Nexus Relationship Between the Oil and Non-Oil Sectors in Libyan Economy

Dr. Fouzi Salih Faraj

Associate Professor, Department of Agricultural Economics, Faculty of Agriculture, University of Benghazi, Benghazi, Libya.
Corresponding Author Email: *salehfara1981[at]yahoo.com*

Abstract: ***Libya is an oil-producing country, and oil occupies a significant position in its economy, as it is a primary and pivotal source of income. Strengthening the positive nexus between the oil sector's activities and non-oil sectors activities is a strategic step toward achieving comprehensive and sustainable economic growth. Hence, this study aims to investigate the nexus between the oil sector activities and non-oil sector activities in the Libyan economy during the period 1997-2019. The data set were tested by using the ADF. At the same time, the Johansen cointegration test and the VEC Granger Causality test are used to estimate the cointegration and causal relationship between the study variables. The findings of this study showed the variables were in the first difference. Likewise, there is co-integration between the study variables. The causality findings show that the non-oil sector activities have a nexus with oil sector activities in the long and short run. These results hopefully will give the decision-maker guidelines to motivate these sectors to participate effectively in the gross domestic product.***

Keywords: Oil sector activity, Non-oil sectors activities, VEC Granger Causality, Libya

1. Introduction

Economic growth is the increase in the productive capacity of the economy so that it can produce additional quantities of goods and services (Palmer, 2012), As a result of that, the production capacity increases with the expansion of resources (Vengedasalam and Madhavan, 2013). Then, the ultimate goal of economic growth becomes the achievement of material wealth for the people and developing them on the highest ladder of civilization and culture (Haller, 2012).

The Libyan economy is an increased and depends on the oil sector. Before the discovery of oil, it relied on foreign aid from foreign countries and international bodies. Besides that, it depended on some agricultural product exports that were greatly affected by climatic conditions and some primitive traditional industries. After the oil discovery, the oil sector activities played a fundamental role in Libya's economic development and provided giant funds for all sectors. These huge oil activity revenues have been widely invested in non-oil sectors for diversifying sources of income. It also, provides fuel for cars and aircraft. Moreover, it provided the materials needed to manufacture electricity for factories and homes. In addition, the raw materials for the chemical industry, including fertilizers and pesticides for agricultural sectors, as well as raw materials for the manufacture of plastic materials. These efforts lead to an increase in the contribution of these sectors activities to production and income.

The development process was not limited to oil activities only, but non-oil activities too, because the nexus between the oil and non-oil sectors provides production factors to each other. So that this nexus between them achieves growth in all sectors and stimulates the economy as a whole. Based on what was mentioned previously, this study deals with an essential problem related to nexus between sectors in Libya. Consequently, this study is attempting to describe the trend of the study variables development and investigate the nexus relationship among the oil sector activities and non-oil sectors activities. The results from this study are hopefully providing empirical evidence to economic policymakers to design effective economic policies through understanding the reality of this nexus to support the economic growth of Libya.

2. Previous Empirical Studies

There are many studies that support the hypothesis that non-oil sectors activities have a nexus relationship with non-oil sectors activities; for instance, Klein (2010) analyzed the relationship between the oil and the non-oil sectors using annual data for 1985–2008 for 23 developing countries. The study adopted the panel VAR approach. The empirical results signaled that in low oil-intensity economies, the incentives to strengthen both fiscal and private sector institutions lead to positive inter-sectoral externalities. While the weaker incentives in high oil-intensity economies adversely affect fiscal and private sector institutions and consequently lead to negative inter-sectoral externalities. Furthermore, Idoko and Wada (2017) conducted a study that investigates the contributions of oil and non-oil sectors to the performance of the Nigerian economy through the use of the ordinary least squares (OLS) method during the period 1981–2016. The empirical findings reported that the oil and non-oil exports have a significant positive impact on the performance of the Nigerian economy.

The study done by Raid et al. (2024) aimed to determine the role of non-oil institutional sectors in the economic growth of the Saudi economy during the years 1970–2020. The methodology used for this study is vector autoregression, impulse response function, and variance decomposition for this purpose. The empirical results concluded that the growth in the non-oil sector is stable and reduces the negative shocks on economic growth. In Libya, research made by Allafi (2018) relied on secondary data from multiple sources to study the agricultural sector contribution to the non-oil Libyan economy during the period 1973–2010. The study concluded that the contribution of agricultural sector amounted to about 2024.73 million dinars, which reflects the real agricultural sector contribution to the Libyan GDP, which was significant.

