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The Impact of Oil Price Fluctuations on the Public Budget and Fiscal Sustainability in Algeria during the Period 1990–2023

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Abstract

This study examines the impact of oil price fluctuations on Algeria's public budget and fiscal sustainability from 1990 to 2023, employing the Autoregressive Distributed Lag (ARDL) model. It aims to assess the dynamic relationship between oil prices (PP), budget balance (OBB), and non-oil revenues (NORY), focusing on transmission mechanisms of oil shocks to public finances. Results reveal that oil prices are the primary determinant of budget balance, with a 1% increase in oil prices raising the budget surplus by 0.18% in the short term. Conversely, non-oil revenues decline by 15.26 units per unit increase in oil prices, supporting the "Dutch Disease" hypothesis. The findings also highlight pro-cyclical fiscal policies in Algeria, where public spending expands during oil booms and contracts sharply during downturns, exacerbating economic volatility.

Keywords: Public Budget; Fiscal Sustainability; Oil Price Fluctuations; ARDL Model.

JEL Classification: C32; H63; Q43.

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I. Introduction:

Natural resources, particularly oil and gas, represent a double-edged sword for economies heavily reliant on them. While they provide substantial financial inflows capable of funding development and supporting social stability, they also expose these economies to the volatility of global markets, posing significant challenges for macroeconomic policy management, foremost among which is public finance. Algeria, with its long history as a major producer and exporter of hydrocarbons, stands as a clear example of this complex dynamic. Over the past decades, the hydrocarbon sector has formed the backbone of the Algerian economy, contributing significantly to GDP, dominating export revenues, and representing the primary source of state budget financing (World Bank, 2023; IMF, 2024). This structural dependency renders Algerian public finance highly sensitive to international oil prices, which are inherently volatile due to the interaction of multiple factors including geopolitical tensions, global supply and demand levels, global economic growth cycles, and the transition towards alternative energy sources.

The period from 1990 to 2023 witnessed sharp and varied fluctuations in oil prices, starting with the increases following the First Gulf War, passing through periods of relative stability followed by declines towards the end of the 1990s, then a significant price boom extending until the global financial crisis in 2008, and subsequent volatilities, most notably the price collapse in mid-2014, followed by the

repercussions of the COVID-19 pandemic, and finally the increases associated with the war in Ukraine. These price cycles were directly and immediately reflected in the Algerian economy. Periods of high prices led to fiscal surpluses that allowed for expanded public spending and the accumulation of foreign exchange reserves, while periods of decline resulted in significant pressure on the public budget, depletion of reserves, and resorting to austerity measures or exceptional financing solutions.

The problem statement of this study is that the intense reliance on inherently volatile oil revenues imposes structural and continuous challenges on public budget management in Algeria. The issue is not limited to how these fluctuations affect the immediate budget balances of revenues, expenditures, and deficit or surplus, but extends to encompass the state's ability to maintain a sustainable fiscal position in the long term. The absence of fiscal strategies capable of absorbing external shocks resulting from oil price volatility, or the inefficiency of the mechanisms adopted, could jeopardise financial and economic stability and undermine sustainable development efforts. Hence, a fundamental question arises regarding the extent to which the fiscal policies pursued by Algeria during the study period were capable of mitigating the negative effects of oil price fluctuations and insulating the national economy against them.

Stemming from this problem statement, this study seeks to answer the following research questions:

- To what extent have oil price fluctuations impacted the general budget balance in Algeria during the period 1990-2023?
- How have oil price fluctuations affected non-hydrocarbon revenues as a key indicator of public finance sustainability in Algeria during the same period?
- What are the dynamic effects of oil price shocks on key public finance variables in Algeria?

To answer these questions, the main objectives of this study are as follows:

- To analyse and measure the impact of oil price fluctuations on the Algerian general budget balance during the period 1990-2023.
- To evaluate the implications of these fluctuations on the indicator of public finance sustainability (non-hydrocarbon revenues).
- To attempt to deduce the nature of Algerian fiscal policy responses to oil price fluctuations.
- To provide policy recommendations aimed at enhancing the resilience of the general budget and the sustainability of public finance in the face of oil price volatility.

The importance of this study stems from two aspects; the first is academic, as it seeks to contribute to the economic literature related to natural resource economies and public finance in rentier states, by applying econometric models to the case of Algeria, and providing an updated analysis covering a long and eventful period. The second aspect is practical, as the study's results are hoped to provide a deeper understanding for policymakers in Algeria regarding the mechanisms through which the impact of oil price fluctuations is transmitted to various aspects of public finance, thereby aiding in the design of more effective and proactive fiscal policies to ensure macroeconomic stability and fiscal sustainability in the long term.

The limitations of this study are confined to the analysis of the Algerian economy during the period from 1990 to 2023, a period long enough to observe multiple oil price cycles and various policy responses. The substantive analysis also focuses on key public budget variables and fiscal sustainability indicators, acknowledging that other influential factors may not be fully included in the econometric model due to data constraints or the need for model simplification.

To achieve the desired objectives, this study has been divided into several sections. Following this introduction, Section Two reviews the theoretical framework and relevant previous studies on the research topic. Section Three discusses the methodology adopted in the study, including data sources, variable definition, and specification of the econometric model used. Section Four is dedicated to

presenting and analyzing the results obtained. Finally, Section Five provides a conclusion that includes the main findings and proposed recommendations.

II. Theoretical Literature On Fiscal Policy and Oil Price Volatility

To provide a solid analytical basis for understanding the complex relationship between oil price volatility, the public budget, and fiscal sustainability in Algeria, this study draws upon a set of economic theories. This section aims to review these theories, highlighting their importance in explaining the fiscal dynamics in natural resource-dependent economies.

1. Theories on the Relationship between Natural Resource Prices and the Public Budget

Natural resource prices, particularly oil, affect the public budget of producing countries through two main channels:

- **Revenue Channel:** This channel is the most direct and evident. A rise in oil prices generally leads to a direct increase in government revenues originating from taxes imposed on oil companies, export revenues, and profits generated by national companies operating in the hydrocarbon sector. Conversely, a decline in prices leads to a contraction of these revenues, placing significant pressure on the budget. The strength of this channel depends on the structure of the tax system applied to the resource sector and the proportion of this sector's contribution to total public revenues (Auty, 2001, p. 45).

