 0.05 at 5 percent significance level which means H_1 will be accepted and H_0 will be rejected. So, as both are significant we can say that there is Mean spillover and Volatility spillover from PKOL to PSO. The value of R^2 is 0.0369.

Table 20

	Variable	Coefficient	P-Value
	FROM PKOL TO PSO		
Mean Equation	PKOL	0.2152	0.0000
Variance Equation	PKOL_2	0.1357	0.0001

Table 21

	Variable	Coefficient	P-Value
	FROM PKOL TO SHEL		
Mean Equation	PKOL	0.4921	0.0000
Variance Equation	PKOL_2	0.0729	0.0204

As we can see return series of PKOL is significant in Mean Equation of return series of SHEL with a P-value of 0.0000 which is smaller than 0.05 at 5 percent significance which means H_1 will be accepted and H_0 will be rejected and in Variance Equation of return series of SHEL, PKOL_2 which is square of return series of PKOL is significant with a P-value of 0.0204 which is smaller

than 0.05 at 5 percent significance level which means H_1 will be accepted and H_0 will be rejected. So, as both are significant we can say that there is Mean spillover and Volatility spillover from PKOL to SHEL. The value of R^2 is 0.1326.

Table 22

FROM PPL TO APL

	Variable	Coefficient	P-Value
Mean Equation	PPL	0.1115	0.0022
Variance Equation	PPL_2	0.0632	0.0000

As we can see return series of PPL is significant in Mean Equation of return series of APL with a P-value of 0.0022 which is smaller than 0.05 at 5 percent significance which means H_1 will be accepted and H_0 will be rejected and in Variance Equation of return series of APL, PPL_2 which is square of return series of PPL is significant with a P-value of 0.0000 which is smaller than 0.05 at 5 percent significance level which means H_1 will be accepted and H_0 will be rejected. So, as both are significant we can say that there is Mean spillover and Volatility spillover from PPL to APL.

Table 23

FROM PPL TO HASC

	Variable	Coefficient	P-Value
Mean Equation	PPL	0.1402	0.0986
Variance Equation	PPL_2	0.2160	0.0208

As we can see return series of PPL is not significant in Mean Equation of return series of HASC with a P-value of 0.0986 which is greater than 0.05 at 5 percent significance which means H_0 will be accepted and H_1 will be rejected and in Variance Equation of return series of HASC, PPL_2 which is square of return series of PPL is significant with a P-value of 0.0208 which is smaller than 0.05 at 5 percent significance level which means H_1 will be accepted and H_0 will be rejected. After seeing the P-values we can say that there is Volatility spillover effect from PPL to HSAC but there is no Mean spillover effect from PPL to HASC.

Table 24

FROM PPL TO HITE

	Variable	Coefficient	P-Value
Mean Equation	PPL	0.1559	0.0186
Variance Equation	PPL_2	0.2160	0.0020

As we can see return series of PPL is significant in Mean Equation of return series of HITE with a P-value of 0.0186 which is smaller than 0.05 at 5 percent significance which means H_1 will be accepted and H_0 will be rejected and in Variance Equation of return series of HITE, PPL_2 which is square of return series of PPL is significant with a P-value of 0.0020 which is smaller than 0.05 at 5 percent significance level which means H_1 will be accepted and H_0 will be rejected. So, as both are significant we can say that there is Mean spillover and Volatility spillover from PPL to HITE.

Table 25

FROM PPL TO PSO

	Variable	Coefficient	P-Value
Mean Equation	PPL	0.0237	0.0051
Variance Equation	PPL_2	0.1582	0.0000

As we can see return series of PPL is significant in Mean Equation of return series of PSO with a P-value of 0.0051 which is not greater than 0.05 at 5 percent significance which means H_1 will be accepted and H_0 will be rejected and in Variance Equation of return series of PSO, PPL_2 which is square of return series of PPL is significant with a P-value of 0.0000 which is smaller than 0.05 at 5 percent significance level which means H_1 will be accepted and H_0 will be rejected. After seeing the P-values we can say that there is Mean and Volatility spillover effect from PPL to PSO but there is no Mean spillover effect from PPL to PSO.
As we can see return series of PPL is not significant in Mean Equation of return series of SHEL with a P-value of 0.2384 which is greater than 0.05 at 5 percent significance which means H_0 will be accepted and H_1 will be rejected and in Variance Equation of return series of SHEL, PPL_2 which is square of return series of PPL is significant with a P-value of 0.0001 which is smaller than 0.05 at 5 percent significance level which means H_1 will be accepted and H_0 will be rejected. After seeing the P-values we can say that there is Volatility spillover effect from PPL to SHEL but there is no Mean spillover effect from PPL to SHEL.

Table 26

	Variable	Coefficient	P-Value
FROM PPL TO SHEL			
Mean Equation	PPL	0.0602	0.2384
Variance Equation	PPL_2	0.1352	0.0001

4.3. Results of ARCH-LM Test

Table 27

FROM MGAS TO APL	
P-Value	0.6694

The P-value is 0.6694 and the ARCH-LM test is insignificant hence there is no heteroskedasticity.

Table 28

FROM MGAS TO HASC	
P-Value	0.7848

The P-value is 0.7848 and the ARCH-LM test is insignificant hence there is no heteroskedasticity

Table 29

FROM MGAS TO HITE	
P-Value	0.8193

The P-value is 0.8193 and the ARCH-LM test is insignificant hence there is no heteroskedasticity.

Table 30

FROM MGAS TO PSO	
P-Value	0.1595

The P-value is 0.1595 and the ARCH-LM test is insignificant hence there is no heteroskedasticity.

Table 31

FROM MGAS TO SHEL	
P-Value	0.9507

The P-value is 0.9507 and the ARCH-LM test is insignificant hence there is no heteroskedasticity.

Table 32

FROM PKOL TO APL	
P-Value	0.9714

The P-value is 0.9714 and the ARCH-LM test is insignificant hence there is no heteroskedasticity.

Table 33

FROM PKOL TO HASC	
P-Value	0.7082

The P-value is 0.7082 and the ARCH-LM test is insignificant hence there is no heteroskedasticity.

Table 34

FROM PKOL TO HITE	
P-Value	0.8718

The P-value is 0.8718 and the ARCH-LM test is insignificant hence there is no heteroskedasticity.

Table 35	
FROM PKOL TO PSO	
P-Value	0.7805

The P-value is 0.7805 and the ARCH-LM test is insignificant hence there is no heteroskedasticity.

Table 36	
FROM PKOL TO SHEL	
P-Value	0.4846

The P-value is 0.4846 and the ARCH-LM test is insignificant hence there is no heteroskedasticity.

Table 37	
FROM PPL TO APL	
P-Value	0.9821

The P-value is 0.9821 and the ARCH-LM test is insignificant hence there is no heteroskedasticity.

Table 38	
FROM PPL TO HASC	
P-Value	0.6749

The P-value is 0.6749 and the ARCH-LM test is insignificant hence there is no heteroskedasticity.

Table 39	
FROM PPL TO HITE	
P-Value	0.6339

The P-value is 0.6339 and the ARCH-LM test is insignificant hence there is no heteroskedasticity.

Table 40	
FROM PPL TO PSO	
P-Value	0.4160

The P-value is 0.4160 and the ARCH-LM test is insignificant hence there is no heteroskedasticity.

Table 15	
FROM PPL TO SHEL	
P-Value	0.1139

The P-value is 0.1139 and the ARCH-LM test is insignificant hence there is no heteroskedasticity.

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