

Fiscal policy and the impact of oil prices shocks on non-oil GDP in Algeria: NARDL model.

السياسة المالية و أثر صدمات أسعار البترول على الإنتاج الداخلي الخام غير النفطي في الجزائر:

نموذج NARDL

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Abstract:

This study employs the NARDL model to investigate the relationship between oil prices, fiscal policy, and non-oil gross domestic product in Algeria. Using annual data from 1970 to 2022. The results show the existence of nonlinear cointegration, revealing differential impacts of positive and negative oil shocks on non-oil GDP. Short- and long-run analyses reveal that both total government revenues and oil price changes affect non-oil GDP.

Keywords: Oil prices, fiscal policy instruments, non-oil GDP, NARDL model, asymmetric impact.

JEL Classification Codes: E62, C22, E6

ملخص:

نقدر في هذه الورقة البحثية نموذج NARDL لمعرفة العلاقة بين أسعار البترول، الإنتاج الداخلي الخام غير النفطي والسياسة المالية في الجزائر باستعمال بيانات سنوية من 1970 إلى 2022. تبين النتائج وجود تكامل مشترك غير الخطي، يكشف عن التأثيرات التفاضلية للصدمات النفطية الإيجابية والسلبية على الناتج المحلي الإجمالي غير النفطي. وتكشف التحليلات أن كل من إجمالي الإيرادات الحكومية وتغيرات أسعار النفط يؤثر على الناتج المحلي الإجمالي غير النفطي.

كلمات مفتاحية:

تصنيفات JEL : E62, C22, E6

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1. INTRODUCTION

The first oil shock of the 1970s was marked by oil crises that significantly impacted the global economy. In 1973, OPEC imposed an embargo on oil exports in response to the United States and Europe's support for Israel during the Yom Kippur War, leading to a significant price hike. In 1979, the revolution in Iran triggered another oil crisis, further increasing prices and reducing supplies. Instability in the Middle East and North Africa exacerbated the energy crisis, leading to high inflation and a global recession. High energy costs affected production and consumer spending, resulting in trade deficits and debt problems for many countries. (Meshcheryakova, 2024).

Several oil shocks occurred subsequent to this period, leading researchers to acknowledge the importance of studying oil price fluctuations on economic variables. Hamilton's seminal work in 1983 played a crucial role in introducing a fresh perspective on understanding the effects of oil shocks on these variables. Hamilton's research specifically delved into the relationship between oil prices and macroeconomic variables, ultimately concluding that a negative relationship exists between these variables during periods of recession. This conclusion finds further support in another study conducted after the Iraq War (Hamilton, 1983, 1996).

One notable characteristic of the Algerian economy is its reliance on the oil sector, it is greatly influenced by international oil trade, specifically oil prices. Algeria is striving to reduce this dependency by diversifying its economy through the development of sectors beyond hydrocarbons. However, these efforts are not immune to the impact of oil price fluctuations, as evidenced by numerous studies examining the effects of oil prices on various macroeconomic variables.

For instance, using the NARDL model on the economy of Algeria, Chekouri et al. (2020) investigate the causality between oil prices and the exchange rate. Their findings revealed long-run asymmetric effects of oil prices on Algeria's real effective exchange rate (REER), indicating that a higher oil price result in real exchange rate appreciation, whereas lower oil prices results in REER depreciation(Chekouri& Sahed, 2021).

Furthermore, Dahmani (2020) examined the impact of oil prices on Algeria's real GDP using two NARDL models, uncovering different effects of oil prices on GDP and government revenues.(Mohamed Driouche et al., 2020).

