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Impact of Crude Oil, Exchange rate and Gold Price on KSE100 Index: Before &during Covid-19 Pandemic by using VAR model

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Abstract

The Covid-19 pandemic has been one of the most severe global crises, effected nearly 87m people with a death count of 1.8m people around the world, and particularly affected mostly the developing countries. Overall, the economic movement got massive shocks by facing a crystal-clear decline in almost all the economic activities. This research will figure out the before and after COVID-19 impact of Gold, oil prices, and exchange rate on the movement of the KSE100 index. A daily data set of 10 months for KSE-100 Index, Crude Oil Price, Exchange Rate and Gold Prices before (from January 01, 2019, till February 26, 2020) and after (February 27, 2020, to December 15, 2020) pandemic have been employed to undertake this study. Structural Vector Autoregressive (VAR) model has been applied to determine the direct effects and shocks on stock market. Further, the before and after effect hypotheses have been tested through the WALD test. Findings revealed that before the Covid-19 exchange rate, gold price and oil price showed insignificant impact on the KSE-100 index, but after the Covid-19 period, all the three variables showed a significant but negative impact on the KSE-100, which is also reconfirmed by Impulse Response Function (IRF). This research article will be helpful to sketch a sound policy to optimize the effect of such a pandemic by taking some key measures. With best of our knowledge, this attempt is one of the few attempts in such detailed and structured with the reported effect of Covid-19 before and during the pandemic regime in Pakistan. This articulated

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research gives valuable insight into capital market sentiments in relation to the segments mentioned above.

Keywords: Global Pandemic: Novel Coronavirus 2019, Vector Autoregressive Regression (VAR), KSE-100 Index

Introduction

The COVID-19 strong disease has caused over 137 million affirmed cases and over 2.9 million deaths worldwide (Coronavirus Update: Deaths from COVID-19 Virus Pandemic - Worldometer, n.d.)This severe disease has triggered profound loss not alone to the Global medical services structures but all over the world economy. This contagion has extra adverse effects than the global financial crisis (GFC) in 2008. For the period of the COVID-19 epidemic, oil costs encountered a surprising drop during April 2020. The US crude futures fallen to negative rates, slamming from $18 a barrel to - $38, for the first time in prices of Gold have tooked a slighter decrease by the epidemic of COVID-19. However, this was straggled by an upward movement shape start in February 2020. The global exposure involved to this COVID-19 contagion altogether has disturbed the components of the price of raw Gold and oil (Mensi et al., 2020).

In Pakistan subsequently, in the past few years, the cost of Gold remained extremely high. It had reached 55 thousand during these years, and globally gold prices revealed that prices were equally affected. A rise in gold prices has seriously influenced the country's economy. Costs of Gold are known as the most significant sign of the economy of a financially sound economy. The decline in the costs of Gold implies that the country's economy is going down the track. Oil cost is known as the essential aspect of determining industrial production. The prices of Gold influenced the overall progress of the economy (Baur and McDermott, 2010).

The impact of this disease pandemic on global securities exchanges has been seen in approximately every region. Pakistani stock exchange is also one of the trades that have been affected by COVID-19. Pakistan has seen massive growth in its confirmed cases from the starting two cases on February 26 2020, to around 329,375 as of October 26 2020. Pakistan's forex money holds are evaluated to drain by another $3 billion to $8 billion. In contrast, the money may depreciate to Rs.170 against the US dollar by June 30 2020, as stated by the main local research house. Pakistan national bank is relied upon to keep the benchmark financing cost constant at 11% till December 2020. The public authority will probably revise the credit program with the International Monetary Fund (IMF) pushes Pakistan's positive improvements side (Tribune, 2020). All around the world, prices of Gold have faced a comparatively more decrease with the result of COVID-19, yet this was covered by an upward pattern initiating since the mid of March 2020 (Gharib et al., 2020). Undoubtedly, the global exposure involved to this COVID-

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19 virus has essentially disturbed the prices of crude oil and Gold, twisted a risk-averse situation that has driven speculators towards the safest resources, for example, Gold (Le et al., 2020).

External shock wave also may result in expectancies for reliable gold investment, indicating a rise in the average future cost of Gold. As oil and Gold are the most frequently exchanged products in the derivative business sectors, the whole market dynamics and the value fluctuation of these two products should have significant consequences for the monetary markets during the ongoing pandemic of COVID-19. To conclude, we notice a considerable body of literature investigating the link between gold value, oil cost and stock value (Bedoui, et al., 2019; Ewing, B.T., 2013; Narayan, 2010; Soytas et al., 2009; Zhang, et al., 2010). Though, sequences of disasters, for example, monetary emergency of 1970, Exchange Rate Mechanism Crisis, Organization of Petroleum Exporting Countries (OPEC) choices in 1994, Russian Crisis in 1997, Asian economic emergency in 1998 and worldwide GFC in 2007 to 2009 have urged the risk-takers to assess the other speculation resources for diversity throughout financial declines (Vacha & Barunik, 2012). Prior researches are conducted in the developed economies to examine the relation concerning covid19 virus and stock trades (Al-Awadhi et al., 2020; Baker et al., 2020; Boon et al., 2020; Kowalewski & Śpiewanowski, 2020), and also we found a small number of researches with regards to developing nations, like Pakistan that investigates the relation between commodity, Energy, Money markets and securities exchanges (Ahmed, 2020; Waheed et al., 2020). This paper has added to the literature on this issue. This research is the illustration that breaks down Market interruptions following the ongoing COVID-19 pandemic with regards to Pakistan. So, this study examines the combined effect of costs of gold, oil and Exchange rate on Pakistan's securities exchange due to its volatile resources (Almansour & Almansour, 2016; Asad, M, 2009; Shaker, et al., 2018). Number of researches are found on this subject with regards to Pakistan.

