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Examining the Relationship between Average Price of Gold in India and International Price of Crude Oil From 1990-2021

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Abstract
Most of the economies across the world is invariably controlled by two of the most important macroeconomic variable gold and crude oil. As per the existing literature, Gold and crude oil prices in a country are affected by many macroeconomic variables such as exchange rates, imports, exports, trade deficit, surplus,national income and many more. Variables considered in the study are inflation rate, Gross domestic product, international crude oil price. The present study examines the interrelationship between average price of gold and its growth rate with respect to international crude oil price. The study also examines the average variation of gold price in India with respect to exchange rates, inflation, and Gross domestic product.

Keywords:OPEC, International crude oil price, Average price of gold, Inflation rates, exchange rates, GDP.

I. Introduction

Gold and crude oil rule the commodity market or one can also say that they control the economy. Gold is a principal commodity and it holds much value because of the significance it has gained over several thousands of years. Due to its strong history of being the most reliable medium of exchange, the value of it is on ever rising mode. Gold has also been historically favored by traders, investors, government, and other producers. Over the past 50 years, its price has climbed up significantly high. Gold is majorly influenced by supply and demand, like most commodities, but it also retains significant value which makes it stand out. Demand for the metal is largely controlled or affected by governments and central banks. The demand for investments, particularly from sizable ETF(exchange traded funds), has an impact on gold prices as well. Given that it is priced in dollars and acts as an inflation hedge, gold occasionally fluctuates against the US dollar. The primary factor affecting the supply of gold is mine output, which has stabilized since 2016. Paper money and gold are kept in reserve by central banks. The price of gold normally increases as central banks diversify their monetary reserves away from the paper money they have amassed and into gold. Many countries have gold deposits as their main component. Because the metal is dollar-denominated, the price of gold typically has an inverse relationship with the value of the US dollar. In the absence of other factors, a stronger U.S. dollar tends to keep the price of gold lower and more under control, while a weaker U.S. dollar is likely to push the price of gold higher due to rising demand because more gold can be purchased when the dollar is weaker. A common defense against inflation is gold. Price increases are referred to as inflation, and they also occur when the dollar's value declines. The cost of gold rises in tandem with inflation.

As we all know crude oil has been recognized as the world's major energy source since the mid-1950s. It is the lifeblood and motor of the industrialized world and has become a key driver of economic growth for many nations. The international crude oil is measured by including WTI (West Texas Intermediate) crude oil price, Brent crude oil price, Murban crude prices and natural gas prices. On the other hand, Oil prices are not set by OPEC(Organization of petroleum exporting countries), by imposing limits on member nations' oil output, OPEC manipulates the price of crude oil on the open market. And it also plays an important role in the market and the economy. Few existing literatureshows that like gold and crude oil also determines the alterations in some macroeconomic variables. In both exporting and importing nations, the volatility in the price of oil may have a considerable macroeconomic effect. Additionally, it has an impact on transportation,

manufacturing, and heating costs, which adds to economic uncertainty globally.

The price of oil products is more variable and unpredictable than the price of any other commodity due to its enormous significance. Due to demand inelasticity, the prices of crude oil also have a negative impact on family purchasing power. They also have a direct impact on international trade, investments, industrial output, and other types of production. Furthermore, the uncertain future is a result of how directly the high price of crude oil affects consumer goods and services. These two commodities that play an active role in the economy might be observed to be moving in a similar direction This paper is an attempt to understand the relationship between two different commodities that are affected by similar variables with respect to the Indian economy.

Objectives

- To estimate the growth of average price of gold in India and international crude oil price from 1990 – 2021.
- To analyze the relationship between gold prices in India and OPEC price of crude oil.

Hypotheses

H_0: There is no statistically significant relationship between the average price of gold in India and international crude oil prices, the OPEC prices of crude oil, inflation rate in India, exchange rates in India and the GDP growth in India

H_0: There is no statistically significant relationship between the average price of gold in India and international crude oil prices, inflation rate in India, exchange rates in India and the GDP growth in India

H_0: There is no statistically significant relationship between the average price of gold in India and OPEC price of crude oil, inflation rate in India, exchange rates in India and the GDP growth in India

H_0: There is no statistically significant relationship between the average price of gold in India and OPEC price of crude oil, inflation rate in India, exchange rates in India and the GDP growth in India.