Similarly, Benaissa (2020) investigated the effect of monetary policy on gross domestic production and inflation in a rentier economy dependent on the oil sector using Bayesian VAR. This study concluded that oil prices distort the performance of monetary policy instruments.(Benaissa, 2020)

Indeed, the pivotal studies on fiscal policies in Algeria are conducted by Chibi et al. (2019) and Chekouri et al. (2024). These researchers delve into public debt sustainability across Algeria, Libya, Morocco, and Tunisia post-COVID-19, exposing unsustainable debt periods and highlighting weak fiscal policies across the region. Meanwhile, Chibi et al. (2019) specifically target Algeria, uncovering non-stationary budget balances and an inability to sustain deficits over time. Both studies emphasize the pressing necessity for MENA policymakers to confront rising public debt levels and prioritize adept fiscal policy management to avert potential crises.(Chekouri et al., 2024; Chibi et al., 2019)

Despite the abundance of studies examining the correlation between oil price fluctuations and various macroeconomic variables in Algeria, there still exists a research gap concerning the influence of oil prices on non-oil sectors.

The objective of this paper is to examine the asymmetric effects of oil price shocks on non-oil gross domestic product and fiscal policy instruments, tracing their effects over different periods, particularly focusing on the behaviour of real non-oil gross domestic product (GDP). The primary objectives of this study are to address the following questions: How do non-oil real GDP and fiscal policy in Algeria respond to oil price shocks? Specifically, do these shocks exert weak or strong effects on non-oil GDP? Moreover, are these effects symmetrical or asymmetrical? To address these questions, I employ the NARDL approach, which was recently Shin et al. (2014) initiated this approach to illustrate asymmetric effects in both short- and long-term relationships between oil prices and non-oil GDP, beside with fiscal policy instruments, between 1970 and 2022.

The structure of the paper is as follows: Section 1 reviews the existing literature. Section 2 describes the data collection process and details the methodology, including the econometric approach used for the analysis. Section 3 presents the results and key findings. Lastly, Section 4 provides the summation of this study.

2- Literature reviews:

The analysis of scholarly literature on the impact of oil prices on fiscal policy and economic growth is important, as it provides clear direction for the objectives and enhances the understanding of this study's contribution. That is why this section is dedicated to these studies. Starting with the study of (Hamilton, 1983) which is considered as the first searcher who studied the impact of oil shocks on macroeconomic variables, his study played a role in developing a new approach to monitoring the effects of oil disruptions on these variables. Hamilton (1983) constated a significant correlation over the period 1948-1972, which confirms that Oil shocks is a contributing factor caused the recession in us prior to 1972. This conclusion is confirmed by the study of the same searcher in 1996, when he studied the regression for 1948: I to 1994: II of GDP growth on a constant and eight lags of itself. The author observed an inverse relationship between oil price increase and GDP growth, he concluded that the increase in oil prices had been the fundamental cause of recessions. (Hamilton, 1996).

In 2020, Akinsola and Odhiambo investigated the influence of oil prices on economic growth in the short and long term for seven low-income, oil-importing sub-Saharan African countries. Using panel data from 1990 to 2018 and an ARDL model, they found that short-term effects on economic growth were insignificant for the group as a whole, but individual country coefficients showed significant, mixed impacts. The error correction terms were negative and statistically significant for both the PMG and five countries. In the long term, oil prices had a significant negative impact on economic growth. The study concluded that lower oil prices positively and significantly affect growth, whereas higher oil prices have a significant negative impact (Akinsola & Odhiambo, 2020).

Amany A. et al. (2012) investigated the impact of oil prices on fiscal policy in oil-exporting countries. Their findings indicate that, in the short run, public

spending rises less than proportionately in response to growing oil revenues, suggesting a trend towards greater fiscal prudence among oil-producing nations. Importantly, this result remains robust across various specifications of oil price shocks and different sample periods.(El Anshasy& Bradley, 2012)

The COVID-19 pandemic has caused unprecedented levels of government debt worldwide, prompting many researchers to examine the sustainability of public debt. Similarly, Chekouri& all. (2024) focus on this issue for Algeria, Libya, Morocco, and Tunisia. Using the Generalized Supremum Augmented Dickey–Fuller (GSADF) and Quantile Auto-Regressive (QAR) unit root analyses, the research reveals that all four countries experienced periods of explosive public debt during the studied period, indicating unsustainable fiscal policies. Specifically, while lower quantiles suggest strong debt sustainability, middle and upper quantiles indicate an unsustainable dynamic. These findings underscore the study's focus on the weak sustainability of debt and fiscal policies in the region, highlighting the growing unsustainability of fiscal policies in recent years, They emphasize the need for policymakers in MENA (Middle East and North Africa) countries to address the challenges posed by escalating public debt levels when formulating economic stimulus strategies.(Chekouri et al., 2024).