- **Expenditure Channel or "Wealth Effect":** The impact of oil prices is not limited to the revenue side; it extends to encompass public expenditure. During periods of high prices, producing countries often witness an increase in government spending, driven by a sense of increased "wealth effect" and liquidity availability (Frankel, 2010, p. 12; Bova, Medas, & Poghosyan, 2016, p. 7). This expansion in spending may include salary increases, expansion of subsidy programs, and investment in large infrastructure projects. However, this spending may not always be sustainable or directed towards productive sectors, which could create future obligations that are difficult to meet when prices decline.

2. The Concept of the Dutch Disease

The concept of the "Dutch Disease" provides an important theoretical framework for understanding the macroeconomic effects of a natural resource boom, with significant implications for the state's fiscal structure (Corden & Neary, 1982, pp. 828-830; Corden, 1984, p. 360). This concept suggests that a boom in the resource sector (such as oil) can lead to negative effects on other tradable productive sectors (such as manufacturing and agriculture). This occurs through two main mechanisms:

- **Resource Movement Effect:** Resources (capital and labour) are attracted from other sectors towards the booming resource sector due to higher returns in it.

- **Spending Effect:** Increased income from the resource sector leads to increased demand for non-tradable goods and services (such as services and real estate), which raises their prices and leads to a real exchange rate appreciation. The appreciation of the real exchange rate causes other export sectors to lose their competitiveness in international markets and increases the attractiveness of imports. The result is a decline in these sectors, deepening reliance on the volatile resource sector and limiting efforts to diversify state income sources, which is vital for achieving long-term fiscal stability (Sachs & Warner, 1995, p. 22).

3. Theories of Fiscal Sustainability

Fiscal sustainability refers to the government's ability to meet its current and future financial obligations without the need to renegotiate its debt or make drastic and undesirable adjustments to spending or revenue policies (Blanchard et al., 1990, p. 9; Chalk & Hemming, 2000, p. 3). In other words, it means that public debt does not grow at a rate exceeding the economy's capacity to service it in the long term. Key indicators for assessing fiscal sustainability include:

- **Analysis of the Public Debt-to-GDP Trajectory:** Stability or decline of this indicator is a sign of sustainability.

- **Primary Budget Balance:** This is the budget balance before accounting for interest payments on debt. Achieving a primary balance sufficient to stabilize or reduce the debt-to-GDP ratio is necessary for sustainability.

- **Sustainability Gap:** This refers to the size of the required adjustment in the primary balance (as a percentage of GDP) to achieve a specific public debt target in the future (IMF, 2013, p. 15).

- **Growth of Non-Traditional (Non-Rentier) Revenues:** In countries heavily reliant on traditional revenue sources (such as oil and gas), the growth of revenues from other sources (such as taxes and fees on diverse economic activities) is an indicator of government income diversification and increased budget sustainability in the face of commodity price volatility (Yousef, 2025, p: 13).

4. Fiscal Rules:

Fiscal rules are defined as permanent constraints on fiscal policy, usually specified through quantitative indicators related to fiscal performance, such as the budget balance, public debt, expenditure, or revenues (Kopits & Symansky, 1998, p. 2). These rules aim to enhance fiscal discipline, strengthen fiscal policy credibility, and ensure long-term fiscal sustainability, especially in natural resource-dependent countries exposed to revenue volatility. Common examples of these rules include:

- **Stabilization Funds:** These are mechanisms aimed at separating natural resource revenues from the current budget. Exceptional revenues (resulting from prices exceeding a certain level) are transferred to these funds to be used during periods of low prices or to finance long-term investments, which helps smooth public expenditure (Davis, Ossowski, & Fedelino, 2003, p. 78).

- **Balanced Budget Rules or Deficit Rules:** Which set a ceiling for the budget deficit or require achieving balance or surplus.

- **Debt Rules:** Which set a ceiling for total public debt as a percentage of GDP.

- **Expenditure Rules:** Which set a ceiling for the growth of public expenditure (IMF, 2009, p. 5).

5. Theory of Government Fiscal Behavior in Rentier States:

The fiscal behaviour of governments in rentier states – those heavily reliant on external revenues derived from exporting natural resources (rent) rather than taxes imposed on domestic production – often exhibits a pro-cyclical pattern (Tornell & Lane, 1999, p. 30; Kaminsky, Reinhart, & Végh, 2004, p. 15; Ilzetzki & Végh, 2008, p. 04). This means that government spending tends to rise significantly during periods of high resource prices (booms) and falls, often sharply and disruptively, during periods of low prices (recessions). This pro-cyclical fiscal behaviour is due to several factors, including political and social pressures to increase spending during periods of abundance, weak financial and oversight institutions, difficulty in predicting resource prices, and a focus on short-term objectives. This behaviour can exacerbate macroeconomic volatility, hinder long-term planning, undermine the efficiency of public expenditure, and make public finance vulnerable to shocks.

Applied Literature

A broad segment of international studies agrees that the economies of oil-producing countries, especially in the Middle East and North Africa region, exhibit a strong correlation between their oil revenues and the performance of their public budgets. Numerous analyses, such as studies by (El-Anshasy & Katsaitis, 2013) and (Abdih & all, 2010), have shown that shocks in global oil prices are directly and strongly reflected in government revenue levels, and consequently on the volume of public spending and the overall fiscal balance. This direct relationship often leads to a tendency for fiscal policies in these countries to follow the pro-cyclical pattern of oil prices, where public spending expands significantly during periods of high prices, which can create considerable pressures and challenges when the price trend reverses, as explained by (Villafuerte & Lopez-Murphy, 2010). This cyclical fiscal behaviour increases uncertainty and makes long-term fiscal planning extremely difficult.

Moving to a deeper level of analysis, the topic of non-oil revenues emerges as a crucial component in evaluating the economic diversification efforts and fiscal sustainability of oil-dependent countries. The literature in this area presents a complex picture; on the one hand, some studies may suggest that oil abundance and the accompanying easy financial flows can weaken government incentives to develop and mobilize revenues from non-oil sources, which aligns with some aspects of the "resource curse" as pointed out by (Bornhorst & all, 2008) in the context of tax effort. On the other hand, researchers like (Gupta & Crivelli, 2014) argue that high oil prices can stimulate general economic activity, including in non-oil sectors, which might indirectly lead to an increase in tax and non-tax revenues from these sectors. However, the challenge remains in the extent to which this indirect growth can provide a stable revenue base independent of oil price fluctuations and capable of financing public expenditures sustainably in the long term. Therefore, numerous studies, such as the work of (Velasco & Cespedes, 2014), have emphasized the importance of building sufficient "fiscal buffers" during periods of oil price booms to enhance the capacity to withstand negative price shocks and protect fiscal stability.