Moreover, huge instability transference is also seen from commodity to stock exchanges. Subsequently, the key objective behind our research is to recognize the influence of Gold and oil costs on the Pakistani stock exchange during the COVID-19 epidemic. The goals are to determine the relationship between oil, Gold and Exchange rate and on Stock Index of Pakistan and the influence of oil, Gold and Exchange rate and the Stock Index of Pakistan before and during Covid-19.

Literature review and hypothesis development

The Efficient Market Hypothesis (EMH) based on the hypothesis that there are vast quantities of rational, profits looking for investors in the market who respond rapidly to new data announcements. As new data about stocks seems, investors rethink the characteristic estimation of the stock and change the price consequently. In this manner, anytime a stock cost is an equitable indication of all accessible data and addresses the best gauge of the stocks actual worth (Corbet et al., 2020), (Cleary, 2001). A differentiation between three types of EMH is being

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made: a) the weak structure, b) the semi-strong structure, and c) the strong structure. Nonetheless, it is the semi-strong type of EMH that has shaped the reason for the most empirical study of research (Russel, Torbey, 2002). The intense type of market productivity expresses that protections costs mirror all accessible data, including confidential data.

Russel and Torbey find that Seyhun, in his works, dated 1986 and 1998, gives adequate proof that insiders benefit from exchanging data not consolidated into costs (Russel, Torbey, 2002). Subsequently, the strong type of market productivity does not hold in reality. The semi-strong type of EMH declares that the prices of stocks are a mirror of all openly accessible data. There are no underestimated or overestimated protections, and hence, exchanging rules are unfitted for making higher returns. At the point when new data is delivered, it is completely joined into the cost relatively quickly.

The Random Walk Theory proposes that new data concerning stocks is spread randomly over the long run. Subsequently, value changes are unsystematic and tolerate no connection to past value changes (Cleary, 2001). The hypothesis reveals that if stock costs follow an irregular walk, the market can be proficient as it limits all accessible data (Dockery et al., 2001). This theory has been broadly tried in both established and emerging capital markets (Dockery et al., 2001). In general, though, the proof has been reasonably blended (Dockery et al., 2001); for example, a few analysts discover no indication of examples in stock costs, while others support the RWH (Random Walk Theory)

Empirical literature

It is examined in the study of (Corbet et al., 2020) that the contagious effect of the COVID-19 in which they presented the financial markets in China since the spread of the pandemic that served the bit part of the epicenter for both physical and financial contamination. The discovery of the examination stipulates a sizeable figure of anticipated attributes throughout a "flight to safety". Throughout the extensive fiscal crisis, the correspondence between Chinese stock markets and bitcoins has gradually evolved.

(Schoenfeld, 2020) evaluated the element of uncertainty in the circumstances of pandemic and monetary markets. The research used COVID-19 as a personal demonstration to arbitrate how an economic market reacts to extensive pandemics. Furthermore, it stipulates that the executives underrated the pandemic uncertainties' collated to the Security Exchanged Commission (SEC) extreme risk elements and therefore reduce the worth of industries in this regard. Additionally, it also indicates that the pandemics are comprehensively crucial for the monetary markets, administration, and performance.

A systematic framework has been formulated in this research to understand the patterns of extemporal incidents of infectious diseases like COVID-19, its insinuations, and pertinence

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regarding financial markets. The study initiates a narrative multidisciplinary geometrical viewpoint and the conceptualization of aggression in the storyline of the pandemic (Ruiz Estrada et al., 2021)

The risk associated with the exchange rate has influenced the payback of stocks for all four picked countries from Europe. Though, prime interest rates have affected the payback of stocks of only France and Germany. Besides, the study revealed the consequences of fluctuations in interest rates and market exchange rate's reactivity on the payoff of stocks by taking into consideration four regions of Europe includes Italy, Germany, France and UK

(Hyun, 2020) has analyzed South Korea's stock exchange, another foremost nation of the emerging countries. In his examination, it was discovered that the economy had indicated a thrill ride. The month to month trade shows a downtrend in January, improved in February, and dunked down in March and June. The nation's fare volume has descended to an 11.2 percent point in contrast with the earlier year. (Raja, 2020) in his research has discovered that COVID-19 crashes the whole worldwide portion.

