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THRESHOLD EFFECTS OF OIL PRICE AND OIL EXPORT ON TRADE BALANCE IN AFRICA

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ABSTRACT

The impact of various macroeconomics variables on trade deficit has been studied in large OPEC (e.g., United Arab Emirates and Kingdom of Saudi Arabia); however other African countries are still needed to be studied. This study uses the transmission oil price (OP) changes to various economic sectors to examine the threshold effects of OP and oil export on trade balance in African OPEC members (Algeria, Angola, Libya and Nigeria). This study applied Pedroni cointegration test to establish the cointegration relationship among different macroeconomics variables by using three different proxies of OP. The dynamic panel models were used to examine the long-run impact of OP changes and threshold analysis. The study found that increase in OP and oil export positively encouraged import while exchange rate depreciation is significantly discouraged import. The study found that the threshold effect of oil export on the trade balance, when oil export is above a certain threshold, the impact is higher than below threshold. The aforementioned countries have to take into account that there is a threshold level and can increase oil export to improve the trade balance.

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INTRODUCTION

The global falling in oil price (OP) witnessed in the middle of 2014 brought severe issues to the African countries to maintain favorable trade balance (TB), especially in oil-exporting countries. Occasionally OPEC (The Organization of the Petroleum Exporting Countries) members are discussing on the quantity of oil production/export shared to each member. In the earlier years, most of the African OPEC members are trying to maximize their oil production by getting a higher quota of exports. Moreover, the increase of oil export (OX) does improve their TB, recently it's seemed to be changed. An increase in oil production/export was unsuccessful in improving the TB, and this has caused a drop in OP. The oil exporting countries voluntarily agreed to reduce the oil production/export in order to have higher OP. The African OPEC members are uncertain about whether will benefit from an increase in OP or an increase in OX. Which strategy will successfully improve the overall TB? The response of exchange rate policy towards OP shock depends on how the economy relies on oil export. If the economy heavily relies on OX, a decrease in OP will lead to a decrease in oil revenue. Hence, the policy makers may devalue their currency in order to make her export more attractive. However, the outcome on TB will be ambiguous because the decrease in oil revenue will lead to a decline in the TB. In the

theory, a devaluation of currency will result in an increase in export and decrease in import, therefore this increases the TB. But in the oil-dependent economy, devaluation of currency seems to be insignificant for export as the devaluation cannot influence the OP. Due to the high dependency on oil, about 90 percent of their foreign earnings and oil exports consist of more than 80 percent of their total exports. While oil-importing countries falling in oil prices will improve their current account balance reported by (World Bank, 2014; Baffes et al., 2015). The main factor for the slowdown is weak in OP in the world market. The way these shocks can be absorbed is to associate with the effective monetary policy intervention. Although the adopting appropriate monetary tools that will stabilize the economy out of external and internal disequilibrium. The decision faces an argument among policy-makers on the effectiveness of those instruments in controlling the overall economic activities. Mostly this depends on the nature of the economy, it also depends on how the economy relies on the oil export (Feussi, 2013). External shocks can be transmitted into various economic channels such as via inflation, trade and output. Most of the oil exporting countries in African has been facing difficulties during decreasing OP shock. The central authority always delays responding when OP drops due to the

uncertainty and some assume that the relationship is linear. Thus, the policymakers have treated the shock indifference between the negative and positive changes. The increase in oil prices controlled the weakening of GDP, while the decline does not accelerate the economic activities. Several compensations were explained by the economists (Mork, 1989; Lee et al., 1995; Hamilton, 1996). Their explanations addressed the presence of an inadequate specification of the models and stressed to restore OP, macroeconomic relationship, non-linear specifications. Stress and the uncertainty of the financial markets are the sources of this asymmetry (Ferderer, 1996). Among the others, response of the monetary policy of OP fluctuation is the major cause of asymmetry (Balke et al., 2002; Brown and Yucel, 2002). The oil supply has become relatively exogenous, which significantly affects the price of oil fluctuations; this explanation fits the world experience in the 1970s. Alternatively, flexible oil supply case impersonates another case without oil supply fluctuations. The reason behind this is obvious if the supply of oil responds endogenously to determine the organization of petroleum exporting countries (OPEC), which is the quantity to supply, the world oil supply will respond. Similarly, the relative price of oil is expected to regulate (Backus and Crucini, 2000). In the literature, there are different views of evaluating the impact of OX changes and OP. For instance, the quota system shared among the OPEC members could not be depicted by the conventional supply-price nexus (Watkins and Strelfel, 1998). Moreover, a contradictory relationship was found in previous

literature between OPEC production and OP (Ramcharran, 2002). In the same year, Krichene (2002) found that the supply price elasticity for oil production is low and the following year Cleveland and Kaufmann (2003) noted that the oil supply rise lead to the decrease in OP. In contrast, Kaufmann et al. (2008) observed that the positive relationship between real prices and oil supply.

The study observed the selected variables among the OPEC member countries. Figure 1 reveals the association between import, export and trade balance (TB) for the African OPEC Members from 1970 - 2013. Generally, the total export and total import of these countries increased over the years. Periodically, these countries are experienced balance in trade whereby the trade balances fluctuated around zero. However, these countries experienced a trade surplus since 2000. This can be observed as oil price (OP) increased from the year 2000 to 2008 in which the trade surplus of these countries increased substantially. This can be observed during the falling of OP in 2008 to 2009; all these countries experienced a decrease in TB, but with different severity. Nigeria has the smallest drop as compared to other countries. Later, the OP increased from 2009 to 2011 in which the TB gradually increased for Algeria, Angola and Nigeria, except Libya. Again, Nigeria has the largest improvement in TB as compared to other countries. Libya and Algeria have a different pattern. The TB of Nigeria dropped in 2014 due to the falling of OP. However, Algeria had a sharp decrease in the TB in 2014. These asymmetric responses of TB may be caused by different policy responses towards OP shock.

