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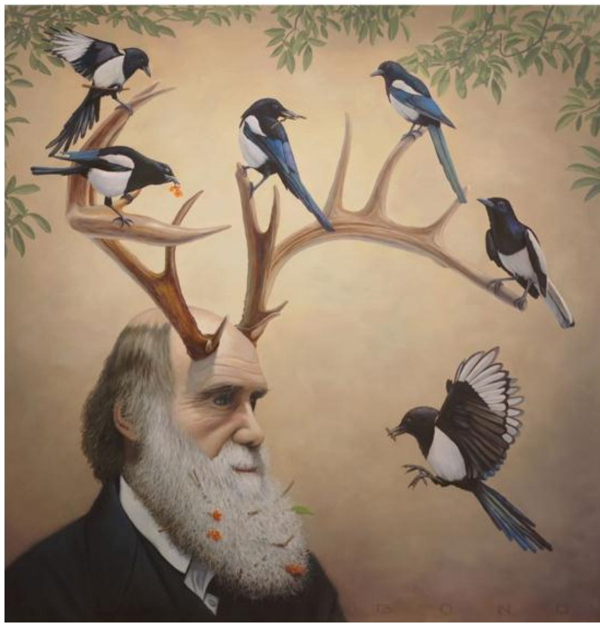

Universidad del Zulia
Facultad Experimental de Ciencias
Departamento de Ciencias Humanas
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Measurement and Analysis of US tight oil Determinants. An applied study for the period (2004-2019)

Wisam H. Ali Al-Anezi[1], Mamdooh Attallah Faihan[2], Abed Ali Hamad[3]

**[1]Asst. Prof. Dr.; wisamali@uoanbar.iq, [2]L. Dr.; Mmaa.ff@uoanbar.edu.iq,
[3]Asst. Prof. Dr.; Abidh1965@oanbar.edu.iq
College of Administration and Economics / University of Anbar**

Abstract
This study aims to demonstrate knowledge of the factors determining the production of American shale oil during the period (2004-2019), as (global demand for crude oil, global crude oil supply, West Texas oil prices, global growth rate and world population) were used as factors Shale oil production was determined, and the VECM model was used to analyze the long and short term relationship and the results demonstrated that there is a long-term balance relationship between all independent variables and shale production as a dependent variable except for the global demand variables for crude oil and the reason may be that the changes That you get in the global demand for Aft crude is absorbed through changes in crude oil production without compromising the US shale oil, and the global variable as the growth of the changes that you get this variable may affect the quantities produced and sold crude oil as well.

Medición y análisis de los determinantes del petróleo hermético de EE. UU .: un estudio aplicado para el período (2004-2019)

Resumen
Este estudio tiene como objetivo demostrar el conocimiento de los factores que determinan la producción de petróleo de esquisto estadounidense durante el período (2004-2019), como (demanda mundial de petróleo crudo, suministro mundial de petróleo crudo, precios del petróleo del oeste de Texas, tasa de crecimiento global y población mundial) se usaron como factores Se determinó la producción de petróleo de esquisto bituminoso, y el modelo VECM se usó para analizar la relación a largo y corto plazo y los resultados demostraron que existe una relación de equilibrio a largo plazo entre todas las variables independientes y la producción de esquisto bituminoso como una variable dependiente excepto Las variables de demanda global para el petróleo crudo y la razón pueden ser que los cambios que se obtienen en la demanda mundial de crudo en popa se absorben a través de cambios en la producción de crudo sin comprometer el petróleo de esquisto de EE. UU., y la variable global como el crecimiento de los cambios. que obtenga esta variable también puede afectar las cantidades producidas y vendidas de petróleo crudo.

Introduction:

The shale oil industry in the United States played a major role that contributed to increasing the global supply of shale oil, as it developed rapidly during a decade and thus occupied an important position in the global oil market, and even became a real competitor to traditional oil producers, despite its modernity and the ambiguity that accompanied It was established, but it has become a major player in the global oil markets, which many economic analysts have wagered that companies producing shale oil cannot compete with companies producing traditional oil, but they have proven and through the modern technologies that have used them and the factors and support received Here by the US government to withstand the decline in crude oil prices globally, as these companies received significant logistical, technical and financial support by the major oil companies and private equity companies managed to achieve huge increases in shale oil production, and perhaps one of the most important factors that led to this occurrence The boom in production is the US strategy in the field of energy and US national security. As the United States is the largest energy consumer in the world, it must rely on local options and reduce imports of this important strategic commodity.

Several studies have examined shale oil production and its economic relations, as a study (Apergis and et al, 2016) examined the dynamic relationship between shale oil production and crude oil prices using the error correction model, while the study (Miljkovic & Ripplinger, 2016) examined the impact of the oil boom on the reality of Employment and wages in the oil fields in the United States of America using the dynamic regression (VEC), which concluded that the increase in oil prices led to an increase in employment and wages in the oil fields of the United States of America, In contrast, a study (Kaden & Rose: 2015) impact of the shale oil revolution on prices oil and growth Economic using the balanced general model, as the study showed that increased shale oil production led to a decrease in global crude oil prices and an increase in the gross domestic product of importing countries. The study proved that the main reason behind the drop in oil prices in the middle of 2014 is the positive shocks in supply.

