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Effects of oil price shocks on economic sectors of net oil-importing countries: case of Togo

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Abstract

Less analyzed, the impact of world oil prices on the economy of net oil-importing countries is becoming more significant due to the increase in oil consumption. This paper analyzes the linear and the nonlinear impact of world oil price on Togo's economic sectors based on annual time series from 1970 to 2017, using an unrestricted vector autoregressive (VAR) model. With the linear impact model, the results show that the world oil price shock does not affect the value-added of the economic sectors. As expected, Togo's economic sectors fail to affect the world oil price markets, which confirms that Togo, a small net oil-importing country, has no pricing power in the world oil markets. However, by using the VAR asymmetric impact model proposed by Mork (1989), we find that the impact of world oil price on economic sectors is nonlinear. Thus, positive changes in world oil price do not affect the value-added of economic sectors considered while the negative changes in oil price contribute to improve significantly the value-added of primary and secondary sectors, but not the tertiary sector. Finally, our analysis shows that the value-added of primary and secondary sectors affect respectively the value-added of the tertiary sector. The inverse is not true. This paper recommends that Togo must seek to take benefit from all negative changes in world oil price for boosting the value-added of their economic sectors.

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1. Introduction

The relationship between energy prices, in particular, oil prices and macroeconomic performance, has drawn attention in many recent studies. The literature boom on the influence of oil prices on an economy was initiated by Hamilton (1983), who intended to measure the impact of oil prices on US macro-economic aggregates. Treating the oil price as an exogenous variable, Hamilton (1983) found that oil prices had a significant impact on the US economy. Mork (1989)[1], Lardic and Mignon (2006) and Cunado and de Gracia (2005) found consistent negative impacts of oil prices on GDP for industrialized, industrializing, oil-importing and oil-exporting economies. Like Hamilton (1983), the negative relationship between oil shocks and growth is supported by a series of empirical works, such as Gisser and Goodwin (1986), Rotemberg and Woodford (1996), Brown and Yücel (2002), and Zhang (2008). However, it was shown by Hooker (1996) using data after 1985 to be less convincing. But a consensus was found by Blanchard and Galí (2010) and Baumeister and Peersman (2013a, 2013b) that the impact of oil price on economies declined strongly over time.

Oil price shocks affect economies differently depending on whether they are net oil-importers or oil-exporters (Berunment et *al*., 2010). Oil price increases might be considered bad for net oil-importing countries (Yanagisawa, 2012, Berunment et *al*., 2010) but good news for oil-exporting countries. The reverse might be expected for oil price decreases. High oil prices for net oil-importing countries could lead to high import costs with an adverse effect on GDP, exchange rate, inflation and balance of payment. For this category of countries, the immediate effect of positive oil price shocks is to increase the cost of production and therefore affect negatively growth (Sachez, 2011). Higher oil prices lower disposable income and this decreases consumption. However, high oil prices for oil-exporters improves the general balance of payment due to the increase in oil revenue. Besides, high oil price volatility increases uncertainty regarding cashflows which can be challenging for government in policy decisions. Many studies have been conducted on oil-exporting countries around the world (Alimi et Aflouk, 2017; Anyanwu and Yaméogo, 2015; Anyanwu and Erhijakpor, 2014; Anyanwu, 2014; Ogwumike and Ogunleye, 2008; Jimenez-Rodriguez and Sanchez, 2005 and Cunado and de Gracia, 2003).

Oil price shocks affect oil-importing economies differently depending on whether they are developed or developing countries. Several empirical studies on the impact of oil price shocks on economic components conducted for oil-importing developed economies such as United States, European Union, and Japan as in Kurihara (2015) and Akira (2012), show that oil price increase causes economic growth. However, studies carried out on oil-importing developing countries such as Kenya, Nicaragua, Tanzania and Thailand reveal that increase in oil price generally has a negative impact in GDP causing an increase in unemployment, higher consumer prices and reduced welfare for citizens (Sachez, 2011).

