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Original article

Is the Relationship Between the Price of Oil and Economic Growth Asymmetrical in Togo?

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Abstract *- This research examines the effect of oil prices on economic growth in Togo, a low-income oil importing country. In a non-linear NARDL framework, asymmetries are introduced by accumulating oil price increases separately from decreases through the partial sum processes of positive and negative changes. Using annual data for 1980-2017, the results reveal that oil price fluctuations asymmetrically affect the country's economic growth in the short and long run. We observe a larger positive asymmetric effect of lower oil prices on growth than the negative effect of higher prices. The country should benefit from a sustained decrease in oil prices and implement effective energy policies. But implementing a sound economic diversification policy would help move away from dependence on oil to other types of sustainable energy, especially in times of soaring oil prices*

Keywords *- Oil price fluctuations, asymmetric effects, NARDL, economic growth, Togo*

I. INTRODUCTION

Oil is an important raw material for global production, and fluctuations in its price significantly affect economic activity (Baumeister and Hamilton, 2019; Gong and Lin, 2017; Kilian, 2009; Wen et al., 2016). Today, oil remains the largest primary energy source in the world and therefore plays an important role in the global economy, with a market share of 40.7% of global energy consumption and a predominance in the transport sector, where it accounts for 94% of the energy used (IEA 2012; Rotimi and Ngalawa, 2017; Wachtmeister et al., 2018). According to the 2017 British Petroleum (BP) report, this share is 42% in sub-Saharan Africa (BP, 2017). The fluctuation of oil prices has become a global phenomenon felt by countries around the world due to the rapid increase in oil consumption over the period, especially in importing countries with volumes estimated at 98.2 mb/d in 2017, compared to 59,522.50 million barrels per day in 1980, recording an increase of 39.39% and projected to reach 195 mb/d until 2040 with an increase of 77% (British Petroleum Report, 2018).

In recent years, according to studies by the International Monetary Fund (IMF), the countries of the West African Economic and Monetary Union (WAEMU) are one of the regions that are not immune to growing economic uncertainties and external shocks emanating from the international situation (IMF, 2017). Also, falling into the category of low-income countries (IMF, 2017), Togo is further revealed as a country with a high dependence on oil and its derivatives. Its heavy dependence on the international market for commodities and petroleum products to guarantee its growth and strengthen its industrial fabric could accentuate its vulnerability to the global economic situation. The consumption of petroleum products increased from 4100 barrels per day in 1980 to 8800 in 2003, and then to nearly 15550 barrels per day in 2017 (Ushebrooke base, 2017 and INSEED, 2018).

Several types of research on the effect of oil price fluctuations are conducted internationally on many macroeconomic indicators for oil-exporting countries as well as oil-importing countries (Ratti and Vespignani, 2016), attracting the attention of policymakers and investors due to its volatile nature. In this context, this concern of the relationship between oil price and economic growth is also that of African countries. Primarily, Babuga and Naseem (2021) argue that African countries have in common oil, which they all import for domestic use, including the main use of their various manufacturing activities.

However, specifically in the situation of low-income West African countries, the uneven effect of oil price changes on growth, the so-called "asymmetric effect", remains poorly elucidated in previous research. Not with standing the fluctuation of oil prices in the crucial international market, the increased and rapid role of oil in these economies due to a significant increase in energy import demand combined with a sustained increase in economic growth, oil dependence remains a major concern due to the increasing expenditure on energy in various sectors of economic activity, especially in transport, extractive industries, trade and for domestic needs (Saidu et al., 2021). This could expose them to a situation of vulnerability to oil price fluctuations.

The interest of this research is to investigate in the specific case of Togo the effects of oil price fluctuations on economic growth to further explore and better understand the nature of the link between oil price and economic growth. Our research question is: Are there asymmetric effects of oil price fluctuations on economic

growth in Togo? To achieve our research objective, we use the approach of Shin et al. (2014).

The remainder of this paper is structured as follows: Section 2 presents a review of the literature. Section 3 presents the methodology, model specification, and data used. Section 4 provides the empirical analysis with a discussion of the results. Finally, the last section presents the conclusion of the results and policy implications.