II. Literature Review

Long before paper currency gold was the medium of exchange, while gold as a medium of exchange and monetary standard came with its own advantages and disadvantages over several years gold has become an essential commodity. Not just a critical entity, the value of gold is an integral part of the economy and it is a social construction which we do not find in other commodities. It is a great contributor to economic growth as well. Similarly, another such commodity is crude oil and it is known that they contribute up to 3 percent to the GDP of an economy. globally most of our energy needs are satisfied by crude oil and this characteristic of crude makes it an important commodity for trading. The relationship between these two commodities is quite inconsistent but strongly linked.

It is observed that when there is a disturbance between national currencies and exchange rates there is a slow restoration in the gold parity than the expected rate this can be backed up by the unpredictability of government actions, speculation, and obstacles to the free market in foreign exchange. (Bertrand Fox,1935).

On studying the effect of LERM (liberalized exchange rate management) on the Indian rupee's devaluation and depreciation. It is found that the depreciation of the Indian rupee had no favorable effect on the value of the US Dollar and the balance of trade during 1971-90. The trade and payments deficits widened as the dollar quantities of imports increased more quickly. The rupee's depreciation process accelerated in the 1980s. However, there was very little indication that the growth of exports measured in dollars had accelerated. (Prabirjit sarkar,1992).

With the help of a stock and flow model, we can understand the effect of oil on increasing exchange rates if a certain increase in oil price leads to higher demand for Deutschmarks and lower demand for US dollars the Deutschmark will appreciate against the dollar the main factors that lead to this is incremental share of oil deficit and portfolio preferences. OPEC's import pattern and magnitude of absorption affect the oil deficit. (Stephen S. Golub,1983)

Evidence shows that there is a strong non-linear negative relationship between the value of the Norwegian krone and crude oil prices. Similarly, the strength of the negative correlation between the level of exchange rate and the trend in oil prices. A change in oil prices has a strong effect on the exchange rate when oil prices are particularly low the relationship also becomes strong when oil prices fall. Furthermore, oil prices are found to have numerically and statistically insignificant effects on

the exchange rate in the long run. (Q. Farooq Akram, 2004).

The study reveals under the flexible exchange rate period variations in real and nominal exchange rates are mainly because of real shocks which demonstrate that real factors play a key role in determining the behavior of real exchange rates. The degree to which these factors are shifting in response to the widespread liberalization of the macro economy, then it can be expected that the Rupee is likely to behave in a non-stationary way in the immediate future. (Tomoe Moore And Eric J. Pentecost, 2006).

The fall in the value of the rupee reduced the inflows of foreign capital and increased external debt burdens leading to a rise in India's oil and fertilizer subsidy bills. The bright side of the depreciation is that it lead to the stimulation of merchandise exports and the discouragement of merchandise imports, which improved trade. Despite major increase in exports and sales in 2008, Indian companies have gone through huge forex losses due to the depreciation. It also leads to reducing in imports but we can't conclude that depreciation is good as it discourages imports for a country like India imports are essential (Sumanjeet Singh,2009).

As we are aware that gold prices are affected by inflation which affects the purchase pattern, by using a hypothesis it is known that buying during an upswing and selling during a downswing would have helped the investor make a profit from the increase in gold prices during an upswing and gain from bonds or stocks during a downswing. (Geoffrey H. Moore,1990).

With GARCH models it is found that there is a positive and significant relationship between inflation and the level of inflation and variability of inflation in India. There is evidence that price stability along with the other indicators should be one of the important factors for a monetary policy as higher inflation in India has led to inflation uncertainties. (John Thornton, 2006)

The study reveals that U.S inflation is sensitive to real oil price shocks, the degree of sensitivity has been proven to change after the 1990s even with the inflation expectations which call for the role of pricing and monetary policy. (Benjamin Wong,2015)

With the help of the cyclical theories of Kondratiev and Kitchin to present realities and trends. It shows that the world has been in the midst of the "bearish wave" of Kondratiev's sixth cycle since 2008, which will last until 2020 and with that, we can arrive at the conclusion that Oil and gold prices are mirrorlike variables with qualitative changes in the state of the world economy. When the world market is on a buoyant wave of development, oil and gold prices are at a minimal level. (Alexandr Ajvazov,2013)

