www.rericjournal.ait.ac.th

Energy-Finance Nexus: Evidence from African Oil Exporting Countries

Zunaidah Sulong*,[1] and Ibrahim Sambo Farouq*

ARTICLE INFO

Article history:
Received 28 May 2020
Received in revised form
25 January 2021
Accepted 10 February 2021

Keywords:
Energy intensity
Energy price
Financial development
Dumitrescu and Hurlin

ABSTRACT

The focus of this study is to examine the effect of energy consumption, energy intensity, energy prices on the financial development of some selected top oil exporting countries in Africa. The study takes the period from 1976 until 2019 for the analysis. Both the cross-sectional and the homogeneity tests confirmed the presence of cross-sectional dependency and heterogeneity across the panel data set. Likewise, the dynamic and heterogeneous co-integration result reveals the presence of long run relationship among the scrutinized variables. The estimation result further indicates that both the energy intensity and energy use positively relate with the financial development of the sampled economies, while energy price indicates a negative relationship towards financial development. In addition, the causality results by Dumitrescu and Hurlin causality shows a uni-directional causal relationship from energy use to financial development. It also indicates another one-way causal linkage from energy intensity to financial development. Meanwhile, there exists a feedback causal effect between energy price and the financial development for all the sampled economies. In the last section of the paper, the analysis makes available policy recommendations.

1. INTRODUCTION

In most of the economic structures, the fundamental role of financial sector cannot be overemphasised, this is because as an intermediate and a savings mobilizer, it provides financial credit more than any other sector in any given economy. For quite some time now, financial sectors in Africa have seen substantial changes, especially among the continent's leading oil-exporting economies. This was followed by the speed of its growth. This dramatic growth has led to renewed interest in Africa, transforming its reputation from a civil war region, hardship and instability into a province of hope, stability and trade.

Financial sectors in Africa have progressed in recent years in terms of efficiency, more especially from the part of the African oil exporting countries, considering their relative revenue generation from the energy sector. It is therefore essential to investigate the effect of energy sector in relation to the financial development of some top oil exporting African countries. By so doing, it will add to the very few studies in the area since literature on this aspect is patchy. It will also shed light on productivity growth, since studies have shown that growth relate positively to the financial development [1]-[2]. Investigating this linkage between the energy sector and financial development is essential for the relevant authorities to promote a better economic policy in handling energy sector towards boosting economic activities and improved financial development in these economies on the basis of the empirical findings [3].

In the current era, focus is drawn from environmental analysts and scholars to the nexus between energy use and financial development. As a result, numerous research studies have been undertaken to investigate linkages, including financial development and global energy use. The existing literature offers two streams of analysis that consider the effect of financial developments on energy use. The First Line of thought suggests that financial development strengthen energy use [4]-[5]. However, the second stream of analysis established that financial advances are deflating the facts of energy use from the [6]-[7]. In recent years, financial development has been a soothing mechanism for energy usage demand [8]. Rising investment and sustainable and non-renewable energy use are stimulating economic growth, which ultimately leads to financial progress.

Meanwhile, technically, the association between financial development and energy intensity is being argued on both negative and positive ties. In this regard, the primary assumption is that the progress of financial alliances between banks, financial markets and international investment motivates expanded credit to be domestic and facilitates corporate funding of energy-intensive goods such as vehicles and machinery, thus increasing energy consumption, which has a negative effect on the atmosphere through more air and water pollution.

On the other hand, the collapse of the Bretton Woods regime in 1971 and the first oil shocks in 1973

*Faculty of Business and Management, Universiti Sultan Zainal Abidin, Terengganu, Malaysia.

[1]Corresponding author;
E-mail: zunaidah@unisza.edu.my.

endangered some of the traditional macroeconomic systems, such as the distribution mechanism. However, the global crisis was followed by a sharp rise in oil prices due to the oil embargo on the Organisation of Petroleum Exporting Countries (OPEC). Despite the problems associated with these oil spikes, relatively few studies recognize the correlation between oil prices and financial developments. Reference [9] has argued that the rise in oil prices is at least partly responsible for almost the post-second world war recession except the one in 1960.

In essence, an analytical study of the energy sector and its effect to financial development would also provide a new perspective for regions with much financial inefficiency and underdevelopment by raising their lack of exposure on how the energy sector is abundant and how effective it can influence the financial system [10]. As oil-exporting countries, the sampled countries are characterized by their abundant natural resource, which the energy sector is the most crucial one.

In this article, it provides new evidence that sheds light on the effects of energy consumption, energy price and energy intensity towards financial development of the selected top African oil exporting countries. Energy use promotes economic opportunities, reduces travel costs and improves the industrial base that contributes to urban regeneration, which in turn increases the demand for financial services and then triggers financial development [11].

Although, there are several aspects of backwardness in the oil exporting countries in terms of development and the level of efficiency in their respective financial sectors despite their existing endowments, coupled with the fact that these economies are suffering from the rising environmental issues. In the light of this, the UN Sustainable Energy for All (SE4All) initiative has been launched to benefit from renewable energy for all by 2030. But still, it has become a challenge for developing countries to use energy efficiently. It is therefore acknowledged that to achieve efficient energy that depends on the overall level of financial sector development of a particular economy. This is because inefficient financial system may hinder incentives that can reduce energy intensity [12].

Thus, considering the broad argument that the financial sectors in the major African oil-exporting countries are underdeveloped and unable to intermediate financial funds efficiently [13]-[14]. It is further requiring that for financial sector to be able to mobilized and allocate savings most efficiently and effectively, it demands an atmosphere of macroeconomic stability [9]. This stability is clearly not on site for the fact that oil price is involved. As volatility in the price of crude oil may influence the financial development in these economies. It is because economic activities in these developing economies relies on crude oil price [15]-[16].

