International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2018): 7.426

Assessment of Libyan Economy through Key Economic Performance Indicators Using TOPSIS Method

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Abstract: ***The need for economic development and economic growth gave the research through economic performance indicators a great significance. Considering the limitations of the current equations and models, there is a need for a more complex machine-learning approach to assess economic performance over several years for comparison and precise outcomes. Multi-criteria decision-making techniques (MCDMs) are widely used to compare attributes and select alternative in complex decision-making problems. While the main source of data is often the input of experts from the field, adopting actual economic data can eliminate the uncertainty factor of the MCDM and provide more accurate results. The current study, which is derived from the authors' thesis studies at Istanbul Aydin University, aims to assess the performance of the Libyan economy between the years of 2009 and 2017 using the TOPSIS method in order to understand the factors that contributed into enhancing the economy in the best years. The TOPSIS method is widely used in economic and management applications, as it is helpful in determining the alternative that is the closest to the ideal solution. Through studying the economic factors affecting the Libyan economy between 2009 and 2017, the findings of the research shows that 2017 was the best year for economic performance with the selected parameters. Prior the late political instability in the country, 2010 is indicated as the second-best year for economic performance with 20.18% enhanced performance from the year before. The worst years for economic performance in Libya were between 2012 and 2014 due to the civil war between the different political and militant powers in the country. However, from 2015 to 2017 a substantial enhancement in the economic performance is observed during a stability period. The current crisis in the country highlighted the impact of oil-dependency on the Libyan economy. Thus, it is understood that adopting oil as the main income of the country increase the vulnerability of the economy and has impacts on the other economic factors, including foreign currency exchange rates.***

Keywords: Economic performance indicators; Libya; TOPSIS

1. Introduction

Key performance indicators are used in economic studies to investigate or test a certain phenomenon and suggest the suitable recommendations for development. Several methods have been suggested to provide an indication of the performance of a specific economy, such as the economic performance index (EPI) (Khramov and Lee, 2013) and Chicago Fed National Activity Index (CFNAI) (Evans, Liu, & Pham-Kanter, 2002). Different studies have considered several performance indicators; however, the majority of research had a consensus on indicators like GDP, FDI, inflation and unemployment (Tampakoudis, et al., 2014; Alzaidy, et al., 2017; Gungor and Ringim, 2017;Kagri, 2014), while other studies included economy-specific indicators, such as oil production, expatriate population and foreign exchange rates (Radda, et al., 2015; Barguellil, et al., 2018; Lowell & Findlay, 2001). Therefore, it is important to include the common economic indicators in the performance assessment, while ensuring that the economy-specific indicators are considered and highlighted.

Furthermore, the method of assessment is one of the important factors that determines the accuracy of the final results, response and economic measures. Equations were widely invented and used for that purpose (Wilson & Briscoe, 2004). Nonetheless, machine learning solutions and algorithms have not been utilized for that purpose, despite their proven success in solving complex decisions in different domains, including economy and management. Multi-criteria decision making (MCDM) methods are a group of solutions that can be used in order to determine the most influential factors, the interrelations between these factors and/or the measures that can be implemented for best and desired outcomes (Jayant & Sharma, 2018). The logical sequence of MCDMs allows for breaking down the problem into parts and steps; simplifying the problem and providing a mathematical model that can be implemented to reach precise conclusions (Singh & Malik, 2014).

The case study in the current research is performed on the performance of the Libyan economy. Concerned literature observed the high dependency of the Libyan economy on oil production as the main product and source of income (Ali, 2011) , which hindered development besides lack of national development plans, processes and systems (Triki, 2017). The fluctuating oil market affected the Libyan economy with instability and influenced other factors, such as exchange rates, GDP and employment, as well as growth and development (Yahia & Metwally, 2007). In the late years of instability on the political and security levels, the high dependency on oil exports had severe impacts on the country, especially during the civil was between 2012 and 2014 (Bhattarai & Taloba, 2017). Foreign currency exchange rates were also one of the most instable economic factors in the selected years of the current study. Thus, oil production and exchange rates are emphasized in the application of the TOPSIS method.

The main aim of this research is to assess the economic performance (with selected factors) of the Libyan economy between the years of 2009 and 2017 using the TOPSIS method, which is one of the MCDM techniques, in order to understand the factors that contributed into enhancing the

economy in the best years. A good understanding of the key economic indicators, the status of the Libyan economy during the study period and the TOPSIS method is necessary in order to achieve the main aim.