(Baker et al., 2020) from the investigation no past transferrable illness epidemic, including the Spanish Flu, has affected the stock exchange as strongly as the COVID-19 pandemic. Past pandemics left just slight drops on the U.S. stock exchange. They utilized content-based strategies to build up these focuses concerning enormous everyday stock exchange that moved back to 1900 and global stock exchange instability back to 1985. They also assessed expected clarifications for the phenomenal stock exchange response to the COVID-19 pandemic. The proof we accumulate recommends that government limitations on business action and controlled social distance, working with incredible impacts in a service-focused on the economy, are the principle reasons the U.S. stock exchange responded much more powerfully to COVID-19 than to past pandemics in 1918-19, 1957-58 and 1968 (Barro et al., 2020)

(Wren-Lewis, 2020) in light of specific presumptions, the COVID-19 pandemic would considerably influence the GDP because of a decrease in the creation and change in purchaser requests. Further, the pandemic will complex circumstance if the banks ignored meeting the funding needs of the organizations because of an unexpected reduction in demand. This will eventually cause the breakdown of the securities exchanges far and wide.

(Boon et al., 2020) portrayed three channels through which the COVID-19 pandemic may influence the worldwide economy. (Ramelli & Wagner, 2020) inspected the effect of the COVID-19 pandemic on stock value responses in US firms. They presumed that the pandemic prompted an amazingly negative and unstable total market responses. Remarkably, the firm experience in China and the portion of foreign incomes that came about is related to generously lower cumulated irregular returns over the research time frame.

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Most recently, (Liu et al., 2020) researched the effect of the COVID-19 incident on the most influenced nations' securities exchanges utilizing the occasion study technique. They reported that the stock exchanges reacted adversely to the COVID-19 epidemic, which had to decline their management. The Study of (Qing et al., 2020) found that COVID-19 had an adverse and restricted effect on China's stock markets and other Asian states in the initial phase of the pandemic.

(Zhang & Hu, 2020) estimated the overall example of nation detailed risk and organized hazard across world financial markets within sight of COVID-19 explosion distress. They recorded that worldwide business sectors have become extremely unstable, and monetary market hazard has expanded because of the vulnerability of economic situations. They recommended that non-traditional strategy intermediaries (quantitative facilitating) could build more issues for the economy on account of the USA.

(Aslam et al., 2020) concludes the efficiency of conversation rates markets during the starting time of the continuing Covid infection 2019 (COVID-19), which has upset the worldwide financial markets. Apply high-rate of recurrence (5-min span) information of six major monetary exchanged markets from October 1, 2019, to March 31 31, 2020. Generally, the outcomes confirm the presence of multi-fractality in forex markets, which illustrates. The biggest effect is noticed for the AUD, which indications the higher (lower) efficiency previously (throughout) the COVID-19 epidemic, surveyed as far as little (great) multi-fractality. The CAD and the Swiss Franc display the most significant efficiency during the COVID-19 epidemic. Digital currency markets are perplexing frameworks dependent on assumption.

(Arfaoui & Ben Rejeb, 2017) their study used SEM to globally explore the relationship between oil, gold, and stock prices. Fan et al. (2014), in between financial recession, study the relationship between commodity price index, US dollar index, and US treasure CDS spread with gold prices. They conclude that they are positively correlated, but the relationship between Gold and stock prices has been neglected. A hedge is well-thought-out as a characteristic that provides security against declining prices of another asset during a Crisis. Gold has unique characteristics of hedging against inflation, volatility in stock prices, and depreciation in local currency compared to US dollars in Saudi Arabia. Gold is considered a safer alternative of investment because it protects investment from increasing inflation, volatility in stock values, and depreciation in local currency. As stated by (Shaker et al., 2018) conducted a study on the ARDL model and explore the hedging properties of Gold against macroeconomic factors just as Saudi Arabian prices of stock and they conclude that Gold have the property of resist change or have hedge property against prices of Saudi Arabia’s stock. (Bondia et al., 2016) by using multivariate variables to study the association between stock prices of energy firms with oil prices. Applying threshold co-integration tests conclude that there is an effect of prices of oil, interest rates on energy stock prices.

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(Tuna, 2018) concluded that there is long-run cointegration among prices of Gold and stock. Mainly the research on integration among the oil prices, gold prices, and stock prices have been conducted in a different perspective in Malaysia (Ibrahim, 2012), China (Fan et al., 2014) and Singapore (Pandey. V, 2018), and many different authors used the symmetrical model to explore the impacts of macroeconomic factors on prices of stock (Fan et al., 2014; Gupta, R., 2013; Husain et al., 2019; Ibrahim, 2012; Rangan, 2013; Tuna, 2018).

Nevertheless, there is no activity found to become aware of the asymmetrical effect of gold prices and oil prices on PSX as far as we are aware. Inflation has significantly affected the potential gold market. New policies and procedures practices for the economy's stability were made and take on by government body and stakeholder in the stock exchange. So the prices of Gold became fixed and not changeable for the long run. That's why the investor intended to invest in Gold because the costs of Gold became the indicator for inflation (Ziaei, 2012). (Bhunia, Amalendu, 2013) Applying the Ganger test to know to effects of local gold prices and stock return. It found that there is a bidirectional causal relationship between local prices of Gold and stock returns.

Method

Research philosophy plays a vital role to conduct reliable research because it back by research findings driven through massive econometrical, statistical and mathematical models; in short, philosophy plays a role of the heart in research work, hence in this article, we have employed positivism as article is based on deductive research approach.

