INDUS JOURNAL OF SOCIAL SCIENCES
https://induspublishers.com/IJSS
Volume 2, Issue 2 (2024)

Original Article

Determinants of China's Oil Production: Review of Current Developments and Future Prospects

Iram Fatima[1], Barkat Ullah[2], Kashif Munir[3], Muhammad Shahid[4], Muhammad Rahat Abbas[5], & Muhammad Younis[6]

[1] Graduate BS Economics, Department of Economics, Division of Management and Administrative Science, University of Education, Lahore, Pakistan, Email: Iramfatima174@hotmail.com
[2] UE Business School, Division of Management and Administrative Sciences, University of Education, Lahore, Punjab, Pakistan. Email: barkatullah@ue.edu.pk
[3] Graduate MS Business Administration, Department of Management Sciences, National University of Modern Languages Lahore, Email: K.MUNIR@OUTLOOK.COM
[4] Master of Philosophy in Accounting and Finance, School of Accountancy and Finance, University of Lahore, Email: meharshahid.1987@gmail.com
[5] Graduate MS Business Administration, Department of Business Administration, Ghazi University, Dera Ghazi Khan, Pakistan. Email: rahatbaluch@gmail.com
[6] Graduate BBA, Department of Business Administration, Ghazi University, Dera Ghazi Khan, Pakistan. Email: youniskhan6165882@gmail.com

ARTICLE INFO

Key Words:

Crude Oil output, Crude Oil Prices, CP Index, GDP PER Capita, Cointegration, VECM, Parsimonious model, Multiple Regression Analysis, R-Square

***Corresponding Author:**

Iram Fatima
Iramfatima174@hotmail.com

ABSTRACT

Crude oil is a key tool for national financial expansion, and the persistence of fluctuations in crude oil prices has affected all aspects of the economy. In order to maximize its global oil production, China's rapid economic development has necessitated an increase in claim for crude oil and increased its requirement on imported oil. This paper uses a combination of regression analysis and a time series model to achieve greater accuracy. The consequences of the Johansen Cointegration Test demonstrate the existence of a long-term association among crude oil production, the CP index, crude oil prices and GDP Per Capita. After the co-integration of the variables, VEC Model was then applied and Parsimonious model was established. In addition, the multiple regression analysis also shows that there are significant linear relationships between crude oil output, the CPI index, international crude oil prices and GDP per capita which specify that the model is well fit to the information and therefore reliable for future predictions. Diagnostic test such as normality, multicollinearity, heteroscedasticity and autocorrelation were performed and it was revealed that both OLS regression and VEC model did not suffer from a problem of first order autocorrelation, and heteroscedasticity. The OLS model shows that there is no problem of multicollinearity between the CPI index and Global crude oil values and this make the model not misleading and reliable. The satisfactory outcome of the diagnostic test which is also conformity to satisfaction of the basic underlying assumption show that the product is excellent, sturdy, and trustworthy.

Introduction

For almost everyone, energy is a critical component of economic development (Sugiyama, 2009). Furthermore, crude oil's importance in national development cannot be overstated (Rogoff, 2006). It's all about the energy. This paper's primary objective is to assess the elements that affect China's global oil production, so that past and future trends can be gauged. Consequently, China's fast industrialization and economic growth, oil demand has risen, while imports have risen as domestic oil production has fallen short of the country's global needs (Li, Zhu and Yu 2012; Ameer et al., 2024). The general regression of the model is statistically substantial, resulting in a strongly favorable connection among the variables and indicating that the variables can significantly determine or predetermine China's global oil output. Important variables are regarded as an noteworthy determining factor in the assessment of China's oil output because the overall regression of the model has statistical significance, resulting in a strong positive affiliation among the variables and indicating that the variables can significantly determine or predetermine China's global oil output. The investigation's objective is to see if there are any significant and long-term relationships between key factors and China's oil production (Johansen, 1991; Wang & Sibt-e-Ali, 2024). This study used a suitable statistical model that provides a solid foundation for the findings while also addressing all of the model's basic assumptions. Furthermore, crude oil is a critical tool that aids and facilitates all nations' development. As a consequence of a brief drop in oil prices, China has become the biggest purchaser of crude oil worldwide, surpassing even the United States (IEA 2014), allowing it to maintain global oil production while also controlling inflation. In terms of consistency as an importer, China has outperformed the United States (IEA, 2014). There are several factors to consider, including China's overall productivity, global oil production, and economic viability. As a result, it's critical to remember that crude oil is a critical resource that must continue to flow for the world's nations to survive (Alexander, 2015).

Research Gap

International crude oil price is seen to have decline sharply during this critical covid-19 pandemic and it has a drastic effect on the oil production which is the current situation applicable to all nation of the world including China being the case study of this paper. We cannot over emphasized the fact that CPI index measure inflation and when there is shortfall in the domestic supply of oil as oil is a crucial commodity, It will result in an expense hike other commodities as a result of increase in inflationary gap and this might cause an unimaginable adversity in every citizen's existence. So the government of China has the responsibility to pay serious attention to the GDP per capita and CP index in terms of keeping it in reasonable level that will help them have good control on their oil national output through good price mechanism control that will sustain the economy, the oil supply, and to meet up with the global oil output standard.

Definition of terms

GDP Per Capita is the measure of economic output per person and it can be computed by dividing the gross domestic product by the China population.

China Oil Output can be defined as China Oil production which is the component of total crude oil extracted from the ground.

CP Index refers to the consumer price index which is a good economic gauge that is widely used to measure inflation.

International Crude oil prices: This is the global oil prices which are determined by the association of petroleum exporting countries (OPEC).

Background of the study

Chinese oil production was measured in quarters before the industry was developed and the output was used solely as a lubricant (Caporale 2015). Over twenty barrels of oil each day were produced by the first well, which was constructed in the most basic circumstances and with comparatively inexperienced workers (Caporale et al., 2015). There were 9 additional water supplies boiling in the immediate areas of Yumen, apparatus from Szechuan and other sources, and the expansion of multiple distilling plants with a capacity of approximately 1,000 bar, with the exception of cold winter weather, which caused the oil to congeal every day with an oil capacity of approximately 10,000 gallons of petrol (Perron, 1998). This was the first major oil field in China (Perron, 1998).

Since 1949, the Chinese government has been concerned about safeguarding passable energy supplies to maintain economic expansion (Congo etal, 2008). A number of giant oil fields were later discovered in 1959 in the northeastern Chinese basin, Jiang-Liao, Songhua. Heilongjiang Daqing's oil field, it is the primary one that has supported Chinese oil extraction for many years (Xie,1998). In 1973, China started spreading crude oil to Japan as production increased and began exploring offshore oil (Rotemberg and Woodford, 1996). Exports rose to 20 million tons in 1985 before domestic ingesting started to rise earlier than output (Faria, J.R., etc., 2009). In 1993, domestic production exceeded domestic demand for oil, and China became a net import of oil. While China remains a major creator of crude oil, it was imported in the 1990s (IEA, 1992). As demand rose faster than domestic production (IEA, 1994), in 1993, China started to rely on foreign oil for the initial time. Annual production of 1,298 million barrels of crude oil in 2002 amounted to 1,67 million barrels of crude oil (IEA, 2002). The annual consumption of crude oil was 1.67 million barrels.

