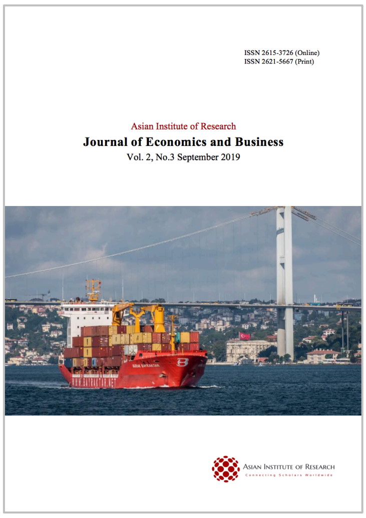

Journal of Economics and Business

Ghalayini, Latife, and Saade, Fabienne. (2019), Estimating the Value of the Lebanese Oil Resources Modeling and Forecasting Oil Price. In: *Journal of Economics and* Business, Vol.2, No.3, 804-817.

ISSN 2615-3726

DOI: 10.31014/aior.1992.02.03.128

The online version of this article can be found at:
https://www.asianinstituteofresearch.org/

Published by:
The Asian Institute of Research

The Asian Institute of Research
Journal of Economics and Business
Vol.2, No.3, 2019: 804-817
ISSN 2615-3726

DOI: 10.31014/aior.1992.02.03.128

Estimating the Value of the Lebanese Oil Resources Modeling and Forecasting Oil Price

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Abstract
The aim of this paper is to estimate the value of the Lebanese oil resources. It presents an overview of the natural resources within the Lebanese territories and economic zone. Furthermore, it analyses the oil spot price characteristics and volatility. It studies the oil future market while exploring the relation between speculation and spot oil price in the short run. Findings prove that in the short run, changes in oil inventories do not Granger cause changes in oil price, neither does the change in future prices. However, outcomes show that in the short run, the change in gold price granger causes the oil spot price. Additionally, in the aim of forecasting accurate oil price, the paper builds a Dynamic OLS equilibrium. The model includes the oil demand, the oil supply, the oil inventories, the USD/SDR exchange rate, the Gold price, and the open interest contracts in futures market as speculation effect. Eventually, with an estimate of the volume of the resources and the price forecasts until 2025, the paper forecasts the value of the Lebanese resources.

Keywords: Dynamic OLS, Future oil markets, Gold price, Lebanese oil resources, Open interest, Spot oil price

1. Introduction

The Levant basin contains large Petroleum resources, a discovery that dates more than a century. However, it was until the year 2010 that the global interest in these resources grows significantly. Lebanon, a country with no petroleum production whatsoever, is trying to draw benefits from the oil and gas reserves it holds mostly in its offshore economic zone. Lebanon imports the vast majority of its energy demand, and oil as a vital energy source represents a high significance to the Lebanese transportation, electricity production, and industries. Therefore, the oil price fluctuation impacts the Lebanese economy and wellbeing, particularly if the country starts producing its oil resources.

Oil price volatility will impact the Lebanese trade, the labor market, and the household expenditures. Hence, it is important to investigate the oil price volatility and to understand the factors influencing the price. Which aspects of the market interpret the price fluctuation? The two accepted common factors are the demand and supply. Besides that, the inventory levels might act as an absorbent for the demand and supply shocks, therefore influence prices. Furthermore, the volatility of the price and the open interest for the future contracts might conclude the impact of speculation on oil prices. Oil contracts are settled in the US dollar, meaning that for every oil contract transaction, a US dollar transaction is mandatory. Therefore, the exchange rate of the USD against major currencies might influence Oil price. Likewise, Gold price is known as a safe haven within the commodity market. In moments of low confidence in the oil markets, investors prefer investing in Gold, explaining the probable impact of Gold price on the oil price. Consequently, the paper hypothesis states that in addition to the global supply and demand, the following four factors may influence the oil prices: inventory levels, gold price, speculation, and exchange rates.

For this purpose, after investing the price volatility and characteristics, the study explores the relation in the short run between the oil spot price and each of: the inventory levels, the speculation, and the Gold price. The paper then develops a dynamic OLS model where the oil price, the oil supply and demand, the inventories, the speculation, the gold price, and the SDR exchange rate are associated in a long-run relationship.

This paper is divided into 8 main sections, section one being the introduction. Section 2 presents the literature review. Section 3 explores an overview of the Lebanese resources. Section 4 investigates the oil price characteristics and volatility. Section 5 analyses the fundamental factors influencing the oil price. Section 6 inspects in a short run granger causality testing the relationship between the oil price and each of the Gold price, inventories, and the speculation impact. Eventually, section 7 builds a dynamic OLS model for oil price equilibrium in the long run, and the last section concludes.

