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# The impact of rationalising public expenditure on reducing the public budget deficit: A case study of Algeria (1990–2019)

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**Abstract---**This study aims to examine the role of rationalising public expenditure in reducing the state's public budget deficit, focusing on Algeria during the period 1990–2019. To investigate this issue, this research discusses the theoretical aspects of the public budget deficit and the rationalisation of public expenditure before turning to the role that expenditure rationalisation plays in limiting the public budget deficit. The study concludes that Algeria's public budget recorded a persistent deficit throughout the period under review due to the inability of public revenues to keep pace with rising public expenditure.

**Keywords---**Public budget; public budget deficit; rationalisation of public expenditure; Algerian economy.

## Introduction

The structural imbalances that affected the Algerian economy in the late 1980s led Algeria to undertake a series of economic reforms. At the beginning of the 1990s, Algeria entered negotiations with the International Monetary Fund and the World Bank for Reconstruction and Development to obtain the financing needed to restore macroeconomic equilibrium, particularly in the public budget, as Algeria was suffering a deficit. Consequently, contractionary measures have been adopted to address the public budget deficit.

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At the beginning of 2000, and as a result of the financial windfall generated by rising oil prices in international markets, Algeria pursued an expansionary spending policy from 2000--2014. In mid-2014, oil prices declined, worsening the public budget deficit and prompting the government to seek mechanisms to reduce it with minimal harm. Here, the importance of rationalising public expenditure emerges as a mechanism for reducing the public budget deficit.

**Research Problem**

Therefore, the research problem involves the following question:

How does the mechanism of rationalising public expenditure contribute to reducing the state's public budget deficit in Algeria during the period 1990–2019?

To answer this problem, we draw on the following subsidiary questions:

- What are the causes of the public budget deficit in Algeria?
- What spending policy has been pursued, and what are the motives for rationalising it?
- What mechanisms have been adopted to address Algeria's public budget deficit?
- To what extent can the rationalisation of public expenditure contribute to reducing the public budget deficit in Algeria?

**Research Hypotheses**

To answer the research problem, along with the subsidiary questions raised, we propose the following hypotheses, which serve as a starting point for addressing the topic:

- The causes of Algeria's public budget deficit stem from rising public expenditure and declining public revenues.
- One reason for the rise in public expenditure in Algeria is the adoption of an expansionary fiscal policy.
- Rationalising public expenditure is one of the mechanisms that Algeria has employed to address the public budget deficit.
- Both the rationalisation of operating expenditures and capital expenditures contribute to reducing the public budget deficit.

**Research Objectives**

This research aims to do the following:

- Identifying the nature of the public budget deficit in Algeria.
- The significance of rationalising public expenditure and its role in addressing the state's public budget deficit is highlighted by examining Algeria's experience from 1990--2019.
- Determine the measures and mechanisms adopted by Algeria to rationalise public expenditure and address the public budget deficit.
- Assess the effectiveness of rationalising public expenditure in reducing the public budget deficit.

**Methodology**

To conduct this research, the descriptive–analytical method was employed to examine the theoretical aspects of the public budget deficit and the rationalisation of public expenditure and to analyse data to reach conclusions. The statistical method was also used to carry out an econometric test of the role of rationalising public expenditure in reducing the public budget deficit in Algeria.

**Section One: The Nature of the Public Budget Deficit**

**First: Definition of the Public Budget Deficit**

There are numerous definitions of the public budget deficit. It is defined as:

"the situation in which public expenditure exceeds public revenues, whereby public revenues are unable to cover expenditure. "[1]

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[1] Abd al-Ḥamīd ʿAbd al-Muṭṭalib, *Economic Policies at the National Economy Level*, Nile Arab Group, Cairo, Egypt, 2003, p. 77.

The budget deficit is also defined as "the shortfall of the State's estimated public revenues in meeting estimated expenditure."[2]
It is further described as "a reflection of the inability of public revenues to cover public expenditure, that is, an increase in public expenditure over public revenues."[3]
On the basis of the above definitions, the public budget deficit may be defined as follows:
"a reflection of the inability of public revenues to cover public expenditure, that is, an increase in public expenditure over public revenues."

**Second: Types of Public Budget Deficit**
The public budget deficit takes various forms and types, the most important of which are as follows:
**1. Current Deficit**
The current deficit reflects the net resource requirements of the government sector that must be financed through borrowing. This type of deficit is measured by the overall difference between total categories of expenditure and public revenues for all government bodies, minus government expenditure allocated to servicing accumulated debt from previous years. In other words, it is the difference between current public expenditure and current public revenues.[4]
**2. Overall Deficit**
Additionally, the traditional or gross deficit is defined as "the difference between total government cash expenditures, including interest paid on public debt while excluding amortisation payments on government debt, and total government cash receipts tax and nontax plus grants, with loan proceeds excluded. The aim of measuring this deficit is to provide policymakers with an indication of the additional resources the government must borrow from the domestic or foreign private sector, or from the central bank."[5]
**3. Operational Deficits**
Additionally, known as the inflation-adjusted deficit, it measures the deficit under inflationary conditions. In this case, the deficit represents the state's borrowing requirements minus the portion paid as interest to compensate creditors for the loss incurred due to inflation. This portion is referred to as the inflationary monetary correction.[6]
**4. Structural Deficits**
A structural deficit occurs when public revenues fail to cover public expenditures continuously, resulting in a permanent deficit. The reason for this lies in the imbalance of the state's financial system, arising from the increase in public expenditure at a rate exceeding the capacity of the national economy in all its sources, that is, the ability of national income to bear public burdens in various forms. This, in general, indicates a flaw or imbalance in the economic structure, as public expenditure may not be sufficiently productive.[7]
**5. Primary Deficit**
This type of deficit is known as the deficit excluding interest payments, as it excludes all interest appropriations. The purpose of this measure is to identify the improvement or deterioration of government indebtedness resulting from the current budget policy. However, a key criticism of this