II. LITERATURE REVIEW

Since the pioneering work of Mork (1989), a plethora of studies have shown that oil price increases have a disproportionate effect on economic growth and other economic variables compared to oil price decreases, alluding to non-linear relationships involving asymmetric effects. Later research also confirms the importance of considering non-linearities in the link between oil prices and GDP (Hamilton, 2003; Jiménez-Rodríguez and Sánchez, 2005; Zhang, 2008; Cologni and Manera, 2009; Kilian and Vigfusson, 2014; Nusair 2016; Raheem, 2017). Since, for some, the drop in oil price in 1986 failed to sustain higher growth and economic boom due to uncertainty in global demand, factor reallocation, and structural changes, while others point out that the drop in oil price would stimulate economic growth. Although the literature on the relationship between output and oil prices for importing countries is extensive, it provides a mixed and more awkward debate that is only partially resolved by considering the asymmetric effects of rising and falling oil prices and by separating the short-term from the long-term effects of oil price changes.

Early work studying the effects of oil price changes on the economy assumed a linear relationship, implying symmetric effects for increases and decreases in oil prices on the economy (Hamilton, 1983; Burbidge and Harrison, 1984). Mork and Hall (1980), Guo and Kliesen (2005) also analyzed the impact of oil price on the US economy and found a negative impact of oil price on output and other macroeconomic variables. However, when the decline in oil prices began to have a smaller positive effect on the economy than the linear models predicted, this consideration of the linear relationship began to be questioned in the mid-1980s (Lardic and Mignon. 2006; Jimenez-Rodríguez, 2009). As a result, Mork (1989), Lee et al. (1995), and Hamilton (2003) proposed non-linear transformations of oil prices by separating positive changes (increases) from negative changes (decreases) in oil prices.

In particular, Mork (1989) finds an asymmetry between US economic activity and oil price changes and that the effects of oil price increases were different from those of decreases and that oil price decreases were not statistically significant. Jiménez-Rodríguez and Sánchez (2005), in an empirical analysis of selected OECD countries, also explained that the effects of oil prices are non-linear on real GDP, while Cologni and Manera (2009) suggest that the effect of oil prices on economic growth in the advanced G-7 countries is best explained by a nonlinear rather than linear relationship. Lee et al. (2001) and Zao et al. (2016) reveal that oil price increases on economic growth have negative effects for Japan and China, respectively. Similarly, Akinsola and Odhiambo (2020), focusing on a panel of low-income oil-importing African countries, and Gbatu et al. (2017b) on a low-income country Liberia, examined the effect of oil price shocks. They found an asymmetric relationship between oil price and economic growth. Rafiq et al. (2009) examined the relationship between oil price on output and other macroeconomic variables for the Thai economy. They also confirmed a negative effect of upward fluctuations in oil prices on output and other macroeconomic variables.

Similarly, using VAR methodology, Du et al. (2010) examined the effect of oil price on economic growth in China using VAR methodology. The study used the linear and non-linear specifications of oil prices. For the linear specification, they found that a 100% increase in oil price had a positive effect on economic growth and resulted in a 9% increase in GDP. However, the non-linear specification of the model gave different results. They found that a 100% increase in oil prices hurt Chinese GDP growth. GDP decreased by 17% using the Mork (1989) skewness transformation, a 10% decrease for the Hamilton (1996) transformation, and a 1% decrease for the Lee et al. (1995) transformation. The study confirmed a non-linear and asymmetric relationship between oil prices and economic growth, as shown in the theoretical literature.

Also, Tefera et al. (2012) focused on another low-income country by examining the consequences of the impacts of oil prices and oil subsidies on the Ethiopian economy. They found that the increase in oil price depreciates the currency, the Ethiopian Birr, and eventually affects economic growth negatively. In short, these studies show that economic activity responds in a non-linear and therefore asymmetric way to oil price fluctuations.

In general, oil price changes affect oil exporters almost in the opposite direction to oil importers. Indeed, Grigoli et al. (2019) suggest that oil price declines in 2014 and 2016 harmed the output of 44 oil-exporting countries. Countries with a diversified export base with adequate capital reserves and a fundamentally sound economy had weathered the economic impacts best. Charfeddine and Barkat (2020) and Nusair (2016) report a larger positive effect of positive oil price changes than negative changes on the total output of Qatar and Kuwait, while Nusair (2019) finds that higher oil prices increase GDP but decrease in case of lower oil prices in the GCC countries. Examining the effect of oil price fluctuations on ten Asian countries and the United States, Abeysinghe (2001) shows that even net oil-exporting countries such as Indonesia and Malaysia are vulnerable to the negative effects of rising oil prices. In terms of cross-country studies, Cunado and Perez-de Gracia (2003) analyzed 14 European countries using quarterly data from 1960 to 1999 and applying a VAR technique. They found a direct relationship between oil prices and GDP for half the countries, but no direct relationship for the other half. They explained that

choosing either world oil prices or a national real oil price index influences the difference between oil prices and output. They also found that only the UK and Ireland exert a long-run relationship between oil prices and output. Therefore, the effect of oil shocks on economic growth is limited in the short run.