2. Literature Review

The contemporary geological studies suggest the presence of petrol and heavy hydrocarbon in the Levant basin region. Though, investors did not show interest in any production, since the operations and processing were expensive, and the Lebanese civil war suspended any further work in the domain. However, after the civil war, geophysical experts regained interest and continued investigating the Lebanese offshore area. Likewise, Rahim (2013) studied a few aspects of the Lebanese oil and gas potential. Lebanon imports oil derivatives nearly 27% of his total value of imports, and about 13.4% of his GDP. The 3D seismic studied over 70% of the exploitation zone of 22730 sqm. The study showed that Lebanon has gas in his northern, central, and southern territorial water, and it holds 25 Trillion Cubic Feet (TCF) of natural gas.

Econometric modeling of energy demand provides information on income and price elasticity. Early papers study industrialized countries such as Pindyck (1980) or Douglas Bohi (1981) while more recent work has addressed the problem of co-integration among variables using primarily correction methods such as Bentzen (1993). Few studies have been directed towards investigating the demand for energy in the developing countries such as Munasinghe (1990) and Elton (1996). Furthermore, along with all other pricing theories, demand and supply for energy are the main factors that drive the oil and gas prices back to another equilibrium point. Zamani (2004) presented a forecasting model accounting for both the Organization of the Petroleum Exporting Countries (OPEC) oil supply and OECD stocks and non-OECD demand. Moreover, Shiu-Sheng Chen and Hung-Chyn Chen (2007) investigate the long-run relationship between oil prices and real exchange rates by using a monthly panel of G7 countries from 1972 to 2005. The study tests the co-integration between exchange rates and real oil prices. Results prove the link between the two variables and suggest that real oil prices might be the dominant source influencing the real exchange rates. In the next step, the study uses panel predictive regression to examine if real oil prices can forecast future real exchange returns. Results also suggest that real oil prices have significant forecasting power.

On another hand, Michael Ye, john Zyren and joanne Shore (2002) forecasted the crude oil spot price using OECD Petroleum Inventory Levels. Their work analyzed how inventory levels influence the oil price, the study used dynamic OLS forecasting model. It demonstrates the relationship between OECD petroleum inventories and WTI prices in a period from 1992 to 2001. The correlation coefficient proves the expected negative price-inventory relationship, yet the Johansen Co-integration test finds no co-integration relation between them.

Additionally, Ghalayini (2015) constructed a model for long-run equilibrium. Findings prove that in the short run, changes in oil inventories Granger cause changes in oil price. In the long run, however, findings prove that, the oil demand, the oil supply, the $/SDR exchange rate, the speculation in future oil market and the oil inventories are associated in a long-run relationship.

In this work, other than exploring the Lebanese resources, the paper extends Ghalayini (2015) model by including Gold price as sixth explanatory variable, and implements the dynamic OLS as long-run equilibrium model.

3. Overview of the Lebanese resources

The interest in the petroleum resources within the Lebanese territory dates back to the French mandate since 1925. From that time, Lebanon onshore witnessed the drilling of several wells, some of them with depth up to 3000m, without any actual oil findings. In 2013, the British Spectrum surveys showed that the oil reserves in Lebanon could be worth 140 billion USD. In the same year, in a study of the northern offshore near the maritime border with Cyprus and Syria, the French survey Beicip-Franlab reported between 440 and 675 million of barrels of oil, and 15TCF of natural gas.

Furthermore, the US Geological Survey, in 2010, estimated a mean of 1.7 billion barrels of recoverable oil and a mean of 122 trillion cubic feet (TCF) of recoverable gas in the Levant Basin Province. Lebanese authorities have estimated that the country's waters could hold 96 trillion cubic feet of natural gas and 865 million barrels of oil after implementing studies on 45% of the territories and with a 50% probability.

While those numbers are a fraction of the reserves held by gas powerhouses such as Russia and Qatar, the U.S. Geological Survey estimates that the East Mediterranean basin, which also includes the territorial waters of Cyprus, Lebanon, and Egypt, may hold as much as four times the estimates.

Moreover, at this stage, all estimations of the resources stay inaccurate, and numbers presented are widely variable. The highest income to a country from exploring Oil and gas resources is the profit share from the production. Under the arrangement between the Lebanese Government through the Lebanese Petroleum Administration and the contractors, the ownership of the resources remains with Lebanon and the latter contracts the petroleum company to extract and develop the reserves.

Moreover, Lebanon will benefit mostly from its share from the production of the energy sources, even though and according to the arrangement, a minimal part of the production profit would be grant to the contractor company.

Furthermore, another profit to the government are royalties. Royalties are payments to the owner of a property, such as natural resources. In other terms, those who wish to use the resources to generate revenue will have to pay the owner of the property an amount called Royalty. Royalties represent a way to compensate the owner for the asset's use, along with taxes and profit shares.

Lebanon will benefit from the development of the oil and gas sector through the fiscal role. Such financial income thru generating taxes and other revenues to the government represents an important benefit to the country. One of the most important benefits for a country from the development of the oil and gas sector is likely to be its fiscal role in generating tax and other revenue for the government. Policymakers will also have to decide on the treatment of indirect taxes such as VAT and customs duties.