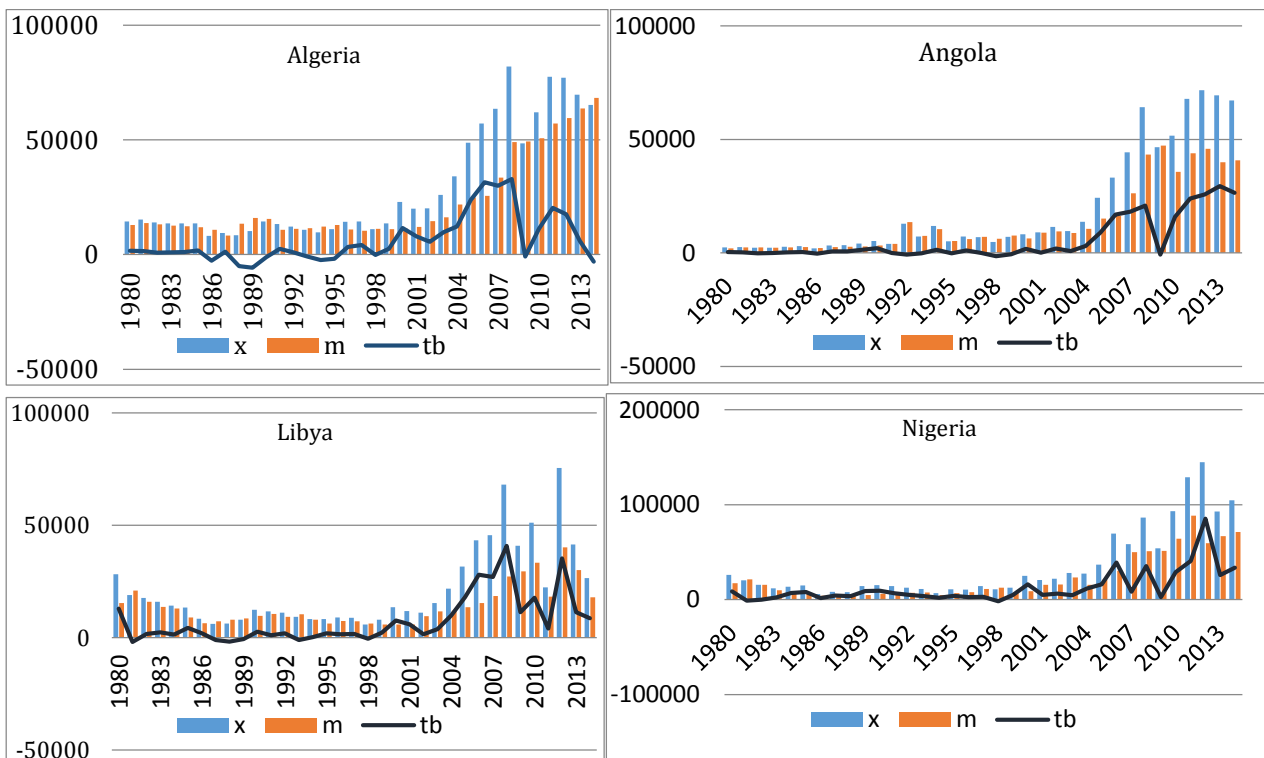


Figure 1. Imports, Exports and Trade Balance for African OPEC Members. Source: Annual Statistical Bulletin 2016.

The response of exchange rate (E) policy towards OP shock depends on the changes in OP. A decrease in OP may push the policymakers to devalue their currency in order to

discourage import and encourage export. In order to allow the nominal E to depreciate, the aim is to lessen the demand for foreign products and reduce pressure on the current

reserves. As OP dropped, the oil exporting countries' economies that are depending on the importing of finish goods for their domestic consumption are distorted due to the short supply of foreign currency. The extra demand for foreign currency pushes to devalue the domestic currency, while the oil prices were at the peak, the currency was devalued. These declarations clearly showed the possibility of non-linearity effects of OP. These oil exporting countries normally depend on importing finished goods for their domestic consumption. These countries would be inferior when their currencies were devalued (Jibrilla, 2010), especially those that are in the cartel, which has required production quota. As it can be witnessed, Algeria, Angola, Libya and Nigerian currencies were depreciated around the

1990s and those that improvement was not shown in the TB. Figure 2 illustrates how the OP changes influence E and TB in Algeria, Angola, Libya and Nigerian. These countries had a different response to the E and TB when OP changes. The TB followed the movement of OP changes, especially in Libya, except during civil war than other countries. The more complex relationship occurred during 2008 when the TB of those countries dropped more than the proportional changes in OP, particularly in Algeria, Libya, Angola and Nigeria. Based on the response of the E of those countries during the period, Libya had a more stable E than other countries, followed by Angola, Algeria and Nigeria. In general, from the period of investigation, the E showed more depreciated than appreciation even when the OP increased.

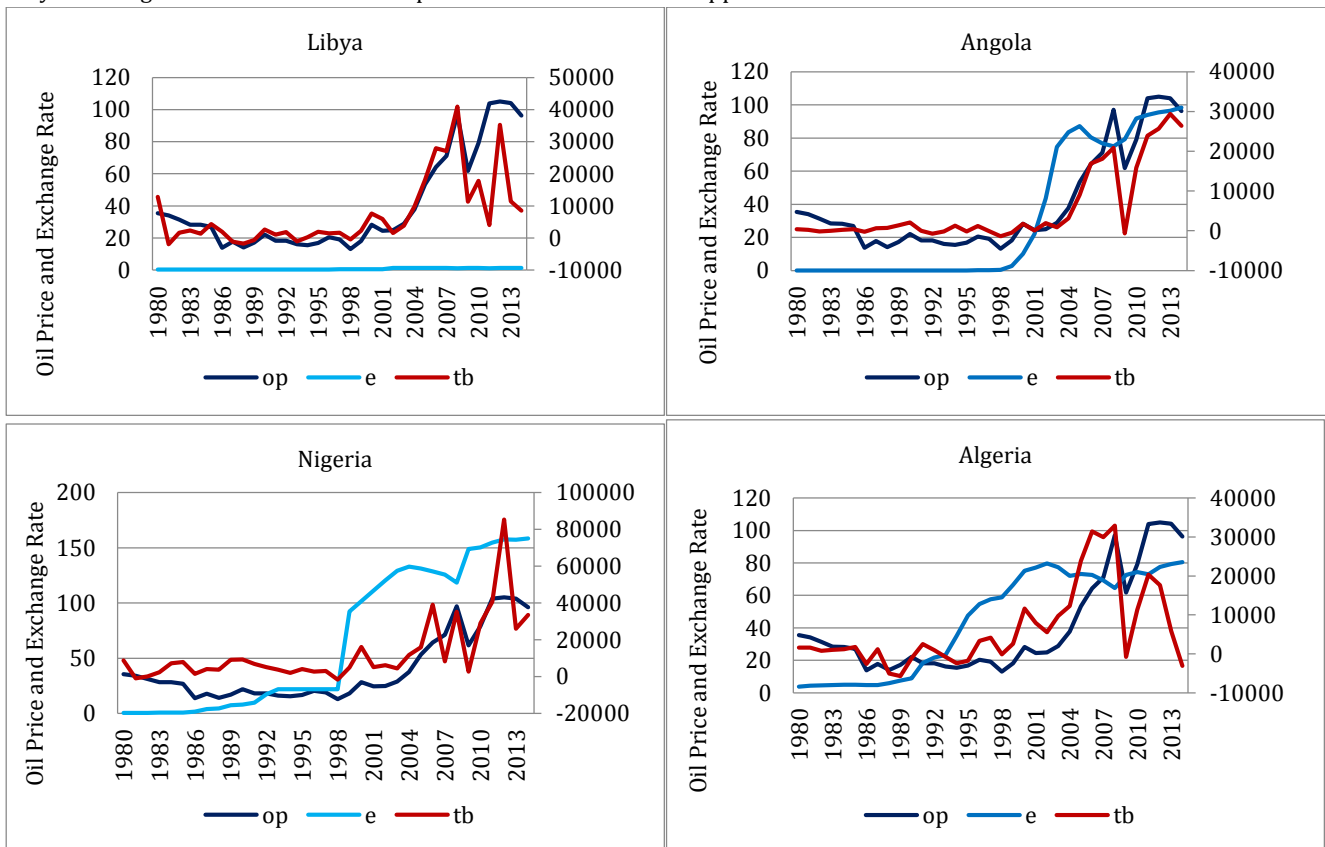


Figure 2. Oil Price (OP), Exchange Rate (E) and Trade Balance (TB). Source: Annual Statistical Bulletin 2016.