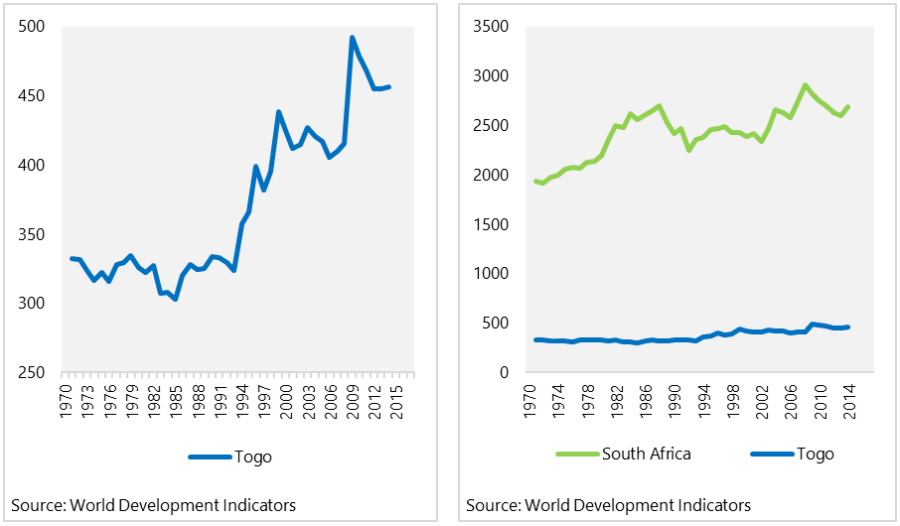
However, recent studies of this relationship on small oil-importing countries claimed that rising oil prices will stimulate economic growth (Gbatu et *al*., 2017, Liew and Balasubramaniam, 2017), which is not consistent with other studies that claimed that rising oil prices have an adverse effect on net oil-importers (Lemazoshvili, 2014; Shabhaz et *al*., 2018). Using an unrestricted vector autoregressive (VAR) model, Wesseh and Lin (2018) evaluate the real impacts of oil price

1 Indeed, Mork (1989) in his study on the role of oil price shocks on economic activity, finds oil price increases to affect economic growth negatively while a decline in oil price does not have the opposite effect.

fluctuations on real GDP in Liberia, a small country in West Africa, and find that, contrary to the bulk of the literature, increase in oil price is sometimes good for net-oil importers and this is, according to Wesseh and Zoumara (2012), probably due to the fact that oil price increase in Liberia is linked to an increased substitution for other factors of production particularly labor. And since the service sector constitutes a large portion of real GDP in Liberia (more than 50% of real GDP comes from services), the substitution of energy for labor (due to higher oil prices) leads to an increase in aggregate output.

Concerning oil-importing countries (developing or developed countries), several studies have investigated the relationship between oil price shocks and economic activities since the first oil crisis of the 1970s, but no study has focused on that of Togo, a small net oil-importing country. For improving its economic growth with the purpose to face his economic and social challenges, Togo has decided to increase its economic production. Therefore, the level of energy consumption and more precisely that of oil has increased (Figure 1). Thus, since 1986, Togo has used more energy to boost their economic production and therefore improve the level of its economic growth. But compared to the huge oil-importer such as South Africa[2] for example, Togo remains a small net oil-importer.

Figure 1: Energy use (kg of oil equivalent per capita)



Being a net oil-importer, Togo's economy depends therefore on the world oil prices. The different sectors (primary, secondary and tertiary) of Togolese economy need oil. Then, it would be possible to see these three sectors be affected by world oil price fluctuations. Indeed, according to Berunment et *al*. (2010), oil prices are not stable, and the fluctuations in oil price have significant effects on the economic activity of a country. Liew and Balasubramaniam (2017)[3] give real empirical proof that oil price fluctuations can affect the economic sectors of a country.

[2] South Africa's economy is the most transformed in Sub-Saharan Africa. Source: African Development Group.
[3] Liew and Balasubramaniam (2017), through the estimation of a nonlinear ARDL model on Malaysia, show that nonlinear oil price-out nexus is revealed for the manufacturing and industrial outputs. They find that rising output is significantly associated to oil price increase, while to falling output is significantly related to oil price decrease.

However, in the context of Togo, it is often argued that, because of the government subventions on oil-derived goods, world oil price shocks/fluctuations do not affect the different sectors of the Togolese economy. Thus, Togolese economy is perceived as resilient to world oil price fluctuations. *de jure*, this claim seems true when we analyze the economic environment; but is not supported by studies. However, *de facto*, it is difficult to find legal published documents that show and explain the subvention mechanisms defended and put in place by Togolese government which allow to conclude that, oil price fluctuations do not affect the Togolese economy. Besides, there is no serious study or research paper carried out on the effect on world oil price shocks on Togolese economy that allows to confirm that the Togolese economy is resilient or not to the world oil price fluctuations. This paper fills these gaps in the literature.

The contribution of our paper is two-fold. There is no study in our knowledge that has investigated the linear and nonlinear impact of world oil price shocks on Togo's economy. The second contribution is the analysis of world oil price shocks on the three sectors of an economy; this for knowing the economic sector that is the most affected by the oil price shocks. By performing this kind of analysis, we would be able to conclude precisely on the effect of world oil price on economic sectors of Togo. This allows to propose policies need to make the Togolese economy more resilient to world oil price shocks.