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[2] Ḥusayn Rātib Yūsuf Rayyān, *Budget Deficit and Its Treatment in Islamic Jurisprudence*, Dār al-Nafāʾis for Publishing and Distribution, Jordan, 1999, p. 92.
[3] Sālim ʿAbd al-Ḥusayn Sālim, "The Public Budget Deficit and Visions and Policies for Its Treatment with Reference to Iraq 2003–2012," *Journal of Economic and Administrative Sciences*, University of Baghdad, vol. 18, no. 68, p. 295.
[4] Khadīja al-Aʿsar, *Economics of Public Finance*, Dār al-Kutub al-Miṣriyya, Cairo, Egypt, 2016, p. 249.
[5] Kerdoudi Ṣabrina, *Financing the State's Public Budget Deficit in the Islamic Economy: A Comparative Analytical Study*, Dār al-Khaldūniyya for Publishing and Distribution, Algeria, 2007, p. 135.
[6] Naṣir Boudjalal and Kamāl Dīb, "Quantitative Easing as a Mechanism for Financing the State's Public Budget Deficit: The Case of Algeria," *Journal of Economic, Management, and Commercial Sciences*, M'sila, vol. 12, no. 1, 2019, p. 247.
[7] Amḥammad ibn al-Bār and Ṣalāḥ al-Dīn Sharīṭ, "Analysis of the Development of the Structure of the Public Budget in Algeria during the Period 2000–2016," *Journal of Financial and Accounting Studies*, University of Shaheed Hamma Lakhdar, El Oued, vol. 7, no. 01, 2017, p. 227.

concept is its exclusion of a significant component of the deficit in developing countries, namely, interest due to external debt, which has become a significant burden on these states.[8]

## Section Two: The Nature of Rationalising Public Expenditure

The evolution of the State's role in economic life has led to an increase in public expenditure and to the inability of public revenues to keep pace with it. This has resulted in the emergence of the concept of rationalising public expenditure.

### The Concept of Rationalising Public Expenditure

#### First: Definition of Rationalising Public Expenditure

Rationalising public expenditure is defined as "the effort to increase the effectiveness of expenditure to the extent that enhances the national economy's ability to finance and meet its internal and external obligations, while eliminating sources of waste and extravagance to the lowest possible level. Hence, rationalising public expenditure does not mean compressing it; rather, it aims to achieve the highest possible public productivity at the lowest level of expenditure. "[9]

On the basis of the preceding definitions, rationalising public expenditure may be defined as the commitment to allocating resources effectively and using them efficiently to achieve the maximum public benefit at the lowest cost, thereby increasing the return on public expenditure.

#### Second: Objectives of Rationalising Public Expenditure

Rationalising public expenditure aims to achieve the following:[10]

**a.** Enhancing economic efficiency in the use of available resources and capacities in a manner that increases the quantity and quality of outputs at the same level of inputs or reduces inputs while maintaining the same level of outputs.

**b.** Improving existing production methods, developing administrative and supervisory systems, introducing technical techniques, and examining motivations and trends.

**c.** Reducing the budget deficit and narrowing the gap between available revenues and required expenditures; helping to control inflation and indebtedness; and contributing to the strengthening, replacement, and renewal of infrastructure projects.

**d.** Conducting a structural review of expenditures by reducing the type and volume of expenditures that do not achieve significant returns.

**e.** Advancing the process of development and overcoming the economic and social challenges faced by the State.

**f.** Combating waste, extravagance, and all forms of misuse of authority and public funds.

**g.** Preparing for all financial conditions, favourable, stable, complex, and volatile, both domestically and globally.

**h.** Preserving the balance between population and resources across short-, medium-, and long-term time horizons.

**i.** Avoiding the risks and consequences of current indebtedness, particularly since many developing countries suffer from difficulties in repaying their debts, which in many cases resulted from past excesses.

**j.** Helping strengthen national capacities for relative self-sufficiency in the long term, thereby safeguarding society from the risks of economic and political dependence and other related vulnerabilities.

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[8] Bīṣār Abd al-Muṭṭalib and Farḥāt Abbās, "The Problem of the Budget Deficit in Algeria and the Proposed Solutions: A Comparative Study for the Years 2014–2018," *The Economic Researcher Journal*, University of 20 August 1956, Skikda, vol. 7, no. 03, 2019, p. 435.

[9] Muḥammad ʿAbd al-Munʿim ʿAfr and Aḥmad Farīd Muṣṭafā, *Formal and Islamic Public Finance: Between Theory and Application*, Shihāb University Foundation, Cairo, Egypt, 1999, p. 72.

[10] Qīmtī ʿAfāf and Ḥafāy ʿAbd al-Qādir, "Modern Approaches to Rationalising Public Expenditure Policy in Algeria during the Period (2001–2017)," *Journal of Economic Studies*, University of Ziane Achour, Djelfa, vol. 12, no. 35, 2018, p. 378.

**k.** Achieving harmony between religious variables and the social values of Arab and Islamic societies, on the one hand, and economic behaviour within these societies, on the other hand.