4. Oil price statistical characteristics and volatility

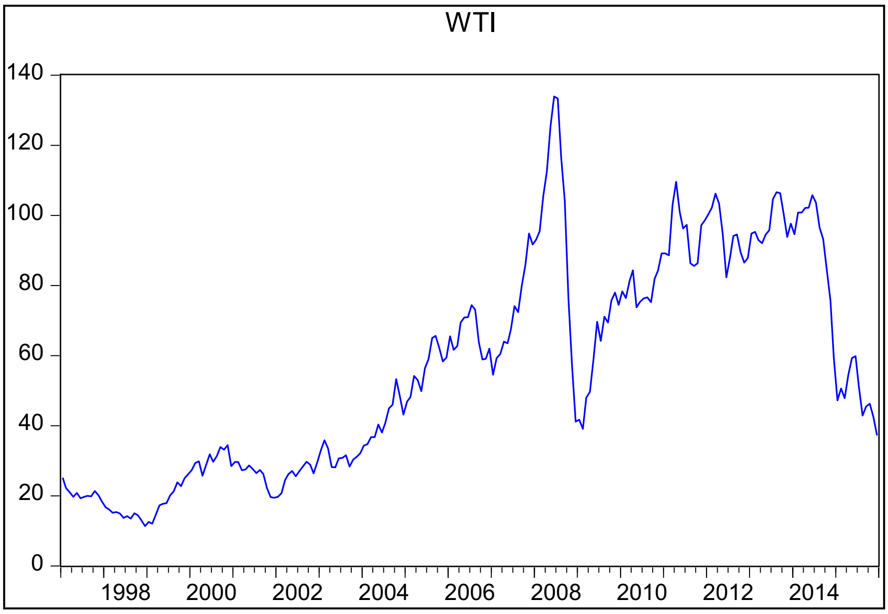
There are many types of oil. They differ in their resistance to flow, in how toxic they are, and how quickly they evaporate. The two most common differences are “light” or “heavy” according to the density of the crude and their

API gravity[1], as well as "sweet" or "sour" according to the quantity of sulfur in it. The lighter the crude is, the lower is its density, it flows easily at room temperature, it has a high API gravity, and low wax content. It also contains high concentrations of toxic composites. However, the Middle East area mostly include heavy oil reserves underground, therefore, it is more probable that the oil extracted from the Lebanese territory would hold the same aspects as the remaining middle east countries of heavy oil.

The three main oil benchmarks are: West Texas Intermediate (WTI) which has an API gravity of 39.6° API, the Bent Crude with 38.06° API, and the Dubai Crude is 31° API. The WTI benchmark listed in the New York Mercantile Exchange (NYMEX) is the most traded commodity, and it is used in this paper.

During the financial market crisis of 2008, the price of Oil experienced a significant decline from the 147.27$ a barrel peak in July 2008, into a 30.28$ a barrel low in December 2008 (Fig. 1). The price then recovered to an 85$ a barrel average after the crisis. A major change in demand or supply implies a change in prices. On the other side, a major increase or decrease in oil and gas prices, affects both economic and political situations, and can lead to turmoil and wars.

Figure 1 : Monthly real WTI spot price



Monthly real WTI spot price (dollars per barrel) from 1 January 1996 until 31 December 2014 Source: realized by the author based on data from the US Energy Information Administration (EIA).

4.1. WTI descriptive statistics:

The paper calculates the monthly Real WTI and Real Henry Hub prices by dividing the nominal WTI and Nominal Henry Hub spot prices by the monthly US Consumer Price Index (CPI) based upon a 1982 Base. The Oil and Gas prices are from US Energy Information Administration (EIA) and CPI index from the US bureau of labor statistics. According to Jarque–Bera (13.25561), the series is not normally distributed with probability (0.001) is less than 5 %. The series is negatively skewed (-0.337351), which might result in negative outcomes. Kurtosis (2.03041) is less than three, with relatively low value, which implies greater investment risk.

4.2. WTI price volatility:

Volatility is a rate at which the price increases or decreases for a given set of returns (Rt = logpt - logpt-1). Volatility is measured by calculating the standard deviation of the annualized returns over a given period of time.

[1] API gravity: Means the American Petroleum Institute gravity, and it is a measure of how heavy or light petroleum liquid is, compared to water.

Generalized autoregressive conditional heteroskedasticity (GARCH) formulation has been first proposed by Bollerslev. Heteroskedasticity designates the irregular pattern of variation of a variable. Essentially, where there is heteroskedasticity, observations do not conform to a linear pattern. Instead, they tend to cluster. The result is that the conclusions and predictive value one can draw from the model will not be reliable. In finance, this model is used to estimate the volatility of returns.
It tests then an equation specification for the mean of the return series (1) and an equation for the conditional variance of the returns (2):

$$R_t = logp_t - logp_{t-1} = c + \epsilon_t \quad (1)$$

$$\boldsymbol{\delta_t^2 = \omega + \alpha \in_{t-1}^2 + \beta\delta_{t-1}^2} \quad (2)$$

Where $\epsilon_t \approx$ N (0,δ_t^2) and δ_t^2 =E (ϵ_t^2).