In 2006, it introduced 47% of its entire oil consumption, 145 million tons of crude oil (IEA, 2006). By 2008, the majority of Chinese oil imports came mainly from Southeast Asia, but their increasing demand required Chinese oil to be imported from all over the world (Andrews and Donald 1993). Chinese growth rates exceeded domestic oil capacity in 2013, and mid-year floods damaged the country's oil fields (Donald, 1993). As a result, in September 2013, China became the world's top oil consumer subsequently surpassing the US in order to make up for the drop in supplies (IEA, 2013).

Research Objectives

- To study the stationarity of China Oil production, Crude Oil Prices, CP Index and GDP Per capita.
- To examine of the presence of a lasting connection between China Oil production, Crude Oil Prices, CP Index and GDP Per capita

- To degree the impression of the Consumer Price Index on China Oil production
- To fit a Parsimonious vector error correction model (VECM).
- To scrutinize the affiliation among the China Oil production, Crude Oil Prices, CP Index and GDP Per capita.

Research Hypothesis

1. There is a long-term connection between China Oil production, Crude Oil Prices, CP Index and GDP Per capita
2. Consumer price index impact China oil production
3. There is a relationship among China Oil production, Crude Oil Prices, CP Index and GDP Per capita
4. China Oil production, Crude Oil Prices, CP Index and GDP Per capita are stationary

Literature Review

Raw oil is a critical lifeline for domestic growth, and its significance cannot be overstated because it fuels economic development and sustainability (IEA, 2013). Oil consumption has increased dramatically since the beginning of China's economic reforms in 1979. China consumed 366 billion tons of oil in 2007, making it the world's second-largest oil customer behind the US. China's demand for oil, however, will continue to rise in the near future due to advances in industrialization and urbanization, particularly with the rise of private cars (IEA 2006). China's domestic oil production, on the other hand, has slowed since 1997, and the country imported nearly half of its oil from abroad in 2007.

According to customer statistics, China's crude oil imports improved by 10.1 percent in 2018, reaching a new high of 461.9 million tons or 9.24 million barrels of oil per day making it the biggest importer of crude oil worldwide. China's demand is also rising due to the quick economic growth. Crude oil imports improved by 10.1 percent in 2018, according to Chinese customs data. The policy response was to safeguard petroleum imports from a variety of sources while also gaining control over external crude oil resources by investing in Midstream and downstream equipment in foreign nations.

Despite Chinese efforts to boost domestic manufacture, yields have not increased significantly. Domestic creation has essentially decreased meanwhile 2015 (US Energy Information Management) (EIA, 2018). Some of the main challenges facing the upstream Chinese industry include the fresh technologies to discourse difficult geology, restricted availability of water, and a high level of marketplace attentiveness.

The US has the world's thirteenth major established conventional oil stock, estimated at 25.62 billion barrels (bl) (U.S. China's proven non-conventional oil investments, comprising substantial and extra-sized oils, oil sands, denser oil, and kerogen oil) and some of the world's largest anodized fuel reserves). Anodized oil is the global addition. Efforts to increase unconventional hydrocarbon search and progress, the creation of interregional gas pipeline systems, have not resulted in sufficient extra output. In China, several big, established fields in Daqing, Shengli, and Liaohe dominate onshore and shallow oil production. When compared to the previous year, output in these areas fell by 9.5 percent in 2016 (IEA, 2017).

China's eccentric oil production will not grow suggestively in the near upcoming due to geological, technological, and financial limitations. China's shale oil resources wax and wane, containing less condensate than the United States (Gordon and others, 2014). Shale oil investments are utilized in China's main basins. Tarim and Junggar are buried profound beneath the earth's surface, where they use harsh geological formations to intensify their capital, energy, and technology production processes. These two basins are situated distant from significant demand centers and present facilities in the western provinces of the nation.

Domestic oil manufacture has not increased as a consequence of Chinese oil and regulatory circulation. Participants in the market are unable or unwilling to raise enough funds to boost expenditure on drilling and extraction. China's offshore industry is extremely focused, with three major ocean development NOCs – China National Petroleum Corporation, Sinopec, and Chinese Petroleum and Chemical Corporation – dominating the market (CNOOCs). CNPC is responsible for 54 percent of domestic production, Sinopec for 19 percent, and CNOOC for 20 percent. These statistics were amassed using data from the IHS Mar-kit Vantage database subscription for 2018. Due to contracts with a designated NOC for a share of production, foreign oil companies have limited access to conventional hydrocarbon development.

Smack dab in the middle Chinese control also extends to the three NOCs. Over 70% of the refineries in the nation are owned or managed by CNPC, allowing Sinopec to access more crude oil import terminals (IHS EDIN subscription analysis). More than the rest of the market players. While private companies may be involved in the storage, trading, and import of crude oil, the essential to gain commercial and importance permits from the Ministry of Trade, as well as governmental obstacles like limits on imports, limits companies' market access.

Despite their market dominance, certain Chinese sectoral regulations have a negative impact on both NOCs and private companies' profits and cash flows. Oil pricing mechanisms controlled by the government and certain segments of the gas market are examples of this. China's oil pricing procedures are still not entirely market-oriented, even though the country's national crude oil charges have been comparatively in line with the worldwide marketplace subsequently the late 1990s. Ad hoc government involvement based on an intriguing 10-day average may affect the prizes. Prices for fuel and oil are still regulated.

Such legal and structural barriers are likely to stymie China's ambitious oil and energy policy goals. China is expected to harvest 200 MMt of crude oil by 2020, according to Beijing's Thirteenth Five-Year Plan, reversing the current downward trend in output. China also plans to add 5 billion tons to its proven oil reserves and make important development in the development and exploration of alternative oil resources. By 2020, it wants to be energy independent to the tune of more than 80% (International Energy Agency, 2016).

In light of China's supply challenges, such as the development of national resources, protectionism rules can be seen as an direct device for achieving detailed goals. Such measures, but are not expected to be sustainable in the long run. Due to strong oil demand forecasts, the state's strong stream stability is shifting to imports. Total oil consumption will reach 590 MMt by 2020, according to the 13th Five-Year Oil Development Plan (National Development and Reform Commission, 2016). On the other hand, numerical experts and players in the business forecast sophisticated statistics: for example, domestic crude oil demand is expected to reach 600 MMt in 2018 and 690 MMt by 2030. (Source: Reuters, 2017). The planned expansion of China's strategic oil understudy to 500 million barrels per day (or even 90 days) by 2020, as well as the development of other commercial oil storage facilities, will all help to keep oil demand steady (S&P Global Platets 2018).

Due to domestic and international market forces, China will be forced to better align national regulations with its strategic goals as its reliance on crude imports grows, as well as ongoing skill, venture, business, and worldwide energy supremacy. The emergence and dominant role of Chinese trading companies based in Singapore in the Dubai Merchants and, additional freshly, the launch of crude power agreements in Shanghai demonstrate China's efforts to reinforce its character in the worldwide oil market. The INE agreements are founded on a medium crude oil source found in Dubai and Oman. With a market share of 16 percent of similar DME contracts exceeding 2015 volume, INE's shortest time agreement was the third most traded global oil prospects agreement (Cooley, 2015). On the other hand, the INE agreement continues to follow the more well-known and liquid Brent and West Texas (WTI) intermediates. International participants have yet to be attracted to the INE (Zhu and Yu, 2012). Speculators in the area primarily trade crude futures. A predictable and unfavorable policy environment, as well as attracting a sufficient number of dealers and providing the essential apparatuses for managing price volatility, are all necessary for contract success (Hook, 2010).