2. Literature Review

There is no single economic performance indicator that can measure the economic status and development in a country, despite the different attempts to create equations that can provide an insight using input factors, such as GDP and budget deficit. Khramov and Lee (2013) proposed a model called the economic performance index (EPI) that is based on four main economic inputs; inflation rate, unemployment rate, budget deficit and GDP. Other more comprehensive systems were used, such as the Chicago Fed National Activity Index (CFNAI) that considers eighty-five indicators. It includes measurement of different sectors within the economy and studies have shown the probability of its benefit in predicting recessions through changes in the economic indicators (Evans, Liu, & Pham-Kanter, 2002). This section explores several economic indicators that are used as inputs to evaluate the economic performance of a country.

Exportation and importation activities are defined as goods that produced within or outside the country and removed or entered into the custom area of the country, respectively (Kartikasari, 2017). The volume of exports and imports have been correlated to economic growth in several case studies in different countries. The main economic growth indicator that was used in these studies is the country's GDP (Bakari & Mabrouki, 2017). The correlation and impact between these indicators is expected, since the total exports and total imports of a country are key determinants of the gross domestic product (GDP) (Uddin & Khanam, 2017).

Khan, et al. (2012) and Hye (2012) found correlations between the change in GDP and the change in the exportation and importation volumes in the Pakistani and Chinese economies, respectively. Albiman and Suleiman (2016) found that exportations and importation volumes have impacts on determining the country's GDP in Malaysia. Nonetheless, Ajmi, et al. (2013) and Abugamea (2015) showed results that did not imply any correlation or impact between GDP and the volumes of exports and imports in the South African and Palestinian economies.

The International Monetary Fund (IMF) and the Organization for Economic Cooperation and Development (OECD) define Foreign Direct Investment (FDI) as the initial and long-lasting business relationship between a direct investor and an investment enterprise, where capital transactions occur by transferring funds from overseas to the local economy. FDI is stated if the foreign investor acquires a controlling stake at the holding company at the host economy.

The positive impacts of increasing FDI in an economy are suggested to enhance economic growth, GDP, and regenerate confidence in the market by other investors to enter the local economy (Alfaro & Chauvin, 2020). Owusu-Antwi, et al. (2013) studied the Ghanaian economy twenty-three years for the effects of FDI on macroeconomic indicators. The results of the study show that the impacts on all factors were significant with a total R square value of 0.947 at the regression analysis. Alzaidy, et al. (2017) studied the impact of the financial development on the economic growth for thirty-nine years, with the mediating effect of FDI on their relationship. The authors found that FDI increased the positive effect of financial development, especially with FDI spill overs. Ibrahim, et al. (2019) researched 46 African economies over thirty-six years and found that FDI is simulated into the economy if the country financial sector is developed and adequate information, communication and technology infrastructures are implemented.

Inflation is identified in the economy through either the continuous rise in the price levels of goods or services, or the reduced value of a currency against worldwide currencies. Despite the conceptual understanding of inflation in relation with other financial variables, some research showed that inflation rates did not increase significantly with the increase of money supply. Such as case is shown through the case study of Tabi and Ondoa (2017), who studied the Cameroonian economy using a VAR model for more than forty years. Islam, et al. (2017) attributed this behavior to the actual demand on money in the market and confirmed that the relationship is proven to be positive through studies over long time periods. The authors investigated the relationship between inflation and each of unemployment and US dollar exchange rates in Malaysia. The regression model showed that exchange rates had the highest impact on inflation, followed by unemployment rate and money supply.

The negative relationship between exchange and unemployment rates with inflation are explained through economic theories. The Phillips curve showed the relationship between the increase in wage inflation with the reduction of the unemployment rate. Full employment in the market causes shortages in money supply that needed for wage increases, which leads to the increase in prices in the market to cover this shortage (Islam, et al., 2017).

Exchange rates have also their significant influence on the economy and vice versa. It was established earlier that financial development has positive effects on economic growth; however, this volatility in exchange rates can lessen these positive effects. Therefore, stability in exchange rates are considered key in empowering the effects of financial development (Ehigiamusoe & lean, 2019). An analysis of eighteen economies confirmed the significance of exchange rate fluctuations on reducing the growth in the economy as a result of financial development (Basirat, et al., 2014). Instability of exchange rates alone has negative impacts on economic growth, especially if the country adopts financial openness and a flexible exchange rate strategy (Barguellil, et al., 2018).