The importance of the study stems from the role played by the shale oil industry in the world from increasing the American oil supply and despite the high marginal cost per barrel, but it was able to compete with the producers of traditional oil, and despite the modernity of this industry and the high marginal cost of the barrel extracted from shale oil and environmental impacts The result of the extraction, however, has achieved significant levels of production, so the problem of the study lies in answering these two questions, namely: What is the feasibility of continuing production in light of the drop in global crude oil prices? Can shale producers meet the consumer needs of producing countries?

1-Theoretical framework of the study:

It is oil extracted from sedimentary rocks containing unconventional oil with modern technologies. Shale oil is a type of light low-sulfur oil confined to narrow low-permeability formations, (2015: 4 Mănescu and Nuño), and is considered the least liquid of conventional oil as well as Its chemical properties differ according to the quality of sedimentary rocks in the ground, as its hydrocarbon and nitrogen components are derived from the organic materials that are of them and which are estimated at less than 1%, and from 1% of oxygen, and from 0.25% to 1.99% of sulfur, as well as materials and molecules The Others (Hassan, 2015: 2).

The development of the shale oil industry in the United States, despite its modernity, has had a clear impact on global markets, despite the presence of large quantities of shale oil reserves in the United States, Russia, Argentina, China, Australia, Mexico, North Europe, Libya, Algeria, South Africa, and even the Gulf states (Al-Hayali, 2015: 8), and its resources outside the United States are estimated to be five times the amount of shale oil resources in the United States according to the Environmental Impact Assessment in 2013, (2015: 2 Mănescu and Nuño), but there are many exceptional factors that contributed to the development of the United States' production of oil and gas Rocky without the other The aforementioned countries, despite the existence of proven reserves of shale oil in these countries, and these factors are of two types: (Feasibility of investment, 2013: 19).

1-1-1: The geological and hydrological characteristics of the United States and the proximity of rock resources to abundant water resources.

1-1-2: Factors above the surface of the earth: This is what is known in the shale oil industry as factors above ground. These factors are:

• A group of companies specialized in exploration and exploration activities for shale oil and have knowledge and experience of the costs, technologies and risks of oil exploration.

• A long and distinguished engineering experience in the field of locating complex oil tanks.

• Owning high-tech equipment, machinery and capabilities in the field of drilling and exploring wells at low costs compared to the rest of the world.

• Legislating laws and regulations that helped those companies exploit the resources located underground, and in a manner that secures these operations legally.

• Community acceptance of the environmental reality that results in these companies exploring and extracting oil and the consequent environmental damage to the water and the surrounding atmosphere from leaking toxic gases.

• Excellent infrastructure in the field of transportation, electricity and water, which contributes to the speed of transportation and the delivery of oil and gas to refineries and cities.

• Modernity and significant development in the field of financial markets to contribute in providing loans in a way that contributes to encouraging specialized investments known to increase their risks.

• The American society accepts shale oil extraction operations and the consequent cracking of sedimentary rocks in the ground and the earthquakes and other consequences that may follow.

All of the above contributed greatly to the growth and recovery of the shale oil industry in the United States, in which that industry was subject to laws and legislations that prevent accidental leakage of chemicals dusty to use during the extraction process, and the United States's share of the total supply outside OPEC rose from five in From 2008 to a quarter in 2012, US shale oil accounted for (2.5%) of all global oil supplies in 2012. (2015: 8 Mănescu and Nuño).

The great development in the process of extracting shale oil in the United States during a decade, which led to the fact that shale oil occupied an important place in the global market for crude oil production, as the volume of shale oil production in the United States increased from nothing in 2004 to nearly 2.2 One million barrels per day in 2012, which is approximately 32% of the total American oil production, to rise to 4.8 million barrels per day in 2015, to reach (9.1) million barrels per day in the month of November of 2019, despite the decrease in the number of rigs for the month Twelfth in a row, as the excavators decreased 30 excavators compared to the previous month The number of rigs 729 Excavators see table (1).

Table (1) Shale oil production in the world and the United States from 2012-2019

(Million bpd)

2019	2018	2015	2014	2013	2012	
		5.61	4.87	3.62	2.63	Global production of shale oil
9.1	8.1	4.8	4.2	3.2	2.2	US production of shale oil
		85.3	86.3	88.4	83.7	United States production ratio to the world (%)

Source: Various issues of Energy Outlook report and monthly newsletters of OAPEC.

The impact of increased production of American shale oil was reflected positively on the reality of the American economy by shifting from being a major oil and laurel importer during the seventies of the last century to an economy that may be self-sufficient and may even amount to being a source of shale oil under certain economic and geological conditions Also, this contributes to reducing the deficit in the American trade balance, developing auxiliary industries and increasing employment in those economic sectors, and just as increasing production of shale oil contributes to lower oil prices, which means lower energy prices, which affects consumption and related Free time for families. (, 2015: 11 Mănescu and Nuño).