China's leaders have reaffirmed their commitment to reforming the country's energy sector. The importance of increasing marketplace drivers, facilitating marketplace entree and rivalry, and strengthening oversight of related national dominations or oligopolies is emphasized in relevant strategic plans. In 2017, the Plusieurs Opinions on the Reform of the Oil and Gas Sector outlined steps to deregulate the industry and develop a competitive landscape (IEA 2017). The plan called for separating the majority of non-core assets from the NOC, lowering social obligations, and collaborating more closely with private companies throughout the oil supply chain. The government's role would be limited to intervention when prices fluctuated significantly, according to the 2017 reform proposal.

As customers confront borderline prices and all obstacles to straight or direct marketplace entry are eliminated, such reform attempts may create short-term disruption but are essential to the long-term growth of China's energy industry, especially the oil sector. With China's increasing influence in the worldwide budget and energy trade, these disruptions might have a big effect on both the local and international oil markets.

The trade war between China and the US in 2018-2019, as well as the reintroduction of US sanctions against Iran, could make Chinese domestic reform efforts more difficult. As a result of Chinese authorities' plans to impose tariffs on US crude imports in the second half of 2018, as well as US government pressure to limit Iran's oil imports, Chinese buyers' imports from Iran and the US dropped dramatically in the second half of 2018 (IEA 2018). In the face of high oil market pressures, domestic sector reforms could be supplemented by import diversification and regional cooperation strategies. Chen (2009) used an optimization tool to assess the risk of oil supplies to East Asian imports, demonstrating the benefits of the latter approach. Global oil prices are continuing to fall, according to China's weakest economic data since the Pandemic Coronary Virus (WHO, 2020).

Overview of Consumer Price Index

Economist agrees that oil prices are a major driver of inputs from the domestic coast and thus boost overall economic inflation (Kim, J.H. 2009). The consumer price index is a good economic indicator that is widely used to measure inflation (World Bank, 2012).

The upsurge in oil prices would directly increase the price of input factors, lead to production costs and also increase sales prices, leading to a profit margin, thus increasing the overall production of materials and, subsequently, to inflation (Zhang.2010). But the CPI (Consumer Pricing Index) is a good measure of inflation and a good determinant of global oil production.

Methodology

In this research, a combination of multiple regression analysis and time series model was used to improve the level of accuracy. We will therefore apply the statistical tools and the concept of each model used. Multiple regression analysis is the first to be reviewed. Multiple regression analysis is used to predict a dependent variable with two or more independent variables. Multiple regression evaluation is a continuation of simple regression analysis. This means that a regression model called a multiple regression model has more than one independent or explanatory variable. The model is expressed mathematically as:

$$Y = B_o + B_1X_1 + B_2X_2 + \ldots\ldots\ldots B_iX_i + \varepsilon$$

Where B_o= is the constant term while B_1, B_2 to B_i are the slopes or the model coefficients. And ε is the error term that takes care of all the unaccounted factors in the model.

Basic assumptions of Multiple regression model

The dependent variable should be on a continuous level (ratio or interval scale)

The independent variables can either be on a continuous level or categorical level (nominal or ordinal)

There should be no auto correlation and this can be tested using Durbin Watson statistics (d) with two critical value of 1.5 and 2.5. So, when d fall between the two critical values that means there is no autocorrelation of the zero first order level but there will be existence of autocorrelation if otherwise. However, if it exists, it can be corrected as there is a corrective measure for every violation of the assumption,

There should be no multicollinearity between the independent variables. Multicollinearity is said to occur when there is a strong linear correlation between two or more independent variables. That is, correlation values of almost 1. Pearson correlation or correlation matrix can also check it and It can also be detected using the variance inflation factor (VIF) and you can know this if VIF is greater than 10 but if VIF is less than 10, then there is no multicollinearity.

There should not be a significant outlier among the variable. Outliers are extreme observations that are not in accordance with rest observations and can cause a negative influence on the outcome of a result.

There is need for your data to show a constant variance (Homoscedasticity) which can be checked by plotting scatter plots of residuals against unstandardized predicted values and violation of the constant variance is what is called heteroskedasticity.

A linear link needs to exist among dependent variable and the independent variables and this can be examined through scatter plot. Finally, the residual error should be approximately normally distributed.

It is crucial to remember that when all the above assumptions are met in the course of application of multiple regression model, then the result is very reliable.

The p-value (probability value) of the overall regression in the ANOVA table will form the major decision as to when the model is significant if the p-value is less than alpha level(significant level which usually 0.05 in practice) and not significant if p-value is greater than the significant level.

The coefficient of purpose, R-square is used to explain the total variation in dependent variable that can be explained by the independent variables. It is expressed as the square of the association coefficient (R). it lies between 0 and 1 and it can be expressed in percentage.

Time series Model

The time series analysis carried out using augmented Dickey-Fuller (ADF), the Johansen cointegration and Vector error correction model. For the Johansen cointegration and VECM, all variables were transferred to natural logarithms since natural logarithm can more accurately depict long-term patterns and does not change the cointegration relationship among variables. The augmented Dickey-Fuller (ADF) is employing to determine if or not the series is stationary.

A method for evaluating the cointegration of a combined series with the same level I (0) or of order 1, I (1)- after the first variation is the Johansen cointegration test (Johansen, 2001). Multiple cointegrating relationships are permitted by this test. Associated to the Engle-Granger test, which relies on the Dickey-fuller (or enhanced) test for unit root, it is hence more broadly applicable. The trace and max eigen value are the two forms of Johansen tests that serve as the foundation for the conclusion or choice, and their outcomes may vary somewhat from one another.

The vector autoregressive model, VAR (P) model which also express the vector error correction model (VECM) can be generally expressed as;

$X_t = \mu + \varphi D_t + \prod_p X_{t-p} + \ldots\ldots\ldots +$ and

On the long run VECM can be expressed as :

$\Delta X_t = \mu + \varphi D_t + \prod_p X_{t-p} + \Gamma$ where $\Gamma_i = \prod_1 + \ldots\ldots + \prod_I - I, i = 1.$

It is imperative to note that before the choice of vector error correction model, the following two basic assumptions must be checked: the series should be stationary after the first or second difference (order 1). Secondly, the variables should be cointegrated. That implies there should be a cointegration among the stationary series

Data Analysis

The data collected for this work is secondary data it is obtained from the official site of the National Bureau of statistics of China, Macrotrends.net/1369/crude-oil-price-history, and trading economics.com/china/consumer-price-index. The data collected covers a period of 30years from 1990 to 2019 and the variables are China Crude oil output, Crude oil prices, consumer price index (CPI) and GDP Per Capita. The choice of the period covered is based on the data availability for the purpose of this study. This paper uses combination of multiple regression analysis and time series model. The result is quite revealing and will be discussed accordingly

Regression

Table 1: Descriptive Statistics

	M	SD	N
CHINAOILOUTPUT	25639.5333	4287.19184	30
CRUDEOILPRICES	47.7843	28.63551	30
CPINDEX	103.7133	4.15067	30
GDPPERCAPITA	3400.7667	3329.23743	30

The descriptive statistics table shows the standard deviation of China oil output, Crude oil prices, CP INDEX and GDP Per Capita. CP Index has the least standard deviation of 4.15067 which implies lower variability and dispersion from the mean compare to others with higher variability due to higher standard deviation values.