To fulfil the lack of analysis in the context of Togo in the literature, we intend to analyze the effect of world oil price shocks on the three different sectors (primary, secondary and tertiary) of Togolese economy based on an annual time series from 1970-2017. To achieve our purpose, we use like in Du et *al*. (2010), an unrestricted vector autoregressive (VAR) model which is one the leading approach employed in the existing literature. According to Schirber (2009), Mork (1989), Berunment et *al*. (2010), and Hamilton (1988), the increase and decrease of oil price can have a different impact on an economic aggregate. Based on their results, besides the analysis with the linear impact model, we use an unrestricted VAR asymmetric impact model proposed by Mork (1989) to analyze the asymmetric effects of oil price shocks on Togo's economic sectors. We carry out Granger causality tests, impulse-response functions and variance decomposition in both linear and nonlinear models (asymmetric world oil price shock).

By using a linear impact model, the results show on one hand that, the world oil price does not affect the three economic sectors considered. On the other hand, as expected, Togo economic sectors fail to affect the world oil price markets, which confirms that Togo, as a small open economy and also a small net oil-importing country, has no pricing power in the world oil markets. However, by using an unrestricted VAR asymmetric impact model proposed by Mork (1989), we find that the impact of world oil price is nonlinear. The positive changes in world oil price do not affect the value-added of the primary, secondary and tertiary sectors while the negative changes in world oil price contribute to improve significantly the value-added of the primary and secondary sectors. The paper finishes the analysis by showing that the primary and secondary sectors affect respectively the tertiary sector. The inverse is not true. This paper recommends that Togo must seek to take benefit from all decreases of world oil price for boosting the value-added of the primary and the secondary sectors, and therefore improve its economic activity.

The remainder of this paper is organized as follows. Section 2 describes the methodology and justify the choice of the data. Section 3 presents and interprets both the results of the linear and nonlinear impact models. Section 4 concludes.

2. Methodology and data

VAR model

The VAR model has become since the pioneering work of Sims (1980), one of the best approaches employed in the analysis of the dynamic economic system, especially in the research of interactions, between commodity and energy price shocks and macroeconomy (Du et *al*., 2010; Brown and Yücel, 2002). This study adopts an unrestricted vector autoregressive (VAR) model to analyze the effect of world oil price shocks on the three Togo's economic sectors. Consider the following VAR model of order p:

$$y_t = c + \sum_{i=1}^{p} \phi_i y_{t-1} + \varepsilon_t, \qquad (1)$$

where $y_t = (y_{1t}, y_{2t}, \dots, y_{nt})'$ is a $n \times 1$ vector of endogenous variables, while y_{t-i} is the corresponding lag terms of order i. ϕ_i is the $n \times n$ matrix of autoregressive coefficients of the vector y_{t-i} for $i = 1,2, \dots, p$. $c = (c_1, c_2, \dots, c_n)'$ is the $n \times 1$ intercept vector of the VAR model, $\varepsilon_t = (\varepsilon_{1t}, \varepsilon_{2t}, \dots, \varepsilon_{nt})'$ is the $n \times 1$ vector of white noise process.

We consider the annual VAR model including the following four endogenous variables: the real oil price, the value-added of the primary sector in the economy, the value-added of the secondary sector in the economy, and the value-added of the tertiary sector in the economy. The effects of oil price shocks on the three sectors are our main objects of interest.

Our data are annual time series and the sample period is 1970-2017. The VAR model is estimated with a constant and two lags, which is determined by the likelihood ratio test, Akaike information criteria, and Schwartz information criteria.

Asymmetric analysis

After analyzing the linear effect of oil price shock on the three considered-sectors (primary, secondary, and tertiary) of Togolese economy, we analyze the nonlinear effect of oil price shock on the three sectors. This could lead us to achieve our specific objective which consists to know whether the effects of oil price shock on Togolese economic sectors are nonlinear or not. Thus, according to Du et *al*. (2010), we consider the nonlinear transformation of oil prices developed by Mork (1989), which are widely employed in the empirical literature. Mork (1989) proposes to consider the asymmetric responses by separating the oil price variable into upward (positive changes) and downward (negative changes) movements. Mork (1989) allows an asymmetric response to oil price changes by specifying that the oil price increases and decreases as separate variables. Their definitions are as follows:

$$\Delta Oil_t^+ = \begin{cases} \Delta Oil_t & if\ \Delta Oil_t > 0 \\ 0 & otherwise \end{cases} \quad \text{and} \quad \Delta Oil_t^- = \begin{cases} \Delta Oil_t & if\ \Delta Oil_t < 0 \\ 0 & otherwise \end{cases},$$

where ΔOil_t is the rate of changes in the world oil price, while ΔOil_t^+ and ΔOil_t^- are respectively, the positive and negative rate of changes in the world oil price. As the linear case, it is important to test the stationarity of the transformed series by Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. If the transformed series are stationary, then, we can estimate the VAR model.