Since Algeria is an oil exporting country, it is natural to find a huge study on this subject.

On the one hand, Yasmina Guechari conducted a 2017 study to explore the effects of oil price fluctuations on the Algerian economy, utilizing yearly data from 1980 to 2017 on macroeconomic variables including oil prices, GDP, government spending, investment, inflation, real exchange rates, net exports, and unemployment, employing a VAR the study finds that oil price fluctuations have a limited impact on the Algerian economy. However, positive oil price shocks play a significant role in shaping the macroeconomic dynamics of the country , resulting in volatile responses: macroeconomic variables react sharply to oil price fluctuations.(Guechari, 2017).

Furthermore, the aim of the study conducted by Cherifa Bouchaour et al. (2012) was to examine the effects of oil price anomalies on Algeria's

macroeconomic indicators. They used a Vector Error Correction Model (VECM) to analyze data from 1980 to 2011, encompassing oil prices, inflation, real exchange rate, unemployment, and money supply (M2). Their findings suggest that, in the short period, oil prices positively impact inflation, but negatively affect the effective exchange rate, and a negligible effect on the remaining variables. However, in the long term, there is a positive impulse response function effect on real GDP and inflation, an adverse impact on the real exchange rate and joblessness, and no substantial effect on M2.(Bouchaour& Al-Zeaud, 2012).

Finally, the study conducted by Dahmani et al. (2020) examines the uneven effects of oil price shocks on economic growth in Algeria, employing the nonlinear ARDL method to estimate two models using data from 1970 to 2018. The analysis finds that in the long term, these variables exhibit a non-linear relationship. Real GDP demonstrates a stronger reaction to positive oil shocks compared to negative ones, with positive. Moreover, government revenue has a more significant influence on economic growth than Capital spending(Mohamed Driouche et al., 2020)

On another side, Aicha BEKHALED & all. (2024) examine the impact of oil prices on public expenditures in Algeria with ARDL model from 1989 to 2019. They have come to there is the conclusion that there is a long-term harmonious and balanced connection between government expenditures and petroleum prices(Bekhalel et al., 2014)

Chibi et al. (2019) use quarterly data from 1963Q1 to 2017Q1 on the Algerian budget balance-GDP to estimate a nonlinear model and assess the sustainability and solvency of fiscal policies in Algeria. Findings reveal nonlinear characteristics in the budget balance adjustment behavior, specifically following a Logistic model dependent on Fuel prices. Long-term budget deficits cannot be maintained, indicating the need for the Algerian government to prioritize fiscal policy management and efficiently control budget deficits to prevent a potential debt crisis.(Chibi et al., 2019)

3. Methodology and data:

3.1 Nonlinear autoregressive distributed lag technique (NARDL):

Neither the literature that has addressed the relationship between oil prices and gross domestic production nor the studies that have evaluated the

relationship between fiscal policy instruments and this dependent variable have used the non-linear models in Algeria, except for the research by Mohamed Driouche et al.,(2020), such that they fail to capture potential nonlinear relation between these variables. Moreover, the nature of the chosen variables in my study represents non-linear relationship, Ramsey and Zivot tests show this.

As a consequence, I employ the non-linear ARDL suggested by (Shin et al., 2014). This approach represents an asymmetric extension of the linear Autoregressive Distributed Lag framework developed by Pesaran and Shin (1999) and (Pesaran et al., 2001). It used to analyse the short run and long-run asymmetries.

There are numerous advantages to this technique comparing with the classical cointegration models. it allows for examining asymmetric effects in both the short and long run, has the ability to estimate models with small and finite sample sizes better than Engle-Granger (1987) and Johansen and Jeselius (1990) cointegration tests. It is flexible with different and mixed levels of stationarity, which is impossible with standard cointegration models. Finally, it can overcome issues related to serial correlation and endogeneity (Pesaran and Shin, 1999).