The price of Crude oil is very meticulous to predict as there are so many conflicting issues that affect it such as the supply and demand, the health of the global economy, geopolitics, global monetary, and the regulatory environment. The factors that are studied to reasons for the steep oil price decline thus far are the glut in the global oil market caused by rising US shale oil production, over-production by members of the Organization of Petroleum Exporting Countries (OPEC) beyond their production quotas, and a slowdown in China and European Union (EU) economic growth thus reducing global demand for oil. (Mamdouh G. Salameh,2015)

The study shows that an appreciation of the U.S. dollar exchange rate can lead to a major decline in the demand for oil in countries that do not use the U.S. dollar as a medium of exchange for local transactions. surprisingly, a one per cent shift in the real U.S. dollar exchange rate is studied to have a stronger impact on oil demand than a one per cent shift in the global real crude oil price determined by the U.S dollar. (Selien De Schryder and Gert Peersman,2015)

The study shows the effect of alteration in the oil price and the changes in the exchange rate of the Indian rupee in terms of the USA dollar the macroeconomic variables. A negative effect on the oil price has a favorable and long-term effect on output as the prices go down and the rupee appreciates temporarily. The response of the economy is asymmetrical to oil price shocks either positive or negative. (Taniya Ghosh,2016)

There is evidence that WTI crude has a strong correlation with the metal market. Especially the Indian metal market has seen medium co-movement with the WTI crude oil with no upward or downward trend. The reason for the co-movement of the metal market with the WTI crude oil market is due to the strong dependency on crude

oil in the production process of metal.(Nikhil Kaushik,2018)

Investors should inspect the direction of causality between crude oil, gold and stock markets since crude oil and gold are considered to be investment assets and their relationships can influence decisions on investment portfolios and in turn potentially affect stock market outcomes. There are no exhibit material differences between various subsamples but non-linear causal links between oil, gold and the stock market are observed.(Semei Coronado et al.,2018).

According to the previously conducted studies considering variables such as gold, and crude oil and the related variables such as inflation rates, exchange rates etc. are have an impact of the macro economy. There is evidence to show that gold holds some kind of relationship with the related variables like inflation and exchange rates in a country and similarly we can also see that crude oil also has a crucial relationship with these same variables. With this empirical evidence this research aims to study the relationship of gold price and crude oil price with respect to the Indian economy and also see how the related variables affect them.

III. Methodology

The study considers 6 variables, considering average price of Gold in as the dependent variable and taking international price of crude oil, OPEC (organization of petroleum exporting countries) price of Crude oil , inflation rates in India, Exchange rates in India and GDP(Gross domestic product) growth rate in India as the independent variables. This paper aims to study the effects on the average price of gold measured in rupees by the international price of crude oil measured in cubic meters and converted in dollars/barrel by multiplying the data by 6.29, OPEC price of crude oil measured in dollars/barrel, the inflation rates of India measured in percentage, the exchange rates of India measured in portion. The logarithm of these variables is considered for regression. The last variable is the national income growth rate in percentage. To find the effects on the average price of gold multiple regression is run. The data collected is time series data from the year 1990 to 2021. To analyse the growth trend annual growth models are utilized. The study is based on quantitative analysis.

Table1: Data review for years 1990-2021

Variable type	Variable name	Abbreviations used	units	source
Dependent	Average price of gold in India	APG	Rupees per 10 grams	Reserve Bank Of India
Independent	International price of crude oil	IPC	Dollars per barrel	World bank
Independent	Organizationof petroleum exporting countriesprice of crude oil	OPEC	Dollars per barrel	World bank
Independent	Inflation rates in India	IR	percentage	World bank
Independent	Exchange rates in India	ER	percentage	Reserve Bank Of India
Independent	Gross domestic product growth in India	GDP GR	percentage	World bank

Source: Computed from secondary data.

Analysis

i) Growth models:

Growth models are a visual representation of behavior of a commodity in a market. A growth model helps us understand the trend of growth for a certain product over the time of several years. In this paper, growth models are used to examine the pattern of average price of gold in India and price of OPEC crude oil from the years 1990 to 2021 and to predict the value of both in the year 2050.

