Modelling the Empirical Impact of Oil Prices Volatility on Stock Exchanges: A Case of A Developing Nation

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Abstract

Petroleum products are considered one of the most important factors affecting any economy around the globe. That is why any change in its prices affects all other economic variables. Furthermore, the health of any given stock of the organization reflects the investor's trust and belief in the good performance of the organization. The study is an effort to gauge the impact of change in oil prices. The aim of the study is to measure the magnitude of the relationship between the volatility of local oil selling prices fixed by the government versus the change in stock prices of the oil marketing companies. The given study based on the secondary data aims to examine the impact of change in Petrol a.k.a. Premier Motor Gasoline (PMG) and Diesel a.k.a. High-Speed Diesel (HSD) prices from Jan 2019 to Feb 2022. Since the nature of the study is quantitative, therefore deductive approach has been used. The data has been extracted from OGRA price notification for the oil prices within the country and Share prices (PSO, HASCOL, SHELL & ATTOCK) has been extracted from Pakistan Stock exchange's website for the given period whereas the regression method has been used on E View, a statistical software. From the results, it is found that price change in Petrol (PMG) and Diesel (HSD) has significant impact on share prices of PSO and HASCOL scrips on given trading day. Further, the price change of PMG positively affects PSO shares however, it negatively effects HASCOL scrips. Similarly, any price change in HSD negatively affects PSO share prices on a given trading day. It is also evident that there is no significant impact on oil price change on the scrips of SHELL and APL.

Keywords: *Oil Prices; Stock Exchange; Petrol; Diesel; Pakistan*

Introduction

Oil and gas sector is huge in size and one of the most intricate industries globally. One that has an impact on everyday lives of people across the globe with its use in logistics, transport, energy, lubricants, chemicals, pharmaceuticals, plastics and a wide range of petrochemical

products. Europe and Asia derive 32% of their energy from petroleum, while Middle East's 53%, North America's 40%, Africa's 41% and South and Central America's 44% of energy consumption if from Petroleum (Seroney et al, 2019). The industry can be bifurcated into three stages of value chain including upstream is where the exploration and the extraction of oil takes place, midstream is where transportation, processions and storage of crude takes place and downstream concerns the refining and purifying for the use in different end products ranging from gasoline for vehicles to plastics and various other chemicals (AlJanabi, 2020).

As per the reports published by OCAC (2021), oil consumption is 437.34 barrels/day as of 2020 in Pakistan and has many players in the supply chain, the downstream players play a pivotal role in the functioning of the economies worldwide. Where refineries have to continuously fulfill demand of the other industries, it is the petrol products (that include gasoline/petrol, kerosene, diesel, liquified petroleum gas, fuel oil, jet fuel, furnace oil and lubricants) that drive the majority of the demand for these refineries and the key job of distribution of these product lies with the Oil Marketing Companies, commonly referred to as OMCs. OMCs market and sell black oil which includes furnace oil, lubricants and greases, and white oil which includes gasoline, high speed diesel, jet fuel, kerosene and light diesel oil. OMCs play a pivotal role in the functioning of the overall supply chain of many industries, transportation and energy sectors having a heavy reliance on their operations among many other industries which naturally makes them entities of high importance for functioning of the economy.

In Pakistan, 59 OMCs have been granted licenses while 28 are conducted their operations. Out of which five major players constitute 80% of the market share and the state-owned Pakistan State Oil (PSO), although declining, has the lion's share of the industry. Other players namely, Total Parco Pakistan, HASCOL Petroleum, Mattock Petroleum and Shell rank among the industry leaders (Taimoor et. Al, 2020). On the other hand, the share markets across the globe are viewed as a mark of any given country performance with respect to its economy. For example, a negative change in stock prices can lead to financial disruption by reducing the income of any household as well as the investors become more careful in making more investment that leads to decrease in consumer spending.

The nexus between share markets and international oil prices has been given much attention in recent decades. For instance, International Energy Agency forecasted that the oil will be comprised of 30% of the global energy mix in 2030 (IEA, 2017). The potential risks and returns related with the oil price are volatile in nature and it sometimes disrupt portfolio of many investors. There are studies being carried out in the given area of change in oil prices and its effects on stock markets using the theoretical framework of Efficient Market Hypothesis (EMH) (Salisu & Oloko, 2015). In general, the available literature discusses that an increase in oil price

can lead a blunting effect on share market by decreasing the economic growth rate, uplifting the raw material price therefore decreasing the company's revenue and increasing consumer prices as a whole.