We have collected data for KSE-100 Index return from the Pakistan Stock Exchange market screener, which is mainstream. Crude Oil, Exchange rates, Gold price data was collected from Investing.com well-architected and well-structured global databases, which is quite reliable. We selected a year before the pandemic and ten months after the pandemic daily and to test before the Covid-19 panel. We took a sample from January 01, 2019, till February 26, 2020, for KSE-100 Index Return, Crude Oil Price % Change, Gold prices % Change and Exchange rates % Change and for after Covid-19, we choose data from February 27 2020 (When 1st Case was reported) to December 15, 2020.

Multivariate simultaneous equations models were used extensively for macro-econometric analysis when Sims (1980) advocated vector autoregressive (VAR) models as alternatives. At that time, longer and more frequently observed macroeconomic time series called for models that described the variables' dynamic structure. VAR models lend themselves to this purpose. They typically treat all variables as a priori endogenous. They account for Sims' critique that the homogeneity assumptions for some of the variables in simultaneous equations models are ad hoc and often not backed by fully developed theories. Restrictions, including homogeneity of some of the variables, may be imposed on VAR models based on statistical procedures. VAR models

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are natural tools for forecasting. Their set-up is such that past values of the variables involved partly explain the current values of a set of variables. However, they can also be used for economic analysis because they describe the joint generation mechanism of the variables involved. Structural VAR analysis attempts to investigate structural economic hypotheses with the help of VAR models. Impulse response analysis, forecast error variance decompositions, historical decompositions and the analysis of forecast scenarios are the tools that have been proposed for disentangling the relations between the variables in a VAR model.

Vector Autoregressive Model – Equations

A p-dimensional vector autoregressive process Xt is given by

$$X_t = \sum_{K-1}^{K} \Gamma_K \; X_{t-k} + \varepsilon_t$$

Where $\varepsilon_t \sim^{iid} N(0,\sum)$. The matrices Γ_K provide the auto regression coefficients. In the following, we assume that all component-time series in X_t are stationary. Here, we assume that a maximum lag length K_0 can be derived either from economic theory or from some rule of thumb based on the number of available observations. Then, for a given realization of the process $(X1, \ldots, X_T)$, the model selection problem consists in identifying K along with those elements of Γ_K, k = 1, . . . , K, Consequently, the search space can be described by the set $\Omega = \{0, 1\}^{p2\times K0}$, where a zero corresponds to a parameter constrained to be zero, and a one to a parameter to be estimated freely.

Equation - 1

$$KSE_{t,1} = \alpha_1 + \phi_1 KSE_{t-1,1} + \phi_2 KSE_{t-1,2} + \phi_3 CO_{t-1,1} + \phi_4 CO_{t-1,2} + \phi_5 ER_{t-1,1} + \phi_6 ER_{t-1,2} + \phi_7 GP_{t-1,1} + \phi_8 GP_{t-1,2} + w_{t,1}$$

Equation - 2

$$CO_{t,1} = \alpha_1 + \phi_9 KSE_{t-1,1} + \phi_{10} KSE_{t-1,2} + \phi_{11} CO_{t-1,1} + \phi_{12} CO_{t-1,2} + \phi_{13} ER_{t-1,1} + \phi_{14} ER_{t-1,2} + \phi_{15} GP_{t-1,1} + \phi_{16} GP_{t-1,2} + w_{t,1}$$

Equation – 3

$$ER_{t,1} = \alpha_1 + \phi_{17} KSE_{t-1,1} + \phi_{18} KSE_{t-1,2} + \phi_{19} CO_{t-1,1} + \phi_{20} CO_{t-1,2} + \phi_{21} ER_{t-1,1} + \phi_{22} ER_{t-1,2} + \phi_{23} GP_{t-1,1} + \phi_{24} GP_{t-1,2} + w_{t,1}$$

Equation - 4

$$GP_{t,1} = \alpha_1 + \phi_{25} KSE_{t-1,1} + \phi_{26} KSE_{t-1,2} + \phi_{27} CO_{t-1,1} + \phi_{28} CO_{t-1,2} + \phi_{29} ER_{t-1,1} + \phi_{30} ER_{t-1,2} + \phi_{31} GP_{t-1,1} + \phi_{32} GP_{t-1,2} + w_{t,1}$$

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Results and Discussion

We have developed two Panels, whereas Panel-1 represent after Covid-19 impact and Panel-2 witnesses results before Covid-19.

Table 1: Descriptive Statistic– During Covid-19

Descriptive Stats	*CO*	*ER*	*GP*	*KSE*
Mean	0.0035	0.0002	0.0008	0.0005
Median	0.0055	0.0000	0.0019	0.0015
Maximum	0.4971	0.0451	0.0560	0.0480
Minimum	-0.3328	-0.0172	-0.0575	-0.0686
Std. Dev.	0.0601	0.0052	0.0143	0.0157
Skewness	1.2773	2.6125	-0.1874	-1.1469
Kurtosis	29.9980	27.5746	5.9164	7.8781
Jarque-Bera	6619	5681	78	262
Probability	0.0000	0.0000	0.0000	0.0000

The table above tables shows the volatility in the stock market, exchange rate, gold and oil prices. Almost all variables minimum value is negative because ongoing covid-19 pandemic, which means that the market hit by the pandemic. In contrast, standard deviation shows significantly less amount of fluctuation in the stock market, exchange rate, Gold and oil prices in the market which is ideally very minimal compared to other major stock indices in the time of covid, e.g. Stock market of US, Italy and Spain performed significantly worse in the pandemic.