Table 2: Model Summary

Model	R	R^2	Adjusted R^2	S.E. of the Estimate	Durbin-Watson
1	.875[a]	.766	.739	2189.41623	1.439
a. Predictors: (Constant), GDPPERCAPITA, CPINDEX, CRUDEOILPRICES					
b. Dependent Variable: CHINAOILOUTPUT					

Multiple correlation coefficient (R) = 0.875 indicate that there is a strong constructive correlation among China Oil Output, GDP Per Capita, CP Index, and Crude Oil Prices. However, the coefficient of determination (R-square) = 0.766 which implies that 76.6 % variation in China Oil Output can be explained by GDP Per Capita, CP Index and International Crude Oil prices. The R-square is reasonable large meaning that the model is adequate.

Table 3: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	408388272.166	3	136129424.055	28.398	.000[b]
	Residual	124632129.301	26	4793543.435		
	Total	533020401.467	29			
a. Dependent Variable: CHINAOILOUTPUT						
b. Predictors: (Constant), GDPPERCAPITA, CPINDEX, CRUDEOILPRICES						

The ANOVA table displays that the p-value of the overall regression is 0.000 which is less than 0.01 significant level and that implies that the overall regression is statistically significant and it also implies there is a significant linear relationship among China Oil Output, Crude oil prices, CP Index and GDP Per Capita. However, this indicates the multiple regression equation that was fitted fits the findings well and is more suited for making predictions about the future.

Table 4: Regression Estimates

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
	B	S.E.	Beta			Lower Bound	Upper Bound	Tolerance	VIF
(Constant)	15872.848	10348.484		1.534	.137	-5398.765	37144.461		
CRUDEOILPRICES	41.713	18.524	.279	2.252	.033	3.635	79.790	.587	1.702
CPINDEX	46.475	98.692	.045	.471	.642	-156.390	249.340	.985	1.015
GDPPERCAPITA	.868	.159	.674	5.470	.000	.542	1.195	.592	1.690
a. Dependent Variable: CHINAOILOUTPUT									

Regression Equation

China Oil Output = 15872.848 + 41.713 Crude oil prices + 46.475 CP Index + 0.868 GDP Per Capita.

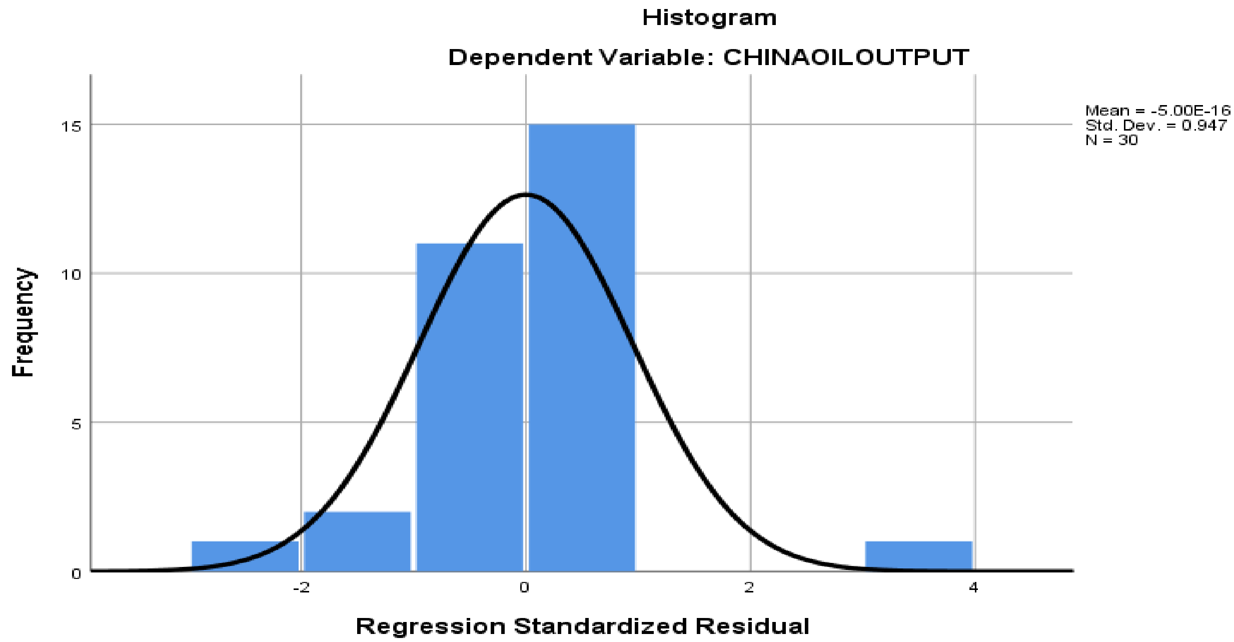
The table above reveal the coefficients of the fitted multiple regression which demonstrations for every 1 USD increase international crude oil prices, China Oil Output will yield an increase of about 41.7 million tons barrel. Similarly, for each 1 component upsurge in consumer price index, China Oil Output will yield an increase of about 46.5 million tons barrel and for 1 USD increase in GDP Per Capita, China Oil output will increase by about 1million tons barrel. The value of 15872.848 is a constant value. Besides, the test of significant of the model coefficient also reveal that the p-value of crude oil prices is 0.033 which is less than 0.05 important equal and that implies that crude oil prices is statistically substantial while the p-value of CP Index is 0.642 which is greater than 0.05 significant level which suggests that it is not statistically substantial and P-value for GDP Per Capita is 0.000 which is less than 0.01 significant level and that implies that international crude oil prices and GDP Per Capita have significant impression on the China Oil Output. The table above also back up the detail that there is no multicollinearity among the three independent variables (Crude Oil Prices, CP Index and GDP Per Capita) as the respective VIF (variance inflation factor) is less than 5. The implication of the multicollinearity is that it causes a misleading R-square and P-values and since the model is free from multicollinearity problem, it means that the model is very reliable.

The correlation coefficient between China Oil Output and Crude oil prices is 0.704 which indicate a strong positive correlation between China oil output and Crude oil prices and this tells us that the higher the crude oil prices, the higher the oil output and vice versa. Besides, the correlation coefficient between China Oil output and CP Index is -0.048 which indicate a very weak negative correlation between China Oil output and CP index and this implies that the higher the CP index, the lower will be China Oil output and vice versa. In the same vein, the correlation coefficient between China Oil Output and GDP Per Capita is 0.848 which suggests a substantial beneficial relationship among the China Oil output and GDP Per Capita and this suggest that the developed the GDP per Capita, the higher will be the China Oil Output and vice versa.