Literature Review

Much research have investigated the association between oil price volatility and its impact on economic models like GDP, foreign exchange rates as well as share prices and share returns. Sadorsky (1999) investigated empirically using Vector Auto Regressive technique to find the association between the change in international oil prices as well as the given economic models where the study found out that any change in oil prices affects the return on shares. Similar work carried out by Kilian & Park (2009) which comprises on the retort of USA's share price to the stocks in oil prices, where they reported that response of share prices is contingent on the fluctuation in oil price.

Recent quantitative studies in the area i.e., change in oil prices and fluctuation in stock market shares has received great attention very recently. However, most of the studies has been carried out in developed economies like United States, Australia, United Kingdom, Canada, and countries from Europe (Wei et al., 2019). For example, a study conducted by Diaz et al. (2017) studied the nexus between oil prices changes and returns on share market on G7 countries which stated that any change in oil prices lead to negative impact on share markets. Another empirical study conducted by Wei et al. (2019) in China showed that oil market has considerable effect on Chinese share markets through direct and indirect approaches on macroeconomic canvas.

Similar work has been reported by Kelikume & Muritala (2019) using quarterly data from various producing countries with share market from 2010 to 2018 using dynamic panel analysis technique having share returns, real GDP, foreign exchange rate and OPEC basket price in underdeveloped region of Africa which revealed that real GDP has a positive impact on African share markets and also confirmed that economic growth positively impact the stock prices in oil dependent economies.

A recent study by Alqahtani (2019) on GCC share market using ARMA-DCC approach reveals that GCC share returns are negatively affected by any change in oil prices. The given study also found out that the effect of oil price fluctuation and uncertainty differs across various GCC members. On the other hand, it has been also studied that any fluctuation in oil prices have a positive but insignificant impact on share market returns in short as well as long run however, the inflation is having a significant impact in short on the stock market of African region (Anyalechi, 2019). Further studies carried out during pandemic time using daily stock market data and

applying the DCC-GARCH model also reveals that there is a positive co-movement between returns on oil prices and share prices (Prabheesh et al.,2020).

Few of the research are carried out through time series on the integration of oil prices and share market prices including Ekong & Ebong (2016) in Africa, Echchabi & Azouzi (2017) in Middle east and similarly by Kapusuzoglu (2011) in Turkey; which states a kind of similar results that oil prices is an impact driver in explaining share market returns. However, Maboudian & Seyyed (2015) employed a VAR approach to gauge the response of share price to a variation in oil price using vertical integration of oil supply, along with demand aggregation and hence concluded that oil supply variation is insignificant in amplification of changes in share market.

Pakistan Stock Exchange (PSX) is a central stock market exchange in Pakistan. Established in 1960 having listed only 5 companies initially with paid-up capital of Rs 37 million only. Few years later, there were 81 companies having a market capitalization of Rs 1.8 billion and currently it is having 531 companies on board with a cap of Rs 7.68 trillion. There are 36 sectors and Oil & Gas marketing companies is one of the sectors which is taken under consideration for this study having 9 companies from the Oil as well as Gas industry of Pakistan.

Oil and Gas Regulatory Authority (OGRA) is a government organization that is responsible for the monitoring of the petroleum prices and petroleum products, and these prices of the petroleum products are decided based on the previous month's cargo of the Pakistan State Oil and then recommended by the OGRA and finally, it is approved by the Prime minister of Pakistan. While on a monthly basis or when required, the Ministry of Energy and Petroleum manages, controls also approve the planning of supply and demand to determine the shortfall of petroleum products and their import by allowing the permission of its import or otherwise to import by the allocation of the production of the local refineries, and the approval for the imports on which time (Zeb et al., 2017).

The nexus between change oil price and immediate change in the given share prices has been examined through a regression analysis by the given conceptual framework.

