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A Study on the Relationship among the Returns of Gold Rates, Crude Oil Prices and the Stock Market Investments! An Empirical Evidence!!

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Abstract

The present study attempts to examine the relationship among the returns of gold rates, crude oil prices and the stocks included in Dow Jones Industrial Averages (DJIA) for a four year period (48 months) from 2016 to 2019 using the monthly data of the above three variables collected from indexmundi.com (Crude oil prices and Gold rates), marketwatch.com (DJIA). Returns were calculated on all the three rates after standardizing the data applying 'Dixon's Outlier test' procedures to identify the 'outliers' in the time-series data. The normality of the data was checked using five different parameters which included Skewness, Kurtosis, Jarque-Bera test, Kolmogorov-Smirnov (K-W test) and Shapiro-Wilk test. Descriptive statistics revealed a few interesting insights into the returns and volatility patterns of the three variables included in the sampling framework. Further, to examine the relationship and impact among the variables, three multiple regression analyses were performed keeping each variable as the dependent variable (y) while the other two remaining variables as predictor variables (X_1 & X_2). To ensure that the multiple regression equation does not suffer from any kind of assumptions-related violations for applying multiple regression, Durbin-Watson (DW test) statistic was applied to check if the data have any issues related to autocorrelation while VIF (Variance Inflation Factor) test was applied to examine the multi-collinearity related issues. It has been observed that while Dow Jones and oil price returns (Independent variables) had no statistically significant relationship or impact on the gold price returns (Dependent variable), in yet another analysis Dow Jones and gold returns (Independent variables) had a statistically significant relationship and had an impact on the Oil price returns at 10% level of significance during the study period. In the same way, oil price returns and returns from gold rates had no statistically significant relationship or impact on the stock price returns. Further, oil-price returns were higher when compared to the other two variables while it recorded higher volatility, as well, confirming that high-risk taking is associated with higher rewards. The findings of this study gain significance as security analysts and investors could design their investment strategies in different market scenarios, accordingly.

Keywords: Stock returns; Gold price; Oil price behavior; International stock returns
Jel Classification: B26, B27, C12, Q41, Q43

1. Introduction and Need for the Study

The interrelationship among crude oil, gold, and stock markets has triggered enormous interest among the academicians and investors as all the three markets can bring about growth as well as decline to the global economy both in the short and long run time-horizons. Gold and crude oil are traded on a global scale. While crude oil is considered as an important source of global energy as almost one-third of energy consumption comes from this source, gold is a precious metal which is not only kept by the central banks as a reserve, many governments also maintain gold reserves as a buffer to overcome turbulent economic scenarios and stability of their respective currencies. Economic literature has much evidence to prove that up and downward movements in crude oil prices could cause significant shocks and volatilities in the financial markets across the world, more particularly, in both developed and emerging markets. It is obvious to note that when stock markets witness see-saw movements, on many occasions, it affects the global economy, as well. In his analytical research work Bouri (2015) observes that oil price shocks and volatilities get transmitted to equity markets leading to disruptions in the economy. This argument has, earlier, been confirmed by Fowowe (2013) who states that higher oil prices result in slower economic activities and affect both producers and consumers leading to decreased consumption. So, such a phenomenon leads to sluggish growth in the economy. Ever since oil has taken the center stage as the engine of growth of the global economy, the attention of investors has faced a tilt towards emerging markets where more emphasis has been laid upon the risk-return dynamics and profit-earning strategies. In the same way, gold, known as the yellow metal, is considered by the investors as a safer investment, more particularly, when stock and oil markets experience a higher degree of volatility and uncertainty about their future price-movements. For instance, a reduction or high variations in share price behavior goads the investors to the gold market thus pushing its prices to higher levels. Gold, according to researchers, is a good option to overcome inflationary scenarios. Further, it is argued that an increase in crude oil prices leads to a decline in financial market activities. On the other hand, a decrease in crude oil prices gives fresh fillip to economic activities as oil would be available cheaper. This, obviously, leads to lesser cost of production, and an increase in profit, an increase in salaries and wages, an increase in savings and investments. In other words, an increase in oil price puts greater pressure on the margins of business establishments leading to many cost-cutting and austerity measures thus depriving the investors of their ambitions to save and make investments in any form, including stock market investments.