With a VAR analysis, Rafiq and Salim (2011) examined the effect of oil price fluctuation on six emerging Asian countries. Their results for China and Malaysia showed that oil price volatility has an effect on output growth in the short run. In contrast, for the Philippines, oil price only affects inflation, while oil price volatility affects both GDP growth and inflation in India and Indonesia. For Indonesia, however, the effect was felt before and after the Asian crisis. Oil price changes affect GDP growth but seem to disappear after the Asian crisis for Thailand,

Similarly, for Nusair and Olson (2021), the results suggest that oil price changes do not affect domestic output in the linear ARDL (Autoregressive Distributed Lag) model. However, with NARDL (Nonlinear Autoregressive Distributed Lag), they observe a larger asymmetric effect of higher oil prices on output than lower prices, but the effects vary across ASEAN-5 countries as well as Japan and Korea. Gbatu et al. (2017a) examined the asymmetric effects of oil shocks and exchange rate fluctuations on real GDP for a panel of ECOWAS countries. The fixed-effects model was used. They further show that exchange rate volatility harms the sample for all ECOWAS countries and net oil-importing countries.

Bacon (2005) examined the effect of rising crude oil prices for 131 countries. The study found that the effect was more severe for poorer oil-importing countries than for developed countries. For example, a 10% increase in the price of crude oil resulted in a 4% decline in economic growth for countries with a GDP per capita of less than US$300. If the increase in oil price is doubled, the shock has also been doubled. However, countries with a GDP per capita of more than US$9,000 and higher foreign exchange reserves experienced an average decline of 0.4% in economic growth.

However, Khan et al. (2019) use the NARDL approach with quarterly data for the period 1980 to 2014 to study the asymmetric impacts of oil price changes on 13 Asian economies. Overall, their results suggest the absence of asymmetry in the long-run relationship between oil price changes and output in most countries. Yet Salisu and Isah (2017) examined the non-linear relationship between oil prices and stock prices in oil-importing and exporting countries. They found that stock prices respond asymmetrically to changes in oil prices in both groups of countries.

From our review of the literature, we can conclude that there is a lack of consensus on the effects of oil price changes on economic activity in countries. To better understand the contradictory results reported in the literature, we now examine how oil price fluctuations affect economic growth in Togo as this literature has identified oil price as a dominant commodity and determinant of economic growth.

III. METHODOLOGY AND DATA SOURCE

A. Data

The data cover the periods from 1980 to 2017. They allow us to examine the dynamic relationship between oil price fluctuations and economic growth. Data on variables (GDP, inflation, interest rate, government expenditure, tax revenue, and real effective exchange rate) were obtained from the World Bank's Word development indicators (WDI) 2019 database, the
Bruegel datasets database and INSEED. Data on international oil prices were obtained from the UNCTAD database.

B. Empirical specification and methodology

The theoretical model used is based on a reduced form derived from the IS-LM model following Mills and Pentecost (2001). Bahmani-Oskooee and Mohammadian (2018) modify this model by including a measure of fiscal policy and oil price (Nusair and Olson, 2021), constructing an alternative model for the effect of oil price on output. Then we infer:

$$LnRGDP_t = \alpha_0 + \lambda_1 LnRGDP_{t-1} + \lambda_2 LnPP_{t-1} + \lambda_3 INF_{t-1} + \lambda_4 IR_{t-1} + \lambda_5 LnDGOUVR_{t-1} + \lambda_6 LnRTS_{t-1} + \lambda_7 LnREER_{t-1} + \varepsilon_t \quad (1)$$

Where $Ln\ RGDP_t is$ the logarithm of real GDP, and $LnPP_t$is the logarithm of the real price of oil in Dubai $etINF_{t-1}$, IR_{t-1}, $LnDGOUVR_{t-1}$, $LnRTS_{t-1}etLnREER_{t-1}$ are inflation, interest rate, government expenditure, tax revenue, and real effective exchange rate respectively, $\alpha_0$is the constant, $\mathcal{E}_t$is the white noise error term, λ_1 à λ_7 are the long-run coefficients. Some of the variables are converted to logarithm for consistency and reliability of empirical results (Shahbaz et al., 2017).

