

# **Asymmetric Effects of Health Expenditure on Economic Growth: An Empirical Study of Algeria (1990–2023)**

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**Abstract :** This research explores the connection between health care spending and Algeria's economic growth over the period from 1990 to 2023 using NARDL. The results reveal a long-run equilibrium with an asymmetric effect : reducing health expenditure significantly harms growth, while increasing it has an insignificant effect. the number of physicians positively impacts growth, whereas higher infant mortality rates and population growth have negative effects. Surprisingly, life expectancy shows a negative long-term impact. The findings emphasize that increasing health expenditure alone is insufficient ; efficiency and targeted investments in human capital are crucial for maximizing economic benefits and fostering sustainable growth.

**Keywords:** Health Expenditure, Economic Growth, NARDL, Human Capital, Algeria.

**Jel Classification Codes:** C32, H51, O47, I15.

## **Introduction :**

Spending on health care is widely viewed as a key measure of how strongly a nation prioritizes the health and well-being of its population. It constitutes a key dimension for evaluating the quality of public policies and the effectiveness of governmental

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performance (WHO, 2019). Good health serves as the cornerstone of any productive and balanced society, as it enhances individuals' physical and mental capacities, boosts the efficiency of human capital, and, in turn, acts as a critical driver of economic growth (Bloom & Others, 2024). With the growing global focus on achieving sustainable development, it has become imperative to recognize that investing in healthcare is not a burden on public finances but rather a strategic, long-term investment that yields tangible economic and social returns (Banna & Others, 2023). However, the actual impact of health expenditure on economic performance remains a subject of debate, particularly in emerging economies like Algeria, where budget constraints and structural inefficiencies pose challenges to optimizing healthcare investments..

Analyzing the relationship between healthcare expenditure and economic growth has garnered significant attention from researchers and policymakers, particularly amidst the demographic, social, and economic transformations witnessed by most countries worldwide. Structural shifts in healthcare systems and the rising demand for healthcare services—driven by increasing aging populations and the prevalence of chronic diseases—have placed mounting pressure on financial resources allocated to the health sector (Loprete & Zhu, 2020). In this context, the need has emerged to assess the effectiveness of healthcare spending and its ability to achieve its objectives, not only from a health perspective but also from an economic standpoint that highlights its impact on gross domestic product (GDP) and various growth indicators.

Numerous studies have demonstrated a close link between improved health indicators—such as reduced infant mortality rates and increased life expectancy—and economic growth. Good health contributes to enhanced labor productivity, greater workforce participation, and reduced burdens resulting from absenteeism due to illness or disability (Weil, 2007). Furthermore, it attracts foreign investments, which place significant importance on the availability and quality of healthcare services. Additionally, healthcare expenditure influences aggregate demand by stimulating multiple sectors, such as the pharmaceutical industry and medical equipment production, thereby driving economic activity

#### **Research Question :**

To what extent does healthcare expenditure contribute to stimulating economic growth in Algeria during the period (1990–2023) ? Furthermore, does this relationship exhibit asymmetry, where reductions in spending have a stronger impact than increases ?

This research seeks to examine the link between healths pending and economic growth in Algeria over the span of 1990 to 2023. It focuses on three main objectives: (analyzing the conceptual framework of healthcare expenditure—its types, determinants, and indicators—while highlighting its crucial role in enhancing human capital and productive efficiency ; assessing The study estimates the effect of healthcar espending on economic growth using the Nonlinear Autoregressive Distributed Lag (NARDL) model capable of identifying asymmetry in the effects and dynamic cumulative impacts. It also examines the key indicators of health—such as life expectancy, infant mortality, and doctors—considered as intermediate variables that assist in explaining the link between health and economic performance. The adoption

of the NARDL model provides a robust econometric approach, particularly suited for detecting asymmetric effects over time, making it an appropriate tool for analyzing this relationship in the Algerian context.

Study Hypotheses:

- **H1** : Healthcare spending has a statistically significant and positive influence on economic growth in both the short run and the long run.
- **H2** : There is an asymmetric effect of changes in healthcare expenditure on economic growth.

### 1. Literature Review :

**-Study (Avcin&Zafer, 2024)** : This research examines how health effect the economic growth in Turkey over the period 1960 to 2014, employing a production function framework that includes human capital as a core component. Health and education were integrated as the primary components of human capital within this production function. the (ARDL) approach used , integrating Economic growth (GDP), Health (life expectancy), education (number of students per teacher), total factor productivity, capital, and labor force. The study establishes that health and education exert a substantial influence on economic growth in Turkey. It recommends enhancing investments in human capital, particularly in the domains of health and education, to bolster economic growth in the country.