2- Shale oil determinants

2-1 World oil demand:

The global demand for conventional and shale crude oil is one of the most important determinants of the shale oil industry, as the demand for oil in the case of the rest of the raw materials is inversely related to the price, but the price elasticity of demand for oil remains low because the price of oil is not determined simultaneously and interactively between demand, supply and price And, as we have previously emphasized, the elasticity of demand is low and is more low in the short term because the demand for oil and its supply do not move up or down except in limited quantities when the price changes, as absorption of excess supply or responding to excess demand requires wide changes to reach the balance, which is one of the most important reasons. Violence in oil prices has become (Ali, 2016: 90).

The prices of alternative energy play an important role in the global demand for crude oil, as well as the size of the population and the average per capita income, as the rate of energy demand varies with the variation of the per capita income, as the per capita energy consumption is related to a direct relationship with the per capita income. (Ali, 2016: 6)

When analyzing the global oil demand in 2019, we note, through Table (2), that the global demand for crude oil has increased from 98.84 million barrels / day in 2018 to 99.67 million barrels / day in 2019, an increase of 0.83 million barrels per day and a growth rate of 0.84% Annual (OPEC, 2020: 29), and the reasons for the growth in oil demand in 2019 are due to a rise in the growth rates of the global economy (1.6%), as well as a rise in the actual import of oil by the United States as the largest energy consumer in the world, and an increase Economic growth rates for China and India respectively (6.1%, 5.3%). (OPEC, 2020: 12).

Table (2) world oil demand and supply for the period 2016-2019 million barrels per day

2019	2018	2017	2016	
99.67	98.84	97.42	95.7	Global demand for oil
99.1	99.08	96.13	95.47	World oil supply
-0.57	0.25	-1.29	-0.23	Market balance

Table of researchers prepared by relying on OPEC 2016-2020 publications

2-2 The global oil supply: The global oil supply is one of the most important determinants of the shale oil industry, and the most important determinants of the global oil supply are oil reserves and it is intended to be economically recoverable oil, and here modern technology plays an important role in determining the oil reservoirs by sensing the surface and means Modern exploration of it. (Ali, 2016, 5), and the price of oil in the short and long term plays an important role in determining the supply of crude oil, as well as the costs that contribute to determining the reserves as it is responsible for the shifts in the supply function represented by operational and fixed costs, and the consequent From determining the share of the produced barrel from these costs, the marginal costs of the produced barrel. (Ali, 2016, 6).

It is noted from Table (2) that the global supply of crude oil increased from 99.08 million barrels / day in 2018 to 99.1 million barrels / day in 2019, achieving a growth rate (0.02%) and by 0.02 million barrels per day.

2-3 Oil Prices:

The dynamics of conventional and shale crude oil prices are subject to several factors, including key factors such as the balance between supply and demand and the overall economic situation of the economies of the world countries, as well as geopolitical factors, as the US dollar prices play an important role in that, and therefore any decline in the price of the US currency leads to higher demand for oil And vice versa in the case of high exchange rates for the US dollar, and the general situation of financial markets in the world plays a role in fluctuations in crude oil prices. (Hassan, 2015: 24).

2-4 Growth Rates in the Global Economy:

The increase in the rate of growth in the global economy contributes to a positive role on the demand for crude oil, the higher the rates of growth in the global economy, the higher the rate of demand for crude oil, as the study indicates that the correlation between the relative change of oil demand and global GDP growth for the years 2000 -2015 was positive and the correlation coefficient between the two variables was 0.761 and the level of significance 0.001 although this relationship is not tight in the short term for reasons related to the extent to which different development groups contribute to generating global economic growth, as well as what the oil storage movement plays in that. (Ali, 2016: 25). On Despite this relationship, other factors such as the economic structure, energy intensity, degree of satisfaction in consumption of different economic sectors, prices and energy rationalization policies are constant (Al-Zaytouni, 2019: 48).

It is noted from Table (3) that the rate of growth in the global economy decreased from 3.6% in 2018 to 2.9% in 2019 and the reasons for the decline in global economic growth are due to weak growth in Japan, India and the euro area due to low exports and slow consumption. (OPEC, 2020).

Table (3) Real Growth Rate in the Global Economy(%)

2019	2018	2017	2016	2015	2014	
2.9	3.6	3.8	3,4	3.4	3.6	the world

The table was prepared using the International Monetary Fund, 2019, April, the outlook for the global economy.

2-5- Population:

Population is an important determinant of cans demand for energy in general and oil in particular, with other factors remaining constant such as average per capita income and GDP structure. (Ali, 2016: 3). The increase in demand for oil is either directly to meet daily requirements such as heating, cooling, lighting and transportation due to urban expansion and high rates of urban growth, or indirectly through increased consumption of goods and services whose production requires more energy, including oil such as industrial and agricultural goods, communications and electricity. In this context, a study of the group of oil-exporting countries (OAPEC) indicates that the compound growth rate of the total population of these countries reached (2.4%) during the period from (1980 - 2016), while the compound growth rate of the total energy consumption, including oil, reached and (4.5%), during the same period above, that is, the elasticity of energy demand to the population in these countries amounted to (1.9%), i.e., there is a direct relationship between the total energy consumption and the population in the member states, which clearly indicates the existence of a relationship The expulsion between the demand for oil and the population. (Al-Zaytouni, 2018: 47).