The participation level of the labor force and unemployment are two of the most intercorrelated macroeconomic factors in the literature (Ozerkek, 2013).Data from the literature and theoretical studies show that unemployment affects labor force participation, while unemployment is influenced by several factors, including wage levels, prices and money

supply (Kanapathy & Baharom, 2013).Kagri (2014) correlated labor force participation with the economic growth in Turkey a positive correlation between labor force and employment rates and a negative correlation between the labor participation rate and the unemployment rate. Through a sixth-degree polynomial consisting of six employment variables, the author concluded that the growth in the economy can be not reflected into employment and labor force variables. In countries that include significant numbers of immigrants, data analyses showed that the challenge is higher for an immigrant to find employment in the new community, which extends to the second generation of immigrants (Gorodzeisky & Semyonov, 2017).

Despite all the attempt to find energy substitutions, oil and gas remain the main source of energy worldwide and they are considered part of the national security of all countries. The complex processes that accompany oil production and consumption make the issue complicated and tied to many factors, including availability, costs, energy losses and technological developments. Moreover, the oil and gas sectors provide employment for 40% of the labor force in the Alberta region in Canada (Mansell, et al., 2012) and 44% of the employment in the MENA region in 2010 (Radda, et al., 2015).

Samawi, et al. (2017) performed a study on energy importing countries and found that oil and gas imports are highly correlated to debt levels, inflation, cost of production, spending, sales tax and economic growth.

The calculation of gross domestic product (GDP) is dependent on population consumption volume, investment, the volume of expenditure by the government and the difference between the total exports and imports (Uddin & Khanam, 2017). Furthermore, GDP has its influence on political instabilities, power shortages and fluctuating and high oil prices in developing countries (Kira, 2013). GDP is also considered the main economic indicator for the wellbeing of the economy as it reflects the actual consumptions and expenditures of the country (Dynan & Sheiner, 2018). Tampakoudis, et al. (2014) investigated the European economies following the financial crisis and found that there are opportunities for sustainable economic development indicated by the GDP growth that were shown in the Eurozone in the past years. Therefore, the country's GDP is an indication of the economic wellbeing, as well as a prediction factor for economic and political issues.

3. Methodology

Each MCDM method have been applied in several studies that investigated their strengths, weaknesses, possible applications and the accuracy of their results. While some MCDMs are known for their ability to determine the relative importance of attributes versus each other, such as AHP, MCDMs like TOPSIS are known for an approach that calculates the most ideal solution, the worst solutions and compare the available alternatives to them. Therefore, the utilization of TOPSIS in economic and management studies allowed researchers and practitioners to handle decision-making in human resources, supply chain management, marketing, business processes and strategy management (Velasquez & Hester, 2013). The conventional form of MCDMs depend on input from experts to evaluate attributes and alternatives based on their experience. Several models have been created to enhance the accuracy and precision of the results, such as stochastic and fuzzy models (Triantaphyllou, et al., 1998). However, a few studies have considered attributes that are based on actual data, such as economic indicators that are presented in the current study.

Following acquiring the necessary data and constructing the initial decision matrix between the attributes and the alternatives for the TOPSIS method, a normalized decision matrix is calculated. Weights are incorporated into the normalized decision matrix to consider the difference in effect amongst the attributes and to produce the weighted decision matrix. Ideal positive and negative solutions are calculated, as well as the separation measures between the weighted decision matrix elements and the ideal solutions. Finally, a relative closeness coefficient for each alternative is calculated indicating its closeness from the ideal solutions (Hwang & Yoon, 1981).

3.1 TOPSIS Technique

The TOPSIS technique is performed through calculating hypothetical ideal and worst solutions based on the maximum and the minimum weights yielded from judgements with the criteria. The Euclidean distance is calculated from both solutions and the most ideal alternative is the one that achieves the shortest distance from the positive solution and the furthest distance from the negative solution. The main advantage of the TOPSIS technique is its ability to contain any number of criteria for judgement and its ability to provide an intuitive solution based on distances from ideal solutions. Nonetheless, the disadvantages of the method is the possibility of giving unreliable results and dependency on deterministic judgements in its standard form, which does not take into consideration uncertainty (Gavade, 2014).

Hwang and Yoon (1981) established the first form of TOPSIS technique, which was mainly used as a hypothetical alternative ranking method. The basic steps of TOPSIS are presented by the authors, as follows:

Step 1: Construction of normalized decision matrix.

$$r_{ij} = \frac{x_{ij}}{\sqrt{(\Sigma x_{ij}^2)}} \qquad for\ i = 1, \dots, m; j = 1, \dots, n \quad (1)$$

Where x_{ij} is the original score and r_{ij} is the normalized score from the decision matrix.