Data description

The four endogenous variables considered are constructed as follows:

1. *Real oil price* (Oil). We choose the West Texas Intermediate brent annual crude oil price as the proxy of world oil price. The data are derived from the website of Fred of St-Louis. But, like in Balcilar et *al*. (2017), to obtain the real oil price, nominal values of world oil price are deflated using consumer price index (CPI) from the International Financial Statistics (IFS) of the International Monetary Fund (IMF).

2. *Primary sector (*$Primary_{sec}$). The primary sector tends to make up a larger portion of the economy in developing countries than it does in developed countries. But due to the hard problem of availability of data related to the primary sector of Togo, we choose to quantify the primary sector by the agriculture, forestry, hunting and fishing value-added to the economy in real value.

3. *Secondary sector (*$Secondary_{sec}$*).* This sector includes the industrial activity (including construction, aeronautic, electronic). But, due to the lack of data related to the secondary sector of Togo, we choose to quantify the secondary sector by the industry (including construction) value-added to the economy in real value.

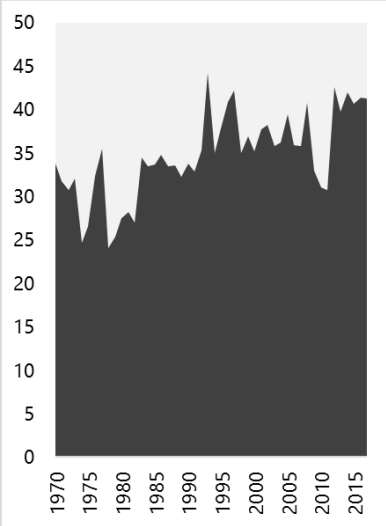
4. *Tertiary sector* ($Tertiary_{sec}$). The tertiary sector is also known as the services sector. The service sector produces intangible goods, more precisely services instead of goods, and it comprises various service industries including warehousing and transportation services, information services, securities and other investment services, professional services, waste management; health care and social assistance; and arts, entertainment, and recreation. We quantify the tertiary sector by the services value-added to the economy in real value.

The data are obtained either from the International Monetary Fund-International Financial Statistics (IFS), World Development Indicators (WDI) and Fred of St Louis databases, depending on the availability.

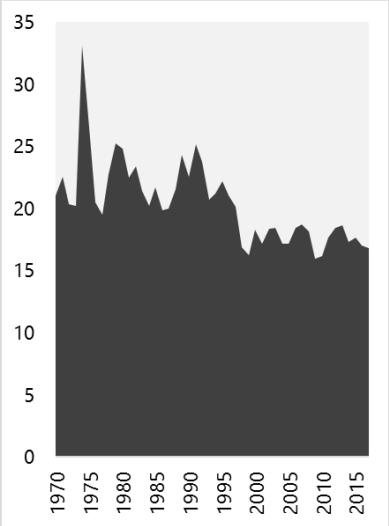
Figure 2 below presents the evolution of the three sectors considered in this analysis and Table 1 summarizes the descriptive statistics. Overall, the service sector is the largest contributor to the Togolese economy. It is followed by the primary sector (agriculture, forestry, fishing) whose contribution has tended over the last five years to outweigh the contribution of the services sector to the economy. Finally, we have the secondary sector (industry) whose added value has been steadily declining over the years.

Figure 2: Sectors of Togolese's economy (1970-2017)

Panel a: Agriculture, forestry, and fishing, value added (% of GDP)



Panel b: Industry, value added (% of GDP)



Panel c: Services, value added (% of GDP)

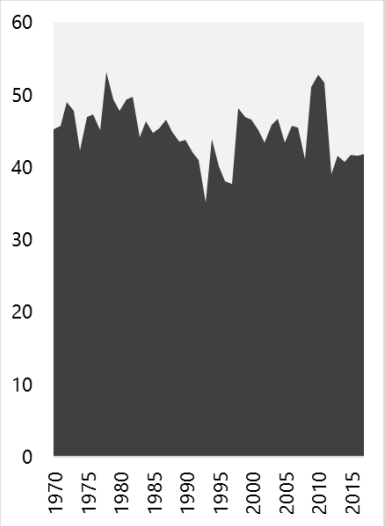


Table 1 shows that oil price is more volatile compared to the value-added of the three sectors because oil price has the highest standard deviation. The four variables are normally distributed according to the Jarque-Bera statistics. This is because the null hypothesis of normal distribution cannot be rejected at 5% significance level for these variables.

Table 1: Descriptive statistics (1970-2017)

	Oil price	Agriculture, value added (% of GDP)	Industry, value added (% of GDP)	Service, value added (% of GDP)
Mean	43.160	37.027	19.158	41.925
Std. Dev.	29.184	3.681	2.475	6.512
Jarque-Bera	4.435	1.669	3.892	2.129
Probability	0.109	0.434	0.143	0.345
Observations	48	48	48	48

Source: Author's calculations.