Table 5: Correlation Estimates

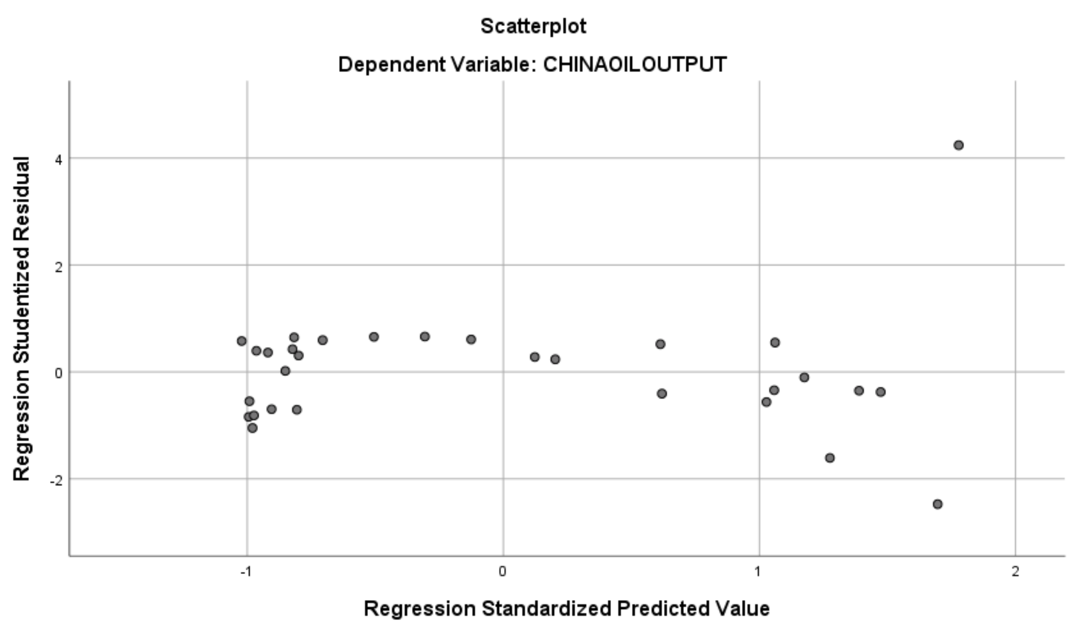
		CHINAOILOUTPUT	CRUDEOILPRICES	CPINDEX	GDPPERCAPITA
Pearson Correlation	CHINAOILOUTPUT	1.000	.704	-.048	.848
	CRUDEOILPRICES	.704	1.000	-.122	.639
	CPINDEX	-.048	-.122	1.000	-.088
	GDPPERCAPITA	.848	.639	-.088	1.000
Sig. (1-tailed)	CHINAOILOUTPUT	.	.000	.400	.000
	CRUDEOILPRICES	.000	.	.261	.000
	CPINDEX	.400	.261	.	.322
	GDPPERCAPITA	.000	.000	.322	.

Figure 1: Histogram



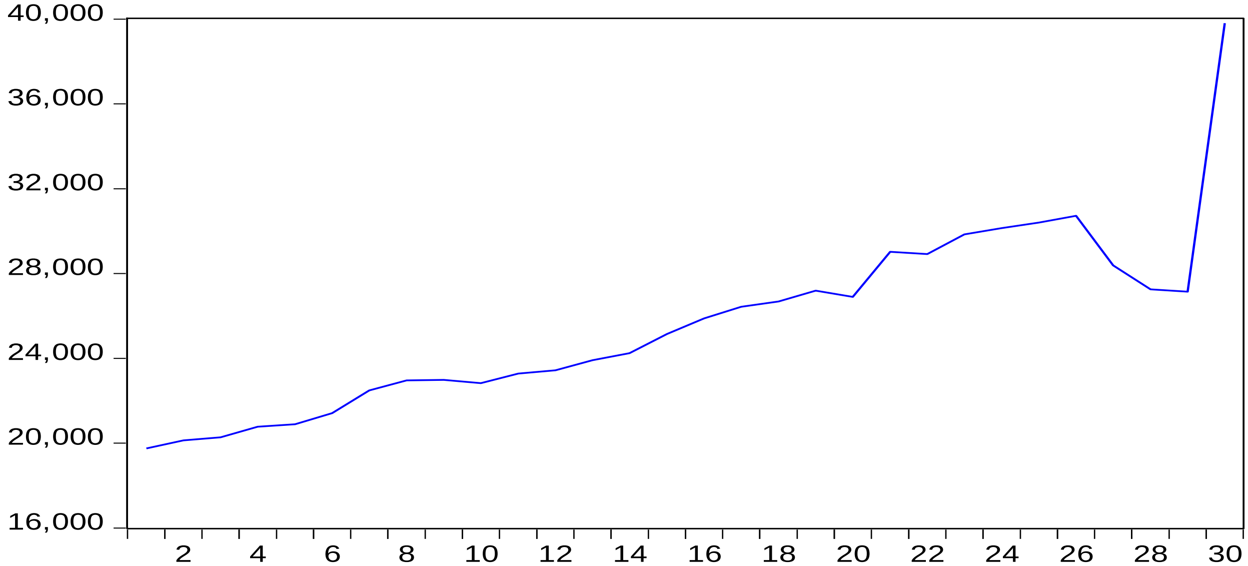
The residual plot reveal that the residual is approximately normally disseminated and the residual observations does not exhibit any extreme observations or what we called an outlier and that satisfy the normality test of the residuals of the multiple regression model and also satisfy that the residuals has no significant outliers.

Figure 2: Regression Standardized Predicted Values



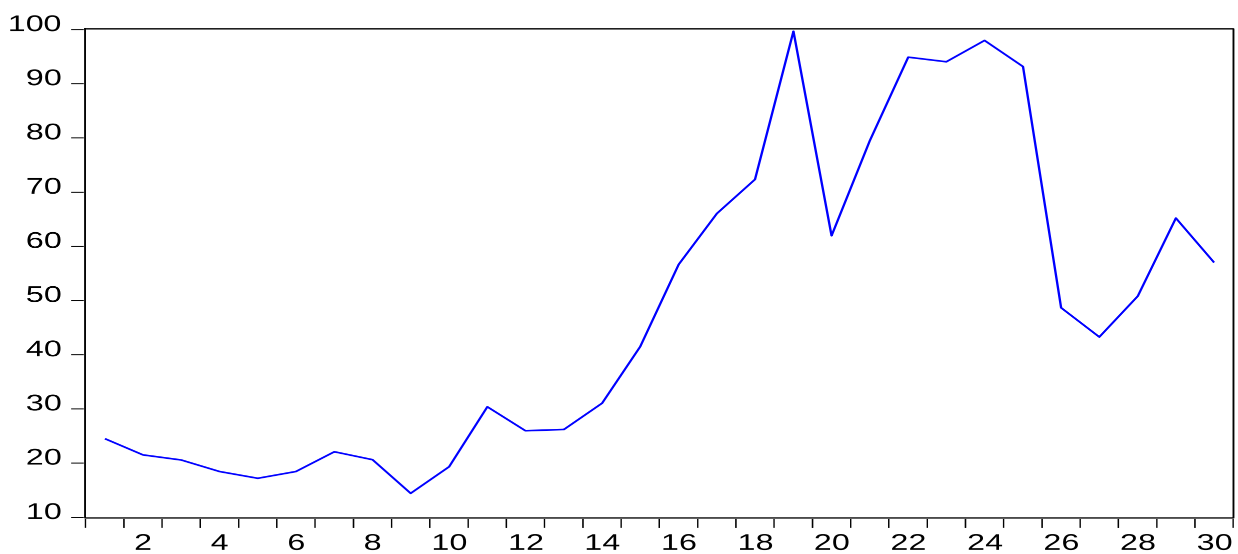
The above heteroscedasticity output with scatter plot graph shows that the scattered spots are diffused and do not form a clear confident arrangement and we can conclude that the OLS regression model does not exhibit heteroscedasticity problem.