The previous equation can also be expressed in a non-linear form by the following equation;

$$LnRGDP_t = \alpha_0 + \lambda_1 LnRGDP_{t-1} + \lambda_2^+ LnPP_t^+ + \lambda_3^- LnPP_t^- + \lambda_3 INF_{t-1} + \lambda_4 IR_{t-1} + \lambda_5 LnDGOUVR_{t-1} + \lambda_6 LnRFR_{t-1} + \lambda_7 LnREER_{t-1} + \varepsilon_t \quad (2)$$

Where lnPP is the oil price while $\lambda_2^+ LnPP_t^+ \ and \ \lambda_3^- LnPP_t^-$are the positive and negative decomposition of the oil price using a partial sum process defined as:

$$LnPP_t^+ = \sum_{j=1}^{t} \Delta PP_j^+ = \sum_{j=1}^{t} max\left(\Delta \mathrm{Ln}PP_j, 0\right) and LnPP_t^- = \sum_{j=1}^{t} \Delta PP_j^- = \sum_{j=1}^{t} min\left(\Delta \mathrm{Ln}PP_j, 0\right)$$

Since the NARDL model is an asymmetric extension of the linear ARDL model of Pesaran et al. (2001), it is the useful following (Shin et al., 2014; Nusair, 2019; Lacheheb and Sirag, 2019) in order to account for the asymmetries in order to produce the NARDL model, to rewrite the error correction model (ECM) as follows:

$$-/\Delta LnRGDP_t = \rho Z_{t-1} + \sum_{j=1}^{p} \theta_1 \Delta RGDP_{t-j} + \sum_{j=0}^{q} (\theta_2^+ PP_t^+ + \theta_3^- PP_t^-) + \sum_{j=0}^{q} \theta_4 INF_{t-j} + \sum_{j=0}^{q} \theta_5 IR_{t-j} + \sum_{j=0}^{q} \theta_6 \Delta \mathrm{DGOUVR}_{t-j} + \sum_{j=0}^{q} \theta_7 \Delta RTS_{t-j} + \sum_{j=0}^{q} \theta_8 \Delta REER_{t-j} + \mathcal{E}_t \quad (3)$$

Where $Z_{t-1} = LnPIBR_{t-1} - \lambda_2^+ LnPP_t^+ - \lambda_3^- LnPP_t^- - \lambda_4 INF_{t-1} - \lambda_5 IR_{t-1} - \lambda_6 LnDGOUVR_{t-1} - \lambda_7 LnRTS_{t-1} - \lambda_8 LnREER_{t-1}$

and$z_{t-1}$is the nonlinear error correction term, $\lambda_2^+ = \frac{\theta_2^+}{\rho}$ and $\lambda_3^- = \frac{\theta_3^-}{\rho}$ are the long-run asymmetric parameters, $\mathcal{E}_t$ is the white noise error term, $\lambda_4 \, to \, \lambda_8$ are the long-term coefficients,$\theta_1$and $\theta_8$is the short-term coefficients. p and q are the optimal lags on the first difference variables selected by some information criteria, such as the Schwarz Information Criterion (SIC) or Akaike Information Criterion (AIC). The ARDL procedure consists in establishing the long-run relationship between the variables by testing the null hypothesis of non-cointegration($\theta_1 = \theta_2 = \theta_3 = \theta_4 = \theta_5 = \theta_6 = \theta_7 = \theta_8 = 0$)versus the alternative of cointegration($\theta_1 \neq \theta_2 \neq \theta_3 \neq \theta_4 \neq \theta_5 \neq \theta_6 \neq \theta_7 \neq \theta_8 \neq 0$).

For this purpose, two-unit root tests are applied, namely the Augmented Dickey and Fuller (ADF) test (1979) and the Philips and Perron (PP) test (1988), before the cointegration check. Like the ARDL boundary test of Pesaran et al. (2001), the NARDL boundary test was used to capture the existence or not of long-run cointegration of the asymmetric effect instead of the symmetric effect. The NARDL model, developed by Shin et al. (2014), is an extension of the linear ARDL limit test approach. The advantage of this approach is that it allows for a mixed model of series, which are stationary at I(0) and I(1), with at least the dependent variable series being stationary at I(1). It has better properties for small samples (Odhiambo, 2010; Caporale and Pittis, 2004; Narayan, 2005). Moreover, the NARDL model would avoid endogeneity and provide efficient and unbiased estimation Wen et al. (2019).