As a matter of fact, the general equation of ARDL model is represented as follows:

$$\Delta y_t = \alpha + \delta y_{t-1} + \theta x_{t-1} + \sum_{i=1}^{n-1} \varphi_i \Delta y_{t-i} + \sum_{i=0}^{m-1} \rho_i \Delta x_{t-i} + \varepsilon_t$$

Here Δ means the first difference operator. $\alpha, \beta, \theta, \varphi_i$ and ρ_i represent coefficients that will be estimated. m and n indicate the optimal lag order to be selected.

While the ARDL cannot measure the asymmetric effect in the non-linear relationship, Shin et al. (2014) introduced the NARDL designed to detect potential asymmetric effects in both the short and long terms. In this model the explanatory variable x_t is broken down into partial sum of negative and positive changes as following manner:

$$x_t = \alpha_0 + x_t^+ + x_t^-$$

Where:

$$x_t^+ = \sum_{j=1}^t \Delta x_j^+ = \sum_{j=1}^t \max(\Delta x_j, 0)$$

$$x_t^- = \sum_{j=1}^t \Delta x_j^- = \sum_{j=1}^t \min(\Delta x_j, 0)$$

As per Shin & al. (2014), the nonlinear asymmetric cointegration relationship is represented in the following manner:

$$y_t = \alpha_0 + \beta^+ x_t^+ + \beta^- x_t^- + u_t$$

The long-run coefficients linked with positive and negative changes in x_t are denoted as β^+ and β^- , respectively. The overall form of the NARDL (n,m) model is derived by integrating equations (1) and (5), resulting in the following:

$$\Delta y_t = \alpha + \delta y_{t-1} + \theta^+ x_{t-1}^+ + \theta^- x_{t-1}^- + \sum_{i=1}^{n-1} \varphi_i \Delta y_{t-i} + \sum_{i=0}^{m-1} (\rho_i^+ \Delta x_{t-i}^+ + \rho_i^- \Delta x_{t-i}^-) + \varepsilon_t$$

The procedure for estimating the NARDL approach involves several steps. Firstly, we examine We verify the order of individual time series, which must be lower than order two. Secondly, I estimate equation (6) to test for cointegration between y_t , x_t^+ and x_t^- . using the F-statistic from Shin et al. (2014), assessing $\delta = \theta^+ = \theta^- = 0$. We then examine long-run asymmetry with a Wald test for $\delta = \theta^+ = \theta^-$ and short-run asymmetry with $\delta_i^+ = \delta_i^-$. Finally, dynamic multipliers (m_h^+ , m_h^-) for x_t^+ and x_t^- capture responses to positive and negative shocks.

$$m_h^+ = \sum_{i=0}^n \frac{\partial y_{t+i}}{\partial x_t^+}, m_h^- = \sum_{i=0}^n \frac{\partial y_{t+i}}{\partial x_t^-}$$

At this juncture: $h=1,2,3,\dots$

Overview : if $h \rightarrow \infty$ then : $m_h^+ \rightarrow \theta^+$ and $m_h^- \rightarrow \theta^-$.

3.2 Data descriptive:

In this research, I posit that the non-oil gross domestic product is influenced by both oil prices and fiscal policy. Consequently, the interaction between these variables is captured by the following function:

$$Y = f(T, G, Debt, OP)$$

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Here, Y represents the real non-oil gross domestic product, G means the real investment government spending, T indicates the real total government revenue, Debt: is regarded as Debt service and OP defines the oil prices.

Be aware that the calculations employ natural logarithms. The adjusted values were calculated using nominal values in billions of dinars and the consumer price index for the reference year 2001.

The Nonlinear Autoregressive Distributed Lag (NARDL) approach is employed when the series are expected to exhibit uneven integration. I predict an uneven impact of oil prices on real GDP. Equation08 is formulated as follows:

$$Y_t = \alpha_0 + LOP^+ + LOP^- + T + G + Debt$$

I use annual data for Algeria over the period of 1970–2022. The data for Y, T, G are collected from National Office of statistic, while debt data is obtained from World bank. However, OP collected from OPEC and OAPEC.