4.2.1. Stationary tests:
The ADF (Dickey David & Fuller Wayne, 1979) unit root test estimates a regression for each series, hence simulating critical values based on each sample details and size. The process of testing the hypothesis adopts a null hypothesis of a unit root (H0: α= 0) versus the alternative of a stationary process H1: α>0).

The Philips Perron unit root test (PP) involves estimating a non-augmented version of regression without the lagged difference terms. PP unit root test practices a non-parametric method to control for serial correlation under the null hypothesis. H0 and H1 are the same as in the ADF test; yet, the unit root test in the PP is based on its own statistic.

The ADF and PP tests show that at level, there is a unit root in the real oil price in log form. However, taking in differences, prices become stationary, and the series is then integrated of order 1.

Table 1: ADF and Phillips Peron test results for monthly real WTI

			Log rWTI
		t-Statistic	Prob
At level	Augmented Dickey-Fuller test statistic	-2.01875	0.2786
At level	Phillips-Perron test statistic	-1.97223	0.2988
First Diff	Augmented Dickey-Fuller test statistic	-7.75312	0
First Diff	Phillips-Perron test statistic	-7.68895	0

ADF and Phillips Peron test results for monthly real WTI price series expressed in log, from 1 January 1996 until 31 December 2014. Source: Calculated by the author using Eviews data collected from EIA.

4.2.2. GARCH results:
After testing the stationary of the WTI real price, the unit root in the real oil price series in log form is confirmed by the Augmented Dikey Fuller (ADF) and Phillips-Perron tests. The paper then conducts the GARCH model, the probability values are written in parenthesis under each coefficient. Equation (3) represents GARCH (1,1) model estimations:

$$\delta_t^2 = 0.001407 + 0.270844 \in_{t-1}^2 + 0.541476\, \delta_{t-1}^2 \quad (3)$$

(0.1595) (0.0111) (0.0104)

The probability for the α and for β are significant (less than 5%). The sum of ARCH and GARCH ($\alpha + \beta$) is 0.270844 + 0.541476 = 0.81231, indicating that the volatility shocks are persistent, and that oil price is volatile.

5. Fundamental factors influencing the Oil price

As a rule, the two factors that mostly affect any price are the supply and demand, therefore the typical fundamental reasons of price volatility reside in the change of the world supply or production and in the world demand or consumption. However, this change in supply and demand does not have the sole impact on prices and does not seem to be the only trigger of the price volatility on the market, it is important to include several other factors that seem to affect oil price significantly.

Furthermore, inventories level is very crucial in estimating prices, it is considered as a precaution measure and as a balance point between the demand and supply. In other terms, a high production exceeding the world demand can result in increasing the inventories quantities. At the opposite, in times of low supply and an increase in the demand for energy, the countries will consume from their inventories to cover the lack and rectify the balance.

In addition, notably, all oil contracts are traded using the US dollar as an exclusive currency. The US dollar is the benchmark pricing for most commodities, and it is the reserve currency of the world, which explains the high dependency of oil on the US dollar. As an example, the Euro area imports most of its oil consumption, therefore, to reduce the impact of high oil price, the European Central Bank (ECB) prefers a higher EUR/USD rate.

Other than the exchange rates, the supply and demand chain, and inventories, the paper covers the impact of speculation on energy pricing. As a start, the financial future market answers the oil rates. A contract in the future market is an agreement that gives the buyer and seller the right to buy or sell oil barrels at a future date and with a predefined price, and the obligation to settle their part of the contract at that specified date.

Subsequently, the majority of traders are the speculators, who aim to make a profit from the change in prices. While trying to predict the future trend, they aim to buy on low prices and sell at the higher price, and in contrary.

5.1. Oil Demand:

The Organization of Economic Cooperation and Development (OECD), consisting of the advanced countries such as the US and most European countries, represent more than half of the world demand for Oil. Growth in the world economy, especially in the emerging economies, requires more energy. The world economy is expected to double over the next 20 years, according to the BP outlook; the transport sector contributes to the biggest part of the world's liquid fuel consumption, with a 60% share of total consumption. Currently, more than half of the world oil demand comes from only 17% of the world population, while India and China represent the two highest population in the world, their growing economy, and progress will probably lead to an excessive growth in the Oil demand.

5.2. Oil supply:

The Organization of the Petroleum Exporting Countries members produce about 40 percent of the world oil and represent about 60% of the world international oil trade, according to the EIA report in 2013. The other 60% of the world production reside in the non-OPEC countries, namely North America, and Russia.

OPEC production policies and production targets are a major factor in affecting oil prices. Changes in the Saudi Arabia policies and production frequently affect prices, because the kingdom represents OPEC's largest producer. During the period of increasing oil and gas prices, from 2003 until the financial crisis of 2008, OPEC's production levels were low, limiting its ability to respond to the surge in the demand and the increase in prices. The world supply about 91.7 million bbl. per day in 2015, the Middle East represents the highest share, with a 32.8% of the world supply (Oil Production levels, 2016).