The expansion of the financial sector has also been closely related to oil, taking into account its important contribution to economic activities and, certainly, its position as a capital liquidity booster. Nevertheless, conservation policies will restrict economic development if a country is heavily dependent on the energy market. This is rather obvious in the sampled economies, since their financial sectors are relatively dominated by the public body [17]. Therefore, policymakers ought to know about the effect of energy consumption, energy intensity, energy prices and financial development. Reference [18] proposed that financial development could lead to a more effective use of energy sources and hence a decline in energy usage costs. Furthermore, increasing economic growth, focused on financial progress, is a convenient excuse for investing funds and hence causes an increase in the use of oil.

More so, energy consumption, has been found to promote financial development [19]-[20], the link between financial development and energy sector is a pristine field for which has no many kinds of research. Transparent relationships have been established in these researches, both between growth-finance and between energy-growth.

In the light of the aforementioned scenarios as the case may be, the main objective of this study is to (i) examine the extent to which energy price, energy intensity and energy consumption affects the development of the financial sectors of the selected leading African oil exporting countries, (ii) to investigate the causal effects of the energy price, energy intensity and energy consumption in relation to financial development and vice vasa, in the top leading African oil exporting countries. The primary objective is to assess whether energy sector in these sampled countries causes financial development (blessing) or not (a curse). In comparison to other results, [21] observed based on his empirics using Tunis, that energy consumption causes financial sector development. Through the use of the Auto-regressive Distributive Lag test, [22] examine Iran and confirmed the presence of long-run relationship among the variables.

The specific components of this analysis, relative to other literature reviews, are: (a) the use of heterogeneous econometrics techniques to resolve the relationship effects between the two sectors; (b) the recognition of separate segments of the energy market with regard to the financial growth of the sampled countries, (c) the potential to attract the attention of stakeholders to comprehend how important these various energy sector units are to the growth of their financial system; (d) as major oil-exporting economies in the continent with a relatively poor financial system, this data would allow stakeholders, in particular policy makers, to understand the influence of the financial system and the energy sector from all of its dimension to finance. The data may also show the susceptibility of oil shocks to the country's financial system and provide an incentive to improve the financial growth of these oil-exporting African nations from an energy perspective.

2. LITERATURE REVIEW

While there exists some relatively substantial number of literatures evaluating the causal link between financial development and energy usage, no consensus has been reached, and the correlations between energy use, energy intensity, energy price with financial development remain obscure. Numerous regions are seeing differing outcomes of the relationship between the energy market and financial growth. Numerous experiments use cross-sectional data to examine the essence of the relationship. Although many researches focus on factors influencing energy intensity at different national levels, there appears to be no systematic or comprehensive analysis demonstrating the association between financial growth and energy intensity. Much of the research concentrate on the conventional relationship between financial growth and energy consumption or carbon emissions. In addition, researchers showed that financial technologies may have a positive or negative impact on the climate.

Mostly, the financial system is supposed to react adversely in certain circumstances of oil volatility. From a statistical point of view, oil prices influence banking production through two different channels: the level of inflation and the level of economic activity, and the rate of unemployment. Increasing inflation tends to improve credit market uncertainty, resulting in detrimental effects on the performance of financial institutions [23]. With respect to unemployment and economic development, past studies have indicated a negative association between oil prices and economic growth [24]-[25]. As [26] points out, banks tend to expand, lend, and generate more income due to increased stock market activity during economic expansion periods.

Reference [27] examined the effect of fluctuations in oil prices on economic and financial trends between 1999 and 2014. Their proof review of the GMM approach indicates that there is a feedback effect between oil markets and financial innovations. [28] noted the link between oil prices and economic growth, along with financial changes, in the output position of the GCC economies for the period 1999 to 2016. They found that trading in oil markets had an enticing impact on economic growth. Their empiric analysis also reveals that financial patterns are reinforcing the price of oil in the GCC economies.

Reference [29] selected 90 economies classified as medium, middle and high-income nations to assess the linkages between growth of the financial sector and energy usage. Results suggest that financial growth benefits the elimination of greenhouse gas emissions in high-income economies, while slightly impacting energy consumption in some low-and middle-income countries. Several single countries are researching the relationship between financial growth and energy use.

Reference [30] noted that the long-term impact of financial changes on energy usage in Malaysia were positive and hopeful. Reference [31] found that financial technologies have had a substantial effect on energy usage in Tunisia. The association between dividend growth and energy usage in South Africa has been negative and significant [32]. Some studies research the effects of financial growth and energy use in emerging markets.

Reference [33] suggested that financial technologies could boost the sustainability of the atmosphere by reducing carbon dioxide emissions in 24 emerging markets. Using China as an example, [34] found that financial advances in China have been the key generator of carbon emissions, thereby rising energy consumption.

However, reference [35] presented clear evidence that, in the long run, financial advances in China would reduce energy consumption. Various proxies have been used as a financial development index, and the effects of the influence of financial changes on energy consumption appear to be correlated to these particular financial development indexes. The proportion of domestic credit to the private sector is the most generally used proxy of financial development [36]-[37].

Reference [38] used time series evidence from 1971 to 2011 and the ARDL bound test method to verify the positive association between financial growth and energy consumption from a long-term perspective. The ARDL approach was also used to investigate the relationship between financial growth and energy usage. The results suggest that financial growth promotes energy use in some GCC (Gulf Cooperation Council) countries.