Table 2: Data stationery

Data stationery	**Augmented dickey fuller (ADF)**	**Phillip-Perron**
Variables	t-Statistic	t-Statistic
CO	-19.76***	-19.96***
ER	-24.65***	-24.65***
GP	-14.98***	-23.85***
KSE	-19.45***	-20.32***

Note: *, **, *** on it at 10%, 5%, and 1% significance.

In statistics and econometrics, an augmented Dickey-Fuller (ADF) & Phillip Perron (PP) tests the null hypothesis that a unit root is present in a time series sample. The alternative hypothesis is different depending on which version of the test is used but is usually stationarity or trend-stationarity (Dickey and Wayne Fuller, 1979; Peter C. B. Phillips and Pierre Perron, 1988).. Therefore the null hypothesis is => H0: $\sigma = 0$ (No Unit Root) and the alternative hypothesis represents null hypothesis is => H1: $\sigma = 1$ (Unit Root). In accordance with table 1, we have checked data stationary by Augmented dickey fuller and Phillip Perron tests and found CO

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(%Change) ER (%Change) GP (%Change), and KSE (%Change) are stationary at the level in Augmented Dicky fuller and Phillip Perron both test because the p-value is less than 5% or 0.05, now after completing the very first pre-requisite, we can perform further time series analysis.

Table 3: Correlation Matrix– During Covid-19

Variables	*CO*	*ER*	*GP*	*KSE*
CO	1			
ER	0.129***	1		
GP	0.073***	0.460***	1	
KSE	0.123***	-0.131***	-0.036***	1

Note: *, **, *** on it at 10%, 5%, and 1% significance.

The correlation matrix was also generated based on data collected after Covid19 to see the clear picture; all correlation is significant. However, we did not detect multicollinearity in the data because the relation of variables is slightly weak, which is an ideal situation to develop the models. However, oil price reflected a positive and vulnerable relationship with the KSE index. This is logical because large companies listed in the Pakistan Stock Exchange belong to the Oil and Gas sector and can move KSE-100 volume. At the same time, ER & GP reflected a weaker or negative effect on KSE 100 Index.

Table 4: Vector Auto-regression Estimates - Before Covid-19

Vector Auto-regression Estimates - Before Covid-19				
	KSE_100	CRUDE_OIL	EXCHANGE_RATE	GOLD_PRICE
KSE (-1)	0.157614	-0.181648	0.006417	0.051209
	-0.05252	-0.08279	-0.02519	-0.03874
	[3.00124]	[-2.19409]	[0.25471]	[1.32173]
KSE (-2)	0.069942	0.077574	-0.036055	-0.070535
	-0.05223	-0.08234	-0.02506	-0.03853
	[1.33913]	[0.94216]	[-1.43895]	[-1.83059]
CO (-1)	0.006038	0.092906	0.036429	0.020284
	-0.03386	-0.05337	-0.01624	-0.02498
	[0.17832]	[1.74068]	[2.24280]	[0.81209]
CO (-2)	0.044437	0.070032	0.003822	0.006866
	-0.03369	-0.05312	-0.01616	-0.02486
	[1.31885]	[1.31847]	[0.23645]	[0.27620]
ER (-1)	0.220078	-0.32974	-0.080518	-0.098199
	-0.13045	-0.20565	-0.06258	-0.09624
	[1.68701]	[-1.60337]	[-1.28656]	[-1.02034]
ER (-2)	0.364261	-0.238956	-0.096146	-0.176316
	-0.13069	-0.20603	-0.0627	-0.09642

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	[2.78721]	[-1.15983]	[-1.53350]	[-1.82872]
GP (-1)	-0.150772	0.360683	0.075498	0.056465
	-0.08491	-0.13386	-0.04073	-0.06264
	[-1.77567]	[2.69456]	[1.85340]	[0.90139]
GP (-2)	-0.296107	-0.039388	-0.000222	0.038015
	-0.08709	-0.13729	-0.04178	-0.06425
	[-3.40017]	[-0.28690]	[-0.00531]	[0.59170]
C	0.00048	-0.00012	0.000247	0.00113
	-0.00057	-0.0009	-0.00027	-0.00042
	[0.84073]	[-0.13306]	[0.90069]	[2.68199]
R-squared	0.093264	0.055183	0.038719	0.026657
Adj. R-squared	0.072597	0.033649	0.016809	0.004473
Sum sq. resids	0.039225	0.097481	0.009028	0.021348
S.E. equation	0.010571	0.016665	0.005071	0.007799
F-statistic	4.512819	2.562564	1.767207	1.201609
Log likelihood	1131.601	967.7383	1396.026	1241.1
Akaike AIC	-6.23667	-5.326324	-7.705699	-6.845003
Schwarz SC	-6.13952	-5.229171	-7.608546	-6.74785
Mean dependent	0.000193	0.00012	0.000284	0.001159
S.D. dependent	0.010977	0.016953	0.005115	0.007816

The vector auto-regression (VAR) is usually applied for structural implication and strategy assessment. In structural modelling, certain presumptions about the causal structure of the data under analysis are required. The subsequent causal effects of sudden stuns or expansions to indicated factors on the factors in the model are summed up. These causal effects are typically summed up with desire response dimensions and predict error fluctuation reductions. The reduced form VAR approach sidesteps the need for structural modelling by treating every endogenous variable in the system as a function of p-lagged values of all of the endogenous variables in the system (Lütkepohl, 2006). We have selected 2 lag based on lagged criterion as suggested by Hannan–Quinn information criterion (HQC) as HQ is a criterion for model selection. It is an alternative to the Akaike information criterion (AIC) and the Bayesian information criterion (BIC). It is given as (Hannan, E. J., and B. G. Quinn, 1979).