5.3. Oil inventories:

The supply or demand impact can be absorbed by the inventories levels. Example, if supply and demand both increased, the impact on the prices can be minimal. While, if supply increased, and demand maintained the same pace, the level of inventories can absorb the impact, for a short term, until eventually affecting the oil and gas prices. Nearly 50 percent of total inventories are held as US Ending Stocks of Crude Oil mostly by the federal government in the Strategic Petroleum Reserve (SPR).

5.4. Oil Speculation:

Oil spot price is the current price of the commodity at which one can buy or sell for immediate delivery and payment, at a specific time. Futures prices are the settlement price that both the buyer and seller agree on, for future transactions, and for future deliveries. Futures represent the anticipation of investors concerning the predicted future price of oil, especially for the long term. Futures also contain information about predicted future trends, movements, and anticipations. Hence, the future price does impact investments in spot prices. This large demand for futures contracts shakes the pricing of futures deliveries, same way as the demand for physical delivery affects spot prices.

5.5. Gold Price:
The link between gold prices and energy prices is strong. When the US dollar drops in price, the assets that are dominated in the USD increases in value, such as the gold and the energy prices. Moreover, the Inflation rate is another justification to the relation between gold and energy prices. When oil prices increase, inflation typically increases, and while gold is the "Safe Haven," it is the hedging commodity against inflation, meaning investments surges on gold, therefore gold prices increases as well.

5.6. Exchange rate:
Primarily, it is elementary to include the impacts of the world's biggest powers and economies, into the estimation model. One of the main indicators of the wellbeing of an economy in a certain country is the exchange rate of its national currency. Therefore, implementing a Special Drawing Rights (SDR) basket of the main influencer in the energy market can maintain a higher efficiency in the estimation model.

For this point, the IMF holds an SDR as a basket of the five main currencies in the world; the US dollar (USD), the Euro (EUR), the Chinese Renminbi (RMB), the Japanese Yen (JPY) and the British pound (GBP).

Since all oil and gas contracts are denominated in the United States Dollar, and since the European Union represents a major importer of oil, a significant increase in the price of oil implies a lower purchasing power petroleum products.

ECB monetary policy advises an appreciation of the EUR/USD parity, such improvement in the European currency makes it cheaper for the Europeans to buy oil and gas contracts. The appreciation of the euro since 2002 has helped protecting the euro area from the effects of the rising oil prices.

Japan's main consumption of oil is due to transportations, industrial, and chemical sectors. The nation consumes around 4million barrels of oil per day, according to the EIA and by that represents the fourth largest petroleum consumer in 2016.

China remains the world's largest energy consumer, with a 23% share of the global energy consumption, according to the annual BP report to the year 2016. Its oil production witnessed the largest decline ever, and its net oil imports increased by 9.6% the largest annual increase in the country's history. The BP report proclaimed that China's oil import dependency ratio rose to its highest 68% ratio, in 2016.

6. Short-run relationship between oil price and fundamental factors

The theory of supply and demand is simple; an increase in demand or in a decrease in supply will eventually end up with a higher price, while a decrease in demand or increase in supply will reflect lower oil prices. The other fundamental factors might differ in simplicity.

This paper proceeds by testing the short-run relation between the oil price and each of the following: inventories, futures contracts, and gold price.

6.1. Methodology:
A recognized way to statistically test whether one variable leads another or inversely is the granger causality testing, This test identified by Granger (1969), and using the F statistics, and the past values of the two variables X and Y examines whether a lagged information on a variable Y leads to any significant information about the other lagged variable X (4).
If yes, then Y does Granger-cause X. If not, then Y does not Granger-cause X

X does Granger-cause *Y,* if *Y* can be well predicted using the histories of both *X* and *Y* than by using the history of *Y* alone.

$$X_j = c_1 + \sum \alpha_j X_{t-1} + \sum \beta_j . Y_{t-1} + u_t \quad (4)$$

Lag length and Stationary tests are an important step before going through the Granger Causality test. Thus, the prior step is to analysis whether individual series are stationary.

6.2. Variables for granger causality:

The variables for the WTI granger-causality Testings are as follow:

- The monthly real spot WTI price (OilP) collected from the EIA from January 2005 until December 2015, totaling 132 observations.
- Monthly future price series of each future WTI contract for 1, 2, 3 and 4 months (OilF1, OilF2, OilF3, and OilF4 respectively) collected from the EIA from January 2005 until December 2015, totaling 132 observations.
- The U.S. monthly Ending Stocks of Crude Oil in Thousand Barrels (Oil_inv) including SPR (strategic petroleum reserves, with mostly crude oil) collected from the EIA from January 2005 until December 2015, totaling 132 observations.
- The Monthly Gold price collected from FastMarkets & Denver Gold Group from January 2005 until December 2015, totaling 132 observations.

6.3. Stationary testing:

Lag length and Stationary tests are an important step before going through the Granger Causality test, the table 2 shows the results of ''Augmented Dickey Fuller test'' identified by Dickey and Fuller, to test the presence of a unit root. In addition, it shows the best lag to be used, using the Akaike information criterion (AIC). All variables are taken in log form.