1.1. Inter-Relationship among Gold, Crude Oil, and Stock Markets!

The present research work assumes its significance in two crucial aspects. Amidst the availability of innumerable research works with statistically significant results to prove that there exists a kind of interrelationship among the three markets, it is not uncommon to note that many research works, on the other hand, have proved that the relationship among these markets are negative and also they are not consistent over a period of time.

Against this backdrop, firstly, the researcher intends to seek an answer to the intriguing question if these three markets, gold, crude oil, and stock markets are interrelated? If yes, what are the markets that are related to and/or impacted? This is the first question to which the researcher would like to seek an answer during a relatively non-turbulent period so that the exact pattern of relationship could be clearly understood to offer fresh insights into the dynamics of these three important markets. Secondly, which market, out of the three being analyzed currently, offers consistently higher returns during the longer time-period horizons so that analysts and investors in all the three markets could take informed-investment decisions while structuring their portfolios. In other words, understanding the co-movements of these three economically crucial markets could lead to fresh insights for the investors, analysts, and decision-makers.

1.2. Paper Organization

The remainder of the paper is organized as discussed, below. The following section, literature review, presents a succinct review of the existing literature on the topic. It offers comments, key learning, and knowledge gained from the literature, as well. The third section discusses the methodology of the present study and gives a detailed description of the sampling methods, analytical framework, period of study, and the rationale for the choice of tools used for analysis in addition to the data standardization procedures being adopted in the study. In section four, the analytical results have been discussed. The final concluding section highlights the major findings of the study in addition to offering focused suggestions based on the results obtained.

2. Literature Review

As discussed earlier, the economic literature has many interesting research works documented by researchers who have examined the interdependence and causation between crude oil prices and share price behavior. Some of the significant contributions made by the researchers have been reviewed in this section of the paper. It is quite interesting to note that research works that attempted to examine the relationship between stock prices and oil prices have got mixed results meaning while some of the researchers found no evidence of a statistically significant relationship between the oil price and share price behavior, a few other research works documented in the literature reveals that there existed a significant relationship and causation in a few instances.

2.1. Share Price Behavior and Oil Prices have Stronger to Moderate Relationship

Pioneering research works to examine the relationship between these two important sectors, whose movements have global ramifications, have been carried out by many researchers. For instance, Kling (1985), which is one of the pioneering works on the topic, undertook an analytical study examining the relationship between crude oil price changes and stock market behavior for the years from 1973 to 1982 and concluded that crude oil prices affected the future stock prices. Basher and Sadorsky (2006), in their study, observed that there was strong evidence to prove the impact of oil price risk on stock returns, particularly, in emerging markets.

In the same way, Miller and Rafti (2009) observed that in the long-run stock markets had reacted negatively to oil price behavior and shocks. Arouri *et al* (2012) undertook a study and analyzed the links between oil prices and stock markets across European stock markets. They used Dow Jones Stoxx Europe 600 index and 7 Dow Jones Stoxx sectoral indices in their sampling framework. Applying the VAR-GARCH method developed by Ling and McAleer (2003), they examined the volatility spillovers across the markets. The results indicated that volatility was transmitted from the oil market to the broad Dow Jones Europe 600 index and six other sectoral indices except for the automobiles and parts sector.

Yet another study by Arouri *et al* (2011) analyzed the volatility spillovers between oil prices and sector stock market in Europe and the USA. They noticed the independence of oil and stock markets from spillover effects. It was quite interesting to note that while the US index transmitted volatility to the oil sector, the European indices did not transmit volatility during the study period. Further, they observed that volatility was transformed from oil markets to stock markets in all cases but for the automobile and parts sector in Europe, industrials, and utility sectors in the USA. Batten *et al* (2017) in their empirical study on examining the relationship between energy (Coal, gas, and oil) and Asian stock markets, noticed that energy and commodities recorded varying degrees of integration in Asian stock markets and further noticed that they were time-varying.

2.2. No Evidence of Relationship between Oil and Share Price Behavior

On the other hand, a few studies did not find any evidence to prove that the share price behavior and oil prices are related. For instance, using ARCH and GARCH models Obendorfer (2009) examined if oil prices affected European Stock market movements with the data gathered for the period from 2002-2007. They found out that increases in crude oil prices affected the European stock returns, negatively.

Kumar (2015) in his analytical study observed that there was a negative relationship between oil prices and share price behavior in the United Kingdom. However, they have noticed a long-run relationship between these two variables.