Reference [39] applied Granger causality approach to examine the detrimental effects of financial changes on energy consumption. Incredibly limited studies consider the energy finance nexus.

3. EMPIRICAL METHODOLOGY AND DATA

Financial development triggers a range of changes within an economy, including, for instance, a decrease in financial risk and funding rates, greater openness between lenders and borrowers, access to higher financial resources and cross-border investment flows, and access to the new energy-efficient technologies and state-of-the-art technology, all of which can in return influence the level of growth [40]. Meanwhile, financial development is found to promote energy efficiency, and in turn promote sustainable growth [42]. Reference [43] also observed the essentials of the financial sector to the energy sector.

Following the above theoretical postulations, this study builds on the model proposed by [44]. Since energy price and energy intensity have been found to influence financial development [45]. Therefore, this study's linear model is specified as:

$$FD_{it} = a_1 + a_2 LEU_{it} + a_3 LEI_{it} + a_4 LEP_{it} + u_{it} \quad (1)$$

Where FD is the financial development, the EU represents the energy use, EI denotes energy intensity, and EP stands for energy price, while u is the error term, and it represents the cross-sectional countries and years.

In this panel data analysis, the empirical analysis begins with the determination of the cross-sectional dependency and heterogeneity tests. The next is the

integration order by using the unit root test. Followed by the unit root test is to analyse the long run relationship among the variables through the help of the cointegration test, and should the long run relation exist, the study then proceeds further to determine the causal direction of the scrutinized variables using the heterogeneous Dumitrescu and Hurlin causality test.

It should be noted that, the justifications behind the application of the aforementioned econometrics techniques is that, the cross-sectional dependence and homogeneity tests confirmed the nature of the data to be a heterogeneous and cross dependent data set, which means the application of second-generation techniques is key in order to avoid bias in the results.

The study further deploys [46] to uncover the causal relationship between the parameters. Given that the approach works very fine with heterogeneous data and fixed coefficient models. Moreover, it has the null hypothesis of no causal relationship. While the alternative hypothesis works with two sub-groups of cross-sectionals: on one side, it is from a to b causal relationship and the other side shows no causal relationship from a to b. The estimates of this heterogeneous panel causality test are:

$$\Delta LFD_{i,t} = \beta_i + \sum_{k=1}^{K} \partial_i^{(k)} \Delta LEU_{i,t-k} + \sum_{k=1}^{K} \partial_i^{(k)} \Delta LEI_{i,t-k} + \sum_{k=1}^{K} \gamma_i^{(k)} \Delta LEP_{i,t-k} + \varepsilon_{i,t} \quad (2)$$

$$\Delta LEU_{i,t} = \beta_i + \sum_{k=1}^{K} \gamma_i^{(k)} \Delta LFD_{i,t-k} + \sum_{k=1}^{K} \partial_i^{(k)} \Delta LEI_{i,t-k} + \sum_{k=1}^{K} \delta_i^{(k)} \Delta LEP_{i,t-k} + \varepsilon_{i,t} \quad (3)$$

$$\Delta LEI_{i,t} = \beta_i + \sum_{k=1}^{K} \delta_i^{(k)} \Delta LFD_{i,t-k} + \sum_{k=1}^{K} \gamma_i^{(k)} \Delta LEU_{i,t-k} + \sum_{k=1}^{K} \partial_i^{(k)} \Delta LP_{i,t-k} + \varepsilon_{i,t} \quad (4)$$

$$\Delta LEP_{i,t} = \beta_i + \sum_{k=1}^{K} \theta_i^{(k)} \Delta LFD_{i,t-k} + \sum_{k=1}^{K} \delta_i^{(k)} \Delta LEI_{i,t-k} + \sum_{k=1}^{K} \gamma_i^{(k)} \Delta LEU_{i,t-k} + \varepsilon_{i,t} \quad (5)$$

Where β_i is the constant, and K stands as the constant lag. $\partial_i^{(k)}, \gamma_i^{(k)}, \delta_i^{(k)}$ *and* $\theta_i^{(k)}$ indicates the slope coefficient and autoregressive parameters to change across the groups. The model uses a fixed individual effect and the fixed coefficient model. The probability value and F-statistics value which depicts whether or not to reject the null hypothesis, account the existence of causality or not, respectively.

This study has 172 observations, the data is generated from the World Development Indicators and the West Texas Intermediate (WTI). The data set spread between 1976 to 2019. In the empirical analysis, after all the required preliminary tests, we check for the co-integration, the causal relationship and the degree of the long-run relationship among the variables for top selected African oil-exporting economies namely: Algeria, Angola, Gabon and Nigeria.

The oil price indicator is derived by measuring the market prices of different barrels of oil to Consumer Price Index (CPI). The study as well measure energy consumption by kg of oil equivalent per capita [47]. Energy intensity is measured by dividing the total primary energy consumption to GDP expressed in US dollars by purchasing power parity. Finally, financial development is measured by domestic credit to the private sector by banks [48].

4. EMPIRICAL RESULTS

4.1 Descriptive Summary

A significant percentage of the economic panel data is commonly characterized as none normally distributed. The major justification for this is the nature of the data because it comprises of many different data from different countries [49]. The Jarque-Bera test is used from Table 1 below to test the normality of the sequence. The study includes skewness and kurtosis coefficients considering the mean values to test the normality of the parameters in our model. Skewness serves as the tilt in the collection and therefore should be within the range values between 0 and + 3 for the data to be normally distributed. Nevertheless, on the other side, for the data to be normally distributed, Kurtosis refers to the height of the distribution and should, therefore, be between the range 0 and + 3.