**-Study (Bloom, Canning, & Sevilla, 2004)** : This study estimates a macroeconomic production function model for economic growth, incorporating two variables identified by microeconomists as fundamental components of human capital which is work experience and health. The analysis spans a diverse set of countries across multiple time periods (1960–1990), employing panel data and the Nonlinear Least Squares (two-stage) method to estimate model parameters. The macroeconomic growth (GDP) has been utilized as the dependent variable, while the independent ones are physical capital, labor force, and aspects of human capital such as education, work experience, and health. The results shows that Health demonstrates a positive, significant, and statistically meaningful impact on economic growth. A one-year increase in life expectancy contributes to a 4% rise in output. Suggesting that investments in health can yield substantial economic returns.

**-Study (Fumagalli&Others, 2024)** : Analyzes the directional influence of health on economic development and economic growth, it focuses on cross-country comparative studies and selected single-country analyses, providing substantial evidence supporting a positive impact of population health on economic growth. The results suggest that there are numerous factors affecting, and the possibility of there being a two-way relationship between health and economic growth complicate determining the accurate measure of the size of the effect and the identification of those mechanisms of greatest consequence. It emphasizes the complexity of measuring this relationship as different health improvements affect productivity in different ways.

**-Study (Söyük, 2023)** : This study explores the dynamic connection between health and economic growth across 34 OECD countries during the period 2003–2019, using the Fixed Effects and dynamic Generalized Method of Moments (GMM) approaches. The findings indicate that healthcare financing systems should prioritize efficient service provision and ensuring financial security to improve access to universal healthcare and reduce catastrophic expenditure risks.

**-Study (Banik&Others, 2023) :** This study investigates the role of Governance quality (QoG) in the impact of healthcare expenditure on human development across 161 countries from 2005 to 2019 using the System Generalized Method of Moments (sys-GMM) technique. The findings reveal that increasing healthcare support is insufficient to enhance human development ; Political stability and the absence of violence/terrorism (PSnAT) exhibit the largest net positive effect on healthcare expenditure resulting in higher human development. The correlation of healthcare expending and the Good Governance Index (GGI) shows the negative but statistically negligible effect in low-income countries (LICs).

## **2-Data and methodology :**

This study adopts an econometric approach to analyze the relationship between healthcare expenditure and economic growth in Algeria from 1990 to 2023, using annual data from the World Bank. It incorporates key variables to capture the dynamic interplay between health indicators, demographic factors, and economic performance.. These variables will be cohesively integrated, drawing on concepts from contemporary studies. Based on statistics and data from the World Bank.

- **CHE:** Healthcare expenditure as a percentage of GDP.
- **LIB:** Life expectancy.
- **MR:** Infant mortality rate per 1,000 live births.
- **POP:** Population growth rate.
- **MED:** Number of doctors per 1,000 individuals.
- **GDP:** GDP growth rate (dependent variable).

## **Model Specification :**

To evaluate the effect of healthcare expenditure and related indicators on economic growth, the following econometric model is specified :

$$GDP = \beta_0 + \beta_1 CHE + \beta_2 LIB + \beta_3 MR + \beta_4 POP + \beta_5 MED + \mu_i$$

where:

- $\beta_0$  is the intercept term.
- $\beta_1 - \beta_5$  represent the estimated coefficients to each independent variable.
- $\mu_i$  is the error term, capturing unobserved factors affecting economic growth.

## **2-1-Stationarity Tests :**

Prior to estimating the model, we conduct stationarity tests on the time series to ensure that all variables are either stationary at level I(0) or at first difference I(1), and to confirm the absence of any time series integrated of order two I(2).