In the same way, Musibau *et al* (2013) investigated the dynamic linkage and relationship between oil price shocks and the share price behavior in the Nigerian Stock Market. They applied 'multivariate vector autoregression', employed the 'generalized impulse response function' and 'forecast variance decomposition error'. They found no strong evidence to suggest that oil price shocks influence share price returns. In a nutshell, the oil price shocks and stock returns are not supported by statistical evidence from the research work undertook by them.

Similarly, Papapetrou (2001) examined the dynamic relationship between the oil price and a few important macroeconomic parameters such as real stock prices, interest rates, real economic activity, and employment. They used the data gathered from the Greece Stock market. Interestingly enough, they found out that the oil price shock had a negative impact on the stock market as well as industrial production and employment.

Babajide (2017) empirically examined the returns and volatility spillovers between oil and the stock markets. They included Nigeria and South Africa in their sampling framework. The authors applied the new measure developed by Diebold and Yimaz (2012) popularly known as 'measures of returns spillovers and 'volatility spillovers' which is referred to as 'spillover indexes'. This technique helps assess the net contribution of one market in the information transmission mechanism of another market. They noticed a bi-directional but weak interaction between the South African and Nigerian stock market and oil market returns. The results further indicated that spills from the oil market to the stock market was to the tune of 13% percent while the reverse was recorded at 10%. Further, they noticed a very weak interdependence of volatility between oil markets as well as Nigerian and South African markets. Further examination of time-varying total spillover plots for returns and volatilities were found to be similar and confirmed with the previous findings found in the literature. An increasing trend was noticed during the non-crisis period, a burst during the crisis year, and a higher level of transmission, afterward.

In the same note, Jouini (2013) examined the return and volatility linkages between oil prices and share price behavior in the biggest market in the Gulf region, Saudi Arabia. Using weekly data for the period from January 10, 2007, to September 28, 2011, with the benchmark oil rates of Brent Crude using Saudi Arabia's Tadawul All-Share Index, including five sectors into the sampling framework, they applied the VAR-GARCH method Ling and McAleer (2003) for analytical purposes. They found no return spillovers between Saudi Arabia's stock and oil markets. The results showed no evidence of bidirectional volatility spillovers between the oil markets and some of the sectors included in the sampling framework.

In like manner, Olfa (2019) attempted to examine the asymmetric effects of negative and positive oil price shocks and further examined the impact of oil price volatility on the Eurozone's super-sector returns. They observed that the oil-stock market relationship was characterized by the presence of 'structural-breaks' in the time-series data. Further, it has been noticed that Eurozone's super-sector returns responded positively to oil price changes in the Post-Global Financial Crisis sub-period.

2.3. Relationship between Gold, Oil and Share Prices

It is of interest to note that the relationship between gold, oil, and share prices is not stable as some of the studies have stronger evidence to prove that gold prices and share prices have a statistically significant relationship while a few other studies have failed to establish any relationship between the variables. The same is true of the relationship between oil and gold prices, as well. Some of the important contributions have been reviewed, here.

In their research work conducted earlier, Gaur and Bansal (2010) found out that a fall in share price behavior increased gold rates. Further, they noticed that the trend is all the more relevant during the crisis period, it has been reported. Melvin and Sultan (1990) in their research work found out that changes in crude oil prices and political unrest significantly contribute to determining the gold price behavior. This is an interesting outcome, indeed.

Alternatively, Narayan *et al* (2010) analyzed the long-run relationship between gold and oil spot as we well as future prices with varying maturities. They, among others, used the inflation channel in their analytical framework. They observed a bidirectional causality between gold and crude oil prices.

Zhang and Wei (2010) examined the cointegration and causality between gold and crude oil prices. Covering a sampling period from 2000-2008 and using appropriate statistical measures, they have identified that there existed a significant positive correlation between crude oil and gold price behavior. Further, they have noticed that the trend has been consistent during the sampling period.

In an empirical study undertaken for the study period between 1989-2007, Wang, and Cheuh (2013) observed a positive interaction between gold and crude oil prices.

The existing contributions that are documented in the finance literature indicate that there is a significant relationship between gold price behavior and share price behavior.