It can be seen from Table 1 below that the sequence is not normally distributed. On the other hand, the standard deviation in the frequency distributions is below the mean of each variable as expected, which fulfils one of the conditions of normal data. Except for energy price, which deviates as a result of the

computation in the variable as expected. Meanwhile, the effects of the statistical correlation summary for the variables are further described in Table 2. Moreover, from Table 2 result, considering the correlation values, there exists no problem of multi-collinearity among the sequence.

4.2 Cross-sectional Dependence

This study uses an observational approach that addresses the topic of cross-sectional dependence. Table 3 below displays the effects of cross-sectional dependency assessments and shows that energy consumption, energy intensity, energy price and financial growth of the countries studied are strongly interdependent across borders. However, the probability values show that the null statistical hypothesis is steadily discarded at a 1% significance level, which means that some cross-sectional dependency must be used in the interpretation of the data for this study in order to eliminate bias in the findings. The implication of this cross-sectional dependency result is that all factors are cross-sectionally dependent across nations. This makes it important to use second-generation approaches to analyse the data of the current research.

4.3 Slope Homogeneity

In view of the approximate delta and adjusted delta values in Table 4 below, and taking into account their P-values, the analysis confidently rejects the null homogeneity coefficients at a 1% significance stage. This implies that in the current analysis, all the variables around the sampled economies are not homogeneous in any way, but there is variation between the countries. Heterogeneous panel methods in which variables vary through individual cross-sections must then be implemented.

4.4 Unit Root

In the analysis, we looked at the presence of non-stationary stochastic powers. The study used reference [50] cross-sectional augmented dicky fuller (CADF) and cross-sectional ImPesaran (CIPS) developed by [51] as a second-generation unit root test technique. Table 5 presents the stationary effects of all variables used, indicating the mixed stationary properties of the various unit-root solution. As such, the tests of CADF and CIPS show mixed stationarity results at a 1% significance level.

4.5 Co-integration Result

The co-integration theory is consistent with the econometrics method used to show the possibility of a long-term relationship between non-stationary parameters. There is also a fair probability of these non-stationary parameters being able to walk with each other in the long run. Panel researchers have developed and used a number of methods to determine long-term relationships and the complexity of their experiences. Below is the result of the Westerlund Co-integration strategy, which shows that in the top-selected African oil exporting countries there is a long-term association between energy consumption, energy intensity, energy price and financial growth.

Table 1. Summary statistics.

Variables	Mean	Standard deviation	Skewness	Kurtosis	Jarque-Bera
FD_{it}	20.270	13.724	2.425	5.920	284.491 (0.000)
EP_{it}	3.250	4.328	10.235	6.280	38.3* (0.000)
EI_{it}	4.973	2.032	1.620	4.273	32.352* (0.000)
EU_{it}	5.924	0.423	0.231	2.581	51.549* (0.000)

Source: WTI and WDI (2020).

Table 2. Correlation matrix.

	FD_{it}	EP_{it}	EI_{it}	EU_{it}
FD_{it}	1			
EP_{it}	-0.052	1		
EI_{it}	-0.349	-0.027	1	
EU_{it}	0.268	-0.093	0.402	1

Source: WTI and WDI (2020).

Table 3. Cross-sectional dependence test.

Tests	Statistics	P-Values
LM	42.52	0.000*
LM adj*	19.26	0.000*
LM CD* $_t$	5.183	0.000*

Source: WTI and WDI (2020).

Table 4. Slope homogeneity tests.

Group	Test	Statistic	P-value
	Delta	4.572*	0.000
	Adjusted Delta	4.932*	0.000

Source: WTI and WDI (2020).

Table 5. Panel unit root test.

	At level	CADF At first diff	At level	CIPS At first diff
LFD_{it}	-5.332*	-6.654*	-4.417*	-6.183*
	(0.000)	(0.000)	(-3.06)	(-3.06)
LEU_{it}	-4.832*	-6.457*	-5.302*	-6.356*
	(0.000)	(0.000)	(-3.06)	(-3.06)
LEI_{it}	-5.402*	-6.539*	-4.461*	-6.263*
	(0.000)	(0.000)	(-3.06)	(-3.06)
LEP_{it}	-4.073*	-6.235*	-5.521*	-6.862*
	(0.001)	(0.000)	(-3.06)	(-3.06)

Note: ** and * denotes in 5% and 1% levels. The p-values are in the brackets, but as for the CIPS, those in brackets represent the critical values.
Source: WTI and WDI (2020)

Table 6. Summary results of heterogeneous co-integration tests.

		With trend		Without trend	
	Statistic	Value	*p*-value	Value	*p*-value
Westerlund	G_t	-3.621*	0.000	-4.570*	0.000
	G_a	-12.309*	0.000	-13.952*	0.001
	P_t	-10.813*	0.000	-7.189*	0.00
	P_a	-15.662*	0.000	-17.963*	0.000

Note: ** and * means the null hypothesis rejection of no cointegration at 5% and 1% levels of significance
Source: WTI and WDI (2020).

Table 7. Dynamic common correlated estimator.

DCCE			
Variables	Coefficient (Std. Err.)	Z	P-value
DCP_{it-1}	-0.326 (0.107)	-3.04	0.002
EP_{it}	-0.514 (0.216)	-2.38	0.017
EI_{it}	0.160(0.071)	2.25	0.024
EU_{it}	0.163(0.077)	2.10	0.035
N	6		
R-squared	0.46		
Adj. R-squared	0.33		
F(58, 237)	1.94	(0.000)	
CD Statistic	1.82	(0.050)	

Source: WTI and WDI (2020).