Unit root test

According to Sims (1980), the VAR system can be transformed into its infinite moving average representation only if the variables used in the model are stationary, and the moving average representation is used to obtain both the forecast error variance decomposition and the impulse-response functions. We test the stationarity of the time series by performing two-unit root tests. More specifically, we perform the Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test. The null hypothesis of the test is that the series has a unit root. If the null hypothesis is rejected, we can conclude that the series is stationary. The results of these two-unit root tests are summarized in Table 2. The first two columns of Table 2 report the test results of the variables in level (log). These results reveal that all the variables are nonstationary in level. Then, in order to get the stationary series, we take the first difference for all the variable in logarithmic form and we perform

again the two-unit root tests. The second two columns of Table 2 reporting the test results of each variable (in first-difference) show that the null hypothesis of having a unit root is rejected for all the variables at 1% significant confidence level, meaning that all the first difference variables are stationary. In the following analysis, we use the first difference form of all the series.

Table 2: Unit root test

Variables	Level (log.)		First difference	
	ADF test	PP test	ADF test	PP test
Oil	0.63	0.64	-5.37***	-5.38***
$Primary_{sec}$	3.34	5.53	-6.07***	-7.79***
$Secondary_{sec}$	2.25	-1.69	-6.92***	-7.31***
$Tertiary_{sec}$	-2.01	-1.83	-8.48***	-8.95***

*, ** and *** denote significant at 10%, 5% and 1% levels, respectively.

Concerning the transformed oil price series, the results are reported in Table 3. The results indicate that the transformed series are stationary. Thus, the VAR models can be estimated with these transformed series directly.

Table 3: Unit root test of the transformed oil price series

	ADF test	PP test
ΔOil^{+}	-4.66***	-4.63***
ΔOil^{-}	-5.63***	-5.97***

*, ** and *** denote significant at 10%, 5% and 1% levels, respectively.

3. Results

In this section, we analyze the empirical results of the VAR model described in the previous section, including the Granger causality test, impulse-response functions and variance decomposition analysis, etc. We focus on the effect of oil price shocks on the three selected sectors of Togolese economy.

Two VAR model are estimated. The first one analyzes the linear effect of world oil price shocks on Togolese's economic sectors and the second one analyzes the nonlinear effects (asymmetric analysis) of world oil price shocks on the Togolese's economic sectors. For the two models, the number of two lags is retained and determined by the likelihood ratio test, Akaike information criteria, and Schwartz information criteria. Then, after estimating the VAR models with two lags on the variables (transformed in first difference), we perform two validation test such us the White test (residual heteroskedasticity, *cf.* Table 4) and the Residual serial correlation LM Tests (serial correlation, *cf.* Table 5). The two tests confirm that our residuals are BLUE.

Table 4: White test

Lags	LM-Stat	Prob
Linear VAR model	304.54	0.416
Nonlinear VAR model		
• Positive changes in world oil price	314.82	0.267
• Negative changes in world oil price	312.26	0.301

Null Hypothesis: no heteroskedasticity.

Table 5: VAR Residual Serial Correlation LM Test

Lags	LM-Stat	Prob
Linear impact model (VAR)		
1	28.47	0.287
2	21.81	0.647
3	28.78	0.273
4	25.56	0.431
Nonlinear impact model (positive changes in oil price)		
1	23.47	0.550
2	26.22	0.396
3	25.51	0.434
4	29.52	0.243
Nonlinear impact model (negative changes in oil price)		
1	34.06	0.107
2	22.18	0.625
3	29.18	0.256
4	26.53	0.380

Note: Null Hypothesis: no serial correlation at lag order h.

3.1. Granger causality test

To investigate the causal relationships of the variables, we perform the Granger causality tests. Granger causality test investigates whether a variable y can help forecast another variable x. If it cannot, then we say that y does not Granger cause x. More formally, y fails to Granger cause x if for all $s > 0$ the mean squared error (MSE) of a forecast of x_{t+s} based on $(x_t, x_{t-1}, ...)$ is the same as the MSE of a forecast of x_{t+s} that uses both $(x_t, x_{t-1}, ...)$ and $(y_t, y_{t-1}, ...)$. For more technical representation, please refer to Hamilton (1994). The results of the Granger causality test are summarized in Table 3. We mainly focus on the causal relationship between oil price (change rate) and the three economic sectors, and also between the three economic sectors.

From Table 6, we can see that oil price does not cause any of the value-added of the three sectors (primary, secondary and tertiary) of Togolese economy. The value-added of the three sectors cannot cause the world oil price too (results not summarized in this paper). Concerning the Togolese economy, the Granger causality tests reveal that the value-added of the primary sector and the secondary sector cause respectively at 1% and 5%, the value-added of the tertiary sector. The secondary sector causes at 10%, the primary sector. This is also true for VAR models on the transformed oil price series.