Identically, Aiza *et al* (2020) attempted to examine the impact of gold and oil prices on the share price behavior. Gathering data for the period from 1991-2016, the study applied a variety of statistical measures that include descriptive statistics, Augmented Dickey-Fuller test, correlation, and autoregressive distributed lag test. They, based on the analytical results, observed that gold and oil prices had a significant impact on the stock market.

Similarly, yet another interesting study by Le and Chang (2012) statistically significant relationship was found between share price behavior and gold prices. They have also stated that the stock market contributed to an increase in gold prices. In the same manner, another study by Gilmore et al (2009) conducted for a sample period from 1996-2007 observed that the stock market index and gold mining companies' price index were linked in the long-run and further noticed that both the variables influenced each other in the short-run, as well.

It has been noticed that during economically uncertain and turbulent periods, investors' attitude is more in favor of gold as it is considered as a 'safe haven' for investment purposes.

The relationship between gold price behavior and stock price behavior was examined during the period of the financial crisis by Choudhry et al (2015) and noticed that the interdependence between returns from gold prices and share price behavior was found to be weaker. They further observed that gold could be considered for investments against risks only during stable financial and economic conditions.

As mentioned earlier, a few research works have strong evidence to prove that gold prices and equity markets are not significantly related. Let's review some of these works in the following paragraphs. Pandey *et al* (2018) examined the crude oil and gold price volatility spill over to the equity markets of BRICS nations. They have applied the EGARCH model for the spill over-analysis. They have found sufficient evidence to prove that there was spillover from both the crude oil and gold to the BRICS stock markets. Interestingly enough, they have noticed that the volatility spillover from gold was not significant before the onset of the financial crisis in the year, 2008. However, the spillover became a statistically significant post-credit crisis. Further, the volatility asymmetry which was not significant before the crisis proved to be significant after the crisis. Raza (2016) examined the impact of volatilities in gold and oil on the share price behavior of emerging economies. They have

observed that gold and oil price volatilities had reacted inversely to the volatility of equity markets. A few other interesting contributions need a special mention, here. For instance, Afsal and Haque (2016) observed that no dynamic relationship existed between gold prices and stock price behavior. Quite interestingly, some of the suggestions put forth by the researchers trigger a lot of interest in the academic literature. For instance, Roberdo (2013) has observed that in inflationary economic conditions, investors increase their holding of gold as it could be hedged against inflationary conditions. This is quite interesting, indeed.

2.4. Comments, Criticisms, and Key Learning from the Literature

Finance literature has plenty of evidence to suggest that investors tend to move towards gold markets on account of the fact the gold is considered as a safe, alternative as well as an attractive investment. It is further argued that gold could be viewed as a portfolio diversifier as it has a low correlation with other assets and contributes to lowering the portfolio risk, Ciner *et al* (2013). The point to be carefully taken note of at this juncture is that we have both strong as well as weak evidence in the economic literature that gold, oil, and stock prices are related. We have research evidence to prove that both gold and oil had a significant impact on the share price behavior.

3. Methodology

The current study makes an attempt to examine if the three globally and economically important markets, i.e., Gold, Oil, and Stock markets have any inter-relationship and impact among themselves so that it would be a great support to the investors to make sound investment decisions based on their individual risk appetite and return aspirations.

3.1. Sampling, Study Period, and Data Collection

A period of four years has been identified by the researcher to achieve the study objectives. The researcher made sure that the sampling did not have any kind of major events or boom or recession to ensure that the data do not suffer from any kind of abnormalities in the form of 'structural-breaks' or 'outliers' etc. so that the results are reliable and could help draw meaningful conclusions. He also kept in mind that the data used for the study should be recent so that the results could be applied in the immediate future in the markets by the analysts and investors. Consequently, he noticed that years starting from 2016 to 2019 did not have any major events that might lead to swift changes in prices of all the three variables, i.e., gold, crude oil, and DJIA's share price indices barring a few instances which he rightfully treated using the accepted methods of standardization of data. The researcher was in favor of gathering monthly data for these sample variables as the prices/rates were uniformly available on the same date for all the three variables thus giving confidence to him for the computation of returns which will be uniform across the study period of four years. This resulted in gathering data for 49 months starting from January 1, 2016, to December 1, 2019 (including data for December 2015, the base month) for the three variables under study. The researcher did not include the first few months in 2020 as the entire world has started receiving adverse messages about the spread of the Corona Virus and Covid-19 Pandemic attack-related negative news from various countries. So, to be on the safer side, the sampling framework did not include any data for the year 2020.