Figure 3: Trend of China's Oil Output



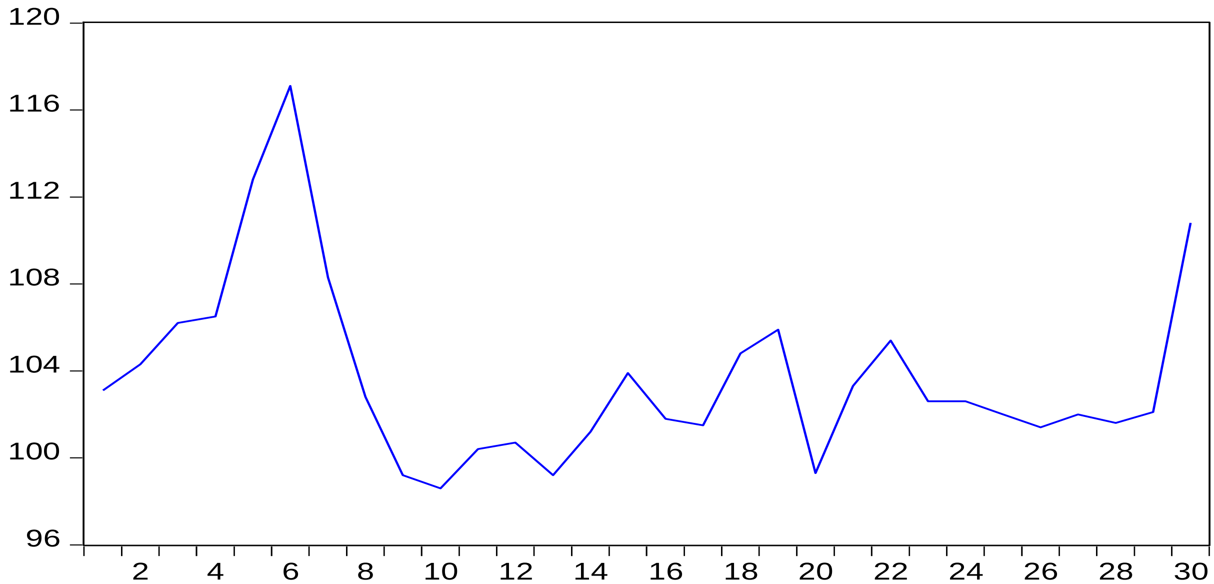
The above graph shows the trend pattern of oil output overtime from 1990 to 2019. From the varying trend graph of China oil output, we can see that the oil output rises gradually from 2000 to 2008 and then decline slightly to 2010 and then rise to 2011 gradually to 2015 and drop off to 2018 and then rise sharply to 2019.

Figure 4: Crude Oil Prices



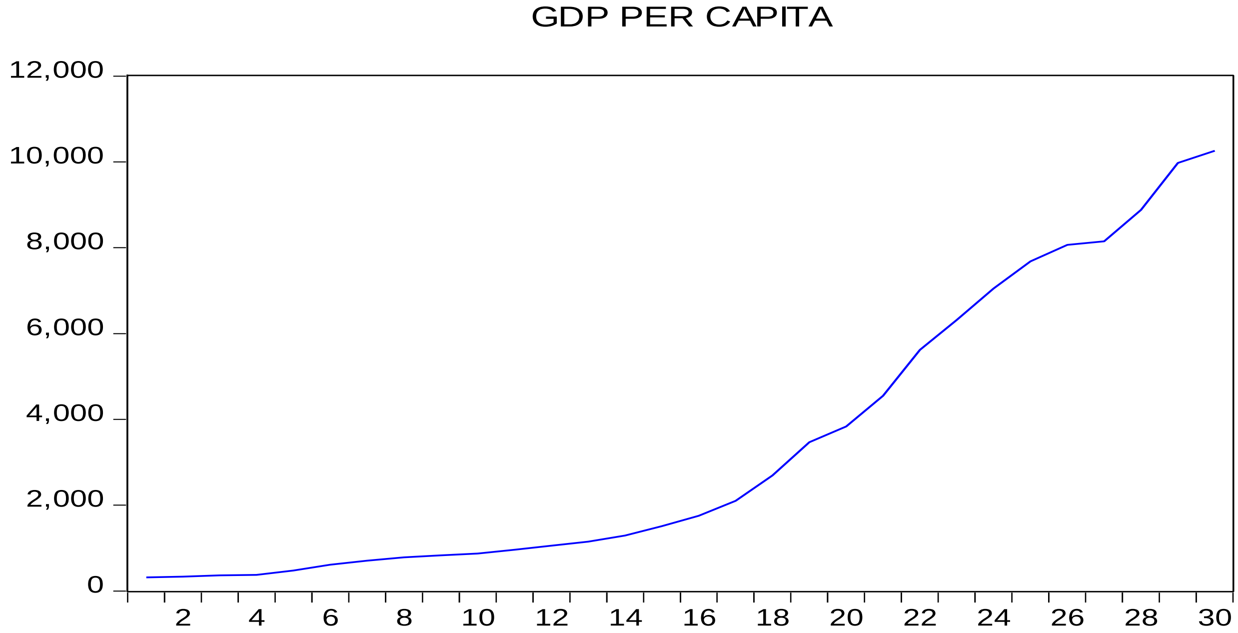
The above shows the trend pattern of crude oil prices over time from 1990 to 2019. The above graph reveal a sharp decline of international crude oil prices from 2015 to 2016 and this has real affected the oil exporting countries and thereby causes series oil crises within this period before it now get stable in 2017 and later decline in 2018, this fluctuations has really caused a sharp increase in the prices of commodities and thereby create an inflationary gap. Similarly, the literature shows that domestic output has indeed declined subsequently 2015 (U.S. Energy Information Administration (EIA, 2018). The upstream Chinese industry has many major hurdles, according to analysts, including aging conventional resources, a requirement to discover new technologies to solve difficult geological conditions, restricted access to water, a great deal of market focus, and an inadequate pace of change.

Figure 4: CP Index



The above graph is an indication of prices irregularities in the consumer price index from 1990 to 2019 and being a measure of inflation, it has reveal the inflationary trend within the period under review and We observe that, accordingly, there was a significant drop from 2008 to 2009 and a significant growth from 2018 to 2019.

Figure 5: GDP Per Capita



We can see from the graph of the GDP Per capita from 1990 to 2019 that there is continuous growth in the China GDP per capita and this tells us that income per person is China has a positive outlook as the graph shows a positive upward trend movement from 1990 to 2019 being the year under review.

Table 6: Unit Root Test

VARIABLES	T-TEST	P-VALUES
CHINA OIL PRODUCTION (TRILLION BARREL USD)	-5.616658	0.0001
CP INDEX	-6.461888	0.0000
INTERNATIONAL CRUDE OIL PRICES (USD)	-5.566058	0.0001
GDP PER CAPITA	-2.304164	0.0180

P<0.01, P<0.05, P<0.10 important equal

The augmented dickey fuller test for China Oil production p-value is fewer than 0.05 and that means we scrap the null hypothesis and it implies that at 1% (0.01), 5% (0.05), and 10% (0.10) significant level, the sequence remains motionless after its initial separation.