Table 2 : ADF results for spot price, futures, and inventories

	At level		At First Difference	
Variables	t-Statistic	Prob.*	t-Statistic	Prob.*
Log OilP	-2.01875	0.2786	-7.75312	0.0000
log OilF1	-2.32288	0.1664	-7.5318	0.0000
log OilF2	-2.32288	0.1664	-7.43689	0.0000
log OilF3	-2.29732	0.1744	-7.4136	0.0000
log OilF4	-2.29654	0.1747	-7.41001	0.0000
log Oil_Inv	-2.07038	0.257	-7.53741	0.0000
log gold	-1.942538	0.3112	-6.181509	0.0000

Table 2: ADF test results for the oil price, oil futures, inventories, and gold price expressed in log, from January 2005 until December 2015. Source: Calculated by the author using Eviews. Data collected from EIA and FastMarkets & Denver Gold Group.

The ADF test results indicate that all series in log form are integrated of order 1. The study considers the series in difference before running the Granger causality testing.

6.4. Granger causality:

The Granger Causality Test follows a null hypothesis of "Ho: No Granger causality of one variable on the other." Using the F statistics, and past values of two variables results show acceptance or rejection of the null hypothesis. If rejected, then Y does Granger-cause X. If accepted, then Y does not Granger-cause. X.

The Granger causality test results reported in table 3 indicate that neither the volume of inventories nor the future oil price for the four contracts, do granger cause the spot oil price. However, the results show that the gold price does Granger cause the oil price and that oil price does granger cause the volume of inventories.

Table 3: Granger causality test results

Null Hypothesis:	Obs	Lags (AIC)	F-Statistic	Prob.	Null hypothesis
D(logGOLD) does not Granger Cause D(logOilP)	127	4	2.82646	0.0326*	Rejected
D(logOilP) does not Granger Cause D(logGOLD)	127	4	1.51321	0.2163	Accepted
D(logOilP) does not Granger-Cause D(logOil_Inv)	127	4	2.97112	0.0222*	Rejected
D(logOil_Inv) does not Granger-Cause D(logOilP)	127	4	0.42698	0.7889	Accepted
D(logOilP) does not Granger-Cause D(logOilF1)	129	2	0.64032	0.5289	Accepted
D(logOilF1) does not Granger-Cause D(logOilP)	129	2	0.73589	0.4812	Accepted
D(logOilP) does not Granger-Cause D(logOilF2)	127	4	0.69513	0.5968	Accepted
D(logOilF2) does not Granger-Cause D(logOilP)	127	4	1.19284	0.3176	Accepted
D(logOilP) does not Granger-Cause D(logOilF3)	127	4	0.55694	0.6943	Accepted
D(logOilF3) does not Granger-Cause D(logOilP)	127	4	1.23042	0.3017	Accepted
D(logOilP) does not Granger-Cause D(logOilF4)	127	4	0.40406	0.8054	Accepted
D(logOilF4) does not Granger-Cause D(logOilP)	127	4	1.16187	0.3312	Accepted

Granger causality test results. Source: Calculated by the author. * Probability < 0.05 then Null Hypothesis is rejected.

7. Oil price Dynamic OLS model

The oil equilibrium model represents the relation between the spot oil price and the independent variables. In this model, the WTI nominal spot price represents the dependent variable. Moreover, and as independent variables, the model (5) includes the oil supply, oil demand, oil inventories, gold price, speculation, and exchange rate. In the process, the paper collected a quarterly average of the variables, during the period between the first quarter of 2000 and the first quarter of 2017 included, therefore totaling 69 numbers of observations.

$$OilPrice = C_0 + C_1 Supply + C_2 Demand + C_3 Inventories + C_4 Exchangerate + C_5 Speculation + C_6 Goldprice + U_t \quad (5)$$

With Ut is the noise disturbance term at time t.

7.1. The variables

The six independent variables seem to have a significant impact on the Oil price. These variables are taken in log form except for the SDR basket value.

1. The Oil demand represented by the World Petroleum and Other Liquids Consumption.
2. The Oil Supply as the OPEC Crude Oil Supply.
3. The Oil inventories represented by the U.S. Ending Stocks of Crude Oil and Petroleum Products including SPR.
4. The exchange rate represented by the SDR basket against the USD
5. The Speculation effect presented as the Oil Futures contract.
6. The Gold price.

Table 4 represents the Variables abbreviation in the model, their definition, and the source of the data. The paper collected all variables from the sources, and worked on calculating their quarterly average accordingly.

Table 4: Oil model variables

Variable	Source	Definition	obs
WTI	US EIA	WTI Quarterly average Price	69

Inv	US EIA	U.S. Ending Stocks of Crude Oil and Petroleum Products (Thousand Barrels)	69
Dem	US EIA	World Petroleum and Other Liquids Consumption quarterly Average million barrels per day	69
sup	US EIA	OPEC Crude Oil Supply-Average million barrels per day	69
SDRavr	IMF	Quarterly Average SDR value against the USD,	69
OpInt	US EIA	Oil Futures contract quarterly average	69
Gold	FastMarkets & Denver Gold Group	Quarterly Real Gold Price	69

Oil model variables. Series are from Q1-2000 until Q1-2017 included, therefore totaling 69 numbers of observations. All variables series are in log form except for the $/exchange rate.