**An Econometric Study of the Effect of Public Expenditure on Budget Balance from 1990–2019**
In this section, we employ econometric tools to examine the effect of public expenditure, in both its components, on Algeria's budget balance over the period from 1990--2019.
**A Study of Time Series Stationarity**
The augmented Dickey–Fuller (ADF) unit root test was used, as this test is based on estimating the following models:[11]

$$\Delta Y_t = \lambda Y_{t-1} - \sum_{j=2}^{p} \emptyset_j \, \Delta Y_{1-j+1} + \mu_t \dots\dots\dots 1$$

$$\Delta Y_t = \lambda Y_{t-1} - \sum_{j=2}^{p} \emptyset_j \, \Delta Y_{1-j+1} + c + \mu_t \dots\dots\dots 2$$

$$\Delta Y_t = \lambda Y_{t-1} - \sum_{j=2}^{p} \emptyset_j \, \Delta Y_{1-j+1} + c + bt + \mu_t \dots\dots\dots 3$$

**The results of estimating the models are presented in the following table:**

**Table (01): Results of the Augmented Dickey–Fuller Unit Root Test**

| Models | Lag Length | Parameter Significance | ADF_cal | ADF_tab 1% | ADF_tab 5% | ADF_tab 10% | Decision |
|---|---|---|---|---|---|---|---|
| SB – Model 3 | 4 | b not significant | – | – | – | – | Estimate Model 2 |
| SB – Model 2 | 1 | c not significant | – | – | – | – | Estimate Model 1 |
| SB – Model 1 | 1 | – | -0.76 | -2.64 | -1.95 | -1.61 | Nonstationary (DS) |
| DF – Model 3 | 1 | b not significant | – | – | – | – | Estimate Model 2 |
| DF – Model 2 | 1 | c not significant | – | – | – | – | Estimate Model 1 |
| DF – Model 1 | 1 | – | 2.20 | -2.64 | -1.95 | -1.61 | Nonstationary (DS) |
| DE – Model 3 | 1 | b significant | -2.38 | -4.30 | -3.57 | -3.22 | Nonstationary (DS) |

*Source: Prepared by the student based on Appendix No. 01.*

From Table (01), it is evident that the time series are nonstationary, as the calculated ADF values exceed the tabulated values at all significance levels (1%, 5%, and 10%). This leads to acceptance of the null hypothesis, which states that a unit root is present. Accordingly, we proceed by taking first differences of the time series and rerunning the test. The results are shown in the following table:

[11] Régis Bourbonnais, *Économétrie*, 5th ed., Dunod, Paris, 2003, p. 234.

**Table (02): Results of the Augmented Dickey–Fuller (ADF) Test for First Differences**

| Models | Lag Length | Parameter Significance | ADF_cal | ADF_tab 1% | ADF_tab 5% | ADF_tab 10% | Decision |
|---|---|---|---|---|---|---|---|
| SB – Model 3 | 1 | b not significant | – | – | – | – | Estimate Model 2 |
| SB – Model 2 | 1 | c not significant | – | – | – | – | Estimate Model 1 |
| SB – Model 1 | 1 | – | -5.25 | -2.65 | -1.95 | -1.61 | Stationary |
| DF – Model 3 | 1 | b not significant | – | – | – | – | Estimate Model 2 |
| DF – Model 2 | 1 | c significant | -4.58 | -3.68 | -2.97 | -2.62 | Stationary |
| DE – Model 3 | 1 | b not significant | – | – | – | – | Estimate Model 2 |
| DE – Model 2 | 1 | c not significant | – | – | – | – | Estimate Model 1 |
| DE – Model 1 | 1 | – | -10.71 | -2.65 | -1.95 | -1.61 | Stationary |

*Source: Prepared by the researcher based on Appendix No. 2.*

From Table (02), we find that the time series are stationary, as the calculated ADF values are lower than the tabulated values at all significance levels (1%, 5%, and 10%). This leads to rejection of the null hypothesis and acceptance of the alternative hypothesis, which states that no unit root is present. Accordingly, the time series are stationary and therefore integrated of the first order.

**Study of the Effect of Operating Expenditure on Budget Balance**

In this section, the effect of operating expenditures on the budget balance is examined by following appropriate econometric steps, including testing for cointegration between the two variables and using a simple linear regression model.

**First: Study of the Cointegration Relationship**

To assess the effect of operating expenditures on the budget balance, the analysis begins with a cointegration test since the two series are of the same order of integration. The purpose is to determine whether there is a risk of spurious regression. The Johansen test was used for this purpose, and the results are presented in the following table:

**Table (03): Results of the Johansen Cointegration Test**

Date: 06/26/21 Time: 22:58
Sample (adjusted): 3 30
Included observations: 28 after adjustments
Trend assumption: Linear deterministic trend
Series: DF SB
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None | 0.129700 | 4.132311 | 15.49471 | 0.8926 |
| At most 1 | 0.008628 | 0.242628 | 3.841466 | 0.6223 |

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

| Hypothesized No. of CE(s) | Eigenvalue | Max-Eigen Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None | 0.129700 | 3.889682 | 14.26460 | 0.8708 |
| At most 1 | 0.008628 | 0.242628 | 3.841466 | 0.6223 |

**Table 03 shows the results of the cointegration test.** The Johansen test consists of two subtests, the trace test and the maximum eigenvalue test. Both tests indicate the absence of cointegration, as all p values exceed 0.05. Accordingly, no cointegration relationship exists.