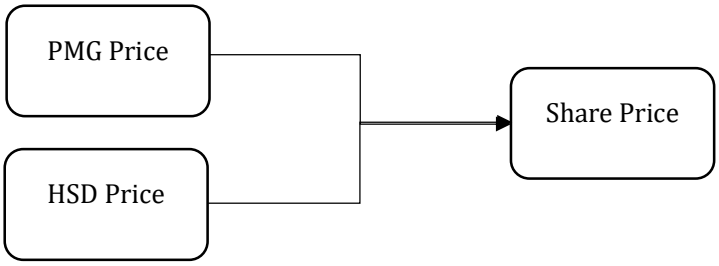

Figure 1: Conceptual Framework

Methodology

The data is based on secondary data comprised of fort-nightly data of oil prices of PMG and HSD duly set by Oil & Gas Regulatory Authority of Pakistan and the share prices of listed company including Pakistan State Oil (PSO), Shell (SHEL), Attock Petroleum Ltd (APL) and Hascol (HASCOL) for the period starting 1st Jan 2019 to 16th Feb 2022 having 34 observations.

Result and Discussion

Data Stationary Test

Augmented Dickey Fuller (ADF) is usually used to check the status of stationary of any given time series.

Table 1 Unit Root ADF Test Statistics

Variables	t-Statistics	P-values	Test Critical Values		
			1%	5%	10%
LPSOCP	0.032066	0.686			
LSHELLCP	-0.400375	0.5317			
LHASCOLCP	-2.947268	0.0045	-2.637	-1.95133	-1.61075
LAPLCP	0.029773	0.6839			
LPMGRP	0.943137	0.9035			
LHSDRP	0.449821	0.8054			

The given data from Jan 2019 to Feb 2022 are comprised of 34 observations therefore there is a need to check the cointegration. If it's existed, it will be in the state of equilibrium in the long run and hence our non-stationary regression will be meaningful. Furthermore, ADF test is also conducted on the error term, and it is revealed that the error(residual) term is stationary, which depicts that the data will remain in equilibrium in long run. Table 2 depicts the error term's probability value and t-statistics are significant.

Table 2 Unit Root ADF Test on ERR

Variable	t-Statistics	P-values	Test Critical Values		
			1%	5%	10%
ERR	-3.1844	0.0026	-2.6534	-1.95386	-1.60957

From the above table, it is evident that the data errors have no Unit root and are having critical p values therefore it can be considered as stationary in long run.

Multi collinearity Test

In the time series analysis, multi-collinearity can become a serious issue and can affect the regression results. To check the same, a test of Variance Inflation Factor (VIF) is usually employed. The same has been applied to the given set of data for each of the given equation.

Table 3 Variance Inflation Factor (PSO)

Sample	**Jan 2019 to Feb 2022**		
Observations	**34**		
Variable	**Co-efficient Variance**	**Uncentered VIF**	**Centered VIF**
C	0.366	1117.89	NA
LHSDRP	0.01705	11811.9	9.835
LPMGRP	0.1408	9658.14	9.835

Table 4 Variance Inflation Factor (HASCOL)

Sample	**Jan 2019 to Feb 2022**		
Observations	**34**		
Variable	**Co-efficient Variance**	**Uncentered VIF**	**Centered VIF**
C	3.263495	1117.888	NA
LHSDRP	1.520143	11811.87	9.735
LPMGRP	1.255484	9658.14	9.535

Table 5 Variance Inflation Factor (SHELL)

Sample	**Jan 2019 to Feb 2022**		
Observations	**34**		
Variable	**Co-efficient Variance**	**Uncentered VIF**	**Centered VIF**
C	1.79203	1117.89	NA
LHSDRP	0.83473	11811.9	9.535
LPMGRP	0.6894	9658.14	9.435

Table 6 Variance Inflation Factor (APL)

Sample	**Jan 2019 to Feb 2022**		
Observations	**34**		
Variable	**Co-efficient Variance**	**Uncentered VIF**	**Centered VIF**
C	0.366	1117.89	NA
LHSDRP	0.17048	11811.9	9.535
LPMGRP	0.1408	9658.14	9.635

From the above tables 3 to 6 it is revealed that the selected data is somewhat free from multi-collinearity i.e., having VIF values less than 10, therefore we can proceed to apply further tests on the same.

Heteroscedasticity

One of the basic assumptions of CLRM is that the variance of error term is constant, but in fact, this is not the case, and the model suffers from Heteroscedasticity. We can check the same through graphical representation of error terms but practically, it's not an obvious method to check the heteroscedasticity.