The first values of every lagged variable are coefficients, values below coefficients, and [square brackets] are t-static of this model. Below the table, the VAR equation is also written to understand how this is equation is determined. The above table interprets that no significant impact of CO, ER, GP on the Stock Market before the covid-19 neither by lagged 1 nor lagged 2, and this is understood by the t-stats, which has a benchmark tabulated value which is equal to or greater than 2.5 at 5% level of significance, meaning when any value excess than 5% or 0.05 in both sides positive and negative than it is guided to accept the alternative hypothesis or vice

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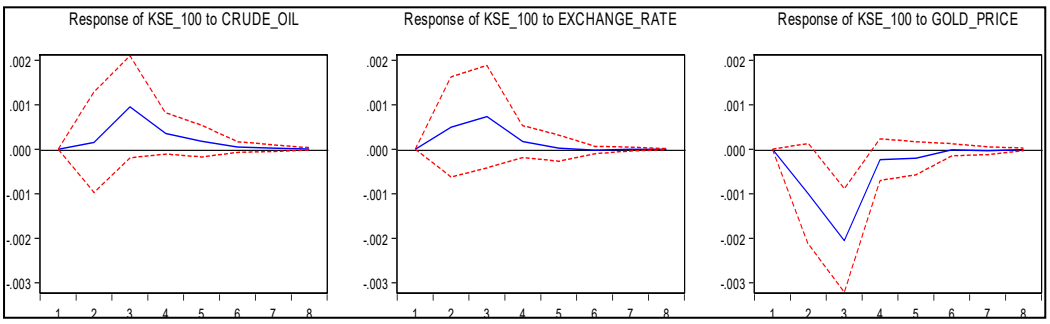
DOI: 10.47750/cibg.2021.27.06.036

versa. Results can be understood that before CO, ER, GP remained stable. Still, the stock market exposed fluctuation due to the market sentiments such as negative and positive shocks. Further, it is also justifiable that the market has significant fluctuation but oil price did not because of the regulatory connection in Pakistan and on the international level, further we have developed Ordinary Least Square (OLS) through system generated equations of the VAR model and get the same understandings (Results can be provided upon request).

Table 5: Wald Test Joint Effect before Covid-19

Wald Test Joint Effect Before Covid-19			
Test Statistic	Value	df	Probability
Null Hypothesis: $\phi_3 = \phi_4 = 0$			
Chi-square	1.82236	2	0.402
Null Hypothesis: $\phi_5 = \phi_6 = 0$			
Chi-square	10.2206	2	0.006
Null Hypothesis: $\phi_7 = \phi_8 = 0$			
Chi-square	14.6282	2	0.0007

As mentioned in table 4, we developed a the Wald test to see the combined or joint effect of CO, GP & ER on the stock market; therefore, the guideline for Wald test when the p-value is less than 5% or 0.05 so we accept alternative hypothesis which means coefficient X and coefficient Y jointly are not zero they have some effect on the dependent variable, hence in the above table in ER and GP Both cases p-value is stood less than 5% or 0.05 which means that combined both coefficients are zero and have a significant joint effect on the dependent variable in before covid-19 outbreak.



Response of crude oil prices to the KSE-100 in remain minimal or reliable from period 1st to 2nd, but from period 2nd to 6th responded as positive with significant increment which seemed like an ideal situation of the market before Covid-19, therefore from the 6th to 8th impulse response function witnessed a stable relationship of both variables, the almost same pattern of response function had been seen in the exchange rate to the KSE-100. Further, we have also seen

P-ISSN: 2204-1990; E-ISSN: 1323-6903
DOI: 10.47750/cibg.2021.27.06.036

the negative response of gold price with KSE-100 continuously from 1st period to the 3rd. In contrast, the relationship gets strengthen from 3rd period to 6th period and then 6th to 8th as a stable response.