3.3 Discussion and results:

*** Unit root test :**

To begin this empirical analysis, we conducted unit root tests for all variables using the Augmented Dickey-Fuller (ADF) and Philips and Perron (PP) tests. The results are presented in Tables 1 and 2 below:

Table 1. Results of ADF, PP, and KSS Tests

		Level (0)		Level (1)		Stationarity
		C	C & T	C	C & T	
Y	ADF	-1.542	-1.641	-5.369***	-5.485***	L (1)
	PP	-1.355	-1.602	-5.336***	-5.460***	
T	ADF	-2.807*	-2.734	-6.937***	-6.909***	L(0)
	PP	-2.193	-1.694	-4.237***	-4.548***	
IG	ADF	-2.131	-2.525	-6.366***	-6.394***	L(1)
	PP	-2.089	-2.735	-6.397***	-6.422***	
Dept	ADF	-0.089	-2.214	-8.475***	-9.368***	L(1)
	PP	0.014	-2.210	-8.375***	-9.362***	
OP	ADF	-7.110***	-7.354***	-8.432***	-8.344***	L (0)
	PP	-7.110***	-7.369***	-50.723 ***	-50.087 ***	

Note: significations : * :1%_ **: 5%_ ***: 10%.

These tests indicate that the time series for G is not stationary, however, KSS evince that is stationary at the first difference at the significative level 10%, this is mean that G can be an integrated time series of the first order. The outcomes of these might not offer a dependable conclusion, especially if

we are aware that the time series contain a structural break caused by volatility in oil prices or changes in fiscal policy regimes.

In this research, I also employ an extension of the ADF test that can detect structural breaks; this is the (Zivot& Andrews, 2002) test. I applied this test to both a series in levels and a series in first differences.

Table3 and Table 04 present results from unit root tests with a single structural break for various economic variables, comparing the results both at the level of raw data and the level 01.

Table 2. Test of Zivot and Andrews.

Variables	At level		At 1st level	
	I	I & T	I	I & T
Y1	-6.378*(1)	-6.285*(1)	-7.957* (0)	-7.913* (0)
TB	2000	2000	2002	2002
Y2	-3.35* (2)	-2.669*** (2)	-7.559*(0)	-7.772* (0)
TB	2000	2004	1998	2000
T	-5.305* (0)	-5.361* (0)	-7.939* (0)	-7.951 (0)**
TB	1999	1999	2001	2001
IG	-4.018**(3)	-4.008*** (3)	-5.173*(3)	-5.129*(3)
TB	1995	1993	2000	2000
Debt	-9.309* (1)	-6.713* (1)	-10.047** (0)	-12.506* (0)
TB	2007	2007	2011	2007
OP	-7.832*** (0)	-9.437* (0)	-6.592* (2)	-6.917* (2)
TB	2014	2014	2000	2013

Notes: The critical values:

*1%: model 01 – 5.34/ Model 02 – 5.57.

* 5%: model 01 – 4.93/ model02 – 5.08.

*10%: model 01 – 4.58/ model 02 – 4.82.

(TB): time of the break. (...) number of lag order.

*Breakpoint Test

Table 3. Breakpoint test

		Level (0)			Level (1)		
		T-statistic	TB	Lag	T-statistic	TB	Lag
Y	I	-5.365*	1999	0	-7.276*	2000	00
	I&T	(1) -2.956	2002	02	(1)-8.493*	2000	00
		(2)-2.497	1999	0	(2)-8.318*	2000	00
T	I	-3.036	1974	0	-9.484*	1999	04
	I&T	(1)-13.088*	1998	010	-9.514 *	1999	04
		(2) -12.690 *	1998	010	-8.318 *	1999	04
IG	I	-4.300 ***	1999	00	-7.528*	1996	00
	I&T	-4.298	1994	08	-7.753	1996	00
		-4.247	1994	07	-7.618*	1996	00
Debt	I	-9.521*	2006	01	-12.595*	2007	00
	I&T	-9.415*	2006	01	-12.743 *	2007	00
		-6.278 *	2006	01	-6.278*	2006	01
OP	I	-7.742*	2012	0	-47.091*	2014	06
	I&T	-7.662*	2012	0	-52.058*	2014	06
		-9.967 *	2012	06	-168.802*	2015	04

Notes: The critical values :

*1%: model 01: – 5.35/ Model 02 : – 4.95.