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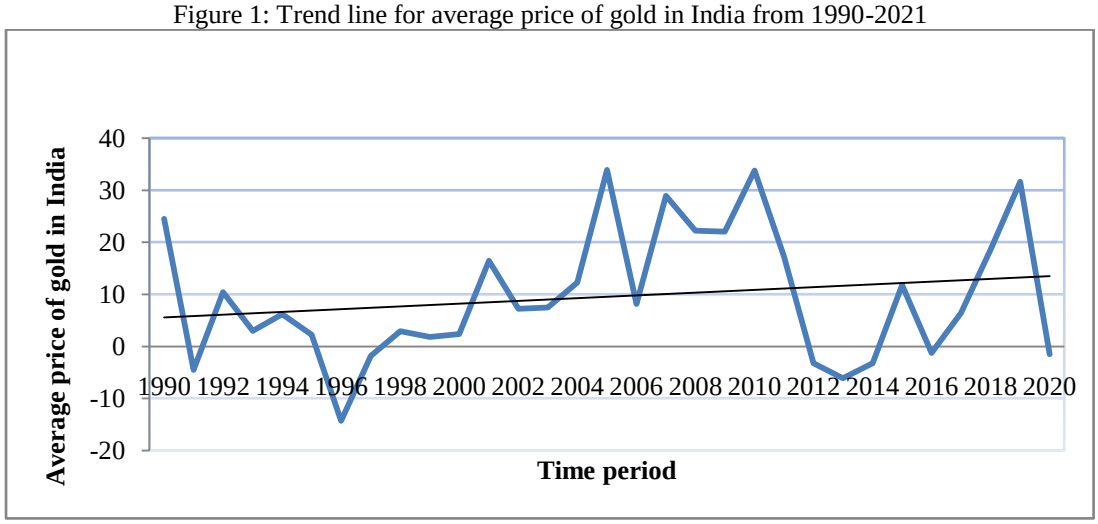
Figure 1: Trend line for average price of gold in India from 1990-2021

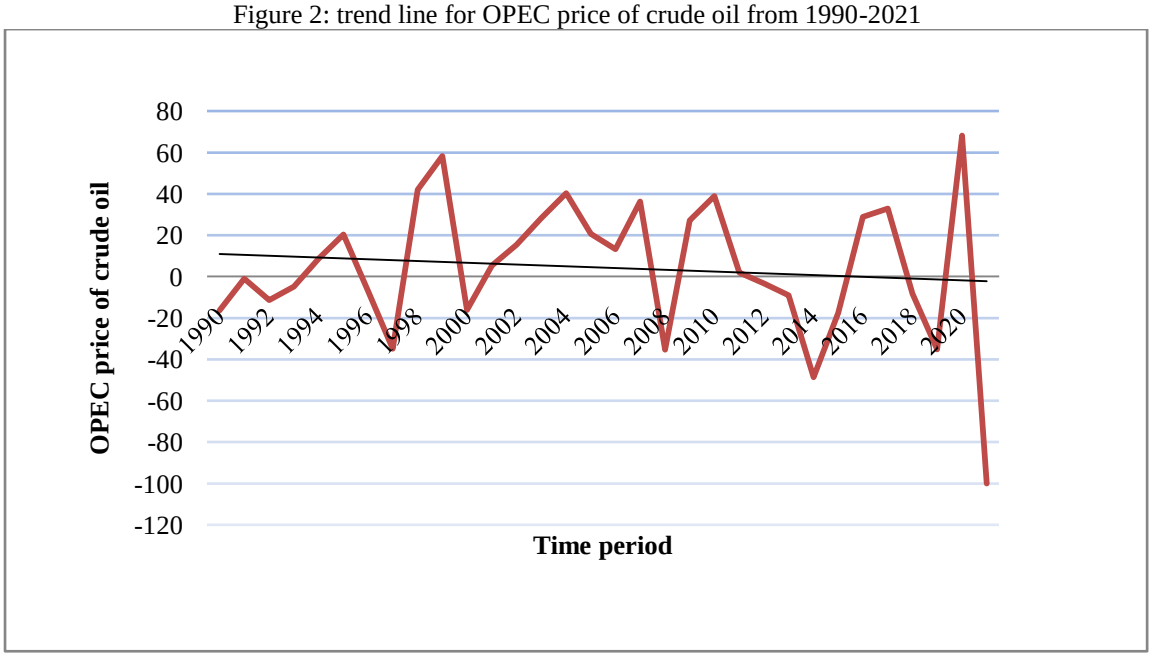


Source: computed from secondary data.