The principle of co-integration corresponds to the econometrics approach used to demonstrate the likelihood of a long-term relationship between non-stationary parameters. Therefore, there is a reasonable chance that these non-stationary parameters can walk with each other in the long term [52]-[53]. Panel analysts have developed and used various approaches to assess long-term relationships and the complexity of their interactions. Above Table 7 is the product of the Westerlund Co-integration approach, which shows that there is a long-term relationship between energy usage, energy intensity, energy price, and financial development in the top-selected African oil-exporting countries.

4.6 Dynamic Common Correlated Effect Estimation

The estimate results using the dynamic common correlated effects (DCCE) estimator in these sampled oil African economies is presented in Table 7 below. The findings of estimation the using Mean Group Dynamic Common Correlated Effect shows the positive role of both energy intensity and energy use towards financial development, with energy price having a negative and significant effect in relation to financial development of these economies. In this table, the lagged value of domestic credit to private sector (DCP) is negative and statistically significant in relation to the current value of DCP. Energy price indicates a negative coefficient of -0.51%, which implies that due to the volatility in the oil price, its increase leads to inflation, thereby raising credit market frictions, and bringing negative effect on the efficiency of the financial system, and this can be traced to the work of [54]-[55]. While, energy intensity shows a positive coefficient of 0.16%, implying that higher energy intensity leads to higher financial development by 16 percent [56]-[57]. However, if the financial sector becomes well efficient, then it can also provide resources and financial services with minimal costs. Thus, leading to favourable circumstances for technological progress and economic transformation for

improved energy efficiency. Likewise, the energy use also increases the financial development by 07% through improved economic activities. This result is consistent with the finding of [58]-[59].

4.7 Causality Result

Considering the nature of the data at hand, given that the result of the homogeneity and the cross-sectional dependency tests shows that the data of this study is heterogeneous in nature and cross-sectionally dependent upon each other, and coupled with the fact that Dumitrescu and Hurlin causality test accommodates data heterogeneity as well as cross-sectional dependence resilient through the application of bootstrap procedure to estimate both the P-value and the critical values associated with Z-bar and Z-bar tilde [60]. Thus, this study employed this Dumitrescu and Hurlin panel heterogeneous causality test to examine the nature of the causal link between the variables within the model. Table 8 below shows the Dumitrescu and Hurlin heterogeneous causality test results. Looking at the decision column in Table 7, and considering their corresponding P-Values, financial development does not granger cause energy use, whereas, energy use causes financial development in the sampled countries, which is very consistent with the findings of [61] as they found same results in their various studies.

Likewise, another one-way causal relationship as well exists, running from energy intensity to the financial development of these selected top leading African oil-exporting countries. In line with [62], energy intensity which measures how inefficient in terms of energy a country might be, increases employment, lowers production cost, lowers energy intensity (which makes it efficient) and improves energy security and environmental standards. These will in return, pave the way for the improvement in the economic activities of the said economies and as a result, brings about financial sector development of these sampled economies in question.

Meanwhile, energy price and financial development appear to have a bi-causal relationship among them in these sampled countries, which aligns with the findings of [63] that found the same feedback causal effect. It is imperative to note that energy prices provide the required financial funds to boost economic activities which subsequently lead to financial sector development. This shows that financial sector development is as well a function of energy price [64]. Furthermore, concomitantly, the financial sector can use its intermediary role to channel the mobilized savings into the efficient and effective productive sectors of the economy in order to suppress the shocks of this energy price [65].

Conclusively, following the aforementioned causal effects of all the scrutinized variables in respect to the financial sector development of the sampled oil exporting countries, these empirical findings conclude that indeed energy sector is a blessing to these African OPEC member countries. This can be found in the presented result of the current study, given that, all the operational activities taking place in both the three sub-sectors of the energy sector are duly causing development in the financial sectors of these top oil exporting economies as observed in the causality results above.

Therefore, the presence of hydrocarbon-macro-financial feedback mechanisms indicates that there is a stronger need to build up buffers in these sampled economies during good times. The value of building buffers to withstand harmful shocks has been well established -- capital and reserves in great times help to boost the stability of the financial system and mitigate the countercyclical feedback mechanisms between asset values and credit. Empirical data in Saudi Arabia reinforces the claim that bank capital and supply reserves dampen the cyclical fluctuations [66]. All these capital and supply ratios spike as financial and business cycle metrics strengthen.

4.8 Robustness

This study further checks robustness to examine the sensitivity of the results to a different measure of financial development. In this robustness check, the study proxy financial development using broad money to measure financial development of these top oil exporting countries as widely used by previous researchers such as [67]. This financial development measure through the broad money ratio of nominal GDP is an index that shows the rate at which financial market transactions are monetized.

Table 8. Dumitrescu and Hurlin causality results.

Null hypothesis	W-Stat	Zbar-Stat	Pvalue	Decision
FD does not cause EU	1.263	0.632	0.705	Fail to reject
EU does not cause FD	20.83	8.842	0.000	Reject
FD does not cause EI	1.326	0.325	0.459	Fail to reject
EI does not cause FD	44.032	17.532	0.000	Reject
FD does not cause EP	8.364	4.355	0.000	Reject
EP does not cause FD	30.654	8.136	0.000	Reject

Source: WTI and WDI (2020).

Table 9. Dumitrescu and Hurlin causality result using M2 as dependent variable.