* 5%: model 01: – 4.86/ model02: – 4.44.

*10% : model 01: – 4.61 / model 02: – 4.19.

(1): breaking intercept, (2): breaking intercept and trend.

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Tables 2 and 3 offer valuable insights into the stationarity of the variable T, corroborating the results of the ADF test. Additionally, they provide information on the years of breakpoints for each series. These results are significant because these years coincide with various political, economic, national, and international events. For instance :

- › The year 1974 represents the onset of the oil crisis, which had significant global economic repercussions.
- › The years 1999 and 2000 mark a period of political change in Algeria, potentially impacting economic dynamics.
- › 2006 and 2007: the onset of the international financial crisis, originating from the subprime mortgage crisis, which had profound effects on financial markets worldwide.
- › 2012: witnessed the European sovereign debt crisis.
- › 2014: a substantial decline in oil prices which had widespread implications for oil-exporting countries and global fuel markets.

Testing nonlinearity of the model:

To evaluate the model's nonlinearity, I estimated an ARDL model and performed multiple tests, including normality, LM, ARCH, and Ramsey RESET tests. The LM test results indicate rejection of non-serial correlation in the model, while the Ramsey test results suggest that the model exhibits nonlinearity.

The Asymmetric Cointegration

Table 4. Bounds test form nonlinear cointegration.

Sample Size	10%		05%		01%	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
45	2.276	3.297	2.694	3.829	3.674	5.019
50	2.259	3.264	2.67	3.781	3.593	4.981
Asymptotic	2.08	3	2.39	3.38	3.06	4.150

Note: F_PSS = 3.996, which is larger than the upper bound critical value at 5% (i.e. 3.829)

* I(0) and I(1) are respectively the stationary and non-stationary bounds.

The discoveries in Table 05 indicate that $F_PSS = 3.996$, surpassing the upper critical value at 5% (3.82). This suggests statistical significance at the 5% level, providing evidence against the null hypothesis of no cointegration

Also, it is noted that the lower bound critical value is lower than F_PSS at 5%. This further supports the evidence of cointegration, as it suggests that the computed test statistic exceeds both the upper and lower critical values, indicating cointegration.

In conclusion, based on the comparison with the upper and lower bound critical values, and considering that F_PSS exceeds the upper bound critical value at 5% significance level, there are indications of cointegration in the model. Thus, the analysis of the findings implies the existence of nonlinear cointegration among the variables.

***NARDL Model for Analyzing Short-Term and Long-Term Dynamics
Test Results for Asymmetry in Short and Long-Term Analysis***

Table 5. Asymmetry Over Long and Short Periods

	Sh. T		L. T		Sh. & L. T	
	Co.	t-stat.		Coef.	t-stat.	
Δy_{t-1}	0.629	2.775*	T_{t-1}	-0.074	-5.642***	
Δy_{t-2}	0.573	3.072**	IG	0.032	-1.457	
Δy_{t-3}	0.223	1.816*	Debt	0.0126	1.390	
ΔLTr	0.032	1.490	LOP^+	0.0003	2.271**	
ΔT_{t-1}	0.017	0.637	LOP^-	0.0004	2.317**	
ΔT_{t-2}	0.030	1.258	Const.	0.178	7.696***	
ΔT_{t-3}	0.059	2.406**				
ΔLOP^+	2.438	0.256				
ΔLOP^-	0.007	5.806				
Const.	1.810	5.763				
R^2	0.747					
R^2 adj.	0.687					
Sym. T.	3.879*		F-stat.	8.947***		4.652***
	3.879**		Chi - sq.	8.947 **		9.305 ***

Not :*, ** and *** indicate the significant at 10%, 5% and 1% level of significance, respectively.