Within the context of studying the specifics of the Algerian economy, several pieces of research have provided specific results showing the extent and depth of the impact of oil price fluctuations on public finance. In general, these results support the initial conclusions of the study by (Aissaoui, 2001), which highlighted the critical nature of the hydrocarbon sector in directing the Algerian economy. Periodic reports by international institutions, such as the International Monetary Fund, often confirm these strong correlations through their quantitative analyses specific to Algeria, pointing to the high sensitivity of fiscal indicators to oil price shocks.

Many applied studies have sought to accurately determine the magnitude and nature of these effects. For example, the results of the study by (Shabab, 2020) revealed a positive and highly elastic (between 41-64%) and sustainable impact of oil prices on the general budget balance in Algeria. The analysis showed the presence of cointegration and highly statistically significant effects in both the short and long term. The study used a Vector Error Correction Model (VECM) for this purpose. In another study employing the Autoregressive Distributed Lag (ARDL) model, (Hadji & all, 2024) found that oil prices have a positive and significant impact on economic growth in Algeria, suggesting that the budget surpluses resulting from high oil prices have translated into long-term economic growth.

Regarding the dynamic effects of oil price shocks, the study by (Al-Othmani, 2016) applying a Vector Autoregression (VAR) model, showed that oil price shocks represent a significant source and a major driver of fluctuations in Algerian macroeconomic variables, with clear and tangible responses from fiscal variables. Furthermore, variance decomposition analysis in such a study showed that oil prices explain a large and influential proportion of the variance in public revenues and expenditures. Similarly, the results of (Rezki & Hadjira, 2024), using a Structural VAR (SVAR) model, indicated that the transmission of oil price shocks to the Algerian economy occurs relatively effectively and quickly, causing substantial impacts on variables such as GDP and inflation, reflecting the fragility of internal balances to external shocks.

As for fiscal policy mechanisms, the role of the Revenue Regulation Fund in Algeria has been evaluated. In this context, (Ben Kheira et al., 2022) provided an assessment of the fund's performance, relying on descriptive statistical analysis and time series analysis of fiscal indicators. Their results indicated that the fund's effectiveness in achieving fiscal stability and mitigating the severity of oil price volatility was varied and limited in some periods, especially when facing sharp and sustained price declines. On a broader level, the study by (Koh, 2017) indicated that oil revenue stabilization funds in general can play a tangible positive role in smoothing fiscal policy, provided there is sound governance and clear operating rules, which can be inferred for the Algerian context.

Concerning economic diversification efforts and non-oil revenues, the study by (Boussalem & Attia, 2021), through time trend analysis and regression models, concluded that the contribution of non-oil revenues to budget financing remains relatively weak and that the determinants for the growth of non-oil sectors have not been sufficiently activated to achieve genuine diversification. Additionally, the study by (Kermi, 2024), using diversification indicators and sectoral analyses, showed that economic diversification efforts in

Algeria have faced significant and structural challenges, and that the economy continues to suffer from a high degree of concentration around the hydrocarbon sector, making public revenues hostage to the volatility of this sector.

III. Measuring the Impact of Oil Price Volatility on the General Budget Balance and Non-Oil Revenues

To achieve the objectives of this study and answer its research questions regarding the impact of oil price volatility on the general budget and public finance sustainability in Algeria during the period 1990-2023, through analyzing the dynamic relationship between oil price volatility and the dependent fiscal variables in Algeria, the Autoregressive Distributed Lag (ARDL) model was employed. Given that this model directly serves the study's objectives, it allows for simultaneous analysis of the short-run and long-run relationships between variables. It can be applied regardless of whether the variables are integrated of order zero I(0), order one I(1), or a mix thereof, as long as no variable is integrated of order two I(2). Furthermore, its estimators are efficient in small samples, as is the case in this paper.

The following table shows the study variables, their units, and data sources:

Table 1: Study Variables and Data Sources

Type of Variable	Symbol	Description	Source
Dependent	OBB	General budget balance as a percentage of GDP	IMF
	NORY	Non-oil revenues in billion Algerian Dinars	Central Bank
Independent	PP	Annual average price of Brent crude oil in USD	OPEC
	INF	Measured by the annual change in the Consumer Price Index	World Bank [1]
	GDP	Real GDP in billion Algerian Dinars	IMF
	REER	Real Effective Exchange Rate of the Dinar against the Dollar	World Bank

Source: *Prepared by the researchers based on applied literature.*

It should be noted that the selection of percentages as standardized units of measurement for the study variables was based on several fundamental methodological considerations. The foremost consideration is achieving homogeneity in measurement units among different variables, which enhances the accuracy and reliability of the econometric analysis of the results. Furthermore, standardizing measurement units as percentages contributes to mitigating potential variations within the observations of each variable individually, which might naturally arise due to differences in their original scales or absolute magnitudes, thereby providing a more stable basis for estimation and analysis.

3.1.1 Model Specification:

The econometric models adopted in this study were constructed based on an extensive review of relevant theoretical and applied literature that addressed the impact of oil price volatility on public finance variables, either wholly or partially. The general framework of these models was adapted to align with the structural and institutional specificities of the Algerian economy during the analysis period. Accordingly, the general mathematical formula for the models used can be expressed as follows:

$$\text{OBB} = f(INF;\ PP;\ NOGDP;\ REER)$$

$$\text{NORY} = f(INF;\ PP;\ NOGDP;\ REER)$$

[1] https://data.albankaldawli.org/indicator/NY.GDP.MKTP.KD.ZG, accessed on: 23/02/2025.

$$d(OBB_t) = \alpha + \rho OBB_{t-1} + \beta_1 PP_{t-1} + \beta_2 INF_{t-1} + \beta_3 NOGDP_{t-1} + \beta_4 REER_{t-1} + \sum_{j=0}^{q-1}(\gamma_n * \Delta OBB_{t-J}) + \sum_{j=0}^{q-1}(\sigma_n * \Delta INF_{t-J}) + \sum_{j=0}^{q-1}(\delta_n * \Delta PP_{t-J}) + \sum_{j=0}^{q-1}(\theta_n * \Delta NOGDP_{t-J}) + \sum_{j=0}^{q-1}(\varphi_n * \Delta REER_{t-J}) + \varepsilon_t$$

$$d(NORY_t) = \alpha + \rho NORY_{t-1} + \beta_1 PP_{t-1} + \beta_2 INF_{t-1} + \beta_3 NOGDP_{t-1} + \beta_4 REER_{t-1} + \sum_{j=0}^{q-1}(\gamma_n * \Delta NORY_{t-J}) + \sum_{j=0}^{q-1}(\sigma_n * \Delta INF_{t-J}) + \sum_{j=0}^{q-1}(\delta_n * \Delta PP_{t-J}) + \sum_{j=0}^{q-1}(\theta_n * \Delta NOGDP_{t-J}) + \sum_{j=0}^{q-1}(\varphi_n * \Delta REER_{t-J}) + v_t$$

(α_0,γ_0) represents the intercept or constant term, (θ,π) represent the error correction coefficients, and (β,λ) are the short-run coefficients for the independent variables, while (δ,μ) represent the long-run coefficients for the independent variables. (j;1...n) represents the lag order of the model, and (t:1...T) represents time. (ϵ_t,ν_t) represent the random error term, which is assumed to be white noise.