In the same vein, Riti et al. (2016) empirically examined the role of the non-oil sector as a key to diversification and performance of the economy in Nigeria. The study utilizes auto-regressive distributed lag (ARDL) and the VECM Granger causality model. The causality results found the agricultural, manufacturing, and telecommunication were statistically significant and caused economic growth. Using the multivariate cointegration and Granger causality methods, the study of Hosseini and Tang (2014) sought to study the role of oil and non-oil exports in economic growth in Iran during the period (1970-2008). The study results revealed that the variables had long-run relationships, and the Granger causality test showed there is uni-directional causality from oil and non-oil exports toward economic growth. Moreover, the study of Merza (2007) aimed to examine the relationship between oil exports and non-oil exports and economic growth in Kuwait during the period (1970–2004). The study findings show that there is a long-run relationship among the three variables. In addition, there is bi-directional granger causality among oil exports and economic growth and a unidirectional causality from non-oil exports to economic growth.

3. Data and Methodology

3.1 Data

This study is based on annual time series data of the oil sector activities and non-oil sectors activities returns obtained from the Central Bank and the General Planning Council of Libya, covering the period from 1997 to 2019.

3.2 Methodology

The study targets to estimate the long- and short-run causal relationship between the oil and non-oil sectors and determine the direction of this causal relationship using a vector error correction framework, which requires conducting several tests. It begins with a stationarity test, thereafter lag order selection and Johansson cointegration testing. Finally, the causal relationship estimates in the short and long-run use a vector error correction model.

3.2.1 Stationary test

Time series data are important types of data used in applied studies, especially those that rely on building regression models to estimate economic relationships. Such studies assume that the time series used are stationary. When time series do not have the characteristic of being stationary, the regression which obtains from these series is often a spurious regression. A time series is stationary if it fluctuates around a constant arithmetic mean, with variance independent of time. However, it is un-stationary for reasons that may include general trend component, seasonality, and a general trend in the variance (non-constant variance).

a) Augmented Dickey – Fuller (ADF) test.

The ADF test assumes that there is no serial correlation between errors. Therefore, if the Durbin-Watson test rejects this assumption, then applying this test is inappropriate and gives inaccurate results regarding the stationarity. For these reasons, the Augmented Dickey-Fuller (ADF) test is used when results show a serial correlation between errors and, there are three forms as follows:

$$\Delta y_t = \theta y_{t-1} + \sum_{i=1}^{p} \delta_1 \Delta y_{t-i} + \varepsilon_t \quad (1)$$

$$\Delta y_t = \gamma_0 + \theta y_{t-1} + \sum_{i=1}^{p} \delta_1 \Delta y_{t-i} + \varepsilon_t \quad (2)$$

$$\Delta y_t = \alpha_0 + \theta y_{t-1} + \alpha_2 t + \sum_{i=1}^{p} \delta_1 \Delta y_{t-i} + \varepsilon_t \quad (3)$$

where:

α_0, γ_0 = Constants;
θ = Coefficient;
α_2 = Time Trend;
p = Optimal Lag Length;

Where, the null hypothesis H_0 is that the time series is non-stationary (it has a unit root) and the alternative hypothesis H_1 is that the time series is stationary (it does not have a unit root).

3.2.2 Optimal lag length selection

Determine the number of lag lengths needed to use the Akaike information criterion AIC or Schwarz information criterion SBC by estimating unrestricted VAR to select the lowest value of AIC or SBC criteria. The length of the lag is chosen as a cause, including the removal of serial correlation (relying on previous values) in the residuals after estimating the model. It also increases the risk of excessive ignorance, as the model adapts excessively to training data and may not be able to predict well for new data. On the other hand, shorter lag may lead to a deficiency in ignorance as the model fails to capture some important patterns in data.

3.2.3 Cointegration Test

Johansson's cointegration test is a tool for assessing relationships between multiple time series variables to make informed decisions based on their long - run behavior. Johansson's Co-integration test is detected by Trace and Max- Eigen values. When, statistics values of Track and Maximum- Eigen greater than the critical values at 5%. Consequently, the null hypothesis will be rejected and alternative hypothesis accepted, indicating the existence of a co-integration between the variables.