Null hypothesis	W-Stat	Zbar-Stat.	Decision
FD does not cause EU	0.423	0.592	Fail to reject
EU does not cause FD	10.542	3.054*	Reject
FD does not cause EI	0.547	0.654	Fail to reject
EI does not cause FD	23.924	10.252*	Reject
FD does not cause EP	2.187	1.075*	Reject
EP does not cause FD	20.340	5.230	Reject

Note: * Signifies the 1 % level of significance and ** indicates 5 % significance level
Source: WTI and WDI (2020).

As shown in Table 8 above, all the causal direction of the variables turns out to be in the same direction as earlier reported in the initial model where the study measured financial development through domestic credit to private sector by banks. Based on the robustness checks results presented above, the authors of this paper conclude that the qualitative nature of the findings is robust.

5. CONCLUSION AND POLICY RECOMMENDATIONS

This paper analyses the effects of energy price, energy intensity and energy consumption on financial development of four selected leading oil exporting African economies; namely: Algeria, Angola, Gabon and Nigeria from 1976 to 2019. The study conducted all the required preliminary checks in order to ascertain the appropriate econometrics techniques to use for the analysis. Both the cross-sectional and the homogeneity tests confirmed the presence of cross-sectional dependency and heterogeneity across the panel data set. Likewise, the dynamic and heterogeneous co-integration result reveals the presence of long run relationship among the scrutinized variables.

The estimation result further indicates the degree of the relationship among these variables. It shows that both the energy intensity and energy use positively relate with the financial development of the sampled economies. Notably, these economies are now in the stage of development, therefore, enhanced economic activities that requires more energy and low intensive machines are used. As align with the first school of thought in the energy-finance literature that claimed a positive relationship between energy and finance, further studies have shown that after improvement in the financial system, through lowering the costs in the financial services, it creates favourable condition for technological innovation and economic transformation that will result to higher energy efficiency [68]. While energy price indicates a negative relationship towards financial development. This could be due to the resulting increased in credit market frictions caused by the oil prices, which eventually have a negative effect on the financial performance of the economies as in the case of [69]-[70].

Regarding the causality results, the Dumitrescu and Hurlin causality test is used for this causal analysis. The result shows a uni-directional causal linkage from energy use to financial development. It also indicates another one-way causal link from energy intensity to financial development. Meanwhile, there exists a feedback causal effect between energy price and the financial development for all the sampled economies.

In a nutshell, the results of this study affirmed the hypothesis that "energy sector is a blessing for financial development." This is indeed a contribution to the body of knowledge, as if this study had not consider these components of energy sector to the financial development of these sampled economies, this research would not have conclude that energy intensity and energy consumption enhances financial development of these economies, and also claim empirically that energy price lower the performance of these financial systems. Notwithstanding, since the oil price might be a problem to these financial systems, then it is required that these financial systems should utilize the generated oil revenue judicially in order to prepare for the rainy days.

In essence, authorities in charge should put forward sound financial policies, which will assist in building up buffers against the negative effect of oil prices towards financial efficiency of these economies. In addition, the financial system should amend cautious recommendations to counter the credit potential risks with the structural risks of oil price fluctuations. From a managerial viewpoint, bank managers should consider setting up early warning and response systems for oil price shocks in order to work with greater results. Efforts must be made to encourage industries to adopt new technologies to enhance the efficient utilization of energy since increased in energy use and energy intensity promotes financial development in these economies.

REFERENCES

[1] Guiso L., Sapienza P., and Zingales L., 2004. The function of social capital in financial development. *American Economic Review* 94(3): 526-556.

[2] Baland J.M. and P. Francois. 2000. Rent-seeking and resource booms. *Journal of Development Economics* 61(2): 527-542.

[3] Hesse H. and T. Poghosyan, 2016. *Oil prices and bank profitability: Evidence from major oil-exporting countries in the Middle East and North Africa.* In Financial Deepening and Post-Crisis Development in Emerging Markets. Palgrave Macmillan, New York, pp. 247-270.

[4] Mahalik M.K., Babu M.S., Loganathan N., and Shahbaz M., 2017. Does financial development intensify energy consumption in Saudi Arabia?

Renewable Sustainable Energy Reviews 75: 1022–1034.

[5] Islam F., Shahbaz M., Ahmed A.U., and Alam M.M., 2013. Financial development and energy consumption nexus in Malaysia: A multivariate time series analysis. *Econ Model* 30: 435–441.

[6] Ouyang Y. and P. Li, 2018. On the nexus of financial development, economic growth, and energy consumption in China: New perspective from a GMM panel VAR approach. *Energy Economics* 71: 238–252.

[7] Kahouli B., 2017. The short and long run causality relationship among economic growth, energy consumption and financial development: Evidence from South Mediterranean countries (SMCs). *Energy Economics* 68: 19–30.

[8] Hafeez M., Yuan C., Khelfaoui I., Sultan Musaad O., Waqas Akbar M., and Jie L., 2019a. Evaluating the energy consumption inequalities in the one belt and one road region: implications for the environment. *Energies* 12(7): 1358.

[9] Parsa H. and S.Z. Sajjadi, 2017. Exploring the trade openness, energy consumption, and economic growth relationship in Iran by Bayer and Hanck combined co-integration and causality analysis. *Iranian Economic Review* 21(4): 829-845.

[10] Gylfason T. and G. Zoega, 2006. Energy resources and economic growth: The role of investment. *World Economy* 29(8): 1091-1115.

[11] Ahmad A.U., Adamu I.M., Ahmad I.M., Ismail S., Farouq I.S., Jakada A.H., and Mustapha U.A., 2020. Empiric on the relationship between pollutant emissions, renewable energy consumption, and economic growth: Evidence from Sub-Saharan African countries. *International Journal of Scientific and Technology Research* 9(1).