3.1.2 Descriptive Statistics of Study Variables:

To determine the basic statistical characteristics of the time series of the economic variables related to the study topic, a set of measures of central tendency and dispersion were calculated. The following table presents a summary of these statistics:

Table 2: Descriptive Statistics of Study Variables

	GDP	INF	NORY	OBB	PP	REER
Mean	5890.66	8.60	1625.61	-1.22	52.60	113.08
Median	5925.57	4.82	950.99	-1.32	49.04	102.63
Maximum	8725.43	31.67	5141.10	12.87	112.94	220.96
Minimum	3630.14	0.34	76.30	-13.88	12.94	86.80
Std. Dev.	1723.69	8.90	1513.09	6.59	32.41	25.54
Observations	34	34	34	34	34	34

Source: *Prepared by the researchers based on Eviews 12 output.*

The arithmetic means show that the general budget balance (OBB) was negative on average (-1.216%) during the study period, indicating the dominance of fiscal deficit in the Algerian budget over the past three decades. This persistent deficit reflects the severe dependence on volatile oil revenues and the state's inability to achieve a balance between revenues and expenditures, especially during periods of low oil prices. On the other hand, the average non-oil revenues (NORY) reached about 1,625.6 billion Algerian Dinars, with significant variation in maximum values (from 76.3 billion to 5,141.1 billion Dinars), indicating the low stability of these revenues and the ineffectiveness of efforts to diversify income sources. As for oil prices (PP), their average was around 58.6 dollars per barrel, with sharp volatility between the minimum (12.86 dollars) and maximum (112.94 dollars), which reinforces the theoretical hypothesis about the high sensitivity of the Algerian economy to global market fluctuations.

The standard deviations show a high degree of dispersion in all variables, especially in oil prices (PP) and non-oil revenues (NORY), where the standard deviation for PP was about 25.54 dollars and for NORY about 1,513.09 billion Dinars. This large dispersion highlights the instability of oil and non-oil revenues, complicating the task of fiscal policy management under repeated external shocks. For the budget balance

(OBB), the standard deviation of 6.59% indicates sharp fluctuations in the fiscal balance between surplus and deficit over the years, which contradicts fiscal sustainability standards that require stabilizing the balance in the long term.

These preliminary statistics reinforce the theoretical hypotheses presented in the theoretical framework, especially concerning the "revenue channel" and the "Dutch Disease". The high variance in oil revenues (PP) and the strong correlation between them and the budget balance (OBB) support the idea that price fluctuations are transmitted directly to public finance through the revenue channel. In contrast, the weak growth and instability of non-oil revenues (NORY) indicate the failure of policies to diversify income sources, which is consistent with the "resource curse" theory linking excessive reliance on natural resources to the underdevelopment of other sectors. Additionally, the sharp fluctuations in the real effective exchange rate (REER) (with a standard deviation of 2.48) reinforce the "Dutch Disease" hypothesis, where rising oil prices lead to the appreciation of the national currency and the loss of competitiveness of tradable sectors.

3.2 Diagnostic Tests for the Model

The validity of the results of ARDL models depends on basic assumptions including the stationarity of the time series of variables (either at level or after first differencing), the existence of a long-term cointegration relationship between them, the satisfaction of the classical assumptions for regression residuals (independence, normal distribution, constant variance), in addition to ensuring the stability of the model structure over time; these conditions together are necessary to ensure the reliability of the statistical estimates derived from the models.

3.2.1 Results of the Stationarity Study:

The stationarity of time series is a fundamental condition for applying econometric models such as ARDL, and it is verified through unit root tests like the Phillips-Perron (P-P) test, which is commonly used in applied literature. The P-P test is based on three models (with constant, with constant and trend, and without) to test two hypotheses: the first states that the series is non-stationary (contains a unit root), and the second states that it is stationary (does not contain a unit root).

Upon analyzing the time series at the original level, the results show that most variables are non-stationary, except for some cases. For example, for the general budget balance (OBB), the test statistic value (t-Statistic = -2.247) in the "with constant only" model does not achieve a statistical significance level (p-value = 0.195), meaning the hypothesis of a unit root (Non-stationarity) remains. This conclusion also applies to the rate and non-oil revenues (NORY) and Gross Domestic Product (GDP), where the probability values indicate the non-rejection of the unit root hypothesis in most models. As for the oil price (PP) and inflation rate (INF), the results also show their non-stationarity, except for one case: the Real Effective Exchange Rate (REER), which records a high statistical value with statistical significance at the 1% level (p-value ≈ 0.000) in the three test models, indicating its stationarity at the original level. This exception may reflect the nature of the exchange rate as a variable affected by direct monetary and fiscal policies, reducing its structural volatility compared to other variables such as oil prices.