Step 2: Construction of the weighted decision matrix from the normalized matrix.

$$v_{ij} = w_j r_{ij} \quad (2)$$

Where w_j is the weight for the j[th]criterion.

Step 3: Determination of positive ideal solution.

$$A^* = \{v_1^*, \dots, v_n^*\} \quad (3)$$

Where $v_i^* = \{\max(v_{ij})\ if\ j \in J; \min(v_{ij})\ if\ j \in J'\}$

Step 4: Determination of negative ideal solution.

$$A' = \{v_1', \dots, v_n'\} \quad (4)$$

Where $v_i' = \{\min(v_{ij})\ if\ j \in J; \max(v_{ij})\ if\ j \in J'\}$

Step 5: Calculation of separation measurement from positive ideal solution for every alternative.

$$S_i^* = \sqrt{\sum(v_j^* - v_{ij})^2} \quad i = 1, \dots, m \qquad (5)$$

Step 6: Calculation of separation measurement from negative ideal solution for every alternative.

$$S_i' = \sqrt{\sum(v_j' - v_{ij})^2} \quad i = 1, \dots, m \qquad (6)$$

Step 7: Calculation of relative closeness to ideal solution.

$$C_i^* = \frac{s_i'}{(s_i^* + s_i')} \qquad (7)$$

Where $0 < C_i^* < 1$

Step 8: Selection of alternative that has its closest relative closeness to 1.

In business administration and management research, the TOPSIS technique have been used widely in the literature. The application of the method extended for many case studies, such as performance evaluations, corporation performance, financial assessments, comparison of business units, risk assessment, forecasting success and failure factors, investment options, determining business alliances, and evaluating business platforms.

The TOPSIS method has been used widely in order to determine the closest alternative to the ideal solution. Like other MCDM methods, TOPSIS requires a set of criteria for judgement another set of alternatives as possible final solutions. In economic performance research, understanding the behavior of the key indicators that influence the performance of an economy could provide an understanding of the possible measures and priorities in developing economic strategies for the country. Therefore, it is possible to acquire data of these indicators over several years and treat them as criteria, while the years that are corresponding to data can be used as the alternatives. Specifying the closest year to the ideal solution provides the most desired combination of the indicators that could achieve the best economic performance. Moreover, studying the behavior of the indicators separately and collectively allows researchers and specialists to diagnose the economic issues that requires immediate intervention and provides a cause and effect analysis for the economic indicators.

Turan, et al. (2016) presented an application of the TOPSIS methodology on data for the Russian economy twenty-three years from 1992 to 2014. The authors started by presenting the available data in numeric and graphical forms in order to show the independent changes over the specified period. Thereafter, the TOPSIS method was applied in order to determine the best and worst economic years in order in comparison with the calculated ideal solution. Nine key performance indicators were used as criteria for each year, including inflation rate, interest rate, GDP in different forms, exportation volume, employment rate and unemployment rate. The TOPSIS method allowed the authors to arrange the years from best to worst based on equal and unequal weights, which were used for comparison. The results showed the year 1995 as the best and the year 1992 as the worst based on equal weights, while unequal weights showed 1995 and 2009 as the best and worst years, respectively. Furthermore, ideal solutions in the equal and unequal weight assignment were plotted for a clearer comparison between the different years.

4. Results and Discussion

4.1Criteria of the Study

Nine criteria are considered to represent the Libyan economy for the case study, which are export volume, import volume, foreign direct investment (FDI), labor force, inflation (GDP deflator), net secondary income, unemployment, US dollars exchange rate, and oil production. The criteria are studied over a nine-year period from 2009 to 2017. Figure 1 shows the exportation and importation volumes of Libya in million US dollars.

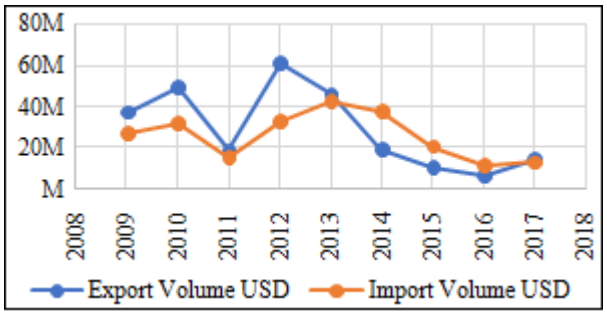

Figure 1: Comparison between export and import volumes of Libya from 2009 to 2017

The highest export volume was in 2012, while the lowest was in 2016. In import volumes, the highest and the lowest values were in 2013 and 2017, respectively. The export volumes were higher than import volumes from 2009 to 2013; however, this trend changed with imports exceeding exports from 2014 to 2017. A sudden in export and import volumes is observed in 2011 due to severe political and security instabilities.