Table 6: Vector Auto-regression Estimates - During Covid-19

Vector Auto-regression Estimates - After Covid-19				
	KSE_100	**CRUDE_OIL**	**EXCHANGE_RATE**	**GOLD_PRICE**
KSE (-1)	0.25098	-0.0688	-0.0903	0.05923
	-0.0683	-0.2779	-0.0223	-0.0637
	[3.67753]	[-0.24760]	[-4.04674]	[0.92974]
KSE (-2)	0.13185	0.12128	-0.0424	-0.0302
	-0.0701	-0.2856	-0.0229	-0.0655
	[1.87968]	[0.42464]	[-1.85044]	[-0.46176]
CO (-1)	0.04226	0.18797	0.00545	0.03478
	-0.0173	-0.0706	-0.0057	-0.0162
	[2.43874]	[2.66442]	[0.96229]	[2.15021]
CO (-2)	-0.0332	0.02405	0.00894	-0.0259
	-0.0175	-0.0713	-0.0057	-0.0163
	[-1.89871]	[0.33760]	[1.56261]	[-1.58460]
ER (-1)	0.85317	1.49192	-0.1473	-0.4996
	-0.2279	-0.9279	-0.0745	-0.2127
	[3.74350]	[1.60779]	[-1.97774]	[-2.34848]
ER (-2)	-0.3409	-0.4989	0.05631	-0.263
	-0.2275	-0.9261	-0.0744	-0.2123
	[-1.49888]	[-0.53866]	[0.75729]	[-1.23847]
GP (-1)	-0.1455	-0.0954	0.01518	0.07944
	-0.0817	-0.3327	-0.0267	-0.0763
	[-1.78064]	[-0.28684]	[0.56832]	[1.04139]
GP (-2)	-0.0384	0.16418	0.10461	0.22899
	-0.0798	-0.3248	-0.0261	-0.0745
	[-0.48157]	[0.50555]	[4.01200]	[3.07558]
C	0.00037	0.00284	0.00013	0.00083
	-0.001	-0.0041	-0.0003	-0.0009
	[0.37156]	[0.69218]	[0.39813]	[0.88806]
R-squared	0.16921	0.05837	0.20616	0.09566
Adj. R-squared	0.13679	0.02162	0.17518	0.06037
Sum sq. resids	0.04393	0.72822	0.00469	0.03828
S.E. equation	0.01464	0.0596	0.00479	0.01366
F-statistic	5.21912	1.58836	6.65486	2.71062

P-ISSN: 2204-1990; E-ISSN: 1323-6903
DOI: 10.47750/cibg.2021.27.06.036

Log likelihood	604.903	304.442	844.178	619.64
Akaike AIC	-5.5692	-2.7611	-7.8054	-5.7069
Schwarz SC	-5.4276	-2.6196	-7.6638	-5.5654
Mean dependent	0.00057	0.00387	0.00019	0.00099
S.D. dependent	0.01576	0.06026	0.00527	0.0141

After completing the analysis before the Covid-19, we have developed the final model that illustrates the Covid-19 impact on Pakistan and Oil, Gold Prices and Exchange rate (%change) in table 5. We have also developed Vector Autoregressive Regressions for more clarification to the stakeholders. In accordance with the equation as mentioned above only equation, 1 and equation 2 is taken as main equations of this research, hence VAR is an inter-correlated system equation modelling method that does not provide p-values to take the precise decision on the research hypothesis. Still, we can determine the results based on t-stats and its benchmark values. This doesn't seem very easy when we have such a considerable amount of autoregressive models. Therefore we have developed an Ordinary Least Square based on VAR and convert VAR in OLS only to attempt the hypothesis of the generated equation to make the more precise decision for our alternative hypothesis. In OLS results, we found equation 1 and observed that C(3) *CO (-1) and C(5)*ER (-1) have positive and impact in lagged 1 that significantly shows that prices of ER & CO % change affect positively in the stock market in post Pandemic period. Equation 3 outcomes revealed that C (19)*KSE (-1) and C (26)*GP (-2) have a negative impact in lagged 1 and a positive effect on lagged 2 on exchange rate prices. Coming towards the Equal 4 C (30)*CO (-1), and C (32)*ER (-1) crude oil and exchange rate lagged 1 value shows that positive and negative impact on ER.

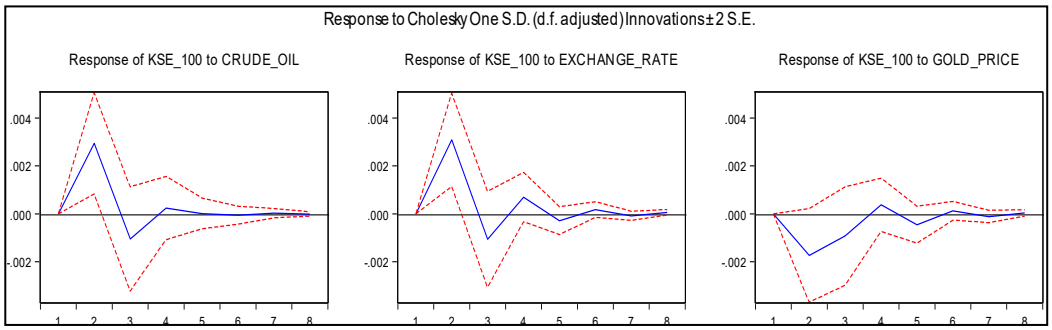
Table 7: Wald Test Joint Effect after Covid-19

Wald Test Joint Effect During Covid-19			
Test Statistic	Value	df	Probability
Null Hypothesis: $\phi_3 = \phi_4 = 0$			
Chi-square	8.270347	2	0.016
Null Hypothesis: $\phi_5 = \phi_6 = 0$			
Chi-square	16.55425	2	0.0003
Null Hypothesis: $\phi_7 = \phi_8 = 0$			
Chi-square	3.537221	2	0.1706

In relation to the above-tabulated illustration, we have confirmed that Covid-19 variables and oil prices and Exchange rate have a significant and negative impact on the stock market of Pakistan because p-value of C(3) & C(4), C(5) & C(6), C(7) are less than 5% or 0.05 which means these are not equal to zero combine and have some explanations in the dependent variable. However, we have observed that crude oil price and exchange rates % change in Pakistan effect on KSE 100 Index, this is because in time of lockdown indeed oil price rate came below to the actual rate

P-ISSN: 2204-1990; E-ISSN: 1323-6903
DOI: 10.47750/cibg.2021.27.06.036

and USD prices goes high because of the central bank of Pakistan has decrease interest rate by 1.5 percent in the policy published in march 2020 which become the cause of dollar become more expensive in Pakistan to some extent lockdown strategies by the Prime Minister of Pakistan has significantly safe many sectors which were on the close of collapse.