The F-test was used to determine the existence of a long-run relationship in the model. The null hypothesis is that there would be no cointegration in the model. This null hypothesis was applied in equations (3). Three results were achieved: 1) we have enough evidence to reject the null hypothesis if the value of the F-statistic exceeds the upper critical limits. 2) We do not have enough evidence to reject the null hypothesis if the value of the F-statistic was below the respective lower critical limit. 3) The result is inconclusive if the value of the F-statistic is between the value of the upper critical limit and the value of the lower critical limit.

We apply the CUSUM and CUSUM of Squares tests of Brown et al. (1975) to test the stability of the parameters over the estimation period. The parameter is considered stable if the plot of the cumulative sum of residual squares does not exceed the upper or lower bounds. In addition, some diagnostic tests such as Breusch-Godfrey LM, Jarque-Bera, and ARCH are used to ensure the goodness of fit of the model. A Wald test would be used to examine and validate significance and to distinguish the importance of positive and negative effects.

IV. RESULTS AND DISCUSSION

A. Results of the stationarity test

As a preliminary test, all variables are subjected to a unit root test to verify the degree of integration of stationarity at either the I(0) or first difference I(1) level. Although the ARDL or NARDL model allows variables to be used at both levels of integration, it must be ensured that no variable is at the second difference I(2). To this end, the Augmented Dickey and Fuller (ADF) (1979) and Philips and Perron (PP) (1988) tests are applied. Overall in Table 1, the two tests illustrate almost similar results, namely that all variables are all integrated of order one I (1), except the inflation variable, which is integrated of order zero I(0). This justifies the use of the NARDL model.

Table 1. ADF and PP unit root test results

Variables	In level		In first difference	
	ADF test	PP test	ADF test	PP test
Real Gross Domestic Product (RGDP)	3,671	-3,671	-4,187***	-4,316***
Price per barrel of oil (PP)	-1,304	-1,356	-5,430***	-5,430***
Inflation (INF)	-4,301***	-4,366***	-4,301***	-4,366***
Real interest rate (IR)	-1,172	-1,040	-6,222***	-6,872***
GovernmentExpenditures (Dgouvr)	5,008	6,200	-4,614***	-3,949***
Tax revenue (RTS)	1,899	1,817	-5,267***	-5,327***
Real effective exchange rate (REER)	-0,873	-1,098	-5,096***	-5,047***

*Note: ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.*

B. Bound test and cointegration test

In Table 2, we find that all variables are cointegrated in the long run. This result is strongly supported by the

results of the negative and significant ECT at the 1% level, which is presented in Table 4. The F-statistic of the model with real GDP (RGDP) as the dependent variable is F= 5.157. It exceeds the upper critical limit at a 1% level of significance. This means that the null hypothesis of no cointegration between the variables at the 1% level is rejected. This suggests the existence of a long-term relationship between economic growth and the explanatory variables.

Table 2. Results of the cointegration test

F-test of statistical limits		**Null hypothesis:** no level relationship		
	Value	Significance	I(0)	I(1)
F-statistics	5.157***	10%	1.92	2.89
		5%	2.17	3.21
		1%	2.73	3.9

*Note: ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.*

C. Results and discussion of the NARDL estimation: Asymmetric effect.

We estimate the long-run effect of oil price on economic growth using the NARDL framework. Table 3 summarizes the results of the non-linear relationship between the real oil price and economic growth by showing the upward and downward fluctuation variables. The effect of oil price increases and decreases on economic growth are significant in the long run. In other words, both upward and downward fluctuations in the price of oil are associated with changes in economic activity. In the case of oil price increases, the effect is negative, and for decreases, the effect is positive on GDP growth in Togo as a net importing country. Thus, a 1% increase in the price of oil reduces economic growth in Togo by 0.28% in the long run. However, a decrease of 1% improves growth by 0.58%. This situation is explained by the fact that oil is one of the main resources in terms of energy used in the production of goods and services necessary for the functioning of the economy in these countries. It becomes one of the engines of the growth of the economy since the country depends heavily on it. Consequently, situations of rising oil prices constitute an increase in production costs and, therefore, in domestic prices of goods and services.