3- Methodology

The methodology used in constructing the standard model was done through a set of steps. First, the test of time series stillness: For the results of time series to be logical, sound, and consistent with economic theory, the time series must be stable through the following conditions are met (Heij and etal, 2004: 536):

$$1) E(z_t) = \mu \quad 2) Var(Z_t) = \sigma^2 \quad 3) E(Z_t, Z_{t-k}) = \gamma_k$$

The unit root tests are among the most important tests that are used to know the stability of the chain and its degree of integration, the most important of which is the use of the Augment Dicky Fuller test (ADF) which is a test developed for the formula of the simple Dickie-Fuller test (Gujarati, 2004: 815) and the Philips-Peron test Phillips-Perron test (1980) (PP) which is a non-teacher test (verbeek, 2004: 273)) is more accurate and comprehensive than the ADF test as it deals with the stability of time series in a state of self-correlation and the mathematical formula for this test (Kozhan, 2010: 73) she :-

$$Z_t = \alpha_0 + \alpha_1 Z_{t-1} + \alpha_2 t + u_t \qquad \text{.....(1)}$$

As for the second step, it was represented by the co-integration test. The idea of this test returns to the world Cranger (1981) and was explained in detail by Engle-Granger (1987). The basis of the idea of this model is that the economic variables that economic theory assumes a balanced relationship between them in The long-term does not diverge from each other in the long-term, with the possibility of diverging in the short-term. There are several tests to uncover joint integration, the most important of which is the Jahansen-Juselius (1990) test, as it can be used in relationships that contain more than two independent variables where it is achieved Common integration in the event that Dar dependent variable on the independent variables and to determine the number of vectors integration joint was used Achtbarien Statisticians depend on the function of the greatest possible likelihood Ratio (LR), namely: -

Trace Test

The mathematical formula for this test is as follows:

$$\lambda_{trace} = -T \sum_{i=r+1}^{p} \ln(1-\hat{\lambda}_i) \qquad \text{.....(2)}$$

Since T represents the sample size, r represents the number of common integration vectors

It represents the smallest values for the self vectors Maximum

$$\lambda_{r+1}, \ldots, \lambda_p$$

Eigenvalue Test
This test is based on the following mathematical formula:

$$\lambda_{\max}(r,r+1) = -T\sum_{i=r+1}^{p}\ln(1-\hat{\lambda}r_{r+1}) \quad .....(3)$$

As for the third step, the Vector Error Correction Model (VECM) was tested. After confirming that there is a common integration between the studied time series, the VECM model is estimated to determine the shape of the short and long-term equilibrium relationship between economic variables with the possibility of its application in the case of samples. Small unlike the previous traditional methods (Green, 2011: 559), which is a simple self-regression model and one of the most important conditions for its application is the existence of a common integration according to the Johannes-Joselius test. The error correction model can be written for any two integrated series of the first degree () according to the following mathematical formula (Hill) etal, 2018: 500):

$$\Delta Z_t = a_{10} + a_{11}(Z_{t-1} - \beta_0 - \beta_1 \Delta y_{t-1}) + V_t^Z \quad ...\ (4)$$
$$\Delta Y_t = a_{20} + a_{21}(Z_{t-1} - \beta_0 - \beta_1 \Delta Y_{t-1}) + V_t^y$$

Where they a_{11}, a_{21} represent the error correction coefficient in the two equations
In order to ensure the quality of the model and its absence from standard problems, the following diagnostic tests were performed,
First ARCH test to ensure that the model is free from the problem of heterogeneity Heteroskedasticity, this is done using the F test or at the expense of the Chi-Square value since the mathematical formula (Gujaratr, 2004: 529) is:

$$nR^2 \rightarrow \chi^2(p) \quad ...(5)$$

Where the R^2 determination factor represents, and when the value of the two tests is significant, this means that there is a problem of heterogeneity of variance
Secondly, the Lacrange factorial of the remaining sequential self-linking (LM) test in order to ensure that the self-correlation problem is clear. This is done using the Ljung-Box (LB) statistic Q test as the mathematical formula (Ljung and Box, 1987: 70):

$$LB = n(n+2)\sum_{i=1}^{n}\frac{\widehat{\rho}}{n-k} \qquad \ldots(6)$$

Whereas, $\widehat{\rho}$ he self-correlation coefficient of the series of residues represents the model, and when its value is significant, this means a self-correlation.

Third, the Jarque Pera Test (J-B) test to ensure that the distribution of residues follows the normal distribution, as the mathematical properties of this test are (Jarque and Bera, 1978: 168):

$$J - b = \frac{N-n}{6}(S^2 + \frac{1}{4}(K-3)^2) \qquad \ldots(7)$$

In order to reach an estimate free from standard problems, the Fully Modified Ordinary Least Squar Estimator (FMOLS) method was used.