[12] Aller C., Herrerias M.J., and Ordóñez J., 2018. The effects of financial sector development on energy intensity in China. *The Energy Journal* 39 (Special Issue 1).

[13] Barajas M.A., Chami M.R., and Yousefi M.R., 2013. The finance and growth nexus re-examined: Do all countries benefit equally? *International Monetary Fund* 13-130.

[14] Farouq I.S., Sulong Z., and Sambo N.U., 2020. An empirical review of the role economic growth and financial globalization uncertainty plays on financial development. *Innovation* 3(1): 48-63.

[15] Moshiri S., 2015. The effects of the energy price reform on households usage in Iran. Energy Policy 79: 177-188.

[16] Mehrara M., 2008. The asymmetric relationships between oil revenues and economic activities: The case of oil-exporting countries. *Energy Policy* 36(3): 1164-1168.

[17] Omitogun O., Longe A.E., and Muhammad S. 2018. The effects of oil price and revenue variations on economic growth in Nigeria. *OPEC Energy Review* 42(4): 387-402.

[18] Mehrara M. and M. Musai, 2012. Energy consumption, financial sector development and economic growth: an ARDL approach for the case of Iran. *International Journal Business and Behavioral Sciences* 2(6): 92-99.

[19] Apergis N. and C.F. Tang, 2013. Is the growth energy-led hypothesis a valid… Fresh evidence from a sample of 85 countries. *Energy Economics* 38: 24-31.

[20] Bartleet M. and R. Gounder, 2010. Energy usage and economic growth in New Zealand: Results of trivariate and multivariate models. *Energy Policy* 38(7): 3508-3517.

[21] Chtioui S., 2012. Does economic growth and financial sector development spur energy consumption in Tunisia? *Journal of Economics and International Finance* 4(4): 150-158.

[22] Mehrara M. and M. Musai, 2012. Energy consumption, financial sector development and economic growth: An ARDL approach for the case of Iran. *International Journal Business and Behavioral Sciences* 2(6): 92-99.

[23] Boyd J.H., Levine R., and Smith B.D., 2001. The effect of inflation on financial sector performance. *Journal of monetary Economics* 47(2): 221-248.

[24] Kilian L., 2008. The economic effects of energy price shocks. *Journal of Economic Literature* 46(4): 871-909.

[25] Deaton A. and R. Miller, 1995. International Commodity Prices. Macroeconomic Performance, and Politics in Sub'Saharan Africa, V Princeton Studies in International Finance 79.

[26] Hesse H. and T. Poghosyan, 2016. Oil prices and bank profitability: Evidence from major oil-exporting countries in the Middle East and North Africa. In Financial Deepening and Post-Crisis Development in Emerging Markets. Palgrave Macmillan, New York. 247-270.

[27] Khandelwal P., Miyajima M.K., and Santos M.A.O., 2016. The effects of oil prices on the banking system in the GCC. International Monetary Fund.

[28] Gazdar K., Hassan M.K., Safa M.F., Grassa R., 2018. Oil price volatility, Islamic financial development and economic growth in Gulf Cooperation Council (GCC) countries. Borsa Istanbul Review 19(3): 197-206.

[29] Riti J.S., Shu Y., Song D., and Kamah M., 2017. The contribution of energy use and financial development by source in climate change mitigation process: a global empirical perspective. *Journal of Cleaner Production* 148: 882-894.

[30] Islam F., Shahbaz M., Ahmed A.U., and Alam, M.M., 2013. Financial sector development and energy consumption nexus in Malaysia: A multivariate time series analysis. *Economic Modelling* 30: 435-441.

[31] Shahbaz M. and H.H. Lean, 2012. Does financial sector development increase energy use? The role of industrialization and urbanization in Tunisia. *Energy Policy* 40: 473-479.

[32] Shahbaz M., Khan S., and Tahir M.I., 2013. The dynamic links between energy use, economic growth, financial development and trade in China:

Fresh evidence from multivariate framework analysis. *Energy Economics* 40: 8-21.

[33] Zhang Y.J., 2011. The impact of financial development on carbon emissions: An empirical analysis in China. *Energy Policy* 39(4): 2197-2203.

[34] Zhang Y., Fan J., and Chang H., 2011. Impact of China's stock market development on energy consumption: an empirical analysis. *Energy Procedia* 5: 1927–31.

[35] Shahbaz M., Khan S., and Tahir M.I., 2013. The dynamic links between energy use, economic growth, financial development and trade in China: fresh evidence from multivariate framework analysis. *Energy Economics* 40: 8-21.

[36] Omri A., Daly S., Rault C., and Chaibi A., 2015. Financial sector development, environmental quality, trade and economic growth: What causes what in MENA countries. *Energy Economics* 48: 242-252.

[37] Ozturk I. and A. Acaravci, 2013. The long-term and causality analysis of energy, growth, openness and financial development on carbon emissions in Turkey. *Energy Economics* 36 262-267.

[38] Mahalik M.K., Babu M.S., Loganathan N., and Shahbaz M., 2017. Does financial development intensify energy consumption in Saudi Arabia? *Renewable & Sustainable Energy Reviews* 75: 1022–1034.

[39] Charfeddine L. and K.B. Khediri, 2016. Financial development and environmental quality in UAE: Cointegration with structural breaks. *Renewable and Sustainable Energy Reviews* 55: 1322-1335.

[40] Shumpeter J., 1932. *The Theory of Economic Development.* Cambridge, MA, US: Harvard University Press.

[41] McKinnon R., 1973. *Money and Capital in Economic Development.* Washington, DC: Brookings Institution.