Table 6: Granger causality test

Null hypothesis H_0	χ^2-statistic	p-value
Linear impact model: oil price shocks		
ΔOil does not Granger cause $Primary_{sec}$	0.796	0.672
ΔOil does not Granger cause $Secondary_{sec}$	0.296	0.863
ΔOil does not Granger cause $Tertiary_{sec}$	0.047	0.977
$Secondary_{sec}$ does not Granger cause $Primary_{sec}$	4.717	**0.095**
$Primary_{sec}$ does not Granger cause $Tertiary_{sec}$	11.227	**0.004**
$Secondary_{sec}$ does not Granger cause $Tertiary_{sec}$	8.046	**0.018**
Nonlinear impact model: Positive changes in world oil price		
ΔOil^{+} does not Granger cause $Primary_{sec}$	2.954	0.228
ΔOil^{+} does not Granger cause $Secondary_{sec}$	0.535	0.765
ΔOil^{+}does not Granger cause $Tertiary_{sec}$	0.054	0.973
$Secondary_{sec}$ does not Granger cause $Primary_{sec}$	4.717	**0.095**
$Primary_{sec}$ does not Granger cause $Tertiary_{sec}$	11.138	**0.003**
$Secondary_{sec}$ does not Granger cause $Tertiary_{sec}$	8.134	**0.017**
Nonlinear impact model: Negative changes in world oil price		
ΔOil^{-} does not Granger cause $Primary_{sec}$	0.012	0.994
ΔOil^{-} does not Granger cause $Secondary_{sec}$	0.171	0.743
ΔOil^{-} does not Granger cause $Tertiary_{sec}$	0.051	0.975
$Secondary_{sec}$ does not Granger cause $Primary_{sec}$	4.810	**0.086**
$Primary_{sec}$ does not Granger cause $Tertiary_{sec}$	11.157	**0.004**
$Secondary_{sec}$ does not Granger cause $Tertiary_{sec}$	7.756	**0.021**

Source: Author's estimates.

3.2. Impulse-response functions

We resort to impulse-response functions to investigate the dynamic/direct impact of the oil price shocks on the VAR system. Impulse-response functions are used to plot the effects of a shock to one endogenous variable on the other variables in the VAR system. Figure 3 plots the responses of the value-added of the primary, secondary and tertiary sectors to one-unit innovation of the world oil price with two standard error bands. We can see that a linear oil price shock does not affect the value-added of the three considered-sectors of Togolese economy.

Figure 4 plots the responses of primary, secondary and tertiary sectors value-added to the positive oil price shocks (positive change in oil price) on one hand and the responses of the value-added of those sectors to the negative oil price shocks (negative change in oil price) on the other hand. Figure 4 allows to analyze the asymmetric impact of oil price shocks.

Figure 4 shows that positive oil price shock does not affect the value-added of the primary, secondary and tertiary sectors. This leads us to conclude that Togo's economic sectors are resilient to positive changes in world oil price. Our results do not corroborate those of Sachez (2011) and Berunment et *al*. (2010). But these results corroborate those of Du et *al*. (2010). This lack of effect and the divergence of results can be explained by the potential subvention mechanisms put in place *de jure* by the Togolese government to control the effects of oil price fluctuations on Togolese sectors. *de facto*, no legal published documents are proving the existence of these subvention mechanisms. Encouraging to improve its governance, Togo is a country that communicates very little about its economic policies, especially those related to petroleum products. Togolese government claims to have subsidized the price of oil at the pump for years when the international price of barrel of oil rises so that this does not adversely affect the purchasing power of the Togolese people and the various sectors of the economy. However, when world prices fall, the drop in the price at the pump in Togo is not immediate and proportional to that on the world market. However, since 2010, Togo has a new adjustment mechanism[4] that limits the increase in pump prices to 30% per year, independently of the evolution of oil prices on the international market.

However, negative changes in world oil price contribute to improve the added value of the primary and secondary economic sectors. These results corroborate those of Berunment et *al*. (2010) but do not corroborate those of Wesseh and Lin (2018) and Liew and Balasubramaniam (2017). Besides, our results reveal that negative changes in world oil price do not affect the added value of the tertiary sector. In full modernization and economic transformation, the primary sector in Togo, like that of developing countries, is becoming more mechanized and motorized over the years. Thus, the whole sector has become over the years more dependent on the world oil price. As in Berunment et *al*. (2010) and Sachez (2011), falls in energy prices, such as oil prices, are an opportunity (lower costs) for the primary sector, while increases in oil price rise production costs. The secondary sector dominated by industrial activity (because of the availability of raw materials), takes benefit from the decrease in energy prices, and therefore from the decrease in the world oil price to improve its value-added and to support its activity. Hence, the positive effect of the negative oil price shock on the value-added of the primary and secondary sectors. The lack of effect of the negative oil price shock on the tertiary sector can be explained by the fact that this sector in Togo, is more dominated by telecommunications, banks and not by transport (maritime, land and air) which requires oil-derived products.