A similar trend is observed with foreign direct investment, with a sudden drop in 2011 and a negative value in 2014, as shown in Figure 2.

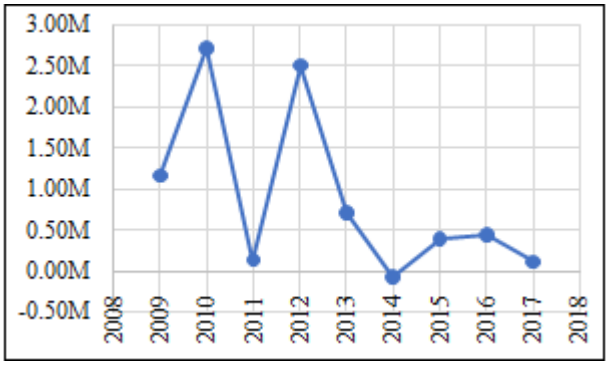

Figure 2: Foreign direct invest in Libya from 2009 to 2017

The highest values for FDI were in 2010, followed by 2012. Nonetheless, FDIs relatively dropped from 2013 onwards to less than 1 million US dollars.

As shown in Figure 3, the total labor force in Libya was stable over the specified period from 2009 to 2017 at around 2.35 million, while the unemployment rate is very high at 45%. Unemployment dropped to 38.4% in 2011, which can be mainly driven by the slight drop in labor force population.

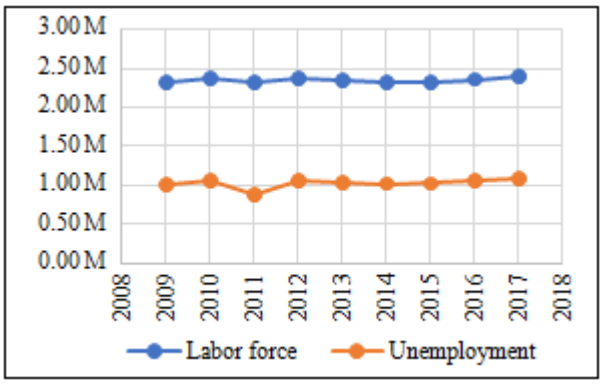

Figure 3: Labor force and unemployment in Libya from 2009 to 2017

4.2Application of TOPSIS Method

As mentioned earlier the period considered in the research to study the Libyan economy is the years between 2009 and 2017, with nine criteria presented in Table 1. Weights are assigned to each criterion to give oil production and exchange rate the highest weights with 0.25, while the remaining weight is distributed on other criteria equally. Notice that with different weights, one can conclude different findings.

Table 1: Criteria of the Study

	Criterion/ Economic indicator	Weight
C_1	Exports of goods and services (volume in USD)	0.071429
C_2	Imports of goods and services (volume in USD)	0.071429
C_3	Foreign direct investment, net outflows (USD)	0.071429
C_4	Labor force, Total	0.071429
C_5	Inflation, GDP deflator (annual %)	0.071429
C_6	Net secondary income (USD)	0.071429
C_7	Unemployment, youth total (% of total labor force ages 15-24)	0.071429
C_8	Exchange rate of US dollars	0.25
C_9	Oil production (thousand barrels per day)	0.25

Table2 illustrates the data that are used in the assessment of the Libyan economy using the TOPSIS method according to the selected economic indicators from 2009 to 2017.