Table 7 of Heteroscedasticity

Null Hypothesis				
	F-Statistic	**2.5961**	***Prob. F (2,31)***	**0.0907**
LPSOCP	*Obs R²*	4.87768	*Prob. Chi Square (2)*	0.0873
	Scaled explained SS	3.28629	*Prob. Chi Square (2)*	0.1934
	F-Statistic	**4.6485**	***Prob. F (2,31)***	**0.0172**
LHASCOLCP	*Obs R²*	7.84423	*Prob. Chi Square (2)*	0.0198
	Scaled explained SS	13.3169	*Prob. Chi Square (2)*	0.0013
	F-Statistic	**5.3962**	***Prob. F (2,31)***	**0.0098**
LSHELLCP	*Obs R²*	8.78013	*Prob. Chi Square (2)*	0.0124
	Scaled explained SS	7.68073	*Prob. Chi Square (2)*	0.0215
	F-Statistic	**5.7918**	***Prob. F (2,31)***	**0.0073**
LAPLCP	*Obs R²*	9.24871	*Prob. Chi Square (2)*	0.0098
	Scaled explained SS	11.4239	*Prob. Chi Square (2)*	0.0033

In order to proceed with the OLS regression process, the data must be free from heteroscedasticity, therefore first difference has been taken and hence the problem is removed and now the model is fit for further regression tests. Above table 7 suggests that we are having p-values are the Heteroscedasticity result after taking the difference. We see the p-value of the F statistics which depicts that such issue has been resolved.

Autocorrelation

Autocorrelation is also a severe issue of the time series data. To detect the autocorrelation in the data set, we used the Breusch-Godfrey Serial Correlation LM Test. Below is table 8, which shows the Breusch-Godfrey test of the Serial Correlation LM Test result for the data set. The p-value for the f statics is very high, which shows that the data is free from the issue of autocorrelation.

Table 8 Autocorrelation

Null Hypothesis	**No serial correlation at up to 2 lags**			
LPSOCP	*F-Statistic*	15.1530	*Prob. F (2,29)*	0.0000
	Obs R²	17.3743	*Prob. Chi Square (2)*	0.0002
LHASCOLCP	*F-Statistic*	0.7262	*Prob. F (2,29)*	0.4923
	Obs R²	1.6215	*Prob. Chi Square (2)*	0.4445

LSHELLCP	*F-Statistic*	8.7830	*Prob. F (2,29)*	0.0010
	Obs R^2	12.8257	*Prob. Chi Square (2)*	0.0016
LAPLCP	*F-Statistic*	4.2897	*Prob. F (2,29)*	0.0233
	Obs R^2	7.7622	*Prob. Chi Square (2)*	0.0206

Regression Analysis

After eliminating all the problems, the data set is now good to go for OLS regression. Regression analysis has been conducted in statistical software EViews. Table 9 depict the findings excluding the first level difference. It is evident that the coefficient of HSD and PMG are significant in the case of PSO and HASCOL while insignificant in case of SHELL and APL having a p-value less than 0.05 and vice versa. It is also notice that the probabilities of the F statistics are also significant excluding the case of APL. i.e., the value is less than 0.05.

The R square value is relatively higher for HASCOL which is 0.758 which shows that 75.8% variation in the dependent variable HASCOL is due to the independent variables (PMG, and HSD). The coefficient of the PMG in case of HASCOL is 10.16, which means that the increase in HSD by 1% will increase the share of HASCOL by 10.16% however, in case of PSO, it will decrease by 1.56%. The sum of all the coefficients is less than one, which states a decreasing rate of the return scale. Further details of all co-efficient in all four cases are given below in Table 9.

Table 9 Regression Analysis

Dependent Variable	Variable	Co-efficient	Std. Error	t-Stat	Prob.	R^2	F-Stat	Prob(F-Stat)
LPSOCP	*C*	5.3205	0.8886	5.9875	0.0000	0.2065	4.0353	0.0277
	LHSDRP	-1.5600	0.6064	-2.5722	0.0150			
	LPMGRP	1.5526	0.5511	2.8170	0.0080			
LHASCOLCP	*C*	4.5691	1.8065	2.5292	0.0010	0.7587	48.7610	0.0000
	LHSDRP	10.1688	1.2329	8.2476	0.0000			
	LPMGRP	-10.6533	1.1204	-9.5078	0.0000			
LSHELLCP	*C*	8.6966	1.3386	6.4964	0.0000	0.2440	5.0100	0.0130
	LHSDRP	0.3264	0.9136	0.3573	0.7230			
	LPMGRP	-1.0759	0.8303	-1.2958	0.2040			
LAPLCP	*C*	5.1022	0.6049	8.4337	0.0000	0.0930	1.5960	0.2188
	LHSDRP	-0.3211	0.4128	-0.7788	0.4420			
	LPMGRP	0.4614	0.3752	1.2298	0.2280			

Model Specification

Ramsey RESET Test is being used for the given economic model to check the issues of model specification for which the results are tabulated in the given table where the p- values of

both F and t statistics are vast and inconsequential. These findings suggest that model has not having model specification errors.