This method was proposed by both Phillips (1995) and Phillips and Hansen (1990) and it is a parameterless correction method for the least squares method (OLS) and is used to estimate independent multivariate co-integration models to eliminate second degree bias by converting the dependent variable for Correcting the least squares capabilities to modify values and solve the problem of simultaneous correlation between random error and independent variables (Maddala, 200: 196).

As is well known, the mathematical formula for the linear regression model is:

$$\begin{aligned} Y_t &= \beta_0 + \beta_1 X_t + u_t \\ &= \theta' Z_t + u_t \qquad \ldots \quad (8) \end{aligned}$$

Whereas $\theta = (\beta_0, \beta_1)$ and $Z_t = (1, X)$

Let Γ the contrast and contrast matrix be where

$$\Gamma = \begin{pmatrix} w_{11} & w_{12} \\ w_{21} & \Gamma_{22} \end{pmatrix}$$

And Φ that the long-term joint integration matrix represents that

$$\Phi = \begin{pmatrix} \lambda_{11} & \lambda_{12} \\ \lambda_{21} & \Phi_{22} \end{pmatrix}$$

As is known, the capabilities of the OLS are Consistence, but it is not sufficient. Therefore, these capabilities were corrected in order to adjust the values , and so the mathematical formula for the fully adjusted least squares (FMOLS) (Wang and Wu, 2012: 533) is:

$$\hat{\theta} = \left(\sum_{t=1}^{n} Z_t . Z_t'\right)^{-1} \left(\sum_{t=1}^{n} Z_t \hat{Y}_t - nL\right) \quad \ldots \quad (9)$$

Whereas $\hat{Y}_t = Y_t - W_{12}\Gamma^{-1}u_t$ and

$$L = \begin{pmatrix} 0 \\ \lambda_{21} - \Gamma_{22} w_{21} \end{pmatrix}$$

4- Results and discussions

1- Time Series Sleep Results: Both the Duque Fuller test and the Phelps Peron test were used to test the time series silence as follows:

A. Extended Duque Fuller test: Table (4) shows the results of the Duque Fuller test for all study variables (P, W, D, G, Z, S) and it was found that all the variables were unstable at the original level of data I (0) whether that With the intersection coefficient, or with the intersection coefficient and the direction, or without the intersection coefficient and direction, this is based on the calculated value of Tau and its statistical significance. (1) Whether with a coefficient of intersection, with a coefficient of intersection and direction, or Bedouin Intersection coefficient and direction. This was confirmed by the Tao value calculated statistical Manoatha since proved that most of the variables were significant at the level of 1% with the exception of variable economic growth, which has proved Manoath at the level of 10%.

Table (4) shows the results of Duque Fuller extended test for all variables

UNIT ROOT TEST TABLE (ADF)							
	At Level						
		P	W	D	G	Z	S
With Constant	t-Statistic	0.7042	-2.652	-1.7244	-1.119	-3.9104	-2.668
	Prob.	0.9915	0.0878	0.4146	0.7036	0.0033	0.0848
		n0	*	n0	n0	***	*
With Constant & Trend	t-Statistic	-0.4762	-2.3636	-3.2057	-4.666	0.3015	-2.5441
	Prob.	0.9824	0.3949	0.0921	0.0018	0.9983	0.3068
		n0	n0	*	***	n0	n0
Without Constant & Trend	t-Statistic	3.2499	-1.5897	2.1562	3.2002	1.7367	0.7276
	Prob.	0.9996	0.1048	0.9921	0.9996	0.9792	0.8697
		n0	n0	n0	n0	n0	n0
	At First Difference						
		d(P)	d(W)	d(D)	d(G)	d(Z)	d(S)
With Constant	t-Statistic	-9.8575	-5.7965	- 16.5372	-2.8137	-2.0548	- 11.1737
	Prob.	0.0001	0	0.0001	0.0618	0.2634	0.0001
		***	***	***	*	n0	***
With Constant & Trend	t-Statistic	- 10.0744	-5.9271	- 16.5343	-1.5527	-5.4562	- 11.3072
	Prob.	0	0	0.0001	0.801	0.0001	0
		***	***	***	n0	***	***
Without Constant & Trend	t-Statistic	-2.6585	-5.7463	- 15.9302	-1.5756	-0.7659	- 11.1795
	Prob.	0.0085	0	0	0.1077	0.3807	0
		***	***	***	n0	n0	***

Notes: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1%. and (no) Not Significant.
Source: Test results using Eviews version 9.