Upon analyzing the time series after taking the first difference, all variables show clear stationarity. For example, for the general budget balance (OBB), the statistical value of the (P-P) test in the second model "with constant only" (t-Statistic=−7.46) is statistically significant at the 1% significance level, given its associated probability value (p-value ≈ 0.000), which indicates the variable's stationarity after the first difference. The same result applies to the other variables, where the statistical values for all variables show high statistical significance, whether in the "with constant only", "with constant and trend", or "without constant and trend" models. This uniform stationarity after the first difference indicates that the variables are considered integrated of order one (I(1)), except for the Real Effective Exchange Rate (REER), which may be integrated of order zero (I(0)) in some specifications. Economically, this conclusion reinforces the idea that aggregate variables such as oil revenues and government spending have a

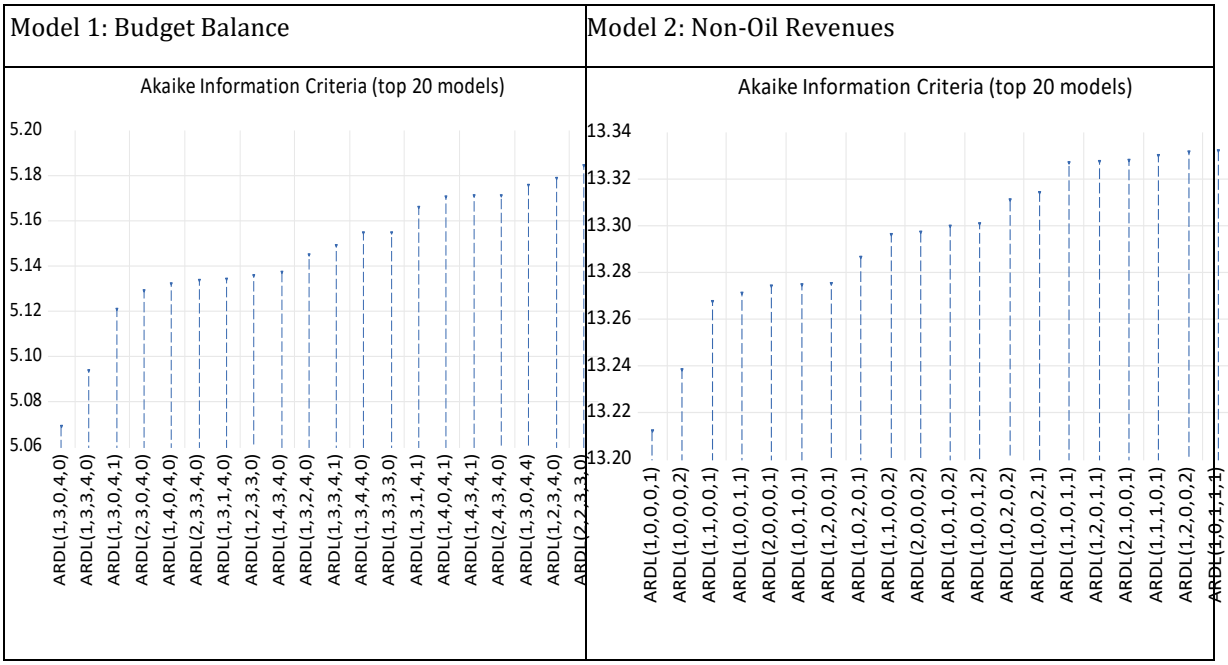
dynamic nature that requires structural correction over time, while some variables like REER show relative initial stationarity due to monetary policy interventions.

These results confirm the validity of using the ARDL model in the two study models according to the stationarity condition, as variables integrated of order one (I(1)) and mixed with variables of order zero (I(0)) can be included, provided that no variables are integrated of order two (I(2)). Since all variables are either I(0) or I(1) and there are no I(2) cases, the proposed econometric model is perfectly suitable for achieving the study's objectives. Additionally, the results show the importance of conducting further tests such as Cointegration Analysis to determine the existence of a long-term equilibrium relationship between variables, which will be covered in the subsequent steps of the analysis.

3.2.2 Cointegration Test According to the Bounds Methodology

Before starting the cointegration test, it is necessary to first determine the short-run lag order of the study models' variables by minimizing the Akaike Information Criterion (AIC) value, as illustrated by the following figures:

Figure 1: Results of the Optimal Lag Length Test



Source: Prepared by the researchers based on Eviews 12.

For the first model, which measures the impact of oil price fluctuations on the general budget balance of the state, the dependent variable was lagged by one time period, while the independent variables were lagged (3, 0, 4, 0) as ordered in the following table; For the second model, which measures the response of non-oil revenues to fluctuations in oil prices, the dependent variable was lagged by one time period, while the independent variables were lagged as follows: (0, 0, 0, 1).

After determining the lag order for the study model, the next stage will involve estimating the short-run equations to check the conditions of the error correction term, as shown in the following table for the two study models:

Table 4: Short-Run Error Correction Model

	Model 1
Dependent Variable: D(OBB)	
Selected model: ARDL(1,3,0,4,0)	

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COINTEQ*	-0.98	0.15	-6.71	0.00
D(GDP)	0.00	0.00	0.58	0.57
D(GDP(-1))	0.01	0.00	3.44	0.00
D(GDP(-2))	0.01	0.00	2.61	0.02
D(PP)	0.18	0.03	6.40	0.00
D(PP(-1))	0.15	0.05	2.91	0.01
D(PP(-2))	0.14	0.04	3.88	0.00
D(PP(-3))	0.10	0.04	2.47	0.02
C	36.53	5.44	6.72	0.00
R-squared	0.85	Durbin-Watson stat		2.37
Adjusted R-squared	0.80	F-statistic		15.09
Akaike info criterion	4.80	Prob(F-statistic)		0.00
				Model 2
Dependent Variable: D(NORY)				
Selected model: ARDL(1,0,0,0,1)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
COINTEQ*	-0.24	0.04	-5.82	0.00
D(GDP)	1.02	0.18	5.56	0.00
C	-2973.88	518.83	-5.73	0.00
R-squared	0.63	Durbin-Watson stat		1.75
Adjusted R-squared	0.61	F-statistic		26.03
Akaike info criterion	12.93	Prob(F-statistic)		0.00

Source: Prepared by the researchers based on Eviews 12 output.

- **Error Correction Coefficient:**

The error correction coefficient (ECT) in the first model shows a value of (-0.98) with high statistical significance (p-value = 0.00), reflecting a strong long-term equilibrium relationship between the general budget balance (OBB) and oil prices (PP) and other variables (GDP, inflation, real effective exchange rate). The negative value of the ECT confirms that any deviation from the long-term equilibrium is corrected in the opposite direction, which is consistent with economic theories related to fiscal stability. However, the large magnitude of the ECT coefficient (-0.98) indicates a very rapid correction of deviations, where 98% of any disequilibrium is corrected within one year. This value shows that Algerian public finance lacks institutional mechanisms capable of absorbing external shocks, such as a fiscal stabilization fund or strict fiscal rules, making it rely on immediate and drastic adjustments in spending or revenues to meet fiscal balance requirements.