[42] Ang J.B., 2008. Economic development, pollutant emissions and energy consumption in Malaysia. *Journal of Policy Modeling* 30: 271–278.

[43] Jalil A. and M. Feridun, 2011. The impact of growth, energy and financial development on the environment in China: A cointegration analysis. *Energy Economics* 33(2): 284-291.

[44] Al-Mulali U. and C.N.B.C. Sab, 2012. The impact of energy consumption and CO2 emission on the economic growth and financial development in the Sub Saharan African countries. *Energy* 39(1): 180-186.

[45] Acheampong A.O., 2019. Modelling for insight: Does financial development improve environmental quality? *Energy Economics* 83: 156-179.

[46] Dumitrescu E.I. and C. Hurlin, 2012. Testing for Granger non-causality in heterogeneous panels. *Economic Modelling* 29(4): 1450-1460.

[47] Ahmad A.U., Ismail S., Jakada A.H., Farouq, I.S., Muhammad A.A., Mustapha U.A., and Muhammad A., 2020. A heterogeneous relationships between urbanization, energy consumption, economic growth on environmental degradation: Panel study of Malaysia and selected ASEAN+ 3 countries. *Journal of Environmental Treatment Techniques* 8(1): 573-581.

[48] Moradbeigi M. and S.H. Law, 2017. The role of financial development in the oil-growth nexus. *Resources Policy* 53: 164-172.

[49] Tamazian A. and B.B. Rao, 2010. Do economic, finance and institutional development matter for environmental quality? Evidence from transitional economies. *Energy Economics* 32(1): 137-145.

[50] Pesaran M.H., 2006. Estimation and inference in large heterogeneous panels with a multifactor error structure. *Econometrica* 74(4): 967-1012.

[51] Pesaran M.H., 2007. A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics* 22(2): 265-312.

[52] Stigler J.W., Givvin K.B., and Thompson B.J., 2010. What community college developmental mathematics students understand about mathematics. *MathAMATYC Educator* 1(3): 4-16.

[53] Engle R.F. and C.W. Granger, 1987. Co-integration and error correction: Representation, estimation, and testing. *Econometrica: Journal of the Econometric Society* 251-276.

[54] Brückner M. and A. Ciccone, 2010. International commodity prices, growth and the outbreak of civil war in Sub-Saharan Africa. *The Economic Journal* 120(544): 519-534.

[55] Hesse H. and T. Poghosyan, 2016. Oil prices and bank profitability: evidence from major oil-exporting countries in the Middle East and North Africa. In Financial deepening and post-crisis development in emerging markets. Palgrave Macmillan, New York 247-270.

[56] Acheampong A.O., 2019. Modelling for insight: Does financial development improve environmental quality? *Energy Economics* 83: 156-179.

[57] Madsen J.B. and J.B. Ang, 2016. Finance-led growth in the OECD since the nineteenth century: how does financial development transmit to growth? *Review of Economics and Statistics* 98(3): 552-572.

[58] Mahalik M.K., Babu M.S., Loganathan N., Shahbaz M., 2017. Does financial development intensify energy consumption in Saudi Arabia? *Renewable & Sustainable Energy Reviews* 75: 1022–1034.

[59] Xu S.J., 2012. The impact of financial development on energy consumption in China: Based on SYS-GMM estimation. In Advanced Materials Research. Trans Tech Publications Ltd 524: 2977-2981.

[60] Lopez L. and S. Weber, 2017. Testing for Granger causality in panel data. *The Stata Journal* 17(4): 972-984.

[61] Al-Mulali U. and C.N.B.C. Sab, 2012. The impact of energy consumption and CO2 emission on the economic growth and financial development in the Sub Saharan African countries. *Energy* 39(1): 180-186.

[62] Adom P.K., Appiah M.O., and Agradi M.P., 2019. Does financial development lower energy intensity? *Frontiers in Energy* 1-15.

[63] Khandelwal P., Miyajima M.K., and Santos M.A.O., 2016. The impact of oil prices on the banking system in the GCC. International Monetary Fund.

[64] Hesse H. and T. Poghosyan, 2016. Oil prices and bank profitability: evidence from major oil-exporting countries in the Middle East and North Africa. In Financial Deepening and Post-Crisis Development in Emerging Markets. Palgrave Macmillan, New York 247-270.

[65] Atil A., Nawaz K., Lahiani A., and Roubaud D., 2020. Are natural resources a blessing or a curse for financial development in Pakistan? The importance of oil prices, economic growth and economic globalization. *Resources Policy* 67: 101683.

[66] Abusaaq H., Alfi A., Khandelwal P., Miyajima K., and Piven B., 2015. Countercyclical Macroprudential Policies in Saudi Arabia. International Monetary Fund, Washington DC.

[67] Moradbeigi M. and S.H. Law, 2017. The role of financial development in the oil-growth nexus. *Resources Policy* 53: 164-172.

[68] Allegret J.P., Couharde C., Coulibaly D., and Mignon V., 2014. Current accounts and oil price fluctuations in oil-exporting countries: The role of financial development. *Journal of International Money and Finance* 47: 185-201.

[69] Hesse H. and T. Poghosyan, 2016. Oil prices and bank profitability: Evidence from major oil-exporting countries in the Middle East and North Africa. In Financial Deepening and Post-Crisis Development in Emerging Markets. Palgrave Macmillan, New York 247-270.

[70] Sulong Z. and P.K. Ahmed, 2011. Ownership structure, board governance, dividends and firm value: An empirical examination of Malaysian listed firms. *International Journal of Business Governance and Ethics* 6(2): 135-161.