3.2. Data Standardization and Checking for Normality

Since the researcher has used the data for over forty-nine months to compute returns for forty-eight months, he made sure that the data do not suffer from any 'structural-breaks' or 'non-normality' concerns. He subjected the data of all the three returns, i.e., share price returns, gold price returns, and DJIA returns to undergo the 'Dixon's Outlier' test and identified the extreme values in the distribution. Following the standard procedures and after treating the 'extreme values' from the distribution, the

researcher applied five different types of normality tests, i.e., Skewness, Kurtosis, Jarque-Bera test, Kolmogorov-Smirnov (K-W test), and Shapiro-Wilk test. Emboldened with the normality of the distributions, he applied further tests such as descriptive statistics, inferential statistics, and the same has been presented and discussed in the following paragraphs. Besides, the researcher had a visual inspection of the time-series data using PP-plot and QQ-plots that were generated using SPSS (Statistical Package for Social Sciences) Version – 25. As 'multiple regression analysis' was applied to examine the interrelationship and impact of each variable on the other predictor variables, the researcher applied the following tools to comply with the assumptions to be satisfied before applying 'multiple regression analysis'. Durbin-Watson (DW test) statistic was applied to check if the sample data have any issues or problems related to 'autocorrelation'. He observed that there were no serious 'autocorrelation'-related issues in the data barring only one instance. However, previous research works have confirmed that based on the number of independent variables used in the study, minor violations were permitted for proceeding with further analysis. Regarding yet another important assumption that is related to 'multi-collinearity' issues in multiple regression analysis, the researcher applied VIF (Variance Inflation Factor) test and ensured that there were no 'multi-collinearity' related issues in the regression equation.

The results of checking for normality and descriptive statistics have been presented in Table-1.

Table 1: Descriptive Statistics of Returns

	Gold-Returns	**Oil-Returns**	**DJIA-Returns@**
N (in months)	48	48	48
Mean	0.0094	0.0221	0.0129
Std. Deviation	0.0249	0.0550	0.0271
Variance	0.001	0.003	0.001
Minimum	-0.04	-0.07	-0.04
Maximum	0.06	0.16	0.07
Skewness	-0.046	0.120	-0.102
Kurtosis	-0.741	-0.482	-0.458
Jarque-Bera*	0.638	0.776	0.920
Kolmogorov-Smirnov*	0.056	0.200	0.200
Shapiro-Wilk*	0.243	0.142	0.349

*P-Values at 5% level of significance @Dow Jones Industrial Average (DJIA) Index

Returns of all the three variables were calculated using the standard formula $R_t = (P_1\text{-}P_0/P_0)$ where R_t indicates Return for the month 't', P_1-ending price – P_0 -initial price, respectively. Based on the analytical results, the descriptive statistics for the returns of all the sample variables are presented in Table -1. First of all, the data have not witnessed any kind of non-normality-related issues as is evident from all the five parameters as discussed above. The recorded values are within the acceptable range and confirmed normality of the distribution. The P-values are greater than the benchmark value of 0.05 indicating that the time-series data could be used for further analysis. Moving forward, it could be seen from table-1 that crude oil has yielded the highest average returns (Mean = 0.0221) during the study period implying that oil price behavior has outperformed the remaining two markets, i.e., gold and stock, in terms of returns during the study period. Of course, oil prices have witnessed see-saw movements since May 2014 and the volatility is still continuing for well over six years. Again, it is proved that the standard deviation of 0.0550 and variance value of 0.003 recorded in the case of oil returns is the highest when compared to the other two variables, gold, and Dow Jones volatility numbers during the study period. Regarding skewness and kurtosis, the values are within the acceptable range (neither > nor < than the acceptable value-1).

In the same manner, Jarque-Bera statistic too confirms that the distributions are 'normal'.