B) Phelps Peruvian test: Table (5) shows the results of the Philips Peruvian test for all study variables (P, W, D, G, Z, S) and it was found that all variables were unstable at the original level of data I (0), whether with a coefficient Intersection or with the intersection and direction coefficient or without the intersection and direction coefficient and this is based on the calculated value of Tao and its statistical significance, as well as table (5) shows the results of the Phillips-Peronne test at the first level which showed that all variables are stable at the first difference of data I (1) whether that With the intercept coefficient, or with the intercept coefficient and the direction, or without the coefficient of the intersection and direction, this is what is confirmed E Tao calculated the value of statistical Manoatha since proved that most of the variables were significant at 1% and 5% with the exception of variable economic growth, which has proved Manoath at the level of 10% .

Table (5) shows the results of the Philips Peruvian test for all variables

UNIT ROOT TEST TABLE (PP)							
		At Level					
		P	W	D	G	Z	S
With Constant	t-Statistic	0.8397	-2.0516	-1.649	0.9025	-5.1203	-2.5435
	Prob.	0.9941	0.2647	0.4524	0.995	0.0001	0.1099
		n0	n0	n0	n0	***	n0
With Constant & Trend	t-Statistic	-0.7258	-1.7851	-5.2583	-7.8457	0.3501	-2.5441
	Prob.	0.9668	0.7013	0.0003	0	0.9986	0.3068
		n0	n0	***	***	n0	n0
Without Constant & Trend	t-Statistic	3.517	-1.3685	3.1927	1.2175	25.9763	0.7978
	Prob.	0.9998	0.1574	0.9996	0.9416	1	0.8827
		n0	n0	n0	n0	n0	n0
		At First Difference					
		d(P)	d(W)	d(D)	d(G)	d(Z)	d(S)
With Constant	t-	-9.706	-5.7997	-21.1965	-2.6468	-3.1184	-

	Statistic						11.4988
	Prob.	0	0	0.0001	0.0888	0.0298	0.0001
		***	***	***	*	**	***
With Constant & Trend	t-Statistic	-9.9135	-5.9085	-28.6002	-2.0189	-5.6668	- 12.4456
	Prob.	0	0	0.0001	0.5805	0.0001	0.0001
		***	***	***	n0	***	***
Without Constant & Trend	t-Statistic	-8.7563	-5.748	-15.7258	-1.6668	-0.9041	- 11.3855
	Prob.	0	0	0	0.09	0.3211	0
		***	***	***	*	n0	***

Notes: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1%. and (no) Not Significant.

Source: Test results using Eviews version 9.

2- Joint integration test (Johansen test): After the results of the sleep tests, which showed that all time series of all variables are stable at the first difference I (1), were used, the Johansson test of joint integration was used, as Table (6) shows the effect of joint integration according to The Johansen test, where the results demonstrated that there are five common integration relationships between model variables .

Table (6) shows the results of the joint integration impact test

Hypothesized		Trace	0.05		
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**	
None *	0.50501	155.2927	95.75366	0	
At most 1 *	0.397126	108.1771	69.81889	0	
At most 2 *	0.386825	74.27193	47.85613	0	
At most 3 *	0.278988	41.50186	29.79707	0.0015	
At most 4 *	0.210798	19.58615	15.49471	0.0114	
At most 5	0.054081	3.72506	3.841466	0.0536	
Trace test indicates 5 cointegrating eqn(s) at the 0.05 level					
* denotes rejection of the hypothesis at the 0.05 level					
**MacKinnon-Haug-Michelis (1999) p-values					

Source: Test results using Eviews version 9.

Table (7) presents the results of the maximum values test for joint integration according to the Johansen test, which proved the validity of the results for the impact test, as the maximum values test shows that there are five common integration relationships between the variables, so long and short-term relationships will be tested using (VEC) .

Table (7) shows the results of testing the maximum values of joint integration

Hypothesized		Max-Eigen	0.05		
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**	
None *	0.50501	47.11561	40.07757	0.0069	
At most 1 *	0.397126	33.90514	33.87687	0.0496	
At most 2 *	0.386825	32.77007	27.58434	0.0098	
At most 3 *	0.278988	21.91571	21.13162	0.0387	
At most 4 *	0.210798	15.86109	14.2646	0.0277	
At most 5	0.054081	3.72506	3.841466	0.0536	
Max-eigenvalue test indicates 5 cointegrating eqn(s) at the 0.05 level					
* denotes rejection of the hypothesis at the 0.05 level					
**MacKinnon-Haug-Michelis (1999) p-values					

Source: Test results using Eviews version 9.

3. Long-term and short-term relationship test (VECM test): The Vector Error Correction Estimates model was used to test the long-term relationship, as Table (8) shows the results of this test and shows that there is a long-term relationship between shale production (P Both the price of West Texas Oil (W), the population of the year (Z), and the global crude oil supply (S), while it was found that there was no long-term relationship between shale oil production (P) and global demand for crude oil (D) and the

reason may be due to The increase in demand is covered by natural oil and not from shale oil, and the results have proven that there is no correlation between shale oil production (P) and growth. Global (G) This may be the result of the nature of shale oil, which is one of the light oils because it is free of impurities, because its production and demand may not be affected by the rate of global growth to some extent, especially if we take into account the period covered by the study, which recorded slight changes in the growth rates and in Worst cases did not reach the stage of economic stagnation, but this does not mean that the sharp decline in the rates of economic growth does not affect shale oil production, but that the sharp decline and the arrival of the global economy to the stage of stagnation will inevitably lead to a significant decrease in shale oil production, either directly or Guy's picture Directly

Table (8) shows the results of the long-term relationship test

Counteracting Eq:	W(-1)	D(-1)	G(-1)	Z(-1)	S(-1)	C
CointEq1	-0.09257	0.734931	0.805641	-92.4766	-1.08092	653.6976
	-0.02007	-0.24744	-0.15878	-13.7749	-0.25215	
	[-4.61121]	[2.97017]	[5.07393]	[-6.71340]	[-4.28686]	

Source: Test results using Eviews version 9.