Economically, this rapid behavior of the ECT is interpreted by the structural fragility of the Algerian economy, where oil price fluctuations are directly translated into changes in the budget balance with minimal intervention to smooth these fluctuations. For example, when oil prices suddenly fall, the state resorts to sharply cutting public spending or increasing borrowing, exacerbating fiscal instability in the

long term. This pro-cyclical fiscal policy is consistent with the results of previous studies such as (Tornell & Lane, 1999) and (El-Anshasy & Katsaitis, 2013), which indicate that rentier states tend to adopt unsustainable fiscal policies due to weak institutions and tax structure.

In the second model, the error correction coefficient (ECT) records a value of (-0.24) with high statistical significance as well (p-value = 0.00), confirming the existence of a long-term equilibrium relationship between non-oil revenues (NORY) and oil prices (PP) and other variables, but with a slower correction speed compared to the first model. The smaller value of the ECT coefficient (-0.24) means that only 24% of the deviations from the long-term equilibrium are corrected annually, reflecting the slow response of non-oil revenues to changes in oil prices. This slowness may be due to several factors, including the low efficiency of the tax system, lack of competitiveness in non-oil sectors, and the absence of economic incentives for income diversification.

Theoretically, this conclusion is consistent with the concept of the "Resource Curse", where excessive reliance on natural resources leads to the marginalization of other sectors, weakening the growth of non-oil revenues (Auty, 2001). Furthermore, the slowness in correcting deviations is explained by weak fiscal governance and economic policies that do not encourage economic diversification, as indicated by the study by (Boussalem & Attia, 2021) on the challenges of economic diversification in Algeria. However, the positive significance of the impact of Gross Domestic Product (GDP) on non-oil revenues (D(GDP) = 1.02) shows that economic growth contributes to enhancing these revenues, but it is not enough to compensate for oil dependence.

- **Bounds Test:**

Table 5: Results of the F-Bounds Test

	Model 1	Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	7.28	30	3.354	4.774
	Model 2	35	3.276	4.63
F-statistic	5.87	Asymptotic	2.86	4.01
k	30 / 33			5%

Source: Prepared by the researchers based on Eviews 12 output.

Since the F-statistic value (7.28) exceeds the upper critical bound (Upper Bound = 4.77) at the 5% significance level and 30 degrees of freedom for the first model, we reject the null hypothesis that there is no long-term equilibrium relationship between the variables. This conclusion confirms that the variables in the model (such as oil prices, non-oil revenues, inflation, GDP, and real effective exchange rate) have a stable equilibrium relationship with the general budget balance (OBB) in the long run.

The same result applies to the second model, where the F-statistic value (5.87) exceeds the upper critical bound (Upper Bound = 4.63) at the same significance level and 33 degrees of freedom, we reject the null hypothesis that there is no long-term equilibrium relationship between the variables. This conclusion confirms that the variables in the second model have a stable equilibrium relationship with non-oil revenues (NORY) in the long run.

3.3 Statistical Analysis of the Estimated Model (Econometric Problems Tests):

Table 6: Summary of Classical Econometric Problems Tests

Test	Model 1: General Budget	Model 2: Non-Oil

		Balance (OBB)		Revenues (NORY)	
		stat value	Prob	stat value	Prob
Breusch-Godfrey Serial Correlation LM Test:	Serial Correlation between Errors	2.87	0.08	0.62	0.24
Heteroskedasticity Test: Harvey	Heteroskedasticity	0.79	0.64	0.08	2.15
Jarque-Bera	Normality	0.06	0.91	0.43	1.59
Ramsey RESET Test	Functional Form Appropriateness	3.58	0.07	0.24	2.69

Source: Prepared by the researchers based on Eviews 12 output.

The first model showed satisfaction of most classical econometric assumptions, enhancing the credibility of its estimates. The Breusch-Godfrey test recorded a high probability value (p-value = 0.62), indicating the absence of significant serial correlation between errors, which supports the assumption of independence in the model residuals. The Harvey test also confirmed homoskedasticity (p-value = 0.64), which weakens the likelihood of a heteroskedasticity problem. Additionally, the Jarque-Bera test showed that the errors follow a normal distribution (p-value = 0.91), which is a fundamental condition for the validity of model estimates. However, the Ramsey RESET test recorded a probability value close to the significance level (p-value = 0.07), indicating a potential minor error in specifying the functional form of the model, but it is not considered a fundamental threat to the accuracy of the results.

The second model showed mixed results regarding the satisfaction of classical assumptions, with some indications of minor statistical issues. The Breusch-Godfrey test recorded a probability value close to the significance level (p-value = 0.08), indicating a potential weak serial correlation in errors, but it is not statistically significant. The Harvey test also showed a probability value close to the significance level (p-value = 0.08). On the other hand, the model satisfied the normality assumption for errors (p-value = 0.43), which increases the researcher's confidence in its results. Finally, the Ramsey RESET test showed a non-significant probability value (p-value = 0.24), indicating that the model has a good functional form fit, with no strong evidence of misspecification.

3.4 Economic Analysis of the Model:

Referring to Table 4, which shows the short-run coefficients, the following results can be recorded:

First: In the Short Run

The first model showed that current oil price fluctuations (D(PP)) have a direct and rapid impact on the general budget balance in Algeria in the short run. The variable D(PP) recorded a positive and statistically significant coefficient (0.18), meaning that a 1% increase in oil prices improves the budget balance by 0.18% in the same year. The lagged values of oil prices (D(PP(-1)), D(PP(-2)), D(PP(-3))) also recorded positive and statistically significant effects, but they gradually decrease over time, indicating that the impact of oil shocks extends for several short periods after their occurrence. This behaviour is consistent with the revenue channel, where price fluctuations are directly translated into changes in government revenues due to the structural dependence on oil.

On the other hand, the lagged values of GDP growth (D(GDP(-1)), D(GDP(-2))) recorded positive and statistically significant effects, while the current growth rate was not significant. This conclusion highlights the non-immediate relationship between economic growth and the budget balance, as

improvements in economic activity take time to translate into tax revenues or fees that improve the fiscal balance. Practically, these results show that Algerian public finance is particularly sensitive to oil fluctuations, while lacking effective mechanisms to link economic growth to immediate improvement in the budget balance.

The second model focused on analyzing the impact of oil price fluctuations and other variables on non-oil revenues in the short run. GDP (D(GDP)) showed a strong and direct positive impact (coefficient: 1.02), indicating that a 1% increase in economic growth raises non-oil revenues by 1.02% in the same period. This conclusion supports the strong relationship between economic activity and tax collection, as growth enhances the tax base and increases taxable income.