Table 10 Model Specification

Equation	UR*	Co-efficient	Std. Error	t-Stat	Prob.	R^2	F-Stat	Prob(F-Stat)
LPSOCP	*C*	657.554	131.433	5.0029	0.000	0.5642	12.949	0.000
	LHSDRP	-377.76	75.809	-4.983	0.000			
	LPMGRP	376.401	75.537	4.983	0.000			
	Fitted^2	-23.116	4.658	-4.96	0.000			
LHASCOLCP	*C*	31.226	11.336	2.754	0.009	0.779	35.401	0.000
	LHSDRP	-2.304	0.91	1.971	0.058			
	LPMGRP	1.794	0.997	-2.04	0.050			
	Fitted^2	0.049	0.012	4.023	0.000			
LSHELLCP	*C*	294.068	95.629	3.075	0.004	0.417	7.16	0.000
	LHSDRP	14.804	4.919	3.009	0.005			
	LPMGRP	-50.543	16.592	-3.046	0.004			
	Fitted^2	-4.513	1.512	-2.984	0.005			
LAPLCP	*C*	1014.9	320.997	3.161	0.003	0.318	4.668	0.008
	LHSDRP	-146.324	46.413	-3.152	0.003			
	LPMGRP	210.258	66.691	3.152	0.003			
	Fitted^2	-39.45	12.54	-3.145	0.003			

Hypotheses Testing

The below table shows that there are a total of eight hypotheses in the study, among which our results supported the four hypotheses while our results do not support the other four.

Table 11 Hypothesis Testing

No.	Hypotheses	β Coefficient	SE	t-Stats	Prob.	R-Squared	Results
H1	LPMGRPàLPSOCP	1.5526	0.5511	-2.5722	0.0084		*Supported*
H2	LHSDRPàLPSOCP	-1.56	0.6064	2.817	0.0151	0.2065	*Supported*
H3	LPMGRPàLHASCOLCP	-10.6533	1.1204	-9.5078	0		*Supported*
H4	LHSDRPàLHASCOLCP	10.1688	1.2329	8.2763	0	0.7587	*Supported*
H5	LPMGRPàLSHELLCP	-1.0759	0.8303	-1.2958	0.2046		*Not Supported*
H6	LHSDRPàLSHELLCP	0.3264	0.9136	0.3573	0.7233	0.2442	*Not Supported*
H7	LPMGRPàLAPLCP	0.4614	0.3752	-0.07778	0.228		*Not Supported*
H8	LHSDRPàLAPLCP	-0.3211	0.04128	1.2298	0.4425	0.0933	*Not Supported*

Conclusion and Recommendations

The given study is an effort to gauge the impact of change in oil prices and the aim is to measure the magnitude of the relationship between the volatility of local oil selling prices fixed by the government versus the change in stock prices of the oil marketing companies. The given study based on the secondary data aims to examine the impact of change in Petrol a.k.a. Premier Motor Gasoline (PMG) and Diesel a.k.a. High-Speed Diesel (HSD) prices from Jan 2019 to Feb 2022. It is concluded that price change in Petrol (PMG) and Diesel (HSD) has significant impact on share prices of PSO and HASCOL scrips on given trading day. Further, price change of PMG positively affects PSO shares however, it negatively effects HASCOL scrips. Similarly, any price change in HSD negatively affects PSO share prices on given trading day. It is also evident that there is no significant impact on oil price change on the scrips of SHELL and APL. The results are in line with the studies conducted by Kelikume & Muritala (2019) and (Prabheesh et al.,2020).

The study improves knowledge and understanding of oil price change and firm's share price changes and the subtle phenomenon of Efficient Market hypothesis, thus providing a new viewpoint to the literature, which usually not focused on such relationships. The study also contributes to help the policy makers to understand the relationship between the dependent and independent variables enabling them to take remedial measures for the same. It is recommended to conduct comparative studies of Asian Stock markets for further research i.e., to increase the geographic horizons.

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