The Multiple Regressions Equation to predict the Gold Price Returns is constructed as follows:

$$Y = b_o + b_1*X_1(\text{Oil Returns}) + b_2*X_2(\text{Dow Jones Returns}) + e_t \quad (1)$$

Y is the dependent variable, Gold Returns,

b_0 (Alpha) is the constant or intercept
b_1 is the Slope (Beta coefficient) for X_1 (Oil Returns)
X_1 First independent variable that is explaining the variance in Y
b_2 is the Slope (Beta coefficient) for X_2 (Dow Jones Returns)
X_2 Second independent variable that is explaining the variance in Y
e_t - the error term

In the same manner, the remaining two equations are constructed as follows:

The Multiple Regressions Equation to examine the relationship with Oil Price Returns is constructed as follows:

$$Y = b_0 + b_1*X_1(\text{Gold Returns}) + b_2*X_2(\text{Dow Jones Returns}) + e_t \quad (2)$$

Dependent Variable, Y = Oil Price Returns

The Multiple Regressions Equation to examine the relationship with Dow Jones Returns is constructed as follows:

$$Y = b_0 + b_1*X_1(\text{Gold Returns}) + b_2*X_2(\text{Oil Returns}) + e_t \quad (3)$$

Dependent Variable, Y = Dow Jones Returns

4. Results and Discussion

The analytical results are presented and discussed below.

4.1 The Relationship among Gold_Returns (y), Oil Returns (X_1), and Dow Jones_Returns (X_2)

In table-2, the analytical results of the multiple regression analysis have been presented. Returns from the gold price behavior (Y) are considered as the dependent variable whereas Oil Returns (X_1) and Dow Jones returns (X_2) have been included as the predictor variables.

The results have been presented in table-2 below.

Table 2: Results of Multiple Regression Analysis

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.135[a]	.018	-.025	.02528	1.335

Anova[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.001	2	.000	.417	.662[b]
	Residual	.029	45	.001		
	Total	**.029**	**47**			

[a] Dependent Variable: Gold Returns
[b]Predictors: (Constants), Dow Jones Returns, Oil Returns

Coefficients

Model 1	Unstandardized Coefficients		Standardized Coefficients	t	Sig	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
Constant	.011	.004	-.139	2.535	.015	.906	1.104 1.104
Oil_Returns	-.063	.070	.017	-.896	.375	.906	
DJ_Returns	.016	.143		.110	.913		

The preliminary inspection of Durbin-Watson indicates that it is slightly lower than the expected value which is from 1.5 to 2.5. Although this value is slightly lower than the expected figure, statisticians advocate that a minor deviation from the reference range (DW statistic value from 1.5 to 2.5) will not affect the results as only two predictors are considered in the model.

Also, the collinearity diagnosis has revealed that there are no multi-collinearity-related issues found in the data and results as the tolerance and VIF values are well within the reference range which

is expected to be closer to 1. We could see .906 and 1.104 for both oil returns and Dow Jones returns for the study period. Having been satisfied with the assumptions, let us now move forward to discuss the results of regression analysis. We could notice that together both the predictor variables Oil returns and Dow Jones returns are not statistically significant predictors of gold price returns. The regression equation (F (2, 45) = 0.417, P = 0.662 > 0.05) indicates that predictor variables do not have any significant influence or causation on the dependent variable. So, combined together, Oil price returns and Dow Jones returns do not cause changes in gold price returns. We notice that gold price returns and predictor variables, oil and stock returns as represented by Dow Jones are related to the tune of 13.5% (R = 0.135) which is a very low positive correlation among the variables. This relationship is not statistically significant. Interestingly, when oil prices go down yielding negative returns, returns from the gold markets tend to move up. This is because crude oil prices and gold prices are inversely related. (Oil returns, Beta -0.139, t = - 0.896). The conclusion here is that a change in oil prices causes a change in gold prices. When oil prices fall, gold prices start moving up pushing the investors to make more investments in the gold market as they look for safer investment avenue to park their funds.

4.2. The Relationship among Oil_Returns (y), Gold Returns (X_1), and Dow Jones_Returns (X_2)

In table-3, the analytical results of multiple regression analyses are presented. Here, as discussed earlier, returns from the oil prices (y) have been considered as the dependent variable while Dow Jones returns and gold price returns have been included as the predictor variables. The results are presented below.