Figure 3 depicts the nexus between TB and OP for oil exporting countries indicate there is a positive relation between them. Figure 4 the relationship between TB and OP of African OPEC members. The existing argument in the OP changes literature is allowing giving more insight, contrast and good understanding the process on how the OP shocks have been previously observed. There are many different methods have been conducted that applied in the previous researches in order to investigate how economic variable indicators are affected by the OP shock. Among of these arguments,

especially the OP shock impacts are symmetry or asymmetry still debated and to what extent oil prices are endogenous. The greatest contribution of this paper is the considering the theoretical framework of how OP is transmitted into a different macroeconomic variable with the monetary policy response. Most of the early studies of OP shock are usually judged based on the standard linear time series methods, Granger causality which may leave certain properties of OP changes unexplained. These methods can examine the short-run and long-run relationships in a linear way.

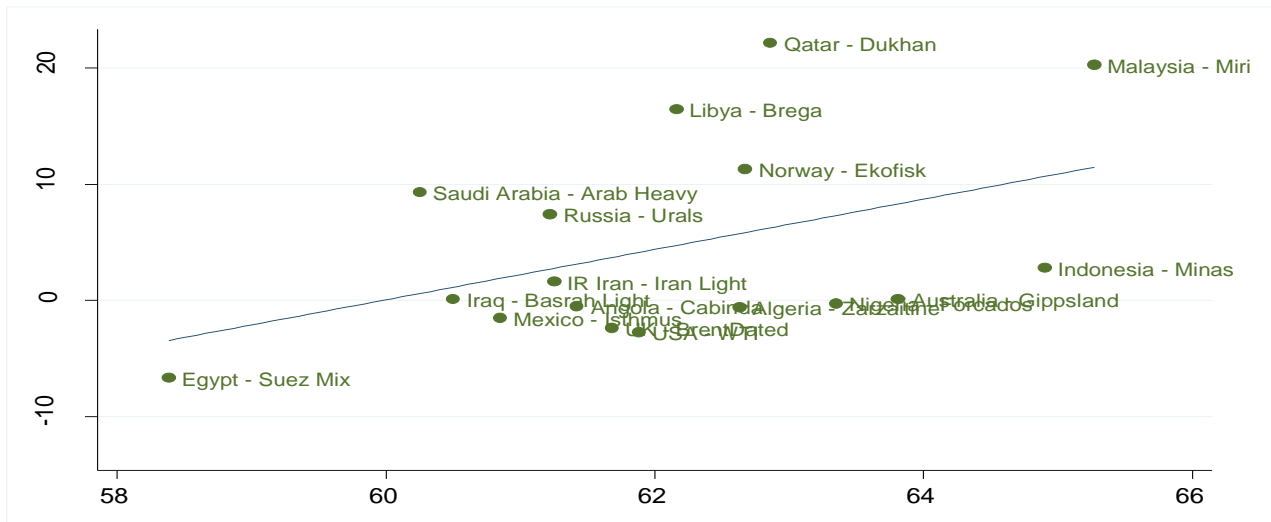


Figure 3. Oil Price and Trade Balance of Oil Exporting Countries.

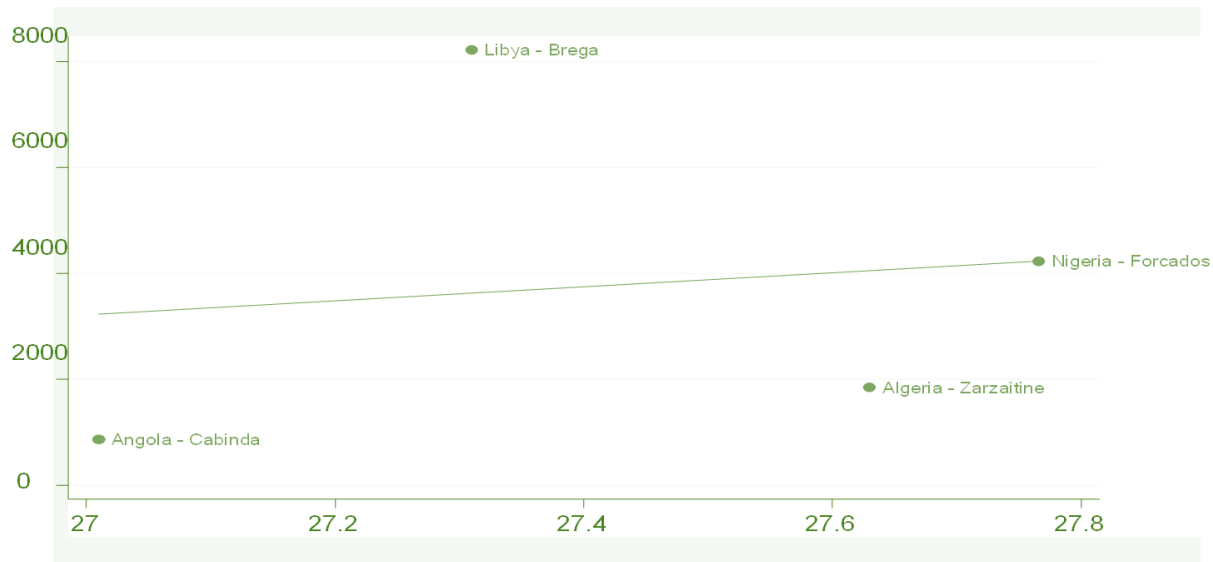


Figure 4. Oil Price and Trade Balance of African OPEC Members.

Therefore, the method does not have the power to capture the possibility of nonlinearities. This research adopted recent advance methods of the well-known ARDL model developed by Pesaran and Shin (1998); Pesaran et al. (2001). These methods are developed to capture both long-run and short-run asymmetries called non-linear ARDL cointegration approach (NARDL) by Shin et al. (2014). The test of asymmetric adjustment by Enders and Siklos, (2001) were applied for the testing of asymmetric adjustment. In the panel cointegration Tests by Pedroni (2004;1999), the MG and PMG proposed by Pesaran and Smith (1995) and Pesaran et al. (1999), dynamic OLS by Kao and Chiang (1999) and FMOLS developed by Pedroni (2000) are best way to asses asymmetric supply responses.

Research is scanty in the literature of oil price (OP) and trade balance (TB) nexus, among others Le and Chang (2013) and Schubert (2014), which studied the association between OP shocks and TB. Merchandise TB is effect by oil demand and supply fluctuations, the magnitude of the shock can be higher

based on its origin, also heavily dependent on the reaction of the non-oil TB (Kilian et al., 2009). Oil users have to pay more due to hikes in oil prices which may affect to decrease their export revenues (profit) for energy-intensive goods and services. In the short-run their current account will be automatically declined while in the long-run, the trade deficit will be decreased due to improvement in the non-oil TB. Meanwhile, policy adjustments may further amplify these effects (Kilian, et al., 2009). Moreover, escalations in the oil prices positively benefit those producers who used energy intensive as an input in their production and manufacturing process. If the countries have the ability to produce more and export to oil producing countries since that time that has enough fund. Oil demand and supply fluctuations have effects on merchandise TB, to what extent, will be determined based on the source and nature of the shock, and is highly depended on the reaction of the non-oil TB (Kilian et al., 2009). In short, lower exports and higher imports are associated with increases in oil prices, which in turn can lower the current

account balance (Abdelaziz et al., 2008; Chortareas et al., 2011), or even worsening the TB (Qianqian, 2011). An increase in world oil prices in oil-exporting countries improve the TB and hence higher current account surplus (Adebiyi et al., 2010). For instance, Yildirim and Arifli (2021) find that oil price shocks adversely impact on a small oil-exporting economy. They found that decline in OP deteriorates TB, increases inflation, causes a currency depreciation and falls economic activity.