Table 2: Decision Matrix of the Study

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
2009	37.335E+6	26.990E+6	1.165E+6	2.334.799	-25,31	-1,572E+9	44,11	1,253	1.556,46
2010	49.055E+6	31.477E+6	2.722E+6	2.375.376	14,16	-1,828E+9	45,33	1,267	1.564,91
2011	19.025E+6	15.542E+6	131E+6	2.328.781	18,25	-377E+6	38,40	1,220	368,36
2012	61.096E+6	32.541E+6	2.508E+6	2.372.530	8,98	-2,824E+9	45,12	1,251	1.424,09
2013	46.136E+6	42.464E+6	707E+6	2.346.067	-6,67	-3,252E+9	44,85	1,258	930,75
2014	19.342E+6	37.803E+6	-77E+6	2.325.988	-17,31	-1,1209E+9	44,61	1,640	464,00
2015	11.127E+6	20.681E+6	394E+6	2.332.698	-19,40	-839,8E+6	44,57	2,750	403,75
2016	6.853E+6	11.557E+6	439E+6	2.363.336	-2,56	-755,8E+6	45,71	5,005	438,58
2017	14.457E+6	13.212E+6	110E+6	2.403.125	14,42	-1,571E+9	45,94	8,878	896,08

In order to construct the normalized decision matrix according to equation (1), presented below, the square roots of the matrix values are calculated and the square root of the sum of the column x_{ij} values are calculated, as shown in Table 3. Finally, the first step of the TOPSIS analysis is completed by producing the normalized decision matrix in Table 3.

$$r_{ij} = \frac{x_{ij}}{\sqrt{(\Sigma x_{ij}^2)}} \quad for\ i = 1, \dots, m; j = 1, \dots, n \quad (1)$$

Table 3: Normalized Decision Matrix of the Study

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
2009	0.3596	0.3229	0.2917	0.3306	-0.5409	-0.2894	0.3315	0.1135	0.5111
2010	0.4725	0.3766	0.6817	0.3364	0.3026	-0.3365	0.3407	0.1148	0.5138
2011	0.1833	0.1859	0.0328	0.3298	0.3900	-0.0694	0.2887	0.1105	0.1210
2012	0.5885	0.3893	0.6283	0.3360	0.1919	-0.5199	0.3391	0.1133	0.4676
2013	0.4444	0.5080	0.1772	0.3322	-0.1425	-0.5987	0.3371	0.1140	0.3056
2014	0.1863	0.4522	-0.0194	0.3294	-0.3699	-0.2063	0.3353	0.1485	0.1524
2015	0.1072	0.2474	0.0989	0.3303	-0.4145	-0.1546	0.3350	0.2491	0.1326
2016	0.0660	0.1383	0.1101	0.3347	-0.0547	-0.1391	0.3436	0.4533	0.1440
2017	0.1393	0.1581	0.0275	0.3403	0.3081	-0.2892	0.3453	0.8040	0.2942

The next step is calculating the weighted decision matrix (Table4) through applying the weights assigned for each criterion and using equation (6) below.

Table 4: Weighted Decision Matrix of the Study

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
2009	0.03	0.02	0.02	0.02	-0.04	-0.02	0.02	0.03	0.13
2010	0.03	0.03	0.05	0.02	0.02	-0.02	0.02	0.03	0.13
2011	0.01	0.01	0.00	0.02	0.03	0.00	0.02	0.03	0.03
2012	0.04	0.03	0.04	0.02	0.01	-0.04	0.02	0.03	0.12
2013	0.03	0.04	0.01	0.02	-0.01	-0.04	0.02	0.03	0.08
2014	0.01	0.03	0.00	0.02	-0.03	-0.01	0.02	0.04	0.04
2015	0.01	0.02	0.01	0.02	-0.03	-0.01	0.02	0.06	0.03
2016	0.00	0.01	0.01	0.02	0.00	-0.01	0.02	0.11	0.04
2017	0.01	0.01	0.00	0.02	0.02	-0.02	0.02	0.20	0.07

The positive and negative ideal solutions are determined through calculating the maximum and minimum values of each criterion from the weighted decision matrix from equations (3) and (4), respectively, as shown in Table5.

$$A^* = \{v_1^*, \dots, v_n^*\} \quad (3)$$

Where $v_i^* = \{\max(v_{ij}) \text{ if } j \in J; \min(v_{ij}) \text{ if } j \in J'\}$

$$A' = \{v_1', \dots, v_n'\} \quad (4)$$

Where $v_i' = \{\min(v_{ij}) \text{ if } j \in J; \max(v_{ij}) \text{ if } j \in J'\}$

Table 5: Calculation of Positive and Negative Ideal Solutions

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
Max A^*	0.04	0.04	0.05	0.02	0.03	0.00	0.02	0.20	0.13
Min A'	0.00	0.01	0.00	0.02	-0.04	-0.04	0.02	0.03	0.03

Separation measurement from the positive ideal solution is calculated for each value using equation (5), as shown in Table6.