Table 3 also shows that the effect of oil price declines on real GDP is larger than increases on GDP growth in terms of magnitude. These results validate our asymmetric effect hypothesis and corroborate the findings of Akinsola and Odhiambo (2020), who show that a decline in oil prices has a positive and significant effect on growth, while price increases have a negative effect. These results also corroborate those of Lopez-Villavicencio and Pourroy (2019), who using dynamic panel data estimators, suggest that the pass-through of oil price is greater during oil price decline than during oil price increase on output and hence on economic growth.

In the short term, as shown in Table **4**, only increases in oil prices negatively affect growth and not decrease. Thus, a 1% increase in oil prices reduces economic growth in the short term by 0.36% in Togo. However, in the case of a decrease, a positive but insignificant effect is observed. This result is consistent with those of (Hamilton 2003, 2011; Jiménez-Rodríguez and Sánchez, 2005; Salisu et al. 2017; Nusair and Olson, 2021), who find that it is an increase that harms GDP growth and that in the case of a decrease the positive effect is small or even non-existent. However, in the short run, consumers would also behave differently in the face of falling oil prices. Even in the event of a fall in the price of oil, consumers would remain skeptical in the short term about the future development of the price of oil and would probably not make an immediate decision to purchase energy-intensive durable goods and would continue to save for the future. As a result, consumers may take longer to change their consumption patterns in response to a fall in oil prices than to respond to an increase in oil prices. This seems to explain the insignificant positive effect of lower oil prices on growth in the short term.

Thus, the hypothesis of an asymmetric effect of oil price fluctuations is verified in the case of Togo. It can also be explained in the short term by the Keynesian theory of downward nominal rigidities in prices and wages, i.e., when the price of oil rises, there is a rapid increase in the price of petroleum products such as petrol at the pump, leading to a rise in production costs in the net importing country, Togo. But when the price of crude oil falls, domestic prices (gasoline) fall slowly because of the existence of costs. The downward rigidity of domestic prices explains the asymmetric effect in the Togolese economy. Any increase in the price of oil results in an increase in the pump price of petroleum products such as premium petrol, diesel, kerosene, and liquefied petroleum gas (LPG). This feeding of inflation in the country, all other things being equal, harms household consumption and consequently on economic growth.

Table 3. Long-run (LR) results of the NARDL model (dependent variable: real GDP)

Variables	**Coefficient**
Oilpriceincreases (PP^{+})	-0,279***
Decreases in oil prices (PP^{-})	-0,577***
Inflation (INF)	0,006***
Real interest rate (IR)	-0,035***
GovernmentExpenditures (DGOUVR)	-0,228***
Tax revenue (RTS)	1,705***
Real effective exchange rate (REER)	-0,011

*Note: ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.*

Also, the inflation rate variable has a weakly significant positive effect on growth. This is explained by the fact that Togo is one of the WAEMU countries where the evolution of inflation rates is moderate.

The real interest rate is one of the control variables. Closely related to the money supply, its value is very important to the proper functioning of an economy. It is, however, the price at which money is demanded and supplied in an economy. The long-run coefficient of the real interest rate is negative (-0.228), which is consistent with our a priori economic expectations. This implies that the real interest rate affects GDP negatively and significantly via the decline in investment, and thus an increase in the real interest rate will lead to a decline in real GDP (Bernanke, 1983). Therefore, a unit increase in the real interest rate will lead to a decrease of about 0.035% in real GDP. Thus, the real interest rate has a significant negative effect on the economic growth of Togo. The significant negative effect of real interest rates on the economic growth of Togo is explained by the fact that an increase in the interest rate leads to an increase in the cost of borrowing, which discourages investment and consequently a drop in production through the reduction of the supply of goods and services, thus a drop in economic growth (Rasche and Tatom, 1977; Barro, 1984). The same is not true in the short term, where the negative effect on growth is delayed.

Government final consumption expenditure is contrary to economic expectations a priori since its coefficient is negative and significant, respectively in the short and long term of (0.092) and (-0.228), indicating the existence of a negative effect of government consumption expenditure on real GDP. An increase in government consumption expenditure will therefore lead to a decrease in real GDP. Thus, an increase in government consumption expenditure of 1% will lead to a decrease of about 0.228% in real GDP. The significant negative effect of government final consumption expenditure on Togo's economic growth is because the Togolese government does not play a dominant role in the economic life of the country. This implies that government efforts to reduce the impact of high oil prices on consumers through increased subsidies reinforce the negative effect of oil price increases on output growth. One possible reason for this is that large subsidies through increased government spending as a result of higher oil prices may redirect government spending to less productive expenditures that may harm the growth of the economy. In addition, changes in oil prices are not easily predictable due to their volatile nature, and therefore it becomes difficult for the government to adequately plan the subsidy payment for a given year.