Oil prices have key role to play in examining exchange rate (E) movements (Golub, 1983; Krugman, 1983). It's also understood from the theory of exchange rate when the OP rises exporters of crude oil are taking advantage in appreciation of their currency and vice versa (Sheehan and Kelly, 1983). Countries that are importers experience depreciation due to the high patroness of foreign products into their economy resulted in more demand for foreign currency. Therefore, rises in oil prices is a favorable development of oil producing countries, while falling in OP for the buyer's countries (Jiménez-Rodríguez and Sánchez, 2005; Setser, 2007). Theoretical relationship between E and TB has long been established (Kreuger, 1983). The trade deficit might worsen if the local currency appreciates and usually countries do opposite. Thus, countries devalue their currencies to improve TB by having more comparative advantages and international competitiveness (Bahmani-oskooee, 2001; Bahmani-oskooee and Fariditavana, 2015). The theoretical argument stated that an oil producing nations could experience appreciation in their E movement during increases in oil prices and depreciation when OP dropped (Golub, 1983; Krugman, 1983; Corden, 1984; De Grauwe, 1996; Zhou, 1995; Chaudhuri and Daniel, 1998; Akram, 2004; Aliyu, 2009; 2010). An OP shock adjusts the oil TB, the E fluctuated in other to stabilize and balancing the economy, or the non-oil TB adjusts to stabilize net foreign assets. Therefore, when positive oil shock occurred in an oil producing nation, the E appreciates while the reverse when OP dropped (Babatunde, 2015). The relationship of currency devaluation is not linear rather J-shape and added the response of devaluation on the TB into two different dimensions. Because of the depreciation of the domestic currency, the TB will respond harmfully in the short-run, while the TB will improve in the long-run after the devaluation. These ideas give the possibility of the mechanism it was claimed that in the short-run TB respond negatively is due to price effect (Bahmani-oskooee, 1985). The elasticity model has explained the possibility of the theoretical relationship between TB and E (Kreuger, 1983). The TB will eventually improve to better level compare to before devaluation (Backus et al., 1994; Bahmani-oskooee and Fariditavana, 2015; Rose and Yellen, 1989). Although there is another condition that has to fulfill before this theory hold by Marshall-Lerner if the $PED_{mx} > 1$ then the depreciation of local currency will improve the TB deficit while if the price elasticity of export and import is less than one $PED_{mx} < 1$ then the devaluation of currency will be worsening in the TB (Bahmani-oskooee, 1985). Le and Chang (2013) investigate the role OP on trade imbalance in 3 Asian countries which are signified different distinct characteristics considering of oil product are chosen as oil importer: Japan, oil refinery: Singapore and oil

exporter: Malaysia. They used monthly data from January 1999 to November 2011 and applied Toda and Yamamoto, 1995 causality approach and generalized impulse response. They found the evidence of short-run dynamics and the long-run causal nexus between oil prices to both trade balances, namely oil and non-oil trade balances. In the research of Edwards and Levy (2005) were able to found an asymmetric response in 183 countries panel analysis used Generalize Movement of Moment method, output response small during positive shock while during negative is more. Hansen and Seo (2001) found similar results that confirm the strong evidence of threshold effect in 100 to 250 countries in two regimes. Chen and Hsu (2012) in their panel analysis consist of 84 developing and developed countries used annual data were utilized within the range of 1984 to 2008. They found that vigorous and robust evidence that flows of international trade have a negative effect on trade when OP shock is significant, conclude that OP shocks hurt globalization in general. Hassan and Zaman (2012) applied ARDL to analyze the annual data ranging from 1975 to 2010 and revealed that the fluctuation of international OP disturbs the TB have created serious noticed among the policy makers around the globe which has dynamic effects in Pakistan with the negative and significant relationship. Timilsina (2015) applied general equilibrium model include multi-country and multi-sectors of both developing and developed world to examine the impact of OP increases in 25 countries and 28 sub-sectors division. They further noted that OP increases have a significant impact on global trade patterns. Countries with highly depend on energy intensive would hurt more than the in labor intensive countries. Aydın and Acar (2011) developed TurGEM-D and applied to the Turkish's economy revealed that OP fluctuation has a significant impact on major macroeconomic variables namely consumer price, GDP, and TB. Ju et al. (2014) used yearly data from 1983 to 2012 to examine the macroeconomic effect of OP in China found that import and export may be more significantly affected by the severe OP shock.

Other findings emerged with similar results that in a situation where simultaneous multiple shocks arise, non-oil balance in general equilibrium affected by oil shocks, different sources of OP shocks are related with a different transmission channel (Bodenstein et al., 2011). With these findings, clearly, indicate the important role of the non-oil TB in order to stabilize the economy after OP fluctuations occurred. Backus and Crucini (2000) found that TB response differently when the OP shock occurred not like other shocks. OP is the main factor effecting the term of trade since 25 years although its quantitative role varies over time. Dynamic general equilibrium model predicts that the economy reacts differently to oil supply fluctuations than to other crises. Bollino (2007) resulted that the higher the OP, the higher the U.S. deficit continues to grow with China. Adewuyi and Akpokodje (2010) used Nigerian annual data from 1973 to 2006 and estimate the data using OLS and GMM. They conclude that trade liberalization has not brought enough trade flows to Nigeria. Lutz and Meyer (2009) found that the advancement in international competitiveness, Germany reduced adverse impacts of increases in energy prices, brings structural change from consumer goods to investment goods. Meanwhile, other findings suggest that

despite the encouragement of integration oil prices is opposed it. Chen and Hsu (2012) revealed interesting findings that when oil prices fluctuated, the international trade flows will be dropped, then conclude that OP fluctuation harms globalization. Korhonen and Ledyeva (2010) show vigorous and robust findings that OP shocks are making oil exporters have more advantage, a positive oil shock leads to increase OP by 50 percent, Russian GDP will improve about 6 percent. Also Le and Chang (2013) categorized countries into three different variety: Malaysia oil exporting, Singapore oil refinery and Japan oil importer used monthly data from January 1999 to November 2011. Found that OP shocks cause the overall trade balances to improve in Malaysia. The positive OP shock seems to increase the oil revenues in order government to finance their expenditure and it contributes to the long-run trade surplus. Furthermore, Sato and Dechezleprêtre (2015) used a broad range of panel data sets consist of 62 manufacturing sectors, 42 countries in 16 years period 1996 to 2011. Found that the fluctuation of energy prices has larger significant impacts on energy mode of production. While the impact is less on imports, 10 percent increases in the energy price imports rise only by 0.2 percent.