The results from the asymmetric test presented in Table 6 indicate that the calculated Wal statistic for the long run stands at 8.947, yielding a probability of 0.005, which is less than 1%. Therefore, we reject the null hypothesis of symmetry and accept the alternative hypothesis of asymmetry. Conversely, in the short run, the Wald statistic amounts to 3.879 with a corresponding probability of 0.05, which exceeds 0.01. Hence, we accept the null hypothesis of symmetry, suggesting that the impact of oil shocks on non-oil GDP exhibits symmetry in the short term.

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In the short term, the coefficient for the lagged change in the dependent variable Δy_{t-1} is 0.629, with a t-statistic of 2.775. This means that if there was a one-unit increase in Δy in the previous period, it results in a 0.629 unit rise in the current period's dependent variable, assuming other factors remain unchanged. This relationship is statistically significant at the 10% level.

Comparable explanations apply to Δy_{t-2} and Δy_{t-3} which can be made for the coefficients of 0.573 (t-statistic: 3.072**) and 0.223 (t-statistic: 1.816*), respectively. The results are significant for the dependant variable Y but their coefficients are low.

The change in the total government revenue have not statistically significant impact on the target variable, particularly in the initial and subsequent period. Nevertheless, in the following period, the coefficient of change is significant. Noting that a large portion of public revenue comes from oil taxation, and that the short-term impact of public investment spending on non-hydrocarbon GDP is not significant, as illustrated in the table. Moreover, Empirical results of the NARDL process indicate that neither positive oil shock nor negative oil shocks have a significant influence in the non-oil GDP in the short run. Never the less, either positive oil shock or negative oil shocks exert a significant and comparable effect on non-oil GDP in the long term.

Aggregate public income (T) also exerts a significant influence on the previous period on non-oil GDP (Y), the coefficient of -0.074 with a t-statistic of -5.642 indicates that, in the long run, a one-unit increase in the lagged change of total government revenue T_{t-1} leads to a decrease of 0.074 units on the target variable. This impact is highly significant at the 1% level.

Influence of overall government revenue on the previous period have a significant adverse effect on the dependent variable in the long term. This implies that increases in total government revenue might be associated with decreases in the dependent variable over time, as indicated by the negative coefficient.

Fig.1. Plots of CUSUM and CUSUMQ statistics for coefficients stability tests:

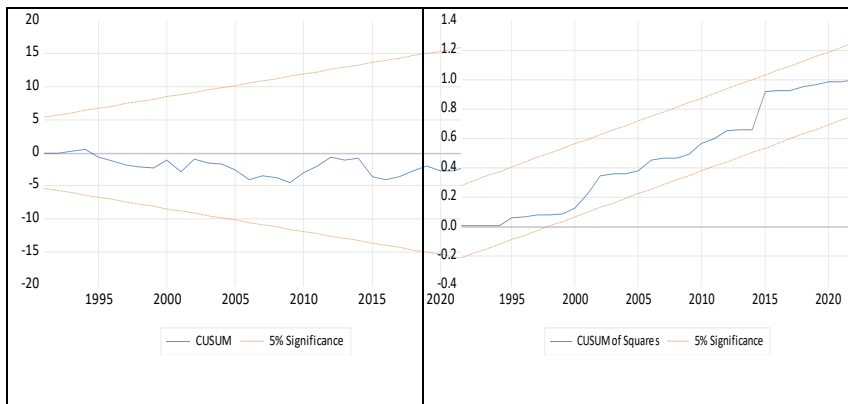


Figure 01 illustrate the model's robustness through CUSUM and CUSUM of squares analyses. The coefficients of both equations are stable, as the models fall within the 5% significance lines for both tests, indicating dynamic stability.