**Table 1: Results of Stationarity Tests for Time Series Data**

|            | Level           |                 | 1ère difference    |                    |             |
|------------|-----------------|-----------------|--------------------|--------------------|-------------|
|            | ADF             | PP              | ADF                | PP                 |             |
| <b>GDP</b> | -2.19<br>(0.21) | -2.57<br>(0.10) | -4.61<br>(0.00)*** | -4.61<br>(0.00)*** | <b>I(1)</b> |
| <b>CHE</b> | -1.59<br>(0.47) | -1.59<br>(0.47) | -4.29<br>(0.00)*** | -4.33<br>(0.00)*** | <b>I(1)</b> |
| <b>LIB</b> | 1.99<br>(0.99)  | 2.39<br>(0.99)  | -5.88<br>(0.00)*** | -5.89<br>(0.00)*** | <b>I(1)</b> |
| <b>MR</b>  | 2.13<br>(0.99)  | -1.44<br>(0.13) | -5.01<br>(0.00)*** | -7.01<br>(0.00)*** | <b>I(1)</b> |
| <b>POP</b> | -0.96<br>(0.29) | -1.21<br>(0.65) | -5.11<br>(0.00)*** | -5.08<br>(0.00)*** | <b>I(1)</b> |
| <b>MED</b> | 0.13<br>(0.96)  | 0.37<br>(0.97)  | -6.47<br>(0.00)*** | -6.49<br>(0.00)*** | <b>I(1)</b> |

**Source:** Author's computation using EViews software

As is clear from Table 1, the Augmented Dickey-Fuller (ADF) test results indicate that all variables become stationary after first difference, indicating integration of order I(1). Similarly, the Phillips-Perron (PP) test also indicates the same, confirming that all the variables are integrated of the same order. This satisfies the condition for applying the Nonlinear Autoregressive Distributed Lag (NARDL) model. Initially proposed by **Pesaran and Shin (1999)**, later developed by **Pesaran et al. (2001)** and **Shin et al. (2014)**, the NARDL model is applied here to determine whether there are any potential asymmetries in the manner in which healthcare expenditure influences economic growth.

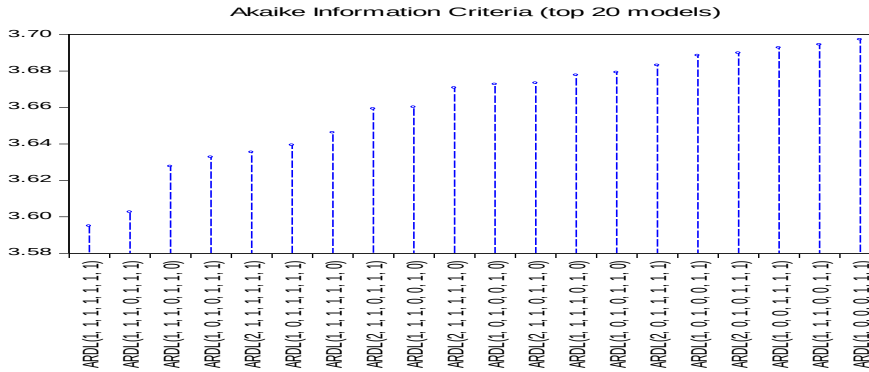
$$\begin{aligned} \Delta GDP_t = & \beta_0 + \sum_{i=1}^p \phi_i \Delta GDP_{t-i} + \sum_{i=0}^q (\alpha_{li}^+ \Delta CHE_{t-i}^+ + \alpha_{li}^- \Delta CHE_{t-i}^-) \\ & + \sum_{i=0}^q \alpha_{2i} \Delta LIB_{t-i} + \sum_{i=0}^q \alpha_{3i} \Delta MR_{t-i} + \sum_{i=0}^q \alpha_{4i} \Delta POP_{t-i} + \sum_{i=0}^q \alpha_{5i} \Delta MED_{t-i} + \gamma_1 CHE_{t-1}^+ + \\ & \gamma_2 CHE_{t-1}^- + \gamma_3 LIB_{t-1} + \gamma_4 MR_t + \gamma_5 POP_{t-1} + \gamma_6 MED_{t-1} \\ & + \delta ECM_{t-1} + \mu_t \end{aligned}$$

We will estimate the positive effect of healthcare expenditure (CHE+) and the negative effect of healthcare expenditure (CHE-) on economic growth within the framework of the NARDL model. This approach enables the detection of an asymmetric relationship between healthcare expenditure and economic growth in both the long and short run.

## 2-2-Selection of Optimal Lag Periods for Variables in Estimating the NARDL Model

The optimal lag period is selected based on the Akaike Information Criterion (AIC), as illustrated below:

**Figure 1: Results of Optimal Lag Selection Based on the AIC Criterion**



**Source:** Author's computation using EViews software

From Figure 1, it is evident that the optimal model according to the Akaike Information Criterion (AIC) is identified as having a lag structure of (1,1,1,1,1,1).