Hassan and Zaman (2012) studies Pakistan economy found that there is a significant negative relationship, 1 percent increments of oil prices lead to E and TB declined by 0.382 percent and 0.342 percent accordantly. Similarly, Qasim et al. (2021) found that increase in OP and exchange rate increase the inflation in Pakistan. In recently Adam et al. (2015) applied LVAR to Indonesian data from 2004:1 to 2014:10 demonstrated similar outcome that the long-term dynamic relationship between world crude oil prices on Indonesian TB is negative. Çulha et al. (2016) used System GMM to estimate Turkish annual data from 2003 to 2013 found that the current export shares the net effect of oil prices on the exports is limited. Other researchers (Allegret et al., 2015) used global VAR model that allowed dependencies between countries. They combined a sample of 30 oil importing and oil producing countries within the period of 1980–2011 and confirmed that the main adjustment mechanism to oil fluctuations is based on the trade channel. Bao (2014) achieved that there are different impacts between the short-run and the long-run coefficient value. For instance, they found that oil prices rise by 1 percent it causes E and TB a reduction of 0.12 percent and 0.79 percent respectively in the long-run. While in the short-run, international E and oil prices are positively affected Vietnam TB which shows that there is a possibility of asymmetric response. Nicita (2013) studied 100 countries in panel analysis used fixed effect model and the data range of 10 years started from 2000 to 2009 short-run has found that E volatility in the short-run is not a major concern. There is a lot of the literature confirmed the evidence of positive relationship between OP and E (Amano and Van Norden, 1998; Chaudhuri and Daniel, 1998; Olomola and Adejumo, 2006; Benassy-Quere et al., 2007; Chen and Chen, 2007; Huang and Guo, 2007; Nikbakht, 2010; Englama et al., 2010; Adeniyi et al., 2012; Beckmann and Czudaj, 2013). Certain literature is found their interaction is negative (Akram, 2004; Huang and Guo, 2007; Ghosh, 2011). Some of the previous literature showed the evidence of a different associationship between OP and E

(Amano and Van Norden, 1995; De Grauwe, 1996; Kutan and Wyzan, 2005; Lizardo and Mollick, 2010). Possibly, the different outcomes in the literature could occur by the use of linear models, which indirectly assumed symmetric properties of an OP and exchange rates positive and negative changes.

Bouoiyour and Selmi (2015) testified trade performance and E and in Tunisia and Morocco regarding what have experienced so far using ARCH and GARCH model in the period of 1996Q1 to 2009Q4. They find that the effect of price differential volatility on export is greater than the nominal E by a huge margin in terms of the determination of increasing time. The relationship shows more complicated in Morocco it is negative and significant and so beyond greater in Tunisia. Also, Nicita (2013) have found that E instability in the short-run is not a major concern in his research of 100 countries, panel analysis using fixed effect model and the data range 2000 to 2009 also found E misalignment. Yilmaz (2012) tried to investigate whether E is a shock absorber or shocks on it on in Turkey collected data from 1990 to 2009 used structural vector autoregressive analysis found E volatility during pre-crisis is actually nominal shock, also the huge proportion of E variability would be contributed to supply and demand shock in the post 2001 crisis era, found that during post-crisis era there is sizeable critical role of E stability, absorbing these shocks and therefore require opposed monetary policy action. Chipili (2014) aimed to investigate the foreign exchange intervention and E volatility in Zambia, data index was employed in the research are in USA dollar, using GARCH model findings reveals that foreign currency intervention is the statistically weak negative impact on E volatility. Another study by Huang and Guo (2007) used Structural vector autoregressive model to determine the role of OP shock on real E in China, there outcome disclose that real OP shock would cause to a slight long-term appreciation of the real E, because China is more reliant on importing oil than their trading partners. Ramcharan (2007) studying 67 developing countries between the year 1980 to 2000 VAR models were adopted and discovered that there is significant indication that E flexibility assists an economy to absorb the shocks. Artis and Ehrmann (2006) used SVAR in their comprehensive analysis of the UK, Canada, Sweden and Denmark quarterly date range 1980 to 1998. The results show that little evidence of E acts as a shock absorber, in Denmark the E performed an extra significant function not like in UK, Canada and Sweden. Babatunde and Egwaikhide (2010) examine the relationship between import demand behaviors in Nigeria applied annual data range from 1980 to 2006. ARDL bound testing approach found the long-run relationship among the variables in the model. The findings indicate that the Marshall-Lerner condition is not held in Nigeria.

METHODOLOGY

This study applied panel strong balanced data comprising of specific spot oil price (OP) of individual countries (OPC), consumer price index (CPI), import (M), export (X), trade balance (TB), oil export (OX) exchange rate (E), money supply (M2), and gross domestic product (GDP). The sample countries Algeria, Angola, Libya and Nigeria have been based on having shared the same continent, OPEC members etc. The OP data

was used individual oil price from that country Algeria (Zarzatine), Angola (Cabinda), Libya (Brega) and Nigeria (Bonny Light). The inflation was proxy with average consumer price index (CPI), import was proxy with total import of goods and services percentage of GDP, export was proxy with the total export of goods and services percentage of GDP, TB was calculated based on total export of goods and services minus total import of goods and services, OX was proxy with the total crude oil export of a particular country, E was proxy with the average official exchange rate against USD, money supply was proxy with M2 USD and economic growth was proxy with GDP current USD. The sample period in this study is based on the availability of data also was converted to natural log.

Data Description

Descriptive statistics and correlation matrix test present the nature of the data of each variable and the relation to others in the oil price (OP) and TB nexus. Table 1 illustrates the descriptive statistics of the data mean, standard deviation, maximum and the minimum value of each variable the overall, between and within a dimension. The overall mean of annual TB is 12855.56 this indicates that on average the balance of trade in African OPEC members are within the range of 12855.56 annually, while OP has 54.83, OX has 31167.76, CPI has 74.98, the E has 59.29 and investment has 22399.96. The correlation matrix illustrates the magnitude of each variable related to the other variable.

Table 1. Descriptive statistics.

Variable		Mean	Std. dev.	Min	Max
IV	overall	22399.96	21429.25	1429.481	85736.7
	between		10424.82	12568.31	32871.81
	within		19408.07	-2592.054	78326.82
OX	overall	31167.76	23933.85	3080	94642
	between		8234.44	25538.95	43380.5
	within		22832.67	-2659.737	82429.26
E	overall	59.2915	50.3602	0.0027	158.5526
	between		45.2360	0.9945	110.3545
	within		31.3369	-29.1785	107.4897
OP	overall	53.3972	33.58019	13.07667	105.0125
	between		0	53.39722	53.39722
	within		33.58019	13.07667	105.0125
OPEC	overall	52.8825	34.32606	12.28	109.45
	between		0	52.8825	52.8825
	within		34.32606	12.28	109.45
OPC	overall	54.8368	35.6944	12.2800	114.1500
	between		0.8666	53.9565	55.8295
	within		35.6864	11.7773	113.1574
CPI	overall	74.9837	38.0718	0.0006	146.0394
	between		19.4111	53.4242	96.8450
	within		34.1070	21.5602	167.5989
M	overall	25602.21	20309.77	5196.88	88377.92
	between		8243.328	16101.07	34023.58
	within		18996.77	-1426.827	79956.55
X	overall	38457.77	30929.33	4842.335	144918
	between		11208.63	28007.48	52681.43
	within		29346.31	-3539.593	130694.4
TB	overall	12855.56	14582.85	-3100.171	85264.21
	between		3985.659	9618.906	18657.86
	within		14163.14	-7482.445	79461.92

Note: IV=investment, OX = oil export, E=exchange rate, OP = average oil price of Brent, WTI and Dubai, OPEC = OPEC reference oil price, OPC = specific oil price for the countries, CPI = consumer price index, M = import, X = export, TB = trade balance, n = 4, T = 20 and N = 80.

Econometrics Technique

The empirical study examines the impacts of OP on trade balance (TB) in four African OPEC members. From the theoretical framework was adapted from the study of Brown and Yucel (2002). OP transmission channel into TB was extracted and presented as Figure 5 implies that TB is affected by OP, CPI and exchange rate and can be presented by equation (1) as: The extracted theoretical framework of OP and TB channel can be written as:

$$tr^* = f(op, cpi, e) \quad (1)$$

Where: tr^* is a vector of import, export and TB cpi is consumer price index and e is the exchange rate.