Table 3: Results of Multiple Regression Analysis

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.332[a]	.110	0.070	.05303	1.869

Anova[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.016	2	.008	2.779	.073*
	Residual	.127	45	.003		
	Total	**.142**	**47**			

[a]Dependent Variables: Oil_Returns
Predictors: (Constants), Dow Jones Returns, Gold_Returns
*Significant at 10% level

Coefficients

Model 1	Unstandardized Coefficients		Standardized Coefficients	t	Sig	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
Constant	.017	.009		1.858	.070		1.0011.001
Gold_Returns	-.278	.310	-.126	-.896	.375	.999	
DJ_Returns	.615	.285	.303	2.157	.036	.999	

Regarding the assumptions to be satisfied for applying the multiple regression, it is clear from the table presented above that the Durbin-Watson (DW-Statistic) value 1.869 is very close to 2 which means that there is no problem of autocorrelation as it is well within the reference range of 1.5 to 2.5.

Further, scrutiny of collinearity statistics has revealed that no multicollinearity related issues have been faced concerning this equation. The VIF value of 1.001 is very close to the reference value of 1.000. Having been satisfied with the crucial assumptions to be met before applying the multiple regression analysis, let us now move on to examine the relationship and combined impact of the predictor variables on the independent variable (y). Here, we could observe that both the predictor variables Gold_returns and Dow_Jones returns together have registered an R-value of 0.332 and they could be considered as significant predictors of oil price returns. The regression equation (F (2, 45) = 2.779, P 0.073< 0.10) indicates that the predictor variables jointly do have a statistically significant relationship on the

dependent variable, the Oil_Price returns. So, Gold_price returns and Dow Jones returns together have a statistically significant relationship with the Oil_Price returns. The R-Square value of 0.110 indicates that the predictor variables together could cause variations on the dependent variable, Oil-Price_Returns. Further, it could be noticed that Dow Jones Returns is statistically significant t = 2.157, P = 0.036 < 0.05 at 5% level of significance. So, there is a statistically significant 'cause and effect' relationship between oil returns and Dow Jones returns. A close look at the cause and effect factor goads us to conclude that, just like the previous results in table-2, here again, oil and gold returns show an inverse relationship which means that when one price goes up the other price falls, and *vice-versa*.

The Relationship among Dow Jones_Returns (y), Gold Returns (X_1), and Oil_Returns (X_2)

In table-4, the analytical results of multiple regression analysis have been presented. In this equation, as discussed earlier, returns from the Dow Jones (y) has been kept as the dependent variable while Gold_returns (X_1) and Oil-returns (X_2) have been included as the predictor variables. The multiple regression equation to predict the Dow Jones_returns is given in equation-3.

Table 4: Results of Multiple Regression Analysis

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.307[a]	.094	0.054	.02639	2.150

Anova[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.003	2	.002	2.343	.108[b]
	Residual	.031	45	.001		
	Total	**.035**	**47**			

[a]Dependent Variable: Dow Jones Returns

[b]Predictors: (Constants), Oil Returns, Gold_Returns

Coefficients

Model 1	Unstandardized Coefficients		Standardized Coefficients	t	Sig	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
Constant	.009	.004	.016	2.118	.040		1.0181.018
Gold_Returns	.017	.156	.309	.110	.913	.982	
Oil_Returns	.152	.071		2.157	.036	.999	

It is apparent from the table-4 presented above that the assumptions to be satisfied before applying the multiple regression analysis, have been satisfied. Since the Durbin-Watson (DW-Statistic) value 2.150 is very close to the reference value of 2, it could be inferred that there is no autocorrelation-related issues in the equation.

Further, the collinearity statistics has also confirmed that no multicollinearity related issues have been faced with regard to this equation. The VIF value of 1.018 is very close to the reference value of 1.000. The tolerance and VIF values are well within the reference range which is expected to be closer to 1. Coming to analyzing the relationship and combined impact of the predictor variables on the independent variable (y), we could observe that both the predictor variables Oil_returns and Gold_returns together have registered an R-value of 0.307 which means that both the variables combined together although enjoy a moderate degree of relationship, the relationship is not statistically significant. The regression equation (F (2, 45) = 2.343, P 0.108 > 0.10) indicates that predictor variables do have statistically significant relationship on the dependent variable, the Dow Jones_returns. So, Oil_price returns and Gold_returns together have no statistically significant relationship with the Dow Jones_returns. The R-Square value of 0.094 indicates that together the predictor variables do not cause variations on the dependent variable, Dow_Jones returns. However, a close examination of the influence of individual predictor variables on the dependent variable guides us to conclude that the Oil_Price_returns have a statistically significant influence or causation on the Dow_Jones_returns (t = 2.157, Sig: 0.036 < 0.05) during the study period which confirms the results obtained from table-3. This

means that Oil price behavior has a significant impact on the share price behavior. The underlying message is that these two markets are inter-related. Individually, variations in one market have a statistically significant relationship with another market as discussed earlier and 'cause-and-effect' relationship is noticed in a few instances as discussed above in the previous paragraphs.