**Second: Studying the Effect via the Simple Linear Regression Model**
Since no cointegration relationship exists between operating expenditures and the budget balance, a simple linear regression model is used to examine the effect of operating expenditures on the budget balance. The model takes the following form:

$$SB_t = C + a \cdot DF_t + e_t$$

Where:

$DF_t$: the independent variable representing operating expenditure.

$SB_t$: the dependent variable representing the budget balance.

$C$: the constant term.

$a$: the coefficient of the independent variable (operating expenditure).

$e_t$: the error term.

An AR(1) term was added to the estimated model to improve performance and eliminate autocorrelation in the residuals. The results are presented below.

**Table (04): Results of Estimating the Simple Linear Regression Model**

Dependent Variable: SB
Method: ARMA Maximum Likelihood (OPG - BHHH)
Date: 06/26/21 Time: 23:01
Sample: 1 30
Included observations: 30
Convergence achieved after 31 iterations
Coefficient covariance computed using outer product of gradients

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 399280.0 | 633264.9 | 0.630510 | 0.5339 |
| DF | -0.575262 | 0.127608 | -4.508027 | 0.0001 |
| AR(1) | 0.761602 | 0.137400 | 5.542952 | 0.0000 |
| SIGMASQ | 1.26E+11 | 2.69E+10 | 4.706670 | 0.0001 |

| | | | |
|---|---|---|---|
| R-squared | 0.884712 | Mean dependent var | -884834.6 |
| Adjusted R-squared | 0.871410 | S.D. dependent var | 1065062. |
| S.E. of regression | 381925.3 | Akaike info criterion | 28.69632 |
| Sum squared resid | 3.79E+12 | Schwarz criterion | 28.88315 |
| Log likelihood | -426.4448 | Hannan-Quinn criter. | 28.75609 |
| F-statistic | 66.50770 | Durbin-Watson stat | 1.692433 |
| Prob(F-statistic) | 0.000000 | | |

| | |
|---|---|
| Inverted AR Roots | .76 |

Table (04) shows that the model takes the following form:
$SB_t = 399280 - 0.5752 * DF_t + e_t \dots\dots 1$

**Evaluation of the Statistical Quality of the Estimated Model:**
From the previous results, we find that the operating expenditure parameter is statistically significant at the 5 percent level, as the p value of the *t* test is 0.01000, which is less than 0.05. Accordingly, we reject the null hypothesis and accept the alternative hypothesis, indicating that operating expenditure is statistically significant. The Fisher value (66.5) further shows that the model as a whole is statistically significant at the 5 percent level. The coefficient of determination indicates that the model explains the data well, with a value of 0.88. To assess the soundness and quality of the model, the following tests are conducted:

**– Test of the Absence of Autocorrelation in Errors:**
The Durbin–Watson test can be used to determine whether the errors exhibit autocorrelation. The estimation table shows that the value (DW = 1.69) lies within the range of the null hypothesis (1.244–2.756). Consequently, the model is free of autocorrelation in the residual series.

**– Test of residual stationarity:**
The autocorrelation and partial autocorrelation tests were used to determine whether the residuals represented white noise. The results are presented in the following table:

**Table (05): Results of the residual stationarity test**

Date: 06/26/21 Time: 23:12
Sample: 1 30
Included observations: 30
Q-statistic probabilities adjusted for 1 ARMA term

| Autocorrelation | Partial Correlation | | AC | PAC | Q-Stat | Prob* |
|---|---|---|---|---|---|---|
| | | 1 | 0.099 | 0.099 | 0.3212 | |
| | | 2 | 0.023 | 0.013 | 0.3386 | 0.561 |
| | | 3 | 0.006 | 0.003 | 0.3400 | 0.844 |
| | | 4 | 0.172 | 0.172 | 1.4303 | 0.698 |
| | | 5 | -0.268 | -0.314 | 4.1970 | 0.380 |
| | | 6 | -0.150 | -0.097 | 5.0962 | 0.404 |
| | | 7 | -0.034 | 0.010 | 5.1438 | 0.526 |
| | | 8 | 0.092 | 0.075 | 5.5100 | 0.598 |
| | | 9 | -0.083 | 0.005 | 5.8221 | 0.667 |
| | | 10 | -0.160 | -0.223 | 7.0497 | 0.632 |
| | | 11 | -0.094 | -0.143 | 7.4988 | 0.678 |
| | | 12 | -0.072 | -0.108 | 7.7731 | 0.733 |
| | | 13 | -0.070 | 0.026 | 8.0493 | 0.781 |
| | | 14 | 0.003 | 0.106 | 8.0497 | 0.840 |
| | | 15 | -0.002 | -0.100 | 8.0500 | 0.887 |
| | | 16 | 0.047 | -0.063 | 8.2024 | 0.915 |

*Source: Prepared by the student on the basis of EVIEWS 9 output.*

Table (05) shows that (Q(16) = 8.20) with a probability of 0.91, meaning that the calculated (Q) statistic is smaller than the tabulated (Q) statistic, which equals 31.41 at 16 degrees of freedom and a 0.05 confidence level. Accordingly, we accept the null hypothesis, indicating that the residuals are stationary and represent white noise.