Fig.2. Cumulative dynamic multiplier: LOP on Y shock evolution

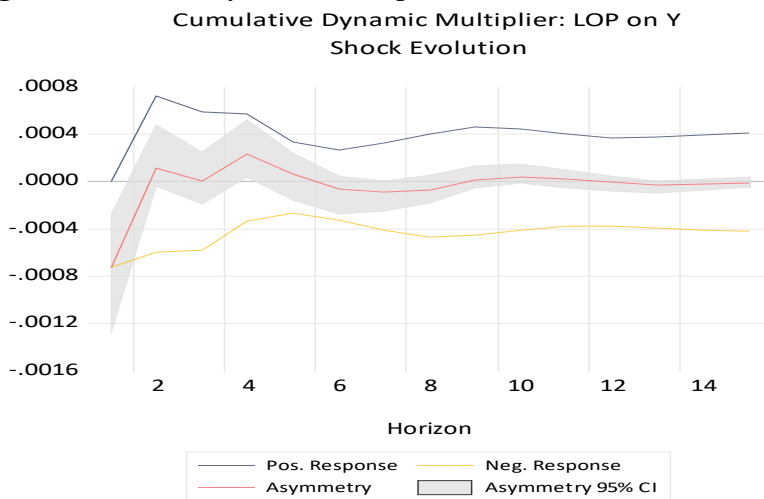


Figure 02 depicts the dynamic impact of fluctuations in oil prices and non-oil GDP. Notably, there is a discernible response to both positive and negative changes over the years. By the third period, the variable experiences a negative reaction. Subsequently, starting from the fourth period, non-oil GDP changes align with the positive response seen in oil prices. Notably, a positive shock to oil prices yields a more pronounced effect on Algeria's non-

oil GDP compared in response to an adverse disruption, signifying that a surge in petroleum costs aligns with a rise in non-oil GDP.

4. Summation

The study empirically explores using the Nonlinear Autoregressive Distributed Lag (NARDL) method the relationship between oil prices, fiscal policy, and non-oil gross domestic product (GDP) in Algeria from 1970 to 2022. Traditional linear models fail to capture potential nonlinear relationships among these variables. The NARDL model overcomes this limitation by incorporating differential effects over both the short and long periods.

There is mixed stationarity properties among the variables, with some showing stationarity in levels and others requiring first differencing to achieve stationarity. Structural break tests indicate significant breakpoints coinciding with notable political, economic, and international events, such as oil crises, political transitions, and financial crises.

The asymmetric cointegration test provides evidence of nonlinear cointegration between the variables, suggesting a long-term relationship with asymmetric effects. Specifically, positive and negative oil shocks exhibit differing impacts on non-oil GDP, with a more pronounced effect observed for positive shocks.

The short-term and long-term analysis using the NARDL model reveals significant insights. In the short period, total government revenue exhibits a statistically insignificant impact on non-oil GDP, while in the long run, it has a significant negative effect. This suggests that increases in government revenue may lead to decreases in non-oil GDP over time. Conversely, changes in oil prices have a notable and balanced impact on non-oil GDP over the long term.

The CUSUM and CUSUM of squares tests validate the dynamic stability of the model, both of which are significant at the 5% level, indicating stable coefficients. The dynamic multiplier analysis further illustrates the impact of oil price fluctuations on non-oil GDP, highlighting a positive relationship between oil prices and non-oil GDP over time.

In summary, the empirical findings offer strong evidence of the nonlinear relationship between oil prices, fiscal policy, and non-oil GDP in Algeria. The NARDL approach proves effective in capturing asymmetric effects and providing insights into both short- and long-term dynamics.

The results underscore the importance of considering nonlinearities and asymmetries in modeling economic relationships, particularly in resource-dependent economies like Algeria. Policymakers should take into account the differential impacts of positive and negative oil shocks on economic growth and adjust fiscal policies accordingly.

Further research could explore additional factors influencing the relationship between oil prices, fiscal policy, and economic performance, such as institutional quality, political stability, and global economic conditions. Additionally, incorporating other nonlinear modeling techniques or exploring alternative specifications of the NARDL model could enhance our understanding of the complexities inherent in economic systems.

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