(1) Growth model : LnY(GOLD)= β1+β2X(TIME)
(2) Ln gold= 7.76+0.091(time)

From figure1 we can see the trend of growth in the average price of gold from 1990 to 2021. We can understand that gold prices were the highest at 2004 where is 33.9percent ofgrowth and it was its lowest at 1995 where it showed 14 percentfall. Growth model of gold prices is estimated to predict the value of gold in the year 2050 and the predicted rate of growth for the year 2050 is 13.31 percent

Figure 2: trend line for OPEC price of crude oil from 1990-2021



Source : computed from secondary data

(3) Growth model: Ln (OPEC)= β1+ β2(time)
(4) Ln (OPEC)= 2.7+ 0.05(time)

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From figure1 we can see the trend of growth in the OPEC price of crude oil from 1990 to 2021. We can understand that OPEC prices were the highest at 2020 at approximately 68 percent of growth is seen and it was its lowest at 2021 where it showed 100 percent fall.

Growth model of OPEC prices is estimated to predict the value of OPEC crude oil in the year 2050 and the predicted rate of growth for the year 2050 is 5.75 percent.

ii) Descriptive analysis

Table 2: Summary statistics for the variables considered

Variables	Observations (N)	Mean	Standard deviation	Minimum	Maximum
APG	31	15852.27	2449.218	3451.52	48723.22
IPC	31	99710.76	15405.58	21710.06	306469.1
OPEC	31	47.99844	5.450641	12.28	109.45
IR	31	7.227813	0.560312	3.33	13.87
ER	31	47.5458	2.623619	17.4992	74.0996
GDP GR	31	0.059097	0.005274	-0.066	0.0895

Source: computed from secondary data

Table 2 shows summary statistics of average price of gold in India, international crude oil price, OPEC price of crude oil, inflation rates in India, exchange rates in India and the GDP growth in India. We can see that the mean gold price in India is Rs.15852.27 per 10 grams, average international crude oil price is 99710.76 dollars/barrel, average OPEC price of crude oil is 47.99dollars/barrel, the average inflation rate in India 7.22percent, the mean exchange rate in India is 47.5percent and the average growth in GDP of India is 0.05 percent. The standard deviation of APG is approximately 2449 which is low and shows that there is less variation in gold prices in India over the 30 years. The standard deviation of IPC is approximately 15406 which shows there is less variation in the international price of crude oil from its average over the time period. The standard deviation of OPEC price of crude oil is 5.5 approximately, this shows there is consistency in the prices of crude oil over the years as it is less when compared to it mean prices. The standard deviation of inflation rates in India is 0.5 this shows there is consistency in the inflation rates in India. The standard deviation of exchange rates in India is 2.6 which shows there is consistency in the exchange rates in India for the concerned time period. The standard deviation of GDP growth rate in India is 0.005 which is very high which tells us that there is much variation in the GDP growth rates. The average price of gold in India ranges from Rs.3451.52 to Rs.48723.22. The international price of crude oil ranges from $21710.06/barrel to $306469.1/barrel. The price of OPEC crude oil ranges from $12.28/barrel to $109.45/barrel. The inflation rates in India ranges from 3.33 percent to 13.8percent and the exchange rates range from 17.5percent to 75 percent approximately. The GDP growth rate in India ranges from -0.06 percent to 0.08 percent.

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iii)Correlation matrix

Table 3: correlation matrix for the considered variables

	APG	IPC	OPEC	IR	ER	GDP GR
APG	1					
IPC	1	1				
OPEC	0.6194	0.6194	1			
IR	-0.1977	-0.1972	0.0164	1		
ER	0.8716	0.8716	0.5034	-0.5089	1	
GDP GR	-0.2037	-0.2037	0.0981	-0.0968	-0.0572	1

Source: computed from secondary data.