In contrast, oil price (D(PP)) did not show a direct impact in the second model. However, the results indicate that non-oil revenues depend mainly on economic growth and not on oil price fluctuations, highlighting the importance of supporting productive sectors to enhance fiscal sustainability. Theoretically, this behaviour is considered a positive indicator of the Algerian economy's ability to generate alternative revenues, but it is not enough to compensate for excessive oil dependence, as shown by the "Dutch Disease" hypothesis.

Second: In the Long Run

Table 7: Long-Run Coefficients and Equation of the Study Model

				Model 1
GDP(-1)	0.00	0.00	-2.83	0.01
INF	0.02	0.11	0.15	0.88
PP(-1)	-0.09	0.04	-2.28	0.03
REER	-0.21	0.08	-2.63	0.01
				Model 2
Variable *	Coefficient	Std. Error	t-Statistic	Prob.
PP	-15.26	5.87	-2.60	0.01
REER	42.11	18.83	2.24	0.03
INF	42.76	19.33	2.21	0.03
GDP(-1)	1.68	0.28	6.02	0.00

Source: Prepared by the researchers based on Eviews 12 output.

The first model showed a long-term relationship between the general budget balance (OBB) and oil price fluctuations (PP) and other variables such as the real effective exchange rate (REER) and economic growth.

- **Oil Price (PP):** Recorded a negative and statistically significant coefficient (-0.09, p-value = 0.03), indicating that a decrease in oil prices leads to a deterioration of the budget balance in the long run. This conclusion is consistent with the revenue channel, where oil price fluctuations are directly translated into changes in government revenues due to the dominance of oil over state resources.

- **Real Effective Exchange Rate (REER):** Showed a negative and significant impact (-0.21, p-value = 0.01), reinforcing the Dutch Disease hypothesis, where currency appreciation leads to a decline in the competitiveness of non-oil sectors, thereby reducing government revenues from these sectors, exacerbating the fiscal deficit in the long run.

- **Gross Domestic Product (GDP):** Recorded a slight statistically significant impact (0.002, p-value = 0.01), highlighting the weak relationship between economic growth and tax collection in the long run, which is an indicator of the inefficiency of fiscal policies in converting growth into stable revenues.

- **Inflation (INF):** Is not statistically significant (p-value = 0.88), indicating that inflation does not exert direct pressure on the budget balance in the long run, due to the lack of linkage between monetary policies and fiscal stability in Algeria.

The second model focused on analyzing the impact of oil price fluctuations and other variables on non-oil revenues in the long run, where the results showed the following:

- **Oil Price (PP):** Recorded a negative and significant impact (-15.26, p-value = 0.01), indicating that an increase in oil prices leads to a decline in non-oil revenues in the long run, which supports the "Dutch Disease" theory. This is because the state focuses on the hydrocarbon sector at the expense of other sectors, weakening economic diversification efforts.

- **Real Effective Exchange Rate (REER):** Recorded a positive and significant impact (42.11, p-value = 0.03), showing that an increase in the exchange rate (Dinar appreciation) enhances non-oil revenues, by improving export competitiveness or reducing reliance on imports, which contradicts some theories but may reflect political interventions to support non-oil sectors during periods of appreciation.

- **Inflation (INF):** Recorded a positive and statistically significant impact (42.76, p-value = 0.03), indicating that rising inflation puts pressure on public finance by increasing borrowing costs or eroding purchasing power, weakening non-oil revenue collection.

- **Lagged Gross Domestic Product (GDP(-1)):** Recorded a strong and direct positive impact (1.68, p-value = 0.00), confirming the strong relationship between economic growth and tax collection in the long run, as growth enhances the tax base and increases taxable income.

Conclusion and Findings

The study showed that public finance in Algeria suffers from extreme structural dependence on oil price fluctuations, making it vulnerable to external shocks and complicating efforts to achieve fiscal sustainability in the long term. By analyzing data for the period 1990–2023 using the ARDL model, the results concluded that there is a strong long-term relationship between oil prices (PP) and the general budget balance (OBB). An increase in oil prices had a direct positive impact on improving the budget balance, especially in the short run. This conclusion is consistent with the "revenue channel," where positive price shocks are translated into higher government revenues, while declines lead to an immediate deterioration of the fiscal balance. However, the results showed that this rapid response does not reflect efficiency in fiscal policy management but rather highlights the fragility of the Algerian fiscal system to oil fluctuations, which aligns with the "pro-cyclical fiscal behavior" theory in rentier states.

On the other hand, the analyses confirmed that non-oil revenues (NORY) lack flexibility and diversification, as they recorded a negative long-term impact from oil prices, which supports the "Dutch Disease" hypothesis. A rise in oil prices leads to currency appreciation and a decline in the competitiveness of non-oil sectors, weakening the growth of these revenues and deepening dependence on oil. This behaviour highlights structural challenges in the Algerian economy, particularly the weak institutional links between economic growth and tax collection, which hinders economic diversification efforts.

Regarding fiscal sustainability, the results showed that the absence of effective stabilization mechanisms, such as a fiscal stabilization fund or strict fiscal rules, exacerbates economic volatility. During periods of high prices, the state resorts to unsustainable public spending, while resorting to sharp austerity in periods of decline, which weakens the economy's ability to recover from shocks. This pattern contradicts the principles of fiscal sustainability, which require counter-cyclical fiscal policies.

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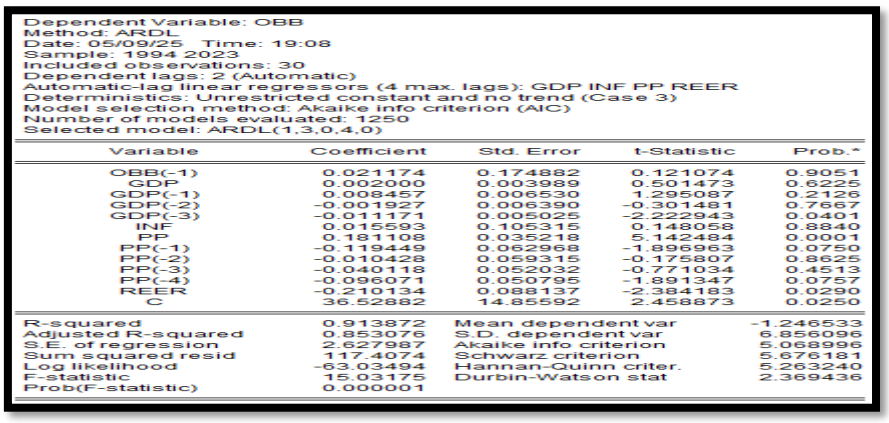
- **Appendix**