The results of the short-term integration relationship between shale oil production (P) and both West Texas price (W), global demand for crude oil (D), economic growth (G), world population (Z), and global oil supply (S) also demonstrated. The lack of a short-term relationship between them, whether that is the first difference or the second difference. Figure 1 illustrates the stability of the integrative relationship of the model, where this form can be read clearly as it begins to decline towards stability until it reaches the stage of stability and then settles a little and then returns to the stage of disruption to End of period.

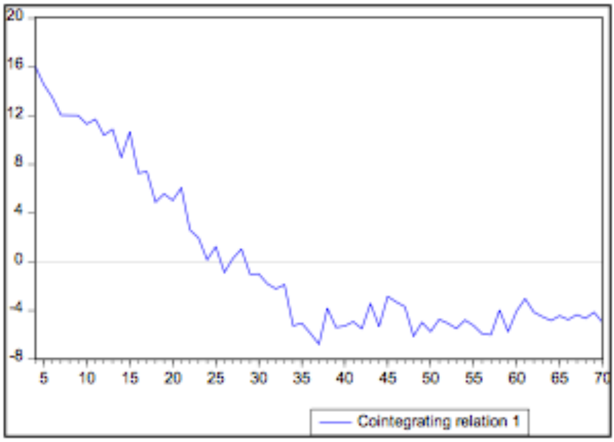

Figure 1: Stability of the integral relationship of the model

Source: Test results using Eviews version 9.

4- Model evaluation: After the model has been tested, we must submit it to the evaluation to see if it is free from standard problems or not. Therefore, a set of tests will be conducted in order to determine the integrity of the model, which is as follows:

A- LM test: Table (10) shows the results of the serial self-correlation test, as it proved that the model suffers from the problem of serial self-correlation, and this was confirmed by the calculated value of F and its statistical significance.

Table (9) shows the results of the (LM) test

VEC Residual Serial Correlation LM Tests						
Null hypothesis: No serial correlation at lag h						
Lag	**LRE* stat**	**df**	**Prob.**	**Rao F-stat**	**df**	**Prob.**
1	55.95547	36	0.0181	1.639275	(36, 187.2)	0.0188
2	37.64747	36	0.3937	1.052768	(36, 187.2)	0.398
3	53.56443	36	0.03	1.559659	(36, 187.2)	0.031
4	42.07776	36	0.2245	1.18991	(36, 187.2)	0.2281
Null hypothesis: No serial correlation at lags 1 to h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	55.95547	36	0.0181	1.639275	(36, 187.2)	0.0188
2	88.5757	72	0.0898	1.271397	(72, 201.7)	0.099
3	119.6161	108	0.2093	1.11813	(108, 179.1)	0.2534
4	176.9029	144	0.0324	1.277459	(144, 148.2)	0.0698
*Edgeworth expansion corrected likelihood ratio statistic.						

Source: Test results using Eviews version 9.

B - Heteroskedasticity test: Table (10) shows the results of the homogeneity test, as it was found that the model suffers from the problem of heterogeneity, and this is proven by the test results, which were statistically significant.

Table (10) showing the results of the (Heteroskedasticity) test

VEC Residual Heteroskedasticity Tests (Levels and Squares)					
Chi-sq	df	Prob.			
597.3707	546	0.0632			
Individual components:					
Dependent	R-squared	F(26,40)	Prob.	Chi-sq(26)	Prob.
res1*res1	0.594292	2.253579	0.0101	39.81756	0.0406
res2*res2	0.548284	1.867353	0.0368	36.73502	0.079
res3*res3	0.383715	0.957884	0.5376	25.70888	0.4792

Source: Test results using Eviews version 9.

C- Bounds: This test measures the partial correlation between the variables. It is noticed through Figure (2) that there is no partial correlation between some of the model variables, and this is proven by the stability of the remaining within the permissible limits.

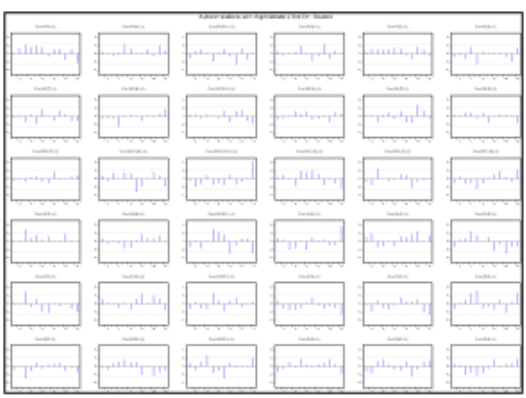

Figure (2) shows the results of the residual stability

Source: Test results using Eviews version 9.