7.2. Econometric methodology:

The first step is to conduct a stationary unit root test on each variable to find the order of integration. The variables need to be integrated of the same order before testing for co-integration. This testing implements the Johansen co-integration test first implemented by Engel and Granger (1988). The test is relevant to the problem of the determination of long-run or ‘‘equilibrium’’ relationship in economics.

Afterward, the study requires building a dynamic Ordinary Least Square (DOLS) forecasting equation using the explanatory variables and seeking better forecasting results. The DOLS procedure developed by Saikonnen (1991) and Stock and Watson (1993), improves the robustness of the model, because using the dynamic OLS testing, the endogeneity of any of the regressors will not have any asymptotic effect on the estimates.

Coefficient results implemented into the equation complete the model and conclude the expected oil price for the upcoming years.

7.3. Oil model Stationary test:

While all variables are in log form, except for the USD/SDR, the Augmented Dickey-Fuller test statistics on each variable, as presented in table 5 show a unit root in all our variables at level and confirm that all variables are integrated in order 1 I (1).

Table 5: ADF test results for oil model

	At level		At first difference		Lag
	t-Statistic	Prob.	t-Statistic	Prob.	(AIC)
Lwti	-1.73042	0.4116	-6.846584	0.0000*	0
Ldem	-0.27042	0.9229	-9.525709	0.0000*	0
Lsup	-1.42651	0.5641	-5.458383	0.0000*	0
Linv	-0.00295	0.9546	-7.026954	0.0000*	0
Lopint	-0.54947	0.8741	-8.008827	0.0000*	0
Sdrav	-1.37506	0.5895	-7.886068	0.0000*	0
Lgold	-2.94171	0.0459	-24.66477	0.0001*	0

ADF test results expressed in log except for the SDR, quarterly from Q1-2000 and Q1-2017. Source: Calculated by the author using Eviews. Data collected from EIA and FastMarkets & Denver Gold Group.

7.4. Co-integration test results:

The Co-Integration tests proposed for time series data is Fisher-type test using a principal Johansen methodology. After proving that all variables in the model are integrated in order 1, the test of co-integration is now applicable. The Schwarz information criterion (SC) denotes the best number of lags and leads that eliminates serial correlation is 1.

The Johansen co integration test is the Unrestricted Cointegration Rank Trace Test and Maximum Eigenvalue. The Leads and Lags are 1 and 1, the results with linear deterministic trend are represented in table 6. Results indicate that the null hypothesis of r = 1 is rejected, which clearly implies 1 co-integration equation, and 1 long-run equilibrium relationship between the variables.

7.5. Dynamic OLS model:

The OLS method is used to estimate unknown parameters in a linear regression model. OLS estimates the coefficients of a linear equation of a set of independent variables by minimizing the sum of the squares of the differences between the observed dependent variable and those estimated by the linear equation. The OLS estimator is then said to be the best linear unbiased estimator if it meets a set of conditions.

Provided all series are I(1), DOLS by Stock and Watson (1993) procedure is employed to estimate the single cointegrating vector that characterizes the long-run relationship among the variables onto contemporaneous levels of the remaining variables, leads and lags of their first differences, and a constant, using ordinary least squares.
The R-squared of our model is of 94.41%, which means that the DOLS model fits well the observed data, and our independent variables were able to explain 94% of the oil price change. The adjusted R-squared is lower than the R-squared at 91%, and the Durbin Watson stands at a robust value of 1.2923.

The root means Squared Error is low, and stands at 0.187, while the Mean absolute Error is at 0.149. Theil Inequality Coefficient is 0.023, and the variance proportion is small of only 0.014. The last step is to test if the regression is spurious by performing unit root tests on the residuals of the estimated OLS regression. The residual diagnostic tests adopted is No serial correlation, and it is based on a null of $E(\hat{\mu}i , \hat{\mu}j) = 0$.

Table 6 : Co-integration test results

No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.
Hypothesized		Trace	0.05	
None *	0.85492	243.2195	150.5585	0.0000*
At most 1	0.433271	113.8782	117.7082	0.0852
At most 2	0.344397	75.83067	88.8038	0.2971
At most 3	0.293853	47.54333	63.8761	0.5272
At most 4	0.151772	24.23193	42.91525	0.8265
At most 5	0.103312	13.2033	25.87211	0.7222
At most 6	0.084255	5.89713	12.51798	0.4735
Hypothesized		Max-Eigen	0.05	
None *	0.85492	129.3413	50.59985	0.0000*
At most 1	0.433271	38.04755	44.4972	0.212
At most 2	0.344397	28.28734	38.33101	0.4356
At most 3	0.293853	23.3114	32.11832	0.3958
At most 4	0.151772	11.02863	25.82321	0.925
At most 5	0.103312	7.306168	19.38704	0.8788
At most 6	0.084255	5.89713	12.51798	0.4735