Appendix 01: Estimation Results of Model One

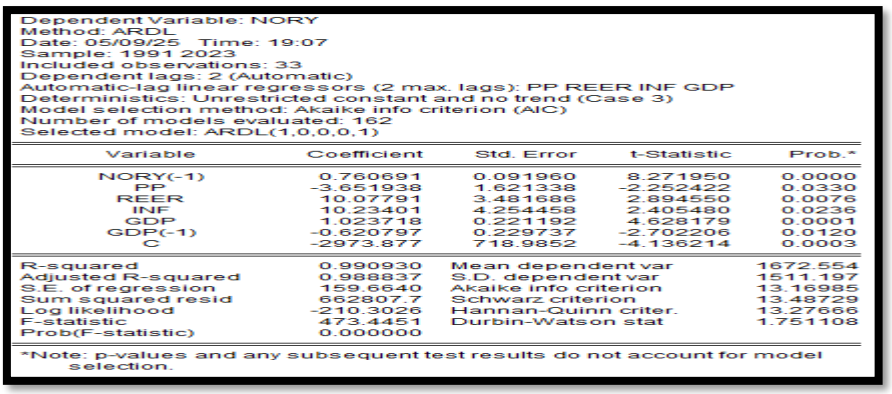


Dependent Variable: OBB
Method: ARDL
Date: 05/09/25 Time: 19:08
Sample: 1994 2023
Included observations: 30
Dependent lags: 2 (Automatic)
Automatic-lag linear regressors (4 max. lags): GDP INF PP REER
Deterministics: Unrestricted constant and no trend (Case 3)
Model selection method: Akaike info criterion (AIC)
Number of models evaluated: 1250
Selected model: ARDL(1,3,0,4,0)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
OBB(-1)	0.021174	0.174882	0.121074	0.9051
GDP	0.002000	0.003989	0.501473	0.6225
GDP(-1)	0.008457	0.006530	1.295087	0.2126
GDP(-2)	-0.001927	0.006390	-0.301481	0.7667
GDP(-3)	-0.011171	0.005025	-2.222943	0.0401
INF	0.015593	0.105315	0.148058	0.8840
PP	0.181108	0.035218	5.142484	0.0001
PP(-1)	-0.119449	0.062968	-1.896963	0.0750
PP(-2)	-0.010428	0.059315	-0.175807	0.8625
PP(-3)	-0.040118	0.052032	-0.771034	0.4513
PP(-4)	-0.096071	0.050795	-1.891347	0.0757
REER	-0.210134	0.088137	-2.384183	0.0290
C	36.52882	14.85592	2.458873	0.0250

R-squared	0.913872	Mean dependent var	-1.246533
Adjusted R-squared	0.853076	S.D. dependent var	6.856096
S.E. of regression	2.627987	Akaike info criterion	5.068996
Sum squared resid	117.4074	Schwarz criterion	5.676181
Log likelihood	-63.03494	Hannan-Quinn criter.	5.263240
F-statistic	15.03175	Durbin-Watson stat	2.369436
Prob(F-statistic)	0.000001		

Appendix 02: Estimation Results of Model Two



Dependent Variable: NORY
Method: ARDL
Date: 05/09/25 Time: 19:07
Sample: 1991 2023
Included observations: 33
Dependent lags: 2 (Automatic)
Automatic-lag linear regressors (2 max. lags): PP REER INF GDP
Deterministics: Unrestricted constant and no trend (Case 3)
Model selection method: Akaike info criterion (AIC)
Number of models evaluated: 162
Selected model: ARDL(1,0,0,0,1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
NORY(-1)	0.760691	0.091960	8.271950	0.0000
PP	-3.651038	1.621338	-2.252422	0.0330
REER	10.07791	3.481686	2.894550	0.0076
INF	10.23401	4.254458	2.405480	0.0236
GDP	1.023718	0.221192	4.628179	0.0001
GDP(-1)	-0.620797	0.229737	-2.702206	0.0120
C	-2973.877	718.9852	-4.136214	0.0003

R-squared	0.990930	Mean dependent var	1672.554
Adjusted R-squared	0.988837	S.D. dependent var	1511.197
S.E. of regression	159.6640	Akaike info criterion	13.16985
Sum squared resid	662807.7	Schwarz criterion	13.48729
Log likelihood	-210.3026	Hannan-Quinn criter.	13.27666
F-statistic	473.4451	Durbin-Watson stat	1.751108
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent test results do not account for model selection.

Appendix No. (3): PP Test for Stationarity of Study Variables at Level and First Difference[2]

UNIT ROOT TEST TABLE (PP)								
At Level								
	Model	OBB	GDPG	INF	PP	REER	NORY	GDP
With Constant	t-Statistic	-2.25	-3.92	-1.68	-1.48	-5.85	4.75	0.86
	Prob.	0.19	0.01	0.43	0.53	0.00	1.00	0.99
		n0	***	n0	n0	***	n0	n0
With Constant & Trend	t-Statistic	-2.57	-3.87	-1.71	-2.36	-9.06	0.55	-2.99
	Prob.	0.30	0.03	0.72	0.39	0.00	1.00	0.15
		n0	**	n0	n0	***	n0	n0
Without Constant & Trend	t-Statistic	-2.18	-2.03	-1.43	-0.16	-2.44	6.09	5.12
	Prob.	0.03	0.04	0.14	0.62	0.02	1.00	1.00
		**	**	n0	n0	**	n0	n0
At First Difference								
	Model	d(OBB)	d(GDPG)	d(INF)	d(PP)	d(REER)	d(NORY)	d(GDP)
With Constant	t-Statistic	-7.46	-10.32	-5.72	-5.38	-21.13	-11.66	-4.32
	Prob.	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		***	***	***	***	***	***	***
With Constant & Trend	t-Statistic	-7.32	-10.90	-6.25	-5.24	-27.28	10.37	-4.39
	Prob.	0.00	0.00	0.00	0.00	0.00	0.00	0.01
		***	***	***	***	***	***	***
Without Constant & Trend	t-Statistic	-7.55	-10.39	-5.75	-5.39	-15.27	-11.04	-2.13
	Prob.	0.00	0.00	0.00	0.00	0.00	0.00	0.03
		***	***	***	***	***	***	**

Source: Eviews 12 output.

[2] (*) Significant at 10%; (**) Significant at 5%; (***) Significant at 1%; (n0) Not significant.