Table 3 shows the correlation matrix for both the dependent and independent variables considered for the study. From the results it is evident that there is positive and high degree of correlation between international price of crude oil and the average price of gold in India that is 100 percent correlation. Average price of gold in India and the OPEC price of crude oil also seems to have positive correlation but only a 60 percent of correlation exists. The inflation rates in India and average price of gold in India seems to have a negative and low degree of correlation as it is only 20 percent approximately. Exchange rates have a strong and positive relationship with the average price of gold in India as their correlation is 87 percent. The growth of GDP in India has a negative impact on the average price of gold in India but the degree of their relationship is not much as their correlation is only 20percent the two similar variables that is international price of crude oil and OPEC price of crude oil seem to have a positive and relation with correlation of just 62 percent approximately. The correlation between the inflation and international price of crude oil is the same as the correlation between the inflation rate and average price of gold that – 20 percent. Exchange rates in India and the international crude oil price have a strong relationship which is showed by their correlation 87 percent. GDP growth rate has a negative and low effect on international crude oil price with a correlation of 20 percent approximately. OPEC seems to have a low correlation with IR as it is only 16 percent, medium correlation with ER that is 50 percent and highest with GDP growth rate as it is 98 percent.

iv)Regression models

Table 4: Regression models considering APG as dependent variable

INDEPENDENT VARIABLES	**MODEL 1** $R^2 = 1$ **F= (0.000)*** **	**MODEL 2** $R^2 = 1$ **F= (0.000)*** **	**MODEL 3** R^2= **0.754056** **F= (0.000)*** **	**FINAL MODEL** R^2 = **0.874188** **F= (0.000)*** **
IPC	2.6E+16 (0.000)*** S.E= 0.000	1.15E+16 (0.000)*** S.E=0.000	_	_
OPEC	_	_	1.7985 (0.0832)** S.E= 57.40413	2.0503 (0.0501)* S.E= 39.10214
IR	_	1.7758 (0.0870)**	_	2.7712 (0.0099)***

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		S.E=0.000		S.E=381.779
ER	_	3.3921 (0.0021)*** S.E=0.000	_	8.8459 (0.000)*** S.E=94.62252
GDP GR	_	-2.054 (0.04977)** S.E=0.000	1.4708 (0.0356)** S.E=3984.512	-2.0681 (0.0483)** S.E=32896.11
Ln(IR)	_	_	5.1537 (0.1528) S.E=5982.097	_

Source: Computed from secondary data.
*** significant at 1 percent level of significance
** significant at 5 percent level of significance
* significant at 10 percent levels of significance

MODEL 1 :
Table 4 shows the regression models that are considered for this study.
Model 1 from Table 4 shows the results of regression between the average price of gold and International price of crude oil. Taking APG as the dependent variable and IPC as independent variable.
Regression model:
(5) $Y(APG)= \alpha + \beta 1\ X1(IPC)$
(6) APG = -1.8E-12 +0.158983(IPC)

Regression model:

Each individual coefficient is interpreted as the average increase in the dependent variable for each unit increase in each independent variable, assuming all the other independent variables held constant. That is if IPC increases by 1 rupee, the APG will increase by 0.15 rupees. The intercept-1.8E-12 is the value of APG when IPC is 0.

The coefficient determination that is the R^2 $_i$t is the proportion of the variance in the dependent variable that can be explained by the independent variable. In this case R^2 is equal to 1 which means there is 100 percent of explained variation, in other words 100 percent of the variation in APG is explained by IPC and there is no residual term.

The significance F value of the model indicates the overall significance of the model in this case significance F is 0.000 which is lower than 1 percent, 5 percent and 10 percent. As it is lower than the levels of significance, we can conclude that the model is statistically significant and reject the null hypothesis. There is statistically significant relationship between the average price of gold in India and international crude oil prices, the OPEC prices of crude oil, inflation rate in India, exchange rates in India and the GDP growth in India

The t stat value and the P value indicates the significance of coefficient in the model. In this the t stat of IPC is 0.000 and P value which is 0.000 as this is also lower than 1 percent,5 percent and 10 percent levels of significance we can understand that IPC has a statistically significant relationship with APG.

The standard error of the regression is the average distance that the observed values fall from the regression line. In this case the standard error 0.000.