Table 7 shows that negative oil price shocks or negative changes in oil price have a positive cumulative effect on primary and secondary sectors. More specifically, a 100% decrease of Mork (1989)'s transformation of the oil price will cumulatively increase after one year the value-added of primary and secondary sectors by about 4.445% and 4.625%, respectively.

Table 7: Cumulative responses to nonlinear oil price shocks (negative change)

	$Primary_{sec}$	$Secondary_{sec}$	$Tertiary_{sec}$
1st year	4.445	4.625	-1.809
2nd year	4.503	3.589	-0.438

Source: Author's estimates.

[4] source: Abdoulaye Tchagawou, Revue de presse, Semaine No. 50, Press Service of the French Embassy in Togo, December, 2010.

Figure 3: Impulse-responses functions to linear oil price shocks

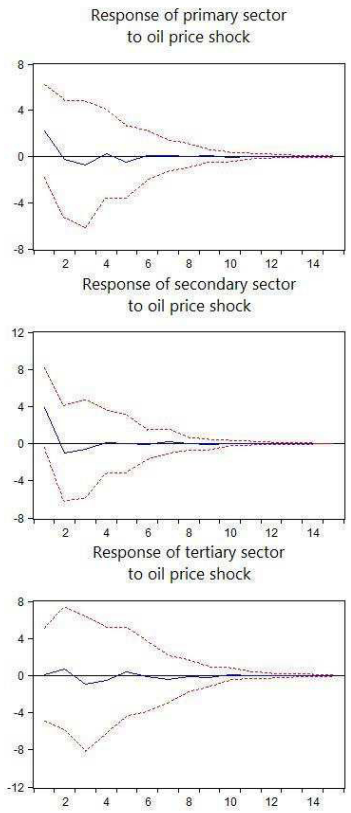
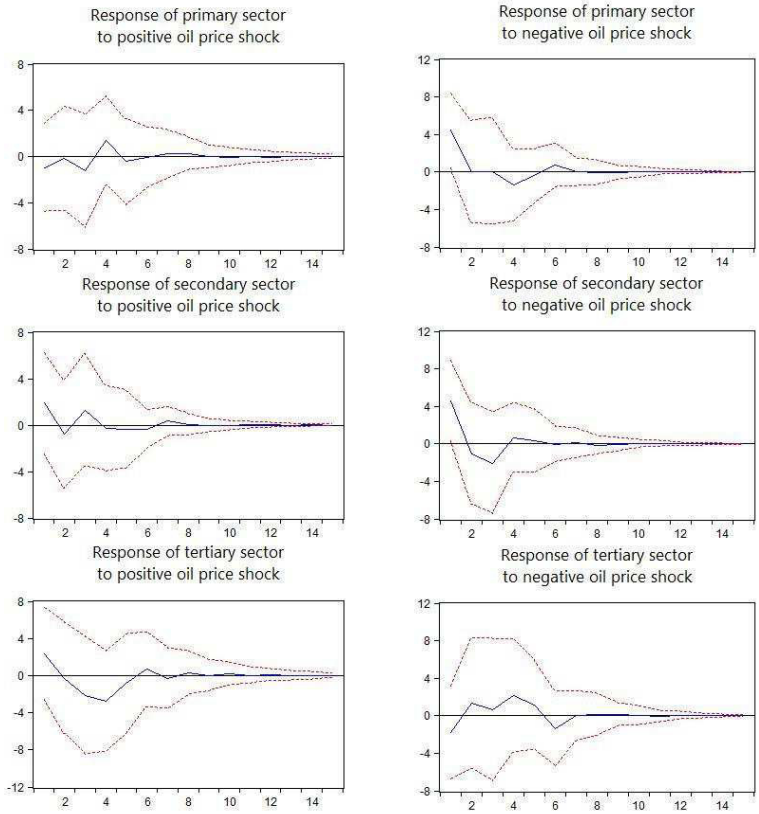


Figure 4. Impulse-responses functions to nonlinear oil price shocks



Source: Author's estimates.

Variance decomposition

Variance decomposition separates the variation in an endogenous variable into the component shocks to the model and provides information about the relative importance of each random innovation in affecting the variables in the VAR model. In this section, we mainly focus on the variance decomposition of the primary, secondary and tertiary sector to see how many of the unanticipated changes of these three variables are explained by each type of different oil price shock (linear, nonlinear oil price shock). The results are presented in Table 8.