Co-integration test results. Calculated by the author

Table 7 : Dynamic OLS estimation results.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LSUP	5.773496	2.04733	2.820012	0.0074
LOPINT	0.187657	0.300454	0.62458	0.5357
LINV	-5.68981	1.469478	-3.872	0.0004
LGOLD	-0.03545	0.182081	-0.1947	0.8466
LDEM	5.253895	2.217811	2.368956	0.0226
SDRAVR	-4.88331	1.2113	-4.03147	0.0002
C	44.5236	14.05397	3.168045	0.0029

Dynamic OLS estimation results. Prepared by the author

Table 8 : Breusch-Godfrey serial correlation LM

F-statistic	4.618323	Prob. F(1,53)	0.0362
Obs*R-squared	5.370131	Prob. Chi-Square(1)	0.0205

Breusch-Godfrey serial correlation LM . prepared by the author using eviews.

The probability $P=0.02 < 0.05$ show the robustness of the model and clarify that it does represent a fair and efficient estimation to the WTI oil price.

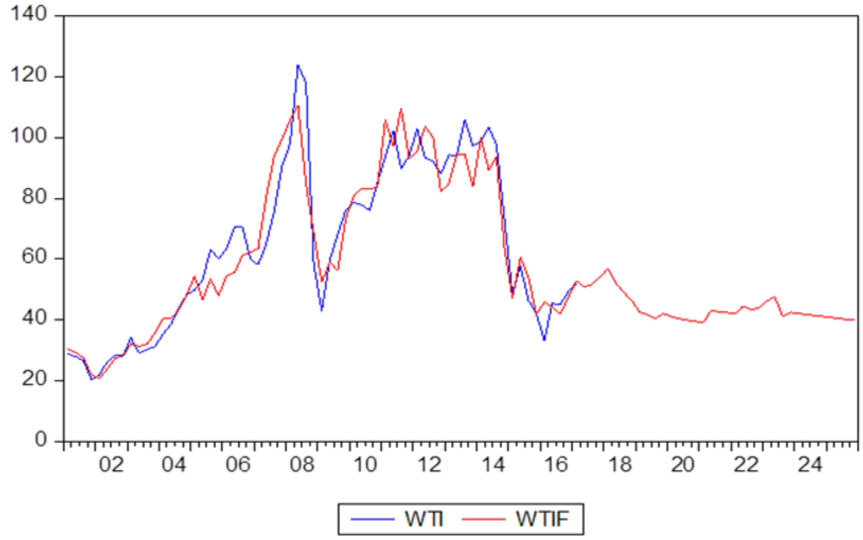
7.6. Results analysis and forecasts:

Findings show that supply, demand, inventories, and exchange are significant in oil price determination. Furthermore, regarding the sign of the coefficient, an increase of 1% in the supply variable decreases oil price by 5.7%, meaning that supply has a significant impact on the oil price. However, an increase of 1% in demand decreases the price by 5%, and an increase of 1% in inventories increases the price by 5%, which contradict theoretical assumptions. Yet, this might be explained that the demand shocks are absorbed by the inventories and what really impacts oil price is the supply level.

Moreover, the significant coefficient of USD/SDR contradicts the assumptions and shows that an increase of 1% in the exchange rate, meaning an appreciation of the USD increases oil price by 4%. Regarding the gold price and the speculation impact, the coefficients are minimal and not significant. Using the DOLS estimation equation (6), the paper forecasts the oil price until the fourth quarter of the year 2025, as showing in figure 2.

$$LWTI = 5.77349561696*LSUP + 0.18765743457*LOPINT - 5.68981323035*LINV - 0.0354510676936*LGOLD + 5.25389547917*LDEM - 4.88331230444*SDRAVR + 44.5236017986 \quad (6)$$

Figure 2: WTI price in USD and the forecasted price until the year 2025



WTI price in USD and the forecasted price until the year 2025. Prepared by the author.

8. Conclusion

This paper investigates the volume of the Lebanese oil resources and the oil price until 2025. The objective is to have an estimation of the oil resources value in US dollars when the production is expected to start. The bi-directional granger causality testing showed that neither the volume of inventories nor the future price granger cause the spot oil price. However, gold price does Granger cause the oil price, and oil price does granger cause the volume of inventories. The DOLS estimation demonstrated that the oil price, oil demand, oil supply, oil inventories, gold price, speculation, and exchange rate are associated in a long-run relationship. Furthermore, results show that the highest impact on price is due to the supply factor, which emphasizes the influence of the OPEC on the oil market.

Regarding the volume of the resources, the paper finds no position in any accurate estimation before the start of the exploration activities. Even after drilling, the well only shows a measure of its location, thus, field volumes parameters will be narrowed down with time. However, the most accurate estimates based on the seismic surveys show reserves of between 900 million barrels and the 1.8 billion barrels and the forecasted oil price until year 2025 suggest a price between 45 and 55 USD a barrel.

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