$$S_i^* = \sqrt{\sum (v_j^* - v_{ij})^2} \quad i = 1, \dots, m \quad (5)$$

Table 6: Separation Measurement from Positive Ideal Solution

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	S_i^*
2009	0.0003	0.0002	0.0008	0.0000	0.0044	0.0002	0.0000	0.0298	0.0000	0.1889
2010	0.0001	0.0001	0.0000	0.0000	0.0000	0.0004	0.0000	0.0297	0.0000	0.1739
2011	0.0008	0.0005	0.0021	0.0000	0.0000	0.0000	0.0000	0.0301	0.0096	0.2079
2012	0.0000	0.0001	0.0000	0.0000	0.0002	0.0010	0.0000	0.0298	0.0001	0.1768
2013	0.0001	0.0000	0.0013	0.0000	0.0014	0.0014	0.0000	0.0298	0.0027	0.1917
2014	0.0008	0.0000	0.0025	0.0000	0.0029	0.0001	0.0000	0.0269	0.0082	0.2035
2015	0.0012	0.0003	0.0017	0.0000	0.0033	0.0000	0.0000	0.0192	0.0091	0.1869
2016	0.0014	0.0007	0.0017	0.0000	0.0010	0.0000	0.0000	0.0077	0.0085	0.1450
2017	0.0010	0.0006	0.0022	0.0000	0.0000	0.0002	0.0000	0.0000	0.0030	0.0845

Separation measurement from the negative ideal solution is calculated for each value using equation (6), as shown in Table 7.

$$S_i' = \sqrt{\sum (v_j' - v_{ij})^2} \quad i = 1, \dots, m \quad (6)$$

Table 7: Separation Measurement from Negative Ideal Solution

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	S_i'
2009	0.0004	0.0002	0.0005	0.0000	0.0000	0.0005	0.0000	0.0000	0.0095	0.1054
2010	0.0008	0.0003	0.0025	0.0000	0.0036	0.0004	0.0000	0.0000	0.0096	0.1315
2011	0.0001	0.0000	0.0000	0.0000	0.0044	0.0014	0.0000	0.0000	0.0000	0.0771
2012	0.0014	0.0003	0.0021	0.0000	0.0027	0.0000	0.0000	0.0000	0.0075	0.1190
2013	0.0007	0.0007	0.0002	0.0000	0.0008	0.0000	0.0000	0.0000	0.0021	0.0677
2014	0.0001	0.0005	0.0000	0.0000	0.0001	0.0008	0.0000	0.0001	0.0001	0.0409
2015	0.0000	0.0001	0.0001	0.0000	0.0001	0.0010	0.0000	0.0012	0.0000	0.0495
2016	0.0000	0.0000	0.0001	0.0000	0.0012	0.0011	0.0000	0.0073	0.0000	0.0988
2017	0.0000	0.0000	0.0000	0.0000	0.0037	0.0005	0.0000	0.0301	0.0019	0.1852

Relative closeness coefficients to the ideal solution are calculated for the years from 2009 to 2017 using equation (7), as shown in Table9.

$$C_i^* = \frac{S_i'}{(S_i^* + S_i')} \quad (7)$$

Where $0 < C_i^* < 1$

Moreover, the years are arranged according to their closeness to 1; from the best year to the worst. The coefficients are plotted in order to illustrate the timeline changes in the Libyan economy from one year to another. As shown in Figure 4, a drop in the economic performance of Libya is observed in 2011 due to the political instability in the country, while the period from 2012 to 2014 had security instability due to the civil war. From 2015 until 2017, the economic performance analysis shows a continuous enhancement in the economy, which is attributed to the period of stability in the country. The political and security stabilities influence many economic indicators in the Libyan economy, especially oil production and the export and import volumes.

Table 8: Relative closeness coefficient and order of year from best to worst year based on data of the Libyan economy

	S_i^*	S_i'	C_i^*	Order
2009	0.1889	0.1054	0.358207814	5
2010	0.1739	0.1315	0.430496543	2
2011	0.2079	0.0771	0.270526098	6
2012	0.1768	0.1190	0.402156191	4

2013	0.1917	0.0677	0.260900308	7
2014	0.2035	0.0409	0.167424189	9
2015	0.1869	0.0495	0.20930626	8
2016	0.1450	0.0988	0.405246326	3
2017	0.0845	0.1852	0.686753395	1