Similarly, the augmented dickey fuller test for Cp Index p-value is fewer than 0.05 and that means we scrap the worthless hypothesis and it implies that at 1% (0.01), 5% (0.05), and 10% (0.10) significant level, the series is stationary after the first differencing. Crude oil prices p-value is 0.0001 which is less than 0.01 significant level and that implies that Crude oil prices is stationary after the first difference.

In the same vein, the augmented dickey fuller test for GDP Per Capita p-value is less than 0.05 significant level and that means we reject the null hypothesis and it implies that at 5% (0.05), and 10% (0.10) significant level, the series is stationary after the second differencing.

Since the three series are stationary after the first difference which has been revealed by the Augmented Dickey Fuller test, hence there is need to test for cointegration among the series. The test of cointegration used in this paper is Johansen Cointegration test which show result below.

Table 7: Johansen Cointegration TEST

Sample (adjusted): 4 30				
Included observations: 27 after adjustments				
Trend assumption: Linear deterministic trend				
Series: CHINA_OIL_PRODUCTION CP_INDEX CRUDE_OIL_PRICES GDP_PER_CAPITA				
Lags interval (in first differences): 1 to 2				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		**Trace**	**0.05**	
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical Value**	**Prob.****
None *	0.815136	76.41439	47.85613	0.0000
At most 1 *	0.542951	30.83482	29.79707	0.0378
At most 2	0.271150	9.694802	15.49471	0.3050
At most 3	0.041877	1.155031	3.841466	0.2825
Trace test indicates 2 cointegrating eqn(s) at the 0.05 level				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		**Max-Eigen**	**0.05**	
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical Value**	**Prob.****
None *	0.815136	45.57957	27.58434	0.0001
At most 1 *	0.542951	21.14002	21.13162	0.0499
At most 2	0.271150	8.539771	14.26460	0.3265
At most 3	0.041877	1.155031	3.841466	0.2825
Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

The decision of the Johansen Cointegration test is determine by the trace and maximum eigen value and both reveal that none p-value for trace and maximum eigen is less than 0.05 and p-value for at most one for trace is also less than 0.05 and we can therefore conclude that there is a cointegration among the series and this suggests that there exist a connection over time between the factors. However, since there is stationarity and cointegration between the sequence, it is suitable to apply vector error correction model.

Table 8: Diagnostic test Vec model coefficients Redundancy test

Wald Test:			
System: %system			
Test Statistic	**Value**	**df**	**Probability**
Chi-square	7.382296	14	0.9190
Null Hypothesis: C(2)=C(3)=C(4)=C(7)=C(8)=C(9)=C(10)=C(11)=C(12)=C(14)=C(16)=C(21)=C(22)=C(23)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(2)		0.197078	0.533821
C(3)		0.966121	30.46020
C(4)		17.95722	124.1619
C(7)		-0.000949	0.001292
C(8)		0.000193	0.004266
C(9)		-0.105485	0.243429
C(10)		0.598902	0.992267
C(11)		0.000385	0.015468
C(12)		1.257034	6.295051
C(14)		0.000453	0.000884
C(16)		0.333675	0.205547
C(21)		2.233770	3.903413
C(22)		-5.287177	15.91109
C(23)		0.283565	0.248024
Restrictions are linear in coefficients.			

Since there is cointegration among the variables, hence we proceed to VEC model and a redundancy assessment was accepted out to test whether the coefficients (C(2) to C(23) of the VECM is redundant and we can see that the p-value = 0.9190>0.05 significant level and this tells us the coefficients C(2) to C(23) are redundant and therefore removed from the model to avoid over parameterized and achieved a parsimonious model.

Table 9: VEC Parsimonious Model

Estimation Method: Least Squares				
Included observations: 29				
Total system (unbalanced) observations 113				
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.560692	0.143618	-3.904056	0.0002
C(5)	8.191296	1.686216	4.857797	0.0000
C(6)	-2122.990	677.1118	-3.135362	0.0022
C(7)	-0.000766	0.000668	-1.145761	0.2546
C(12)	0.955473	2.658550	0.359396	0.7200
C(13)	-0.000753	0.000259	-2.911684	0.0044

C(15)	-0.070678	0.045889	-1.540192	0.1266
C(17)	0.008558	0.003145	2.720828	0.0077
C(18)	-2.617266	1.233721	-2.121441	0.0363
C(19)	0.057420	0.012183	4.713160	0.0000
C(20)	-0.115533	0.063980	-1.805749	0.0739
C(24)	385.1366	49.58271	7.767559	0.0000
Determinant residual covariance		1.15E+14		
Equation: D(CHINA_OIL_OUTPUT) = C(1)*(CHINA_OIL_OUTPUT(-1) +				
57.1276652219*CRUDE_OIL_PRICES(-1) + 462.445711376				
*CP_INDEX(-1) - 0.314753589715*GDP_PER_CAPITA(-1) -				
74929.5218165) + C(5)*D(GDP_PER_CAPITA(-1)) + C(6)				
R-squared	0.485869	Mean dependent var		702.7143
Adjusted R-squared	0.444738	S.D. dependent var		2461.186
S.E. of regression	1833.975	Sum squared resid		84086584
Durbin-Watson stat	2.037292			
Equation: D(CRUDE_OIL_PRICES) = C(7)*(CHINA_OIL_OUTPUT(-1) +				
57.1276652219*CRUDE_OIL_PRICES(-1) + 462.445711376				
*CP_INDEX(-1) - 0.314753589715*GDP_PER_CAPITA(-1) -				
74929.5218165) + C(12)				
R-squared	0.046367	Mean dependent var		1.119310
Adjusted R-squared	0.011047	S.D. dependent var		14.37563
S.E. of regression	14.29600	Sum squared resid		5518.145
Durbin-Watson stat	2.120198			
Equation: D(CP_INDEX) = C(13)*(CHINA_OIL_OUTPUT(-1) +				
57.1276652219*CRUDE_OIL_PRICES(-1) + 462.445711376				
*CP_INDEX(-1) - 0.314753589715*GDP_PER_CAPITA(-1) -				
74929.5218165) + C(15)*D(CRUDE_OIL_PRICES(-1)) + C(17)				
*D(GDP_PER_CAPITA(-1)) + C(18)				
R-squared	0.293521	Mean dependent var		0.232143
Adjusted R-squared	0.205211	S.D. dependent var		3.670912
S.E. of regression	3.272652	Sum squared resid		257.0460
Durbin-Watson stat	1.746485			
Equation: D(GDP_PER_CAPITA) = C(19)*(CHINA_OIL_OUTPUT(-1) +				
57.1276652219*CRUDE_OIL_PRICES(-1) + 462.445711376				
*CP_INDEX(-1) - 0.314753589715*GDP_PER_CAPITA(-1) -				
74929.5218165) + C(20)*D(CHINA_OIL_OUTPUT(-1)) + C(24)				
R-squared	0.483075	Mean dependent var		354.6071
Adjusted R-squared	0.441721	S.D. dependent var		330.0986
S.E. of regression	246.6433	Sum squared resid		1520823.
Durbin-Watson stat	1.731077			