RESULTS AND DISCUSSION

Panel Unit Root Test

This study used five different unit-root test namely Levin et al. (2002), Im et al. (2003), Breitung (1999) and Fisher-ADF and Fisher PP. The tests were firstly carried out with an intercept and secondly with an intercept and linear trend except for Breitung.

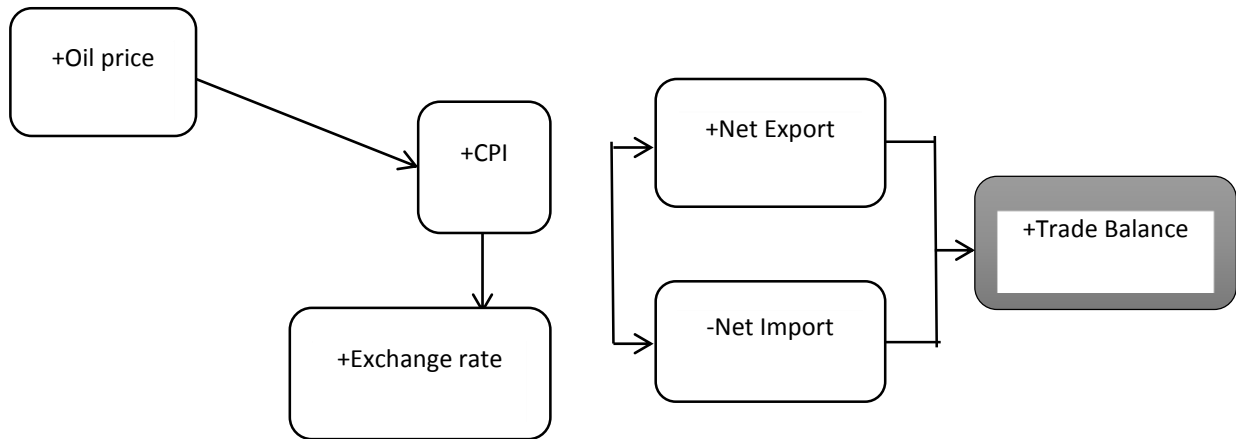


Figure 5. Oil Price Transmission Channel into Trade Balance.

Table 2 reveals that the null hypothesis cannot be rejected at the level for M, X, OX and CPI variables, except for TB, OPC, OPEC, OP, and E variables. Moreover, all the variables are stationary after converted into first difference at 1 percent and 5 percent level of significant, respectively.

Panel Cointegration Results

Based on the unit-root test results, the variables are stationary after converted to first difference, therefore this study further to determine the long-run relationship among the variables in the models of OP and TB. The Pedroni panel cointegrated techniques was used as in the previous objective. OP and oil exports are used interchangeable in each model while import, export and TB are the dependents variables. Table 3 presents the panel cointegration results for OP and TB nexus and Table 4 present the OX and TB nexus. The cointegration result in both tables reveals that three to four out of seven alternative test statistics in the each model rejected the null hypotheses of no cointegration at the 1% and 5% level of significance, except for one model with trend when import was the dependent variable. So generally, the OP models and the OX models with the three dependents variables (import, export and trade balance) are cointegrated both in the within the dimension and between dimension in African OPEC members Long-run.

Results of Oil Prices and Oil Export

Table 5, 6 and 7 present the long-run estimated coefficients of each variable in the models and their level of significant in the OP and import, OP and export and OP and TB. The fully modified OLS (FMOLS) and dynamic OLS (DOLS) estimators were used to detect the long-run parameters. This study used three different proxy of oil price OPC, OPEC and OP and estimated with two different methodologies to ensure the robustness of the findings. From Table 5, it can be observed that all the three proxy of OP are positive and significant at 1% in the both estimators. When countries oil price (OPC) was used, the impacts of OP on import become less (0.93 and 0.96) compare with OPEC reference OP (0.94 and 1.04) and the coefficient of OP oil price (0.97 and 1.06). The coefficient of OP oil price is the higher in both estimators. As shown in Table 6,

the three proxy of oil price has positively and significantly impacted the exports. Generally, the coefficient of OPC, OPEC and OP in export models are slightly larger than one. Table 7 which is the TB models, the three proxy of oil prices is positive and significant at 10% in FMOLS and 5% in DOLS estimators. The coefficients of OPC, OPEC and OP in the TB models are the lowest compared with the import and export models.

Moving to the control variables in both models, the CPI is positive and statistically significant in import model. In the import model with FMOLS estimator, the exchange rate (E) is negative and significant at 5% which shows that exchange depreciation is discouraging import while in the DOLS estimator was positive but statistically insignificant. In export and TB models, FMOLS and DOLS estimators show that the CPI and the E are statistically insignificant. The results imply that the CPI and E are not influencing the export and TB. The results are justified from previous study that oil prices Granger-cause the US dollar exchange rate (Albulescu and Ajmi, 2021). The long-run estimated results of the oil export (OX) models. It can be observed that the long-run coefficients of import, export and TB models are positively correlated with OX at 1% significant level. In both estimators, the results are similar and consistent. Moving to the control variables in both models, the CPI and E are statistically insignificant in import and TB model, while in the export model when FMOLS estimator is used the coefficient of CPI is negative and significant.

Threshold Effect of Oil Price and Oil Export on Trade Balance

Next, this study intended to find out the threshold level for OP and oil export (OX). The justification of choosing the two variables is that this study realized that from the long-run results, the only significant variables influence the trade balances are OP and OX in African OPEC members. Table 8 presents the threshold results. In the first model where OX was used as threshold variable, it is found that there is a threshold effect as the probability for 10.7731 threshold value is significant. The results indicate that the impacts of OX on TB have a different dimension below and above the threshold. The results are in agreement with previous studies (Qasim et al., 2021 and Yildirim and Arifli, 2021). In general, both the impacts of OX are positively related to trade.

Table 2. Panel Unit-root Results for Oil Price (OP) and Trade Balance (TB).