3.2.4 Granger Causality

The basic idea of causality testing is that variable Y_{1t} is said to have caused variable Y_{2t} if the prediction of the values of variable Y_{2t} by the past values of variable Y_{1t} in addition to the past values of variable Y_{2t} is better than the prediction based on the past values of variable Y_{2t} only. Based on the above, testing causality in long and short run requires estimating a vector error correction model that takes the following form:

$$\Delta Y_t = \alpha_1 + \sum_{i=1}^{n-1} \gamma_{1i} \, Ly_{t-i} + \sum_{i=1}^{n-1} \delta_{1j} \, Lx_{t-i} + \lambda_{1i} ECT_{t-i} + \varepsilon_{1t} \quad (4)$$

$$\Delta X_t = \alpha_2 + \sum_{i=1}^{n-1} \gamma_{2i} \, Ly_{t-i} + \sum_{i=1}^{n-1} \delta_{2j} \, Lx_{t-i} + \lambda_{2i} ECT_{t-i} + \varepsilon_{2t} \quad (5)$$

Where,
Y is Oil Gross Domestic Product
X is Non- oil Gross Domestic Product
N-1= the laq length is reduced by1
γ , δ = short-run dynamic coefficients of the models adjustment long-run equilibrium
λ= speed of adjustment parameter with a negative sign
ECT_{t-1}= the error correction term is the lagged value of the residuals obtained from the cointegrating regression of the dependent variable on the regressors. Contains long-run information derived from the long-run cointegrating relationship.
ε t = residuals (stochastic error terms often called impulses, or innovations or shocks).

4. Results and Discussion

4.1 Background of the oil and non-oil activities trend

This section reviews the development trend of oil and non-oil revenues from 1997 to 2019. Oil revenues increased from 4505.8 million Libyan dinars in 1997 to 81149.8 million Libyan dinars in 2008, then declined to 47087.1 million dinars, and then increased to 38945.6 million dinars in 2019. This fluctuation is attributed to fluctuations in global oil prices.

Regarding the non-oil revenues, successive Libyan governments have adopted policies to diversify sources of income and accelerate economic growth. In line with this, revenues increased from 9294 million dinars in 1997 to 41723 million dinars in 2010. However, political events in 2011 led to a decline in revenues to 7787.8 million dinars, which then increased to 65,235.2 million dinars in 2019, as illustrated in the following figure1.

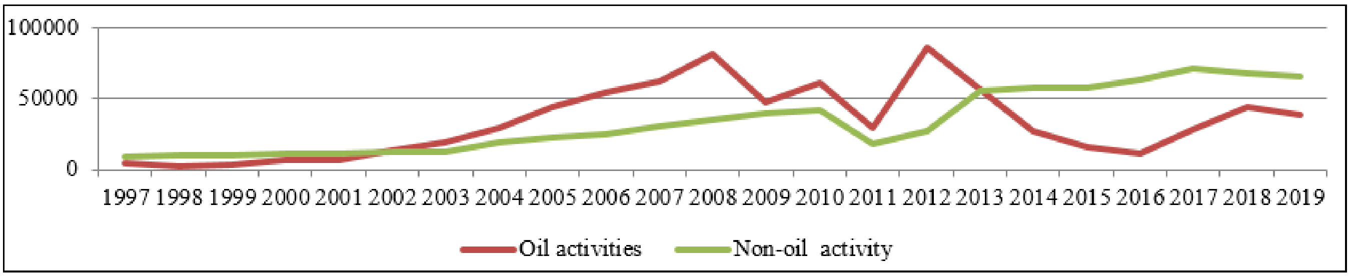

Figure 1: Revenues trend of oil and non-oil activities

4.2 Unit Roots Test

The results summarized in Table 1 for the unit root test using the Augmented Dickey-Filler test show that the variables are not stationary at level. However, they are stationary after taking the first difference, at the 1% significance level. This means that the time series of the variables are integrated at the order one I (1).

Table 1: Augmented Dickey-Fuller (ADF) Test

Variable	ADF test (level)	ADF test first differences	Phillips-Perron test level	Phillips-Perron test first differences	decision
In(oil)	-2.20	--6.2578*	-2.1588	-6.2578*	I(1)
In(non-oil)	-2.52	-11.15*	-0.2741	-6.7359*	I(1)

- Stationary at 0.01 % critical levels
- Source: Eviews version 12 outputs

4.3. Optimal Lag Selection

To perform the Johansen cointegration test and the vector error correction model, vector autoregression is employed to determine the optimal lag for this purpose. This is done by choosing the lowest value of the Akaike Information Criterion (AIC), which was lag 5.