5. Findings, Conclusions, and Recommendations

The present study attempted to examine the interrelationship among the three important markets, gold, crude oil, and stock markets over a period of four years (forty-eight months), from 2016 to 2019 using monthly data. Based on the analytical results, the following conclusions could be drawn from the study.

5.1. General Findings

- Based on the analytical results, one could conclude that all these three markets, gold, oil, and stock are closely related although this relationship is not consistent but time-varying.
- The results indicate that crude oil has yielded the highest average returns (Mean = 0.0221) when compared with the other two markets, gold, and stock markets.
- Further, returns from the oil markets have the highest volatility when compared to the other two markets. This is evident from the standard deviation (0.0550) and Variance (0.003) recorded in the case of oil markets during the study period.
- Together the oil price returns and stock returns have a very low positive correlation (R = 0.135 or 13.5%) and the relationship is not statistically significant. Also, together, both the predictor variables do not cause any change in gold price returns.

5.2. Findings from the Gold_Price Return

- It has been noticed that returns from the gold price behavior and crude oil prices are negatively related (Oil returns, Beta -0.139, t = - 0.896). The present findings corroborate with the previous research findings documented in the literature (Narayan *et al*, 2010). In a nutshell, the change in oil prices causes a change in gold prices. It could be inferred from the results that when oil prices fall, investors look for a safer investment avenue and eventually they land up in the gold market.

5.3. Findings from the Crude_Oil Returns

- Returns from the crude oil prices and share prices are related to each other and the returns are statistically significant. This finding confirms the previous findings documented in the economic literature. (Kling (1985); Ling and McAleer (2003); Kling (2005); Basher and Sadorsky (2006); Baten et al (2017)). Gold_price returns and Dow Jones returns, the predictor variables together have a statistically significant relationship with the Oil_Price returns. The R-Square value of 0.110 indicates that the predictor variables together could cause variations on the dependent variable, Oil-Price_Returns.
- Further, oil price returns and gold price returns show an inverse relationship which means that when one price goes up the other price falls (Gold returns, Beta = -0.126, t = 0.896). Further, Dow Jones Returns cause a change in oil price returns. (Beta = 0.33, t – 2.157, Sig 0.036 <0.05). So, there is a statistically significant 'cause and effect' relationship between oil price returns and Dow Jones returns.

5.4. Findings from Dow Jones_ Returns

- Further analysis of the degree of relationship between Dow Jones returns and the two predictor variables, oil price returns and gold returns together have a moderate degree of relationship with the R-Value of 0.307. However, the relationship is not statistically significant.

- Concerning the examination of the individual impact of the predictor variables on the dependent variable, we notice that Oil price returns (t = 2.157, Sig: 0.036 <0.05) have a statistically significant influence or causation on the Dow_Jones returns during the study period. The interpretation is that both oil and stock markets are interrelated.

5.5. Recommendations

Based on the analytical results and conclusions, the following recommendations are put forth for the security analysts and investors.

- Although crude oil prices have witnessed a lot of variations over the last several years, still there are ample opportunities for the investors to make reasonable returns, particularly, in oil futures markets. Both up and downside movements offer good opportunities for the investors since oil would continue to be the engine of growth for many more years to come. However, one has to exercise care and caution before investing in this highly volatile market.
- Based on historical trends, one could conclude that investors always keep a higher level of confidence in the gold market, particularly, when oil prices take a beating. So, Investing in the gold market could be considered as a safe bet in the long run. Keeping a close watch on both the gold and oil market might prove to be quite useful.
- In many research works, the relationship between oil price behavior and share price behavior has been proved beyond doubt. So, keeping a close watch on both markets would throw good opportunities to make reasonable returns.
- It is further recommended that investors should analyze all the three markets together to make sound investment decisions instead of examining each market in isolation as, in several instances, there is a cause-and-effect relationship in these markets, across the world.
- Among the three markets, the gold market offers greater stability, reasonable returns still consistently over many years.

  So, investors can choose these markets based on their risk appetite and return aspirations.

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