**– Test of the normal distribution of residuals:**

To determine whether the residuals follow a normal distribution, the Jarque–Bera test was used, and the results are shown in the following figure:

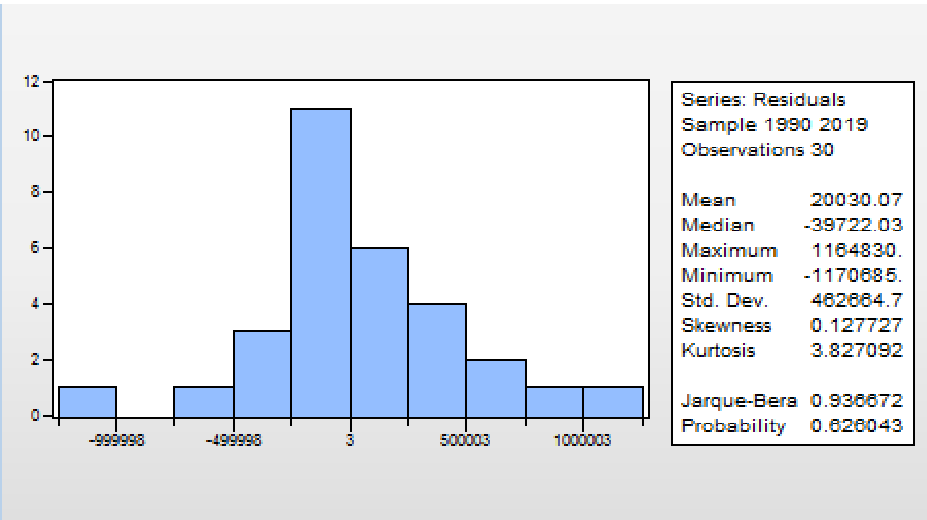


**Figure (01): Test of the normal distribution of residuals**
*Source: Prepared by the student on the basis of EVIEWS 9 output.*

From the previous test, we find the following:

$$\boldsymbol{JB = 0.93 < \chi^2_{0.05}(2) = 5.99}$$

Since the value of $JB$ is smaller than the value of $\chi^2_{0.05}(2)$, we accept the null hypothesis, which states that the distribution of the residuals follows the normal distribution. This is further supported by the p-value of the test, which equals 0.62 and is greater than 0.05.

**– Test of Homoscedasticity:**

To determine whether the variance of the residuals is constant, that is, whether no relationship exists between the residuals and the independent variable, the ARCH test is applied. The results are presented in the following table:

**Table (06): Results of the ARCH Homoscedasticity Test**

Heteroskedasticity Test: ARCH

| | | | |
|---|---|---|---|
| F-statistic | 0.000949 | Prob. F(1,27) | 0.9756 |
| Obs*R-squared | 0.001020 | Prob. Chi-Square(1) | 0.9745 |

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 12/14/20 Time: 21:26
Sample (adjusted): 1991 2019
Included observations: 29 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 2.08E+11 | 7.97E+10 | 2.615361 | 0.0144 |
| RESID^2(-1) | -0.005942 | 0.192873 | -0.030810 | 0.9756 |

**Source: Prepared by the student on the basis of EVIEWS 9 output.**

Table (06) shows that the p value of the test reached 0.000949, with a probability value of 0.97, which is greater than 0.05. Accordingly, we accept the null hypothesis that the residuals exhibit constant variance.

**Third: Interpretation of the Estimated Model**

The previous tests show that the model is statistically sound; therefore, it may be relied upon for economic interpretation. The estimated model took the following form:

$$SB_t = 399280 - 0.5752\, DF_t + e_t$$

From the above equation, we find an inverse relationship between operating expenditures and the public budget balance: a 1% decrease in operating expenditures increases the budget balance by 0.57%.

**Study of the Effect of Capital Expenditure on Budget Balance**

In this section, the effect of capital expenditure on the budget balance is examined by following appropriate econometric steps, including testing for cointegration between the two variables and using a simple linear regression model.

**First: Study of the Cointegration Relationship**

To assess the effect of capital expenditure on the budget balance, the analysis begins with a cointegration test since the two series are of the same order of integration. The purpose is to determine whether there is a risk of spurious regression. The Johansen test was used for this purpose, and the results are presented in the following table:

**Table (07): Results of the Johansen Cointegration Test**

Date: 06/27/21 Time: 22:56
Sample (adjusted): 3 30
Included observations: 28 after adjustments
Trend assumption: Linear deterministic trend
Series: SB DE
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None | 0.229983 | 7.317600 | 15.49471 | 0.5410 |
| At most 1 | 9.75E-08 | 2.73E-06 | 3.841466 | 0.9995 |

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

| Hypothesized No. of CE(s) | Eigenvalue | Max-Eigen Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None | 0.229983 | 7.317598 | 14.26460 | 0.4523 |
| At most 1 | 9.75E-08 | 2.73E-06 | 3.841466 | 0.9995 |

**Source: Prepared by the student on the basis of EVIEWS 9 output.**

Table 7 presents the results of the cointegration test. The Johansen test consists of two subtests: the trace test and the maximum eigenvalue test. Both tests indicate that no cointegration relationship exists, as all probability values are greater than 0.05. Accordingly, no cointegration relationship is present.

**Second: Studying the Effect via the Simple Linear Regression Model**

Since no cointegration relationship exists between capital expenditure and the budget balance, a simple linear regression model is used to examine the effect of capital expenditure on the budget balance.
The model takes the following form:

$$SB_t = C + a\,DE_t + e_t$$

Where:

$DE_t$: the independent variable representing capital expenditure.

$SB_t$: the dependent variable representing the budget balance.

$C$: the constant term.

$a$: the coefficient of the independent variable (capital expenditure).

$e_t$: the error term.