A one SD shock (Innovation) to CO initially has significant increment until the 2nd period; therefore, it has been witnessed that in Pakistan, oil price did not decline between the first two months of pandemic declaration. Hence it has further been witnessed that from 2nd period to the 3rd-period, oil price touched the highest low of the many decades, which ultimately impacted the KSE-100 because of heavy capitalization of the index based on the OEC companies, further it has been also witnessed stagnate behaviour of the stock market in relation to the shock of the oil price to KSE-100 from 3 to 8 period, or it can be said as stable fluctuation, meanwhile is it noticeable that exchange rate has more how similar response as oil price with KSE-100 index returns. Coming towards the gold price, after the pandemic calls globally it has been witnessed masses started shifting their investment from capital market to the commodity market, so from the 1st to 2nd-period heavy decline had been witnessed in impulse function and growth from 2nd to 4th period later on the response of gold price to KSE-100 stagnate and stable from the 4th to the last 8th period.

Discussion & Conclusions

The stock market of any country is the reflection of economic wellbeing. Therefore healthy stock markets portray an attractive picture to gain local and foreign direct investment. To make the stock market attractive for stakeholders, the government set economic policies such as monetary policy, fiscal policy, labor policy, and investment policy to make an economy in equilibrium, control these economic variables, or make investment equal to saving. Therefore, the second side of economic equilibrium relates to the capital market. Now the event begins when the stock market of any country is information sensitive (Positive and Negative Shocks), so measuring this intensity of shock plays a crucial role in generating normal and abnormal profit in respect to specific events. Events could be classified as anything that heavily affects the stock market. Still,

P-ISSN: 2204-1990; E-ISSN: 1323-6903
DOI: 10.47750/cibg.2021.27.06.036

in this research, we have analyzed the stock market data to check the performance and the effect of this ongoing Covid-19 on the capital market. We have taken Crude Oil Price (CO) % of Change, Gold Price (GP) % Change and Exchange Rate (ER) % Change as a regress or and regressed variable. We developed VAR Model to calculate the triangle effect of CO, GP and ER effect on the stock market before and after the covid-19 Period, and we took Crude Oil Price (CO) % of Change, Gold Price (GP) % Change and Exchange Rate (ER) % Change as an independent variable to test its impact on the stock market.

5.1. Conclusion: Conclusively, we have seen that crude oil and exchange rate has a significant effect on the KSE-100 Index return after novel coronavirus measure by the values of coefficient in vector autoregressive regression model, and this is aligned with (Aslam et al., 2020), (Arfaoui & Ben Rejeb, 2017), (Bondia et al., 2016). Results according to above all of them exhibited very minimal but significant impact on the stock market. Before covid-19 result shows that significant impact of exchange rate and Gold in lagged values which are aligned with (Le, and Chang, 2011), (Tuna, 2018), (Shaker et al., 2018). Coming towards After covid-19 results CO and ER has significant effect on the KSE-100 index return in lagged one and GP doesn't shows the effective results this is because the nature of masses of Pakistan and the immune system of Pakistan nation because our significant population is consist on the youth and definitely youth secures strong immune system that's is one of the reason of most minor death and rapid recovery and that demographic feature of youth give benefit in term of financial stability of country specifically in such pandemic situation.

5.2 Recommendation: The analysis is helpful for state and policy-makers, as it will be helpful to realize how the securities exchange is observed as one of the main parts of every economy that gives rights to use the resources of the general public and get it accessible for use by businesses. Policy-makers have to realize who is accountable for arranging the economic growth to teach themselves regarding this matter and should have a comprehensive and complete knowledge of the conduct of this market. Further, as Gold is known as the utmost common strategies government of Pakistan uses to represent its monetary policy, it is significant for financial consultants to have a strong influence among Gold, oil, forex, and the securities exchange in the crises period.

5.3 Limitations: This exploration has its constraint as this research is simply restricted to developing state like Pakistan. The other limitation of the analysis is time constraint data have been gathered from January 01 2019, to December 15 2020. Company's decisions directly or indirectly affected by the actions in exchange rates, either in domestic or foreign currency. Thus, existence in the worldwide market without considering the actions of ER is not a simple undertaking, and it is critical to examine the dynamic forces of Pakistan securities exchange for several reasons:

P-ISSN: 2204-1990; E-ISSN: 1323-6903
DOI: 10.47750/cibg.2021.27.06.036

1. It gives the knowledge of investor behavior in developing economies how the lockdown and government mediation reflects in securities exchange, explicitly for anticipated case situations.
2. This data is helpful for portfolio investor to hedge or estimate their profits from Funds in Oil, Gold and ER on the stock exchange.
3. It explains what necessary actions are expected to hold the interest in developing stock exchanges during Crises Period.

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