This situation may force the government to transfer resources from other sectors of the economy to help finance subsidies that may occur, and as such, this tends to hurt these sectors of the economy, which ultimately affects the growth of the Togolese economy. This result is consistent with the theoretical account presented by Bernanke (1983) and Finn (2000). According to the economic theory, an increase in the price of oil tends to reduce the use of capital, which leads to a decline in output and, therefore, growth. This result also shows that government involvement in determining the pump price of oil reduces the positive effect of government spending on output growth. This result is consistent with the Keynesian view. In addition, WAMA (2008) finds that utility subsidies would also worsen the budget deficit of WAEMU countries.

As regards the REER variable, the short-term effect is negative in time compared to the lagged variable. Indeed, a 1% increase in the exchange rate induces an appreciation that could reduce economic growth by 1.1%. This reaction of the result of this lagged variable could be explained by the variation of imported and exported volumes, which is not immediate as a nominal variable. The appreciation or devaluation of the economy is explained by the magnitude of the elasticities of domestic and foreign demands. The negative effect of exchange rate appreciation in Togo's situation means low price competitiveness of exports in the short term. This can justify the economic theory according to which the relevance of a devaluation decision can stimulate exports, and consequently, contribute positively to economic growth. This shows the low importance of the exchange rate as a factor stimulating economic growth in the long term. Consequently, the effect of price competitiveness is not expected in the long run. This result was confirmed by the study of Ragbi (2015) and Sadok (2018), who show that the resorption of the trade balance deficit by a policy of devaluation is not feasible, thus an ineffective policy. Then, the effect is not expected because of the presence of a weakly competitive foreign trade lacking innovation and sophistication of exported products, dependent on imports of energy products in general and oil products in particular and other intermediate consumption.

Finally, for the tax revenue variable, a 1% increase in the latter stimulates an increase of about 1.71% and 0.45% of real GDP, respectively, in the short and long term. This indicates that the tax revenues via the levy of taxes on petroleum products finance productive investments through road maintenance funds and road infrastructures, which constitute growth engines (Barro, 1990). However, the negative effect of the lagged variable of tax revenues on growth could be explained by the fact that the taxation of these petroleum products reduces the self-financing of enterprises and the purchasing power of households.

Table 4. Result of the short-run dynamics (SR) of the NARDL model

Variable	**Coefficient**
C	4,550*** [0,737]
Oil price increases d(PP^+)	-0,363*** [0,074]
Oil price decreases d(PP^-)	-0,015 [0,050]
Price of oil decreases d(PP^-(-1))	0,235[0,054]
Inflation d(INF)	0,0005*** [0,0006]

Inflation d(INF (-1))		-0,001*** [0,0004]
Real interest rate d(IR)		-0,009 [0,004]
Real interest rate d(IR (-1))		-0,008** [0,003]
GovernmentExpenditures (DGOUVR)		-0,092*** [0,023]
Tax revenue (RTS)		0,447*** [0,057]
Tax revenue d(RTS(-1))		-0,244*** [0,094]
Real effective exchange rate d(REER)		0,009 [0,005]
Real effective exchange rate d(REER(-1))		-0,011** [0,004]
CointEq(-1)		-0,556*** [0,090]

*Note: ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.*

D. Diagnostic and stability tests.

Table 5 presents the diagnostic results to justify the reliability of the NARDL model specification and goodness of fit. The results indicate an adjusted R-squared value of 0.994. This suggests that about 99.4% of the total changes in economic growth are explained by changes in oil prices and other explanatory variables in the model. This result is confirmed by the serial correlation test with constant variance. We performed the LM test, the Breusch-PaganGodfrey heteroscedasticity test, and the ARCH test and found that the chi-square probability values were insignificant, which means that we cannot reject the null hypothesis of homoscedasticity. Whereas, for serial correlation, we performed the Breusch-Godfrey LM test of serial correlation and the Jarque-Bera test of normality. In these tests, we found that the probability chi-square values were statistically insignificant, suggesting normality and the absence of serial correlation in the model. To further support the robustness of our results, we tested the dynamic stability of our model using the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squared recursive residuals (CUSUM) as advocated by Brown et al. (1975). The results in Figure 1 of CUSUM and CUSUMQ show that the overall model is stable. In the case of the long-run relationship between oil price and growth, an increase in oil price reduces economic growth, while a decrease in oil price increases growth. The Wald test for the equality of positive and negative oil price shocks also confirms the asymmetry, as it is significant in the long run (Table 5).