An AR(1) term was added to the estimated model to improve it and eliminate autocorrelation in the errors. The result is as follows:

**Table (08): Results of Estimating the Simple Linear Regression Model**

Dependent Variable: SB
Method: ARMA Maximum Likelihood (OPG - BHHH)
Date: 06/27/21 Time: 22:58
Sample: 1 30
Included observations: 30
Convergence achieved after 26 iterations
Coefficient covariance computed using outer product of gradients

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 355949.1 | 664890.7 | 0.535350 | 0.5970 |
| DE | -0.933903 | 0.233683 | -3.996445 | 0.0005 |
| AR(1) | 0.806644 | 0.108097 | 7.462240 | 0.0000 |
| SIGMASQ | 1.24E+11 | 2.80E+10 | 4.443632 | 0.0001 |

| | | | |
|---|---|---|---|
| R-squared | 0.886707 | Mean dependent var | -884834.6 |
| Adjusted R-squared | 0.873635 | S.D. dependent var | 1065062. |
| S.E. of regression | 378607.0 | Akaike info criterion | 28.68501 |
| Sum squared resid | 3.73E+12 | Schwarz criterion | 28.87184 |
| Log likelihood | -426.2751 | Hannan-Quinn criter. | 28.74478 |
| F-statistic | 67.83121 | Durbin-Watson stat | 1.342672 |
| Prob(F-statistic) | 0.000000 | | |

| | |
|---|---|
| Inverted AR Roots | .81 |

**Source: Prepared by the student on the basis of EVIEWS 9 output.**

Table (08) shows that the model takes the following form:

$$SB_t = 355949.1 - 0.9339\,DF_t + e_t \quad \ldots(1)$$

**Evaluation of the Statistical Quality of the Estimated Model:**

From the previous results, we find that the capital expenditure parameter is statistically significant at the 5 percent level, as the p value of the *t* test equals 0.05000, which is less than 0.05. Accordingly, we reject the null hypothesis and accept the alternative hypothesis, indicating that capital expenditure is statistically significant. The Fisher value (67.83) also shows that the model as a whole is statistically significant at the 5 percent level. The coefficient of determination indicates that the model explains the data well, with a value of 0.88. To assess the validity and quality of the model, the following tests are applied:

**– Test of the Absence of Autocorrelation in Errors:**

The Durbin–Watson test may be used to determine whether the errors exhibit autocorrelation. The estimation table shows that the value ($DW = 1.35$) lies within the range of the null hypothesis (1.244–2.756). Therefore, the model is free of autocorrelation in the residual series.

**– Test of residual stationarity:**

The autocorrelation and partial autocorrelation tests were used to determine whether the residuals represented white noise. The results are presented in the following table:

**Table (09): Results of the residual stationarity test**

Date: 06/27/21 Time: 23:00
Sample: 1 30
Included observations: 30
Q-statistic probabilities adjusted for 1 ARMA term

| Autocorrelation | Partial Correlation | | AC | PAC | Q-Stat | Prob* |
|---|---|---|---|---|---|---|
| | | 1 | 0.314 | 0.314 | 3.2682 | |
| | | 2 | 0.109 | 0.011 | 3.6755 | 0.055 |
| | | 3 | -0.136 | -0.193 | 4.3337 | 0.115 |
| | | 4 | 0.021 | 0.134 | 4.3505 | 0.226 |
| | | 5 | -0.256 | -0.319 | 6.8760 | 0.143 |
| | | 6 | -0.354 | -0.276 | 11.897 | 0.036 |
| | | 7 | -0.180 | 0.123 | 13.242 | 0.039 |
| | | 8 | 0.060 | 0.042 | 13.402 | 0.063 |
| | | 9 | 0.043 | -0.088 | 13.485 | 0.096 |
| | | 10 | -0.052 | -0.069 | 13.613 | 0.137 |
| | | 11 | -0.053 | -0.143 | 13.754 | 0.185 |
| | | 12 | 0.021 | -0.082 | 13.777 | 0.246 |
| | | 13 | 0.021 | 0.043 | 13.802 | 0.314 |
| | | 14 | 0.032 | 0.084 | 13.864 | 0.383 |
| | | 15 | -0.021 | -0.104 | 13.894 | 0.458 |
| | | 16 | 0.037 | -0.045 | 13.987 | 0.526 |

From Table (09), we find that Q(16) = 13.98 with a probability of 0.52, meaning that the calculated *(Q)* statistic is smaller than the tabulated *(Q)* value, which equals 31.41 at 16 degrees of freedom and a 0.05 confidence level. Accordingly, we accept the null hypothesis, indicating that the residuals are stationary and represent white noise.

**– Test of the normal distribution of residuals:**

To determine whether the residuals follow a normal distribution, the Jarque–Bera test was used, and the results of the test are shown in the following figure:

From the previous test, we find the following:

Since the value of $JB$ is smaller than the value of $\chi^2_{0.05}(2)$, we accept the null hypothesis, which states that the distribution of the residuals follows the normal distribution. This is further supported by the p-value of the test, which equals 0.48 and is greater than 0.05.

**Figure (02): Test of the normal distribution of residuals**
*Source: Prepared by the student on the basis of EVIEWS 9 output.*

**– Test of Homoscedasticity:**
To determine whether the variance of the residuals is constant, that is, whether no relationship exists between the residuals and the independent variable, the ARCH test is applied. The results are shown in the following table:

**Table (10): Results of the ARCH Homoscedasticity Test**

Heteroskedasticity Test: ARCH

| | | | |
|---|---|---|---|
| F-statistic | 2.246464 | Prob. F(4,21) | 0.0985 |
| Obs*R-squared | 7.791415 | Prob. Chi-Square(4) | 0.0995 |

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 06/27/21 Time: 23:06

*Source: Prepared by the student on the basis of EVIEWS 9 output.*

Table (10) shows that the test statistic reached 2.246, with a p value of 0.0985, which is greater than 0.05. Accordingly, we accept the null hypothesis, indicating that the residuals exhibit constant variance.