The above fitted parsimonious vector error correction model (VECM) found the long run stochastic trend between China Crude Oil OProduction, International crude oil prices, consumer price index (CP Index) and GDP Per capita and since each variables under VECM are treated as endogenous and each of the variables depend on their lag values as shown above and however, it is important to test for the validity of the above fitted vector error correction model and below reveal the autocorrelation test by Durbin Watson statistic and when the Durbin Watson statistic d lie between the two critical value of 1.5 and 2.5, it means the VECM is free from problem of autocorrelation and one of the significance of VECM is that it solve the problem of spurious correlation

Discussion and Conclusion

On the basis of the analysis of this research work , the overall regression demonstrates the substantial connection among China Oil production, Crude Oil Prices, CP Index and GDP Per capita, meaning that the regression model is a good fit for the information and can be used for upcoming prediction of global Chinese oil production. The normality examination displays that the residual error is circulated approximately normally, and the multicollinearity presence test shows that the model is free from the multicollinearity problem and that the basic underlying assumptions of fitting the ordinary least square model are met. The research also demonstrates that the crude oil prices and GDP Per capita have a substantial impression on Chinese oil production. Furthermore, the Johansen Cointegration test and Vector correction model reveal a long-run affiliation among China Oil production, CP Index, Crude Oil Prices and GDP Per capita. The correlation also demonstrates a linear association between the variables. And the fitted multiple regression and Vector correction model have been used after all the fundamental underlying assumptions have been met. Besides, the parsimonious VEC Model established in this work makes it more better and improved compared to previous research done on crude oil. The result simply suggests that China must always bear in mind that the fluctuations in international crude oil prices, GDP Per Capita and the CP index are both good determinants of its global oil output, and that in order for China to continue to maintain a stable and better economic performance, close attention needs to be paid to the CP Index. The fall in international oil prices has affected the oil exporting countries, which in turn has affected the supply of oil, and this is a strong indicator of the global economic recession, as can be seen from the graphical trend of international crude oil prices. China, however, has built its capacity for industrialization and this has helped China's economy to thrive even in the center of a sudden coronavirus (Covid-19) pandemic. If the CP Index can be accurately measured, however, Chinese global oil output will be under control and the price system mechanism will allow steady oil flow, which in turn will increase its domestic crude oil output and Chinese global oil output will be self-sufficient with the ability to achieve more incessant economic growth now and in the future while continuing to enhance measures to contain the spread of the global coronavirus pandemic.

References

1. Ameer, N., Bhutta, M. A., Nawaz, D., Asghar, M. M., & Jawad, F. (2024). Navigating the Role of Remittances in Attaining Sustainable Development Goals in Developing Countries: New Insights from Panel ARDL Model. *The Critical Review of Social Sciences Studies*, *2*(2), 384-396.

2. Barsky, R.B, L.Kilan.(2004) Oil and the Macroeconomy Since the 1970s. *Journal of Economic Perspectives*, 115-134
3. Bernanke, B. S., Gertler, M., Watson, M., Sims, C. A., & Friedman, B. M. (1997). Systematic monetary policy and the effects of oil price shocks. *Brookings papers on economic activity*, 1997(1), 91-157.
4. Brown S P A, M K Yiicel. (1999) oil prices and the Economy, *Southwest Economy*, (7) 1-6
5. Caporale, G. M., Ali, F. M., & Spagnolo, N. (2015). Oil price uncertainty and sectoral stock returns in China: A time-varying approach. *China Economic Review*, 34, 311-321.Chang, Andrei. (2007). *Analysis: China's Fuel Oil Reserves*, United Press International
6. Chen, S.S. (2009). Oil Price pass through inflation. *Energy Economics*, 31(1), 126—133
7. Chow, C. Gregory (1960). Tests of equality between sets of coefficients in two linear regressions: *Econometrica*, 28(3), 591-605
8. Cong, Rong-Gang, etal (2008). Relationship between oil price shocks and stock market: an empirical analysis from China, *Energy Policy,* 36(9), 3544-3553.
9. Cooley, Alexander. (2015). *US-China Economic and Security Review Commission*, P.8 Retrived 14 January 2016
10. Davidson, James (2000). *Econometric Theory*. Wiley ISBN 0-631-21584-0
11. Dickey, D.A, & Fuller, W.A. (1979). Distribution of the estimators for autoregressive times series with a unit root. *Journal of the America Statistical Association*, 74 (366a), 427-431
12. Dickey, D.A, & Fuller, W.A.(1979). Distribution of estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association*, 74(366a), 427-431
13. Donald (1993). Tests For parameter instability and structure change with unknown change point. Econometrica 61(4);821-856Barber, B.M, Odean, T (2001). *Quarterly Journal of Economics*, February: 261-292
14. Faria, J.R etal (2009). The effect of oil price on China's exports: *China Economic Review* 20(4), 793-805.
15. Hamilton, James (2009). Understanding Crude oil prices. *Energy Journal 30*(2), 179-2006
16. Hamilton, James D (2009). Understanding Crude Oil Prices. *Energy Journal*, P.179-206
17. Hoffmann, Fritz (2004). *China's Quest for oil*, TIME.
18. Höök, M., Xu, T., Xiongqi, P., & Aleklett, K. (2010). Development journey and outlook of Chinese giant oilfields. *Petroleum Exploration and Development*, 37(2), 237-249.
19. Ito, M., & Sugiyama, S. (2009). Measuring the degree of time varying market inefficiency. *Economics Letters,* 103(1), 62-64.
20. Jestin-Fleury, N. (1994). International energy agency. World energy outlook. *Politique étrangère,* 59(2), 564-565.

21. Johansen, Soren (1991), Estimation and Hypothesis Testing of Cointegration on Vectors in Vector Autoregressive Models. *Econometrics*. 59(6): 1551-1580. JSTOR 2938278
22. Julio, J Rotemberg, Michael Woodford. (1996). Imperfect Competition and the Effects of Energy Price Increases on Economic activity. *Journal of Money Credit and Banking*, p.550-570
23. Kim, J.H (2009). Automatic variance and ratio test under conditional heteroscedasticity: *Finance Research Letters*, 179-185
24. King, Byron.(2005). Investing in oil: A History, The Daily Reckoning. https://dailyreckoning. com/investing-in-oil-a-history.
25. Li, S.F,Zhu, H.M & Yu, K. (2012). Oil Prices and stock market in China: A sector analysis using panel cointegration with multiple breaks. *Energy Economics*, 34(6), 1951-1958
26. Meidan, M., Andrews-Speed, P., & Ma, X. (2014). Shaping China's energy policy: actors and processes. *In China's Search for Energy Security* (pp. 46-71). Routledge.Andrews.
27. Philips, P.C.B,Perron,P (1998). Testing For a unit root in time series regression. *Biometrika*, 75(2), 335-346.
28. Ponikelska, Lenka; Subrahmaniyan, Nesa (2008). China Buys Stake in BP. *Азия и Африка сегодня,* (1), 2-10.
29. Rogoff Keneth (2006). Oil and the global economy, *Harvard University Working paper.*
30.
31. Wang, Haijiang.(1995). China's oil policy and its impact. *Energy Policy* 23(7), 627-635
32. Wang, Z., & Sibt-e-Ali, M. (2024). Financial globalization and economic growth amid geopolitical risk: A study on China-Russia far East federal district. *Heliyon*, *10*(10).
33. Xie, An.(1998). Some opinions on compilation of consumer price index in China: *Statistical Research* 3, 72-74
34. Zhang, Q. (2010). Impact of international oil price fluctuation on China's Economy.