Table 2: Lag Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-30.9810	NA	0.1338	3.6645	3.7634	3.6782
1	-10.5259	34.0918*	0.0216*	1.8362	2.1330*	1.8771
2	-8.0506	3.5755	0.0262	2.0056	2.5002	2.0738
3	-4.4472	4.4041	0.0290	2.0496	2.7422	2.1451
4	-3.9542	0.4929	0.0478	2.4393	3.3297	2.5621
5	6.5041	8.1343	0.0285	1.7217*	2.8099	1.8718*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error-
AIC: Akaike information criterion-
SC: Schwarz information criterion-
HQ: Hannan-Quinn information criterion
*Source: Eviews version 12 outputs

4.4. Cointegration Test

To determine whether there is cointegration between the study variables under investigation, the results obtained from the Trace and Maximum Eigenvalue tests in table 3 indicated that the values of the Trace and Maximum Eigenvalue statistics were greater than the critical values. Therefore, the null hypothesis is rejected and the alternative hypothesis accepted, which assumes a long-run relationship between the study variables.

Table 3: Johansen Cointegration Test

Hypothesized no. of CE(s)	Trace Statistic	critical Value 5%	Max-Eigen Statistic	Critical Value 5%
Non*	26.56775	15.49471	22.93095	14.26460
At most 1	3.636796	3.841466	3.636796	3.841466

Trace and Max-Eigen value test indicate 1 cointegration eqn (s) at the 0.05 level.
*Source: Eviews version 12 outputs.

4.5. Long Run Causality

The nexus between the oil sector and the non-oil sectors was examined using vector error correction. .The long-run causal results in Table (4) indicate a causal relationship from non-oil activities to oil activities, as the error correction term C13(-3.782202) was negative and statistically significant, which indicates there is a nexus between the non-oil activities and the oil activities. At the same time, the error correction term C1 (-1.319324) was negative and not statistically significant. This means that the oil activities do not have a nexus with non-oil activities in the long run.

D(LNNONOIL) = C(1)*(LNNONOIL(-1) - 0.243569810048 *D(LNNONOIL(-2)) + *LNOIL(-1) - 7.8647249779) + C(2)*D(LNNONOIL(-1)) + C(3) C(4)*D(LNNONOIL(-3)) + C(5)*D(LNNONOIL(-4)) + C(6)*D(LNNONOIL(-5)) + C(7)*D(LNOIL(-1)) + C(8)*D(LNOIL(-2)) + C(9)*D(LNOIL(-3)) + C(10)*D(LNOIL(-4)) + C(11)*D(LNOIL(-5)) + C(12).

D(LNOIL) = C(13)*(LNNONOIL(-1) - 0.243569810048*LNOIL(-1) - 7.8647249779) + C(14)*D(LNNONOIL(-1)) + C(15)*D(LNNONOIL(-2)) + C(16)*D(LNNONOIL(-3)) + C(17)*D(LNNONOIL(-4)) + C(18) *D(LNNONOIL(-5)) + C(19)*D(LNOIL(-1)) + C(20)*D(LNOIL(-2)) + C(21) *D(LNOIL(-3)) + C(22)*D(LNOIL(-4)) + C(23)*D(LNOIL(-5)) + C(24).

Table 4: Long run causality test based on Vector Error correction model

Error Correction Term	Coefficient	t-Statistic	Prob
C(1)	-1.319324	-1.382415	0.1969
C(13)	-3.782202	-4.868339	0.0007

*Source: Eviews version 12 outputs.

4.6. Short Run Causality

Granger causality test results based on VECM in the short run in Table 5 show that. The Granger causality test, Block Exogeneity Wald Tests, is used to examine the presence and direction of causality between the study variables. The results indicate there is a unidirectional causal relationship running from the non- oil activates toward the oil sector because its probability value is less than 5%, and there is no causal relationship running from the oil sectors to the non-oil sector in the short run due to its probability value (0.4058) being greater than 5%% as shown in Table 5.

Table 5: VEC Granger causality/ Block Exogeneity Wald Tests (short run)

Dependent variable: D(LNOIL)			
Excluded	Chi-sq	df	Prob
D(LNNONOIL)	36.50782	5	0.0000
Dependent variable: D(LNNONOIL)			
Excluded	Chi-sq	df	Prob
D(LNOIL)	5.083333	5	0.4058

*Source: Eviews version 12 outputs.

5. Conclusion

There is no doubt that non-oil activities play a significant role in diversifying sources of income and providing manufactured goods and raw materials needed by the economy. Based on this role, the study sought to answer on controversial question: Are there nexus between non-oil and oil sector activities that would lead to growth and stimulation for the economy as a whole? For this purpose, the study used the Error Correction Model (VECM), reling on time series data issued by the Ministry of Planning and the economic bulletins of the Central Bank of Libya during the period 1997-2019 to understand the nexus relationship. The experimental finding confirmed the unidirectional relationship from non-oil activities to oil sector activities in both the short and long run. In this regard, the study recommends that development implementation authorities increase their investments in non-oil activities to stimulate their productivity and contribution to GDP.

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