**Third: Interpretation of the Estimated Model**
The previous tests show that the model is statistically sound; therefore, it may be relied upon for economic interpretation. The estimated model took the following form:
$SB_t = 355949.1 - 0.9339 * DF_t + e_t \dots\dots$
From the above equation, we find an inverse relationship between capital expenditure and the public budget balance: a 1% decrease in capital expenditure increases the budget balance by 0.93%.
The public budget deficit is one of the most prominent economic problems faced by countries worldwide, both developed and developing. It grows and worsens for various reasons, some stemming from rising public expenditure and others from declining public revenues. This leads to the search for mechanisms to address the public budget deficit; rationalising public expenditure is one of the most effective means of limiting it. For this mechanism to succeed, it must be accompanied by several factors, the most important of which are clearly defined objectives, the identification of priorities, and strengthened oversight.

**– Results of Hypothesis Testing:**
Through our examination of this topic, we reached the following conclusions regarding the testing of the hypotheses:

- **First Hypothesis:**
- The hypothesis stating that the causes of the public budget deficit stem from increasing public expenditure and declining public revenues is correct.
- **Second Hypothesis:**
- The hypothesis that the rise in public expenditure in Algeria is due to the adoption of an expansionary fiscal policy is confirmed. During the third millennium, oil prices rose in international markets, and Algeria pursued an expansionary fiscal policy, which led to an increase in public expenditure, both operating and capital (investment), thereby confirming the validity of this hypothesis.
- **Third Hypothesis:**
- The hypothesis that rationalising public expenditure is one of the mechanisms that Algeria uses to address the public budget deficit is correct. The oil crisis of mid-2014 exacerbated the public budget deficit, prompting the government in 2016 to undertake a series of measures to rationalise public expenditure and reduce the deficit, thus confirming the hypothesis.
- **Fourth Hypothesis:**
- The hypothesis that rationalising both operating and capital expenditures helps address the public budget deficit is validated. The econometric study revealed that rationalising public expenditure, particularly capital expenditure, reduces the public budget deficit, confirming the hypothesis.

**List of Appendices:**

**Appendix No. 01:** Results of the Augmented Dickey–Fuller Unit Root Test

| | | | |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -2.752481 | 0.2261 |
| Test critical values: | 1% level | -4.374307 | |
| | 5% level | -3.603202 | |
| | 10% level | -3.238054 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SB)
Method: Least Squares
Date: 06/24/21 Time: 00:48
Sample (adjusted): 1995 2019
Included observations: 25 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| SB(-1) | -0.561710 | 0.204074 | -2.752481 | 0.0131 |
| D(SB(-1)) | 0.336379 | 0.219499 | 1.532487 | 0.1428 |
| D(SB(-2)) | 0.292308 | 0.217689 | 1.342773 | 0.1960 |
| D(SB(-3)) | 0.501385 | 0.220744 | 2.271345 | 0.0356 |
| D(SB(-4)) | 0.760831 | 0.235647 | 3.228686 | 0.0047 |
| C | 398277.9 | 336877.7 | 1.182263 | 0.2525 |
| @TREND("1990") | -49368.83 | 28157.60 | -1.753304 | 0.0966 |

Null Hypothesis: SB has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -1.305065 | 0.6135 |
| Test critical values: | 1% level | -3.679322 | |
| | 5% level | -2.967767 | |
| | 10% level | -2.622989 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SB)
Method: Least Squares
Date: 06/24/21 Time: 00:49
Sample (adjusted): 1991 2019
Included observations: 29 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| SB(-1) | -0.109965 | 0.084260 | -1.305065 | 0.2029 |
| C | -131544.7 | 116149.8 | -1.132544 | 0.2674 |

Null Hypothesis: SB has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -0.746949 | 0.3840 |
| Test critical values: | 1% level | -2.647120 | |
| | 5% level | -1.952910 | |
| | 10% level | -1.610011 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SB)
Method: Least Squares
Date: 07/01/21 Time: 18:51
Sample (adjusted): 2 30
Included observations: 29 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| SB(-1) | -0.048549 | 0.064996 | -0.746949 | 0.4613 |

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Null Hypothesis: DF has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -1.781738 | 0.6874 |
| Test critical values: | 1% level | -4.309824 | |
| | 5% level | -3.574244 | |
| | 10% level | -3.221728 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DF)
Method: Least Squares
Date: 06/25/21 Time: 23:54
Sample (adjusted): 2 30
Included observations: 29 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| DF(-1) | -0.175385 | 0.098435 | -1.781738 | 0.0865 |
| C | -78722.51 | 143442.2 | -0.548810 | 0.5878 |
| @TREND("1") | 39196.74 | 19674.77 | 1.992233 | 0.0569 |

Null Hypothesis: DF has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | 0.245142 | 0.9709 |
| Test critical values: | 1% level | -3.679322 | |
| | 5% level | -2.967767 | |
| | 10% level | -2.622989 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DF)
Method: Least Squares
Date: 06/25/21 Time: 23:58
Sample (adjusted): 2 30
Included observations: 29 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| DF(-1) | 0.008747 | 0.035682 | 0.245142 | 0.8082 |
| C | 148024.9 | 91976.88 | 1.609371 | 0.1192 |