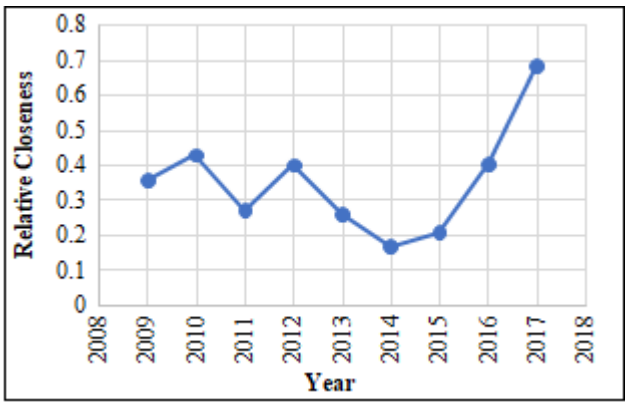

Figure 4: Performance of the Libyan economy (2009 to 2017)

Performance of Libyan economy increased in 2010 by 20.18% from the previous year; however, a declination by 37.16% occurred in 2011 due to political instability in the region. While 2012 brought a 48.66% of improvement in the economic performance, the revolution in the same year affected oil production and exportation, as well as the exportation of other goods and service. This is noticeable in the decrease in economic performance by 70.9% by 2014, as the revolution was followed by a civil war that hindered economic activities in the country. With the establishment of a new government in 2015, the economic performance increased by 25.01% due to the resumption of oil production, manufacturing and trading activities. The following year showed the highest economic performance amongst the research period with 93.61% increase, followed by 2017 with another 69.47% enhancement in the Libyan economic performance.

As emphasized by Ali (2011), Bhattarai&Taloba (2017) and Etelawi, et al. (2017), the Libyan economy is highly dependent on oil production, which can be noticed through the declination of other economic activities with any issues facing production and exportation of oil. Furthermore, oil can be observed to affect unemployment, inflation and exchange rates, as suggested by Bala& Chin (2018). The selected time period in the current study provides an insight on the transition period the Libyan economy is experiencing between different political and economic regimes. The political regime that existed prior the revolution depended mainly on oil production with a communist-like economic system that hindered economic development for decades. Nevertheless, the revolution and civil war from 2012 to 2014 added to the challenges of the Libyan economy with impeded oil production, which controls and affects most of the economic indicators of the country. Noticeable improvements were noticed between 2015 to 2017 due to the establishment of a new government adopting a capitalist economic strategy. The results of the current research confirm the insights provided by Turan, et al. (2016) about the challenges in economic performance faced by the Russian economy during political and economic transition periods, which are similar circumstances faced by the Libyan economy today.

5. Conclusion

The research assessed the performance of the Libyan economy between the years of 2009 and 2017 using the TOPSIS method in order to understand the factors that contributed into enhancing the economy in the best years. The literature review for studies that were focused on the Libyan economy showed that the Libyan economy is highly dependent on oil production, which hindered development besides lack of national development plans, processes and systems. The fluctuating oil market affected the Libyan economy with instability and influenced other factors, such as exchange rates, GDP and employment, as well as growth and development. In the late years of instability on the political and security levels, the high dependency on oil exports had severe impacts on the country, especially during the civil was between 2012 and 2014. Foreign currency exchange rates were also one of the most instable economic factors in the selected years of the current study. Thus, oil production and exchange rates are emphasized in the application of the TOPSIS method.

In method application, data for nine key economic performance indicators over nine years were obtained to construct the initial decision matrix, which is then normalized to produce the normalized decision matrix. Weights are incorporated into the normalized decision matrix to consider the difference in effect amongst the attributes and to produce the weighted decision matrix. The highest weights were given to oil production and exchange rates as the most affecting and affected factors based on the literature review of the Libyan economy. Ideal positive and negative solutions were calculated, as well as the separation measures between the weighted decision matrix elements and the ideal solutions. Finally, a relative closeness coefficient for each year was calculated indicating its closeness from the ideal solutions.

The findings of the research showed that 2017 was the best year for economic performance for the Libyan economy in relevance to the studied period between 2009 and 2017. Prior the late political instability in the country, 2010 is indicated as the second-best year for economic performance with 20.18% enhanced performance from the year before.The worst years for economic performance in Libya were between 2012 and 2014 due to the civil war between the different political and militant powers in the country. However, from 2015 to 2017 a substantial enhancement in the economic performance is observed during a stability period. The current crisis in the country highlighted the impact of oil-dependency on the Libyan economy. Thus, it is understood that adopting oil as the main income of the country increase the vulnerability of the economy and has impacts on the other economic factors, including foreign currency exchange rates.

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