D - Autocorrelations test: Table (11) shows the model self-correlation test, which showed the lack of significance of the estimate, which indicates that there is no problem of self-correlation, indicating the probability value of Q stat, its lack of significance at the level of significance (1% and 5% And 10%), which means that the model is free of the problem of self-correlation.

Table (11) shows the results of the (Autocorrelations) test

Lags	Q-Stat	Prob.*	Adj Q-Stat	Prob.*	df
1	6.694443	---	6.795874	---	---
2	26.40234	---	27.11016	---	---
3	69.55301	0.3588	72.28353	0.2782	66
4	106.4159	0.3627	111.487	0.2448	102
*Test is valid only for lags larger than the VAR lag order.					
df is degrees of freedom for (approximate) chi-square distribution after					
adjustment for VEC estimation (Bruggemann, et al. 2005)					

Source: Test results using Eviews version 9.

The test shows the normal distribution of residues (Residual Normality Tests). It is noted that the results of this test, which are found in Table (12), showed the existence of the problem of not distributing the remaining residues naturally, as the probability value of the test proved to be at a significant level (5%).

Table (12) showing the results of the (Normality) test

Component	Skewness	Chi-sq	Df	Prob.*
1	0.660628	4.873459	1	0.0273
2	-0.19776	0.436721	1	0.5087
Joint		95.43216	6	0
Component	Kurtosis	Chi-sq	Df	Prob.
1	6.058814	26.11979	1	0
Joint		742.6908	6	0
Component	Jarque-Bera	df	Prob.	
1	30.99325	2	0	
Joint	838.123	12	0	
*Approximate p-values do not account for coefficient estimation				

Source: Test results using Eviews version 9.

5- Treatment of estimation problems: A Fully Modified Least Squares (FMOLS) method was used, which is considered one of the best methods of estimating the model. Addressing standard problems, as Table (13) shows the results of the FMOLS test, as it showed that the price of West Texas oil affects Shale oil production has the opposite effect and this may be the result of abundant oil revenues, which drives the United States of America to reduce shale oil production as a rare and depleted strategic commodity, especially if we consider that the United States of America exports shale oil and imports natural oil, and the effect was significant. Statistically A level below less than 1%. On the other hand, the demand for oil had a positive impact on the production of American shale oil. This is a natural result that applies to economic theory. The increase in demand for the commodity leads to an increase in the supply of this commodity in order to meet that demand. On crude oil and shale oil production at a level less than 5%, in addition to a direct relationship between economic growth rates and shale oil production, as the results showed that economic growth has a direct effect on shale oil production, the more global economic growth rates lead to an increase in oil production a As for rocky and vice versa, this result has proven its statistical significance at a level of less than 1%, in addition to the negative relationship between the supply of crude oil and the production of shale oil. Makes an increase in the supply of natural oil leads to a decrease in shale oil production, which came at a significant level of significance less than 1%. After all that was mentioned, the results also proved that there is no relationship between the population and the production of shale oil. Any change that occurs in the world's population does not lead To any change in the production of Aft rock.

The results confirm that these factors explained about 88% of the changes that occur in shale oil production, while 12% of the changes in shale oil production are due to factors outside the model.

Table (13) shows FMOLS test results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
W	-0.03119	0.010874	-2.8679	0.0056
D	0.250652	0.09758	2.5687	0.0126
G	0.183835	0.062924	2.921546	0.0048
Z	-0.88146	3.602619	-0.24467	0.8075
S	-0.30531	0.112229	-2.72045	0.0084
C	3.225558	15.49796	0.208128	0.8358
R-squared	0.889022	Mean dependent var		5.987203
Adjusted R-squared	0.880214	S.D. dependent var		1.409936
S.E. of regression	0.48798	Sum squared resid		15.00182
Long-run variance	0.529928			

Source: Test results using Eviews version 9.

Conclusion:

The results of the static test showed that the time series of the variables under study are unstable at the original level of data and have settled in the first difference. The results of the joint integration proved that there are five complementary relationships through the results of the Johansen test, whether through the results of the impact test or the results of the test of great values. The results of the estimate indicated that there is a direct relationship between shale oil production and both the demand for global natural crude oil and the rate of global growth, which proves the validity of the first and second hypothesis, while it proved an inverse relationship between shale oil production and both the price of West Texas oil and the supply of oil, which negates the validity of the third hypothesis And it establishes the fourth hypothesis. There is no relationship between the population and the production of shale oil. Any changes that occur to the variable of the population do not affect the production of shale oil. This is proven by the results of the standard model. The reason may be that the increase in the population is covering its needs of natural oil. The variables included in the model explained 88% of the changes that occur in shale oil production, which means that these factors largely determine the production of shale oil.

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