	TB		M		X		OP		OPEC		OPC		OX		CPI		E	
	No trend	Trend	No trend	Trend	No trend	Trend	No trend	Trend	No trend	Trend	No trend	Trend	No trend	Trend	No trend	Trend	No trend	Trend
Levels																		
LLC	0.32 (0.62)	-0.48 (0.31)	1.76 (0.96)	-1.92 (0.02) **	1.02 (0.84)	-1.01 (0.15)	-0.86 (0.19)	-0.42 (0.00) ***	-0.78 (0.21)	-3.98 (0.00) ***	-0.86 (0.19)	-4.00 (0.00) ***	-0.87 (0.19)	-1.44 (0.07)	7.11 (1.00)	-0.29 (0.38)	-1.74 (0.04) **	-0.89 (0.19)
IPS	0.05 (0.52)	-2.52 (0.00) ***	3.08 (0.99)	-1.04 (0.14)	2.54 (0.99)	-0.57 (0.28)	1.76 (0.96)	-1.89 (0.02) **	1.80 (0.96)	-1.63 (0.05)	1.73 (0.95)	-1.66 (0.04) **	0.62 (0.73)	-1.11 (0.13)	7.17 (1.00)	1.84 (0.96)	-0.29 (0.38)	-0.31 (0.37)
Breitung	-	-1.60 (0.05)	-	0.13 (0.55)	-	0.85 (0.80)	-	-2.35 (0.00) ***	-	-1.80 (0.03) **	-	-1.92 (0.02) **	-	-0.62 (0.26)	-	0.84 (0.96)	-	-1.10 (0.13)
Fisher ADF	8.47 (0.38)	19.95 (0.01) **	0.83 (0.99)	10.65 (0.22)	2.01 (0.98)	10.08 (0.25)	1.55 (0.99)	14.84 (0.06)	1.49 (0.99)	13.43 (0.09)	1.58 (0.99)	13.58 (0.09)	4.58 (0.80)	11.03 (0.19)	0.50 (0.99)	4.99 (0.75)	6.80 (0.55)	9.15 (0.32)
Fisher PP	13.46 (0.09)	20.36 (0.00) ***	20.09 (0.97)	13.53 (0.09)	4.18 (0.83)	13.26 (0.10)	1.02 (0.99)	13.19 (0.10)	1.02 (0.99)	11.49 (0.17)	1.08 (0.99)	11.53 (0.17)	3.88 (0.86)	10.16 (0.25)	0.16 (1.00)	3.17 (0.92)	7.81 (0.45)	2.98 (0.93)
First Difference																		
LLC	-4.90 (0.00) ***	-1.63 (0.05)	-3.18 (0.00) ***	-1.65 (0.04) **	-8.67 (0.00) ***	-6.19 (0.00) ***	-5.72 (0.00) ***	-7.93 (0.00) ***	-5.35 (0.00) ***	-4.10 (0.00) ***	-5.48 (0.00) ***	-4.04 (0.00) ***	-7.88 (0.00) ***	-4.73 (0.00) ***	-2.41 (0.00) ***	-2.03 (0.02) **	-5.28 (0.00) ***	-4.81 (0.00) ***
IPS	-6.17 (0.00) ***	-4.15 (0.03) **	-3.45 (0.00) ***	-1.88 (0.03) **	-7.93 (0.00) ***	-6.55 (0.00) ***	-5.07 (0.00) ***	-6.32 (0.00) ***	-5.25 (0.00) ***	-3.79 (0.00) ***	-5.28 (0.00) ***	-3.79 (0.00) ***	-7.15 (0.00) ***	-4.52 (0.00) ***	-1.82 (0.03) **	-1.87 (0.03) **	-4.17 (0.00) ***	-3.21 (0.00) ***
Breitung	-	-0.44 (0.32)	-	-0.48 (0.31)	-	-5.80 (0.00) ***	-	-5.87 (0.00) ***	-	-2.08 (0.01) **	-	-2.34 (0.00) ***	-	-2.47 (0.00) ***	-	-1.37 (0.08)	-	-4.84 (0.00) ***
Fisher ADF	46.52 (0.00) ***	29.64 (0.04) ***	28.01 (0.00) ***	19.25 (0.01) **	60.03 (0.00) ***	45.72 (0.00) ***	38.77 (0.00) ***	43.26 (0.00) ***	40.17 (0.00) ***	27.92 (0.00) ***	40.41 (0.00) ***	27.91 (0.00) ***	54.14 (0.00) ***	32.94 (0.00) ***	16.70 (0.03) **	15.74 (0.04) **	31.11 (0.00) ***	23.05 (0.00) ***
Fisher PP	12.33 (0.00) ***	76.42 (0.00) ***	56.94 (0.00) ***	50.71 (0.00) ***	74.16 (0.00) ***	56.72 (0.00) ***	73.68 (0.00) ***	66.82 (0.00) ***	63.32 (0.00) ***	73.68 (0.00) ***	73.05 (0.00) ***	70.78 (0.00) ***	63.59 (0.00) ***	50.06 (0.00) ***	14.61 (0.06) ***	32.48 (0.00) ***	28.61 (0.00) ***	21.74 (0.02) **

Notes: Figures in parentheses are probability values where asterisks (**) denote 5 percent level of significance and asterisks (***) represent 1 percent significance level e.g. both denote rejection of the null of non-stationary. The maximum numbers of lags length are selected based on Akaike information criterion (AIC). (#) Null hypothesis: the series is stationary.

Table 3. Panel Cointegration Results with Oil Price (OP).

Equations	$m = f(OPC + CPI + E)$		$x = f(OPC + CPI + E)$		$TB = f(OPC + CPI + E)$	
	w/o trend	with trend	w/o trend	with trend	w/o trend	with trend
Panel v-statistic	0.8467 (0.19)	-0.2234 (0.58)	-0.4670 (0.67)	-1.6236 (0.94)	7.0021*** (0.00)	5.5411*** (0.00)
Panel rho-statistic	-0.4731 (0.31)	0.5989 (0.72)	-1.2597 (0.10)	-0.0255 (0.48)	-0.6562 (0.25)	0.5052 (0.69)
Panel PP-statistic	-1.7946** (0.03)	-0.7636 (0.22)	-7.8232*** (0.00)	-10.298*** (0.00)	-0.2369 (0.40)	1.2253 (0.88)
Panel ADF-statistic	-1.7996** (0.03)	-0.9081 (0.18)	-4.0617*** (0.00)	-4.0416*** (0.00)	-1.3060* (0.09)	0.4670 (0.67)
Group rho-statistic	0.3158 (0.62)	1.7195 (0.95)	-0.1043 (0.45)	1.1233 (0.86)	-0.9620 (0.16)	0.3437 (0.63)
Group PP-statistic	-1.9696** (0.02)	-0.0500 (0.48)	-7.7594*** (0.00)	-10.477*** (0.00)	-3.8851*** (0.00)	-4.9535*** (0.00)
Group ADF-statistic	-2.0487** (0.02)	-0.9655 (0.16)	-3.1975*** (0.00)	-2.6391*** (0.00)	-3.4157*** (0.00)	-2.7087*** (0.00)

Notes: Figures in parentheses are probability values where asterisk (*) shows 10 percent level of significance, asterisks (**) denote 5 percent level of significance and asterisks (***) represent 1 percent significance level.

Table 4. Panel Cointegration Results with Oil Exports.

Equations	$m = f(OX + CPI + E)$		$x = f(OX + CPI + E)$		$TB = f(OX + CPI + E)$	
	w/o trend	with trend	w/o trend	with trend	w/o trend	with trend
Panel v-statistic	0.4872 (0.31)	-0.3463 (0.63)	-0.2948 (0.61)	-1.2033 (0.88)	6.5821*** (0.00)	6.2166*** (0.00)
Panel rho-statistic	-0.3360 (0.36)	0.8430 (0.80)	-0.8994 (0.18)	0.6747 (0.75)	-0.7275 (0.23)	-0.3894 (0.34)
Panel PP-statistic	-1.5216* (0.06)	-0.2543 (0.39)	-5.6401*** (0.00)	-9.1532*** (0.00)	-0.5716 (0.28)	-0.5690 (0.28)
Panel ADF-statistic	-1.9629** (0.02)	-0.7277 (0.23)	-5.2819*** (0.00)	-6.2622*** (0.00)	-0.9222 (0.17)	-0.6294 (0.26)
Group rho-statistic	0.4430 (0.67)	1.9947 (0.97)	-0.4676 (0.32)	0.9373 (0.82)	-0.3983 (0.34)	0.3664 (0.64)
Group PP-statistic	-1.5361* (0.06)	0.2858 (0.61)	-7.3209*** (0.00)	-10.524*** (0.00)	-3.3300*** (0.00)	-4.4480*** (0.00)
Group ADF-statistic	-2.3275** (0.01)	-1.0423 (0.14)	-6.8990*** (0.00)	-7.8719*** (0.00)	-1.3971 (0.08)	-2.7383*** (0.00)

Notes: Figures in parentheses are probability values where asterisk (*) shows 10 percent level of significance, asterisks (**) denote 5 percent level of significance and asterisks (***) represent 1 percent significance level.