MODEL 2:
Table 4 shows the regression results for model 2 which considers APG as the dependent variable and IPC, IR,ER and GDP growth has the independent variables.
Regression model:
(7) $Y(APG)= \alpha + \beta 1\ X1(IPC) +\beta 2X2(IR)+ \beta 3X3(ER) +\beta 4X4(GDP\ growth)$
(8) APG= - 1.2E-11 + 0.1589(IPC)+3.67E-13(IR)+ 3.06E-13(ER)-3.3E-13(GDP growth)

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Each individual coefficient is interpreted as the average increase in the dependent variable for each unit increase in each independent variable, assuming all the other independent variables are held constant. That is if IPC, IR, ER, GDP growth increases by 1 rupeeindividually holding the influence of other variables constant, the APG will increase by 0.15, 0.000 and decreases by 0.000, 0.000 rupees respectively. The intercept- 1.2E-11 is the value of APG when IPC, IR, ER and GDP growth is 0.

The coefficient of determination that is R^2 value, which indicates about the fit of model and it is the proportion of the variance in the dependent variable that can be explained by the independent variable.. In this case R^2 is equal to 1 which means there is 100 percent of explained variation, in other words 100 percent of the variation in APG is explained by the considered variables that is IPC,IPR,ER and GDP growth and there is no unexplained variation.

The significance F value of the model indicates the overall significance of the model, in this case significance F is 0.000 which is lower than 1 percent, 5 percent and 10 percent. As it is lower than the levels of significance we can conclude that the model is statistically significant and reject the null hypothesis that is there is statistically significant relationship between the average price of gold in India and international crude oil prices, inflation rate in India, exchange rates in India and the GDP growth in India

The t stat and P value indicates the significance of the variables in the model. In this case the t stat value of IPC, IR,ER and GDP w is 1.15E+16,1.775894, 3.392146 and -2.054 respectively and P value is 0.000,0.0870 , 0.0021, 0.04975 repectively. As this is also lower than 1 percent,5 percent and 10 percent levels of significance we can understand that IPC, IR,ER and GDP have a statistically significant relationship with APG.

The standard error of the regression is the average distance that the observed values fall from the regression line. In this case the standard error of IPC, IR,ER and GDP growth is 0.000, 0.000,0.000 , 0.000 respectively.

MODEL 3:

Table 4 shows the regression results for model 3 which considers APG as the dependent variable and OPEC, log of IR, log ER and GDP growth has the independent variables. ER and IR are taken in their log form to see if their effects on APG is much different than their actual observations.

Regression model:

(9)Y(APG)= α + β1 X1(OPEC) +β2X2(LnIR)+ β3X3(LnER) +β4X4(GDP growth)

(10)APG= - 111648+ 103.24 (OPEC)+5860.5(LnIR)+30830(LnER) - 100274(GDP growth)

Each individual coefficient is interpreted as the average increase in the dependent variable for each unit increase in each independent variable, assuming all the other independent variables to be held constant. That is if OPEC, log of IR, log of ER, GDP growth increases by 1 rupee individually holding the influence of other variables constant, the APG will increase by 103.24, 5860.5, 30830 and decreases by100274 rupees respectively. The intercept – 111648is the value of APC when IPC, IR, ER and GDP growth is 0.

The coefficient of determination that is the R^2 value, It is the proportion of the variance in the dependent variable that can be explained by the independent variable .In this case R^2 is equal to 0.754056 which means there is 75.4 percent of explained variation, in other words 75.4 percent of the variation in APG is explained by the considered variables that is OPEC, log of IR, log of ER and GDP growth and there is approximately 25 percent of unexplained variation.

The significance F value of the model indicates the overall significance of the model this case significance F is 0.000 which is lower than 1 percent, 5 percent and 10 percent. As it is lower than the levels of significance we can conclude that the model is statistically significant and reject the null hypothesis that is There is statistically significant relationship between the average price of gold in India and OPEC price of crude oil, inflation rate in India, exchange rates in India and the GDP growth in India

The t stat value and P value indicate the significance of the variables in the model. The t stat value of OPEC, log of IR, log of ER and GDP growth is 1.798546, 1.470819, 5.153701 and -2.21091 respectively and P value is 0.08328, 0.152899, 2.02E-05 and 0.035698 respectively. as this is also lower than 1 percent,5 percent and 10 percent levels of significance we can understand that OPEC, ,ER and GDP have a statistically significant relationship with APG. But IR is not lower than the levels of significance and it doesn't have a statistically significant impact on APG.