Table 5. Diagnostic test results

Statistical models	
R^2	0,997
R^2 Adjusted	0,994
F-Statistics	331,044
Probability (F-statistic)	0,000
LM auto correlation (1) test	0,26
LM auto correlation (2) test	0,711
Heteroscedasticity	0,412
ARCH test (1)	0 ,12
ARCH test (2)	0,959
NormalityJarque-Bera	2,513
Wald $_{LR}$	7,595**
Wald $_{SR}$	0.021
Breusch-Pagan-Godfrey (heteroscedasticity test	0,892

*Note: ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.*

E. Conclusion and policy implications

This paper empirically examines the relationship between real oil price and economic growth for Togo, a low-income oil importing country. The NARDL model was used as an estimation technique. There is growing literature supporting the need for asymmetric analysis (Salisu and Isah, 2017). Therefore, asymmetric effects are investigated using a nonlinear ARDL from the ARDL model of Shin et al. (2014) for time series data over the period 1980 to 2017. This method where short and long-run non-linearities are introduced by positive (increases) and negative (decreases) decompositions of the oil price explanatory variable provides a better understanding of the relationship between the asymmetries. The results suggest that a 1% increase in oil price reduces economic growth in the long run by 0.28% in Togo. However, a 1% decrease in oil prices improves growth by 0.58%, respectively. On the other hand, a 1% increase in oil price reduces economic growth in the short run by 0.36%. At the same time, a decrease has a positive but insignificant effect. This confirms the asymmetric effect of economic growth in response to oil price fluctuations.

Our results show that a reduction in oil prices would be a considerable opportunity to stimulate growth, restore subsidy and taxation policies related to oil products, which are substantial in most low-income countries for the welfare of economic agents. This reduction in oil prices should support economic growth and improve external and fiscal balances, thus reducing macroeconomic vulnerabilities linked to price volatility in our country. In the case of a sustained rise in oil prices, there would be a negative effect on economic growth. Therefore, it would be wise for policymakers to implement an effective economic and energy diversification policy employing technological progress policies to mitigate the risks associated with oil prices in the short and long term, especially in a situation of rising oil prices; this would move us away from oil dependency in the long term.

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Appendixes

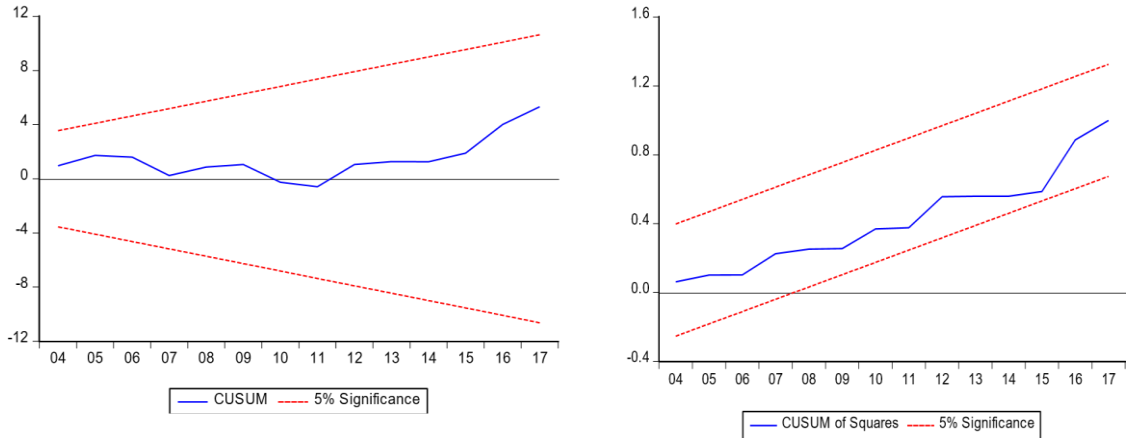

Fig. 1 Results of the stability tests