Table 5. FMOLS and DOLS Results with Import.

Variable	FMOLS	FMOLS	FMOLS	FMOLS	DOLS	DOLS	DOLS	DOLS
OPC	0.939*** (21.13)	-	-	-	0.963*** (3.87)	-	-	-
OPEC	-	0.947*** (21.50)	-	-	-	1.0441*** (4.18)	-	-
OP	-	-	0.970*** (21.51)	-	-	-	1.0610*** (3.76)	-
OX	-	-	-	0.8736*** (14.90)	-	-	-	0.8968*** (9.16)
CPI	0.164*** (2.75)	0.172*** (2.92)	0.184*** (3.14)	0.0160 (0.18)	0.708** (2.65)	0.5758* (2.14)	0.7112** (2.48)	0.2431 (1.43)
E	-0.151** (-2.21)	-0.159** (-2.36)	-0.174** (-2.59)	-0.0306 (-0.31)	0.3040 (0.95)	0.2559 (0.78)	0.1872 (0.51)	0.1593 (-0.36)

Notes: Figures in parentheses are t-statistics values where asterisk (*) shows 10 percent level of significance, asterisks (**) denote 5 percent level of significance and asterisks (***) represent 1 percent significance level.

Table 6. FMOLS and DOLS Results with Export.

Variable	FMOLS	FMOLS	FMOLS	FMOLS	DOLS	DOLS	DOLS	DOLS
OPC	1.059*** (20.07)	-	-	-	1.270*** (4.21)	-	-	-
OPEC	-	1.059*** (19.76)	-	-	-	1.301*** (4.01)	-	-
OP	-	-	1.091*** (20.36)	-	-	-	1.2978*** (3.87)	-
OX	-	-	-	1.003*** (32.67)	-	-	-	1.0037*** (5.63)
CPI	0.0386 (0.54)	0.0490 (0.68)	0.0661 (0.95)	-0.0987** (-2.17)	0.1763 (0.54)	0.0516 (0.14)	0.1976 (0.57)	0.1672 (0.81)
E	0.0105 (0.13)	0.0003 (0.004)	-0.0218 (-0.27)	0.0918 (1.79)	0.2808 (0.72)	0.2646 (0.62)	0.2310 (0.53)	0.1279 (0.44)

Notes: Figures in parentheses are t-statistics values where asterisk (*) shows 10 percent level of significance, asterisks (**) denote 5 percent level of significance and asterisks (***) represent 1 percent significance level.

Table 7. FMOLS and DOLS Results with Trade Balance (TB).

Variable	FMOLS	FMOLS	FMOLS	FMOLS	DOLS	DOLS	DOLS	DOLS
OPC	0.5105* (1.92)	-	-	-	0.4970** (2.17)	-	-	-
OPEC	-	0.4960* (1.85)	-	-	-	0.4979** (2.17)	-	-
OP	-	-	0.5237* (1.90)	-	-	-	0.5055** (2.14)	-
OX	-	-	-	0.6622*** (2.79)	-	-	-	0.6383*** (3.18)
CPI	-0.1433 (-0.40)	-0.1328 (-0.37)	-0.1306 (-0.36)	-0.2760 (-0.78)	-0.0972 (-0.23)	-0.0809 (-0.19)	-0.0517 (-0.12)	-0.0349 (-0.10)
E	0.2340 (0.57)	0.2245 (0.54)	0.2197 (0.53)	0.2974 (0.75)	0.2808 (1.28)	0.4395 (1.17)	0.4477 (1.19)	0.3524 (1.08)

Notes: Figures in parentheses are t-statistic values where asterisk (*) shows 10 percent level of significance, asterisks (**) denote 5 percent level of significance and asterisks (***) represent 1 percent significance level.

Table 8. Threshold Effect of Oil Price (OP) and Oil Exports (OX) on Trade Balance (TB).

Variable	Model 1			Model 2		
	Coefficient	Std-Error	T-Stat	Coefficient	Std-Error	T-Stat
τ Effects	10.7731*	< τ 10.7713	> τ 10.8073	-	-	-
Oil Export < τ	1.3659***	0.4036	3.38	-	-	-
Oil Export > τ	1.4852***	0.3951	3.76	-	-	-
τ Effects	-	-	-	4.5481	< τ -	> τ -
Oil Price < τ	-	-	-	1.3430***	0.4620	2.73
Oil Price > τ	-	-	-	1.1340**	0.4434	2.56
CPI	-0.4208	0.3159	-1.33	0.5661	0.3665	0.15
E	0.4777	0.3551	-1.35	0.2873	0.4060	0.07
IV	-1.0093	0.3503	-2.88	-0.2552	0.3413	-0.75
Cons	5.0723	2.2655	2.24	6.4986***	1.9469	3.34

Notes: The dependent variable is the log of trade balance. Standard errors are given in brackets and the bootstrapped p-value in parentheses asterisk (*) shows 10 percent level of significance, asterisks (**) denote 5 percent level of significance and asterisks (***) represent 1 percent significance level. Following Hansen (1999), each regime has to contain at least 5% of all observations. 1000 bootstrap replications were used to obtain the p-values to test for the threshold effects.

But the impact of OX above the threshold is higher than below the threshold point. The results illustrate that the TB in African OPEC members' are more favorable when OX is increases or than decrease. The results can be justified from previous study

(Salisu et al., 2021). In explaining the control variables, the CPI and E are insignificant in the threshold model, this is also confirmed and robust the previous results in the FMOLS and DOLS estimations. In the second model where OP was used as

threshold variable, it is found that the threshold effect is insignificant. This shows that it not always increases in OP is enhance trade balance surplus while additional OX above a certain level is encouraging trade balance positively.

CONCLUSION AND POLICY IMPLICATIONS

This study examined the impact of oil price (OP) on trade balance (TB) and concluded that the exchange rate (E) depreciation significantly discourages import but insignificant in export and TB counterpart. The results provided more insight on how E works in oil depending countries and how devaluation can make foreign goods more expensive while the price of domestic export (crude oil) is not affected. Hence, the devaluation in oil exporting country currency cannot make its crude oil cheaper. In the threshold analysis, this study concluded that the impact of oil export (OX) on TB has threshold effects when OX is above the threshold and the impact is higher than below the threshold. For countries that are highly dependent on OX, the increase of OX will further improve the TB. For countries that are not highly dependent on OX, the increasing in OX will slightly improve their TB. However, the threshold effects are insignificant when OP was used as threshold variable. This study found that there are robust policy suggestions to the policy makers that heavily rely on OP. This is done in order to gain understanding on the dynamics effects of OP, OX and E policy. The E depreciation or devaluation is an ineffective measure to improve the TB. It's significant in discouraging import while insignificant in encouraging export and TB as the devaluation or depreciation in domestic currency cannot make the domestic crude oil cheaper in the world market. The policymakers have to take into account that there is a threshold level to be considered when OX is above the threshold and the impact is higher than below the threshold. For the countries that are highly dependent on OX, the government can increase OX to improve the TB. However this does not work for countries that are not highly oil dependent.

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