The table shows that linear oil price shocks are not a substantial source of volatility in value-added of the primary, secondary and tertiary sectors. However, the value-added of the primary and secondary sectors are substantial sources of volatility in the value-added of the tertiary sector. The contributions of the primary and secondary sectors in the volatility in the value-added of the tertiary sector are 44% and 25%, respectively. We note that the value-added of the secondary sector is at 13%, source of volatility in the value-added of the primary sector. Concerning the asymmetry analysis, Table 8 shows that the negative world oil price shocks or negative changes in the world

oil price are substantial sources of volatility in the value-added of the primary and secondary sectors. The contributions of negative changes in world oil price or negative world oil price shocks to the primary and secondary sectors are 13% and 15%, respectively.

Table 8: Variance decomposition

Linear impact model (oil price shock)					
Variance Decomposition: value-added of the primary sector					
Period	S.E.	ΔOil	$Primary_{sec}$	$Secondary_{sec}$	$Tertiary_{sec}$
1	10.94	4.20	95.80	0.00	0.00
2	12.25	3.39	83.73	12.69	0.18
Variance Decomposition: value-added of the secondary sector					
1	11.88	10.93	8.33	80.74	0.00
2	12.10	11.30	8.79	79.85	0.05
Variance Decomposition: value-added of the tertiary sector					
1	13.43	0.00	38.93	17.05	44.02
2	16.03	0.19	44.04	24.68	31.09
VAR model with transformed oil price series (positive change in oil price)					
Variance Decomposition: value-added of the primary sector					
Period	S.E.	ΔOil^{+}	$Primary_{sec}$	$Secondary_{sec}$	$Tertiary_{sec}$
1	12.70	0.86	99.14	0.00	0.00
2	13.95	0.70	84.36	14.44	0.50
Variance Decomposition: value-added of the secondary sector					
1	10.36	2.59	17.72	79.68	0.00
2	11.65	2.94	17.54	79.43	0.09
Variance Decomposition: value-added of the tertiary sector					
1	13.13	3.09	38.03	24.23	34.65
2	13.40	2.34	41.20	30.30	26.16
VAR model with transformed oil price series (negative change in oil price)					
Variance Decomposition of Primary sector					
Period	S.E.	Oil^{-}	$Primary_{sec}$	$Secondary_{sec}$	$Tertiary_{sec}$
1	16.55	15.82	84.18	0.00	0.00
2	18.10	12.61	76.34	11.03	0.03
Variance Decomposition of Secondary sector					
1	11.17	15.05	4.00	80.96	0.00
2	12.52	15.22	5.15	79.59	0.03
Variance Decomposition of Tertiary sector					
1	13.12	1.81	35.11	15.04	48.03
2	13.63	1.94	42.59	22.70	32.77

Source: Author's estimates

Overall, although it is often argued that world oil price shocks do not affect Togolese economic sectors, the analysis carried out shows that some effects are hidden. Considering the linear approach, analysis shows that the direct/linear world oil price shock does not affect Togolese economic sectors. However, the adoption of the asymmetric approach proposed by Mork (1989)

reveals that world oil price shocks have a nonlinear effect on Togolese economic sectors. Negative changes in world oil price have a positive effect on primary and secondary sectors but do not affect the tertiary sector. However, positive changes in oil price do not affect the three sectors of activity, due to the subvention/subsidy mechanisms put in place by the Togolese government, but not demonstrated.

4. Conclusion

The impact of the world oil price on the economic activity of net oil-importing countries is becoming more and more significant because of the increase in oil consumption. In this paper, we analyze the direct and asymmetric effects of the world oil price shocks on Togolese economic sectors based on an annual time series from 1970 to 2017. To do so, we have used an unrestricted Vector autoregressive model which is one of the leading approaches employed in the existing literature. In our analysis, we consider the Granger causality test, the impulse response functions and the variance decomposition. As results, as expected, the world oil price is exogenous to Togo' economic sectors. Togo is a small net oil-importing country that cannot affect the world oil price. The impulse-response functions of the linear impact model show that the world oil price shocks do not affect the value-added of the primary, secondary and tertiary sectors of Togolese economy. However, the results of the asymmetric impact model show that the impact of the world oil price on Togo's economic sector is nonlinear. The impact of the positive changes in oil price is not significant on each on the value-added of the three sectors while the negative world oil price shocks increase significantly the value-added of the primary and secondary sectors, but not the tertiary sector. Cumulatively, a 100% decrease in the world oil price, increases the value-added of the primary and secondary sectors by about 4.45% and 4.63%, respectively. The paper finishes the analysis by showing that the value-added of the primary and secondary sectors affect respectively the value-added of the tertiary sector. The inverse is not true. Togo must seek to take benefit from all decreases of world oil price like remarked in March 2020 to boost its economy, and more precisely improve the value-added of primary and the secondary sectors.

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