Null Hypothesis: DF has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | 2.204009 | 0.9917 |
| Test critical values: | 1% level | -2.647120 | |
| | 5% level | -1.952910 | |
| | 10% level | -1.610011 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DF)
Method: Least Squares
Date: 06/25/21 Time: 23:59
Sample (adjusted): 2 30
Included observations: 29 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| DF(-1) | 0.052448 | 0.023797 | 2.204009 | 0.0359 |

Null Hypothesis: DE has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -2.386992 | 0.3781 |
| Test critical values: | 1% level | -4.309824 | |
| | 5% level | -3.574244 | |
| | 10% level | -3.221728 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DE)
Method: Least Squares
Date: 06/26/21 Time: 00:02
Sample (adjusted): 2 30
Included observations: 29 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| DE(-1) | -0.303805 | 0.127275 | -2.386992 | 0.0245 |
| C | -135803.0 | 114517.1 | -1.185875 | 0.2464 |
| @TREND("1") | 38628.62 | 15503.00 | 2.491688 | 0.0194 |

**Appendix No. 02:** Results of the Augmented Dickey–Fuller (ADF) Test for First Differences

Null Hypothesis: D(SB) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -5.134770 | 0.0015 |
| Test critical values: | 1% level | -4.323979 | |
| | 5% level | -3.580623 | |
| | 10% level | -3.225334 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SB,2)
Method: Least Squares
Date: 06/26/21 Time: 00:11
Sample (adjusted): 3 30
Included observations: 28 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(SB(-1)) | -1.030515 | 0.200694 | -5.134770 | 0.0000 |
| C | -134639.1 | 209832.2 | -0.641651 | 0.5269 |
| @TREND("1") | 5876.798 | 11969.11 | 0.490997 | 0.6277 |

Null Hypothesis: D(SB) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -5.193622 | 0.0002 |
| Test critical values: | 1% level | -3.689194 | |
| | 5% level | -2.971853 | |
| | 10% level | -2.625121 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SB,2)
Method: Least Squares
Date: 06/26/21 Time: 00:13
Sample (adjusted): 3 30
Included observations: 28 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(SB(-1)) | -1.025850 | 0.197521 | -5.193622 | 0.0000 |
| C | -43310.67 | 95687.08 | -0.452628 | 0.6546 |

Null Hypothesis: D(SB) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -5.252650 | 0.0000 |
| Test critical values: | 1% level | -2.650145 | |
| | 5% level | -1.953381 | |
| | 10% level | -1.609798 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SB,2)
Method: Least Squares
Date: 06/26/21 Time: 00:14
Sample (adjusted): 3 30
Included observations: 28 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(SB(-1)) | -1.016435 | 0.193509 | -5.252650 | 0.0000 |

Null Hypothesis: D(DF) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -4.600415 | 0.0053 |
| Test critical values: | 1% level | -4.323979 | |
| | 5% level | -3.580623 | |
| | 10% level | -3.225334 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DF,2)
Method: Least Squares
Date: 06/26/21 Time: 00:16
Sample (adjusted): 3 30
Included observations: 28 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(DF(-1)) | -0.916974 | 0.199324 | -4.600415 | 0.0001 |
| C | 67692.36 | 134842.4 | 0.502011 | 0.6201 |
| @TREND("1") | 5648.350 | 7788.624 | 0.725205 | 0.4751 |

Null Hypothesis: D(DF) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -4.585028 | 0.0011 |
| Test critical values: | 1% level | -3.689194 | |
| | 5% level | -2.971853 | |
| | 10% level | -2.625121 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DF,2)
Method: Least Squares
Date: 07/01/21 Time: 18:56
Sample (adjusted): 3 30
Included observations: 28 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(DF(-1)) | -0.893082 | 0.194782 | -4.585028 | 0.0001 |
| C | 151351.2 | 69180.46 | 2.187774 | 0.0379 |

Null Hypothesis: D(DE,2) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 5 (Automatic - based on SIC, maxlag=7)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -4.083694 | 0.0207 |
| Test critical values: | 1% level | -4.440739 | |
| | 5% level | -3.632896 | |
| | 10% level | -3.254671 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DE,3)
Method: Least Squares
Date: 07/12/21 Time: 12:48
Sample (adjusted): 9 30
Included observations: 22 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(DE(-1),2) | -5.890319 | 1.442400 | -4.083694 | 0.0011 |
| D(DE(-1),3) | 3.970098 | 1.289722 | 3.078258 | 0.0082 |
| D(DE(-2),3) | 2.934974 | 1.123821 | 2.611602 | 0.0205 |
| D(DE(-3),3) | 2.263704 | 0.881789 | 2.567173 | 0.0224 |
| D(DE(-4),3) | 1.673171 | 0.620080 | 2.698314 | 0.0173 |
| D(DE(-5),3) | 0.698849 | 0.371943 | 1.878915 | 0.0812 |
| C | 172061.5 | 158998.2 | 1.082160 | 0.2975 |
| @TREND("1") | -8340.533 | 8209.326 | -1.015983 | 0.3269 |

Null Hypothesis: D(DE,2) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=7)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -10.48344 | 0.0000 |
| Test critical values: | 1% level | -3.711457 | |
| | 5% level | -2.981038 | |
| | 10% level | -2.629906 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DE,3)
Method: Least Squares
Date: 07/12/21 Time: 12:49
Sample (adjusted): 5 30
Included observations: 26 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(DE(-1),2) | -2.453359 | 0.234022 | -10.48344 | 0.0000 |
| D(DE(-1),3) | 0.832884 | 0.149892 | 5.556556 | 0.0000 |
| C | -5013.221 | 47721.56 | -0.105052 | 0.9172 |