The standard error of the regression is the average distance that the observed values fall from the regression line. in this case the standard error of OPEC, Log of IR, Log of ER and GDP growth rate

is 57.40413,3984.512, 5982.097, 45354.28 respectively

FINAL MODEL:

Table 4 shows the regression results for model 4 which considers APG as the dependent variable and OPEC, IR, ER and GDP growth has the independent variables.

Regression model:

(11) Y(APG)= α + β1 X1(OPEC) +β2X2(IR)+ β3X3(ER) +β4X4(GDP growth)

(12) APG= -31419.6 + 80.17 (OPEC)+1058(IR)+837.02(ER) -68032.5(GDP growth)

Each individual coefficient is interpreted as the average increase in the dependent variable for each unit increase in a given independent variable, assuming all the other independent variables are held constant. That is if OPEC, IR, ER, GDP growth increases by 1 rupeeindividually holding the influence of other variables constant, the APC will increase by 80.17, 1058, 837.02 and decreases by 68032.5 rupees respectively. The intercept-31419.6 is the value of APC when IPC, IR, ER and GDP growth is 0.

The coefficient of determination that is the R^2 value,. In this case R^2 is equal to0.874188 which means there is 87.4 percent of explained variation, in other words 87.4 percent of the variation in APG is explained by the considered variables that is OPEC,IR,ER and GDP growth and there is approximately 13.6 percent of unexplained variation.

The significance F value indicates the overall significance of the model in this case significance F is 0.000 which is lower than 1 percent, 5 percent and 10 percent. As it is lower than the levels of significance, we can conclude that the model is statistically significant and reject the null hypothesis. That is there is statistically significant relationship between the average price of gold in India and OPEC price of crude oil, inflation rate in India, exchange rates in India and the GDP growth in India

The t stat and P values indicates the significance of each variable in the model . The t stat of OPEC, IR,ER and GDP is 2.0503, 2.7712, 8.8459 and -2.0681 respectively and P value is0.0501, 0.0099, 0.000 and 0.0483 respectively. As this is also lower than 1 percent,5 percent and 10 percent levels of significance we can understand that OPEC, ,ER and GDP have a statistically significant relationship with APG.

The standard error of the regression is the average distance that the observed values fall from the regression line. In this case the standard error OPEC, IR ,ER and GDP growth is 39.10214,381.779, 94.62252,32896.11.

IV. FINDINGS

- The average price of gold in India is shown to be directly and significantly correlated with the price of crude oil on the global market. Particularly, there is a significant correlation between crude oil prices from OPEC and the average gold price.
- Additionally, it has been discovered that the price of gold in India is significantly impacted by the rate at which Indian rupees is exchanged for U.S. dollars.
- Using statistical approaches, it is very much evident that that India's inflation and national GDP have an impact on the price of gold
- Although Inflation does have a great impact and GDP has a negative impact over average price of Gold.
- Price of gold was highest in the year 2004 and lowest in the year 1995. Forecasting model shows that the gold price might rise by 13 percent approximately by the year 2050 in India.
- The OPEC price of crude oil was at its highest in the year 2020 and lowest in the year 2021 and by the year 2050 OPEC price of oil might increase by 5.7 percent.

V. CONCLUSION

Gold and crude oil are two very important commodities in the product market. They share very similar effects on the market forces that drives economic growth. These commodities are very much in demand in today's world. Through a trial and error, we understand that the final model has the highest R^2 which regressors are OPEC, IR, ER, GDP growth and regressand as APG. It is found that international crude oil pricing has a direct and strong relationship with the average price of gold in India. Specifically, OPEC prices of crude oil has a strong relationship with average price of gold. Therefore, Oil price and gold price levels trend upward simultaneously as oil profits increase, stimulating investment in the gold market.

In this case, a spike in oil prices causes a rise in the demand for (and the price of) gold. It is also found that exchange rates of Indian currency with respect to U.S. dollars also have a significant impact on the price of gold in India .This is because of the principal reason regulating the relation between gold and the USD/INR exchange rate . Gold is used as a hedge against the negative exchange value of the currency. Gold's worth rises

with the fall in value of Indian currency. With the help of statistical tools, it is also found that inflation in India and the national income of India affects the price of gold in India to a certain extent.

With inflation, there is an overall rise in price of all the commodity including gold. And if the national income of the country is on the rise it instigates an increase in the confidence of the public on the country's currency which furtherleads to an increase in the demand for gold and its price.

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