### 2-3-Bounds Test :

Table 2 reports the cointegration analysis performed with the Bounds Testing methodology. The calculated F-statistic is greater than the upper critical value at 10%, 5%, and 1% significance levels. The null hypothesis of no cointegration is therefore rejected, reflecting the presence of a long-run equilibrium relationship among the variables included in the study.

**Table 2: Bounds Test Results**

| F-statistic               |                   |                   |
|---------------------------|-------------------|-------------------|
| 15.43                     |                   |                   |
| Critical Values           | Upper Bound I (1) | Lower Bound I (0) |
| At 10% Significance Level | 3.23              | 2.12              |
| At 5% Significance Level  | 3.61              | 2.45              |
| At 1% Significance Level  | 4.43              | 3.15              |

**Source:** Author's computation using EViews software

## 2-4- Estimation of the Autoregressive Distributed Lag (ARDL) Model :

**Table 3: Results of the NARDL Model Test**

| Dependent Variable: GDP                                               |             |                       |             |        |
|-----------------------------------------------------------------------|-------------|-----------------------|-------------|--------|
| Method: ARDL                                                          |             |                       |             |        |
| Date: 03/14/25 Time: 13:47                                            |             |                       |             |        |
| Sample (adjusted): 1992 2023                                          |             |                       |             |        |
| Included observations: 32 after adjustments                           |             |                       |             |        |
| Maximum dependent lags: 2 (Automatic selection)                       |             |                       |             |        |
| Model selection method: Akaike info criterion (AIC)                   |             |                       |             |        |
| Dynamic regressors (1 lag, automatic): CHE_POS CHE_NEG LIB MED MR POP |             |                       |             |        |
| Fixed regressors: C                                                   |             |                       |             |        |
| Number of models evaluated: 128                                       |             |                       |             |        |
| Selected Model: ARDL(1, 1, 1, 1, 1, 1, 1)                             |             |                       |             |        |
| Variable                                                              | Coefficient | Std. Error            | t-Statistic | Prob.* |
| GDP(-1)                                                               | 0.003672    | 0.124027              | 0.029603    | 0.9767 |
| CHE_POS                                                               | -3.910594   | 3.260310              | -1.199455   | 0.2459 |
| CHE_POS(-1)                                                           | 4.309102    | 3.023783              | 1.425070    | 0.1712 |
| CHE_NEG                                                               | 1.418845    | 2.012629              | 0.704971    | 0.4899 |
| CHE_NEG(-1)                                                           | -3.031536   | 1.673579              | -1.811408   | 0.0868 |
| LIB                                                                   | -2.495286   | 2.461314              | -1.013802   | 0.3241 |
| LIB(-1)                                                               | 2.916756    | 2.549844              | 1.143896    | 0.2677 |
| MED                                                                   | -4.108989   | 3.531494              | -1.163527   | 0.2598 |
| MED(-1)                                                               | -5.138887   | 2.853306              | -1.801029   | 0.0885 |
| MR                                                                    | -0.040124   | 0.024495              | -1.638015   | 0.1188 |
| MR(-1)                                                                | -0.146364   | 0.024527              | -5.967564   | 0.0000 |
| POP                                                                   | -14.50279   | 5.401847              | -2.684784   | 0.0151 |
| POP(-1)                                                               | 10.41363    | 7.073001              | 1.472308    | 0.1582 |
| C                                                                     | -5.211750   | 60.71807              | -0.085835   | 0.9325 |
| R-squared                                                             | 0.848498    | Mean dependent var    | 2.603125    |        |
| Adjusted R-squared                                                    | 0.739080    | S.D. dependent var    | 2.460853    |        |
| S.E. of regression                                                    | 1.257012    | Akaike info criterion | 3.594988    |        |
| Sum squared resid                                                     | 28.44142    | Schwarz criterion     | 4.236247    |        |
| Log likelihood                                                        | -43.51981   | Hannan-Quinn criter.  | 3.807547    |        |
| F-statistic                                                           | 7.754639    | Durbin-Watson stat    | 2.607900    |        |
| Prob(F-statistic)                                                     | 0.000060    |                       |             |        |

**Source:**Author's computation using EViews software

Table 3 shows that the explanatory power of the model, as measured by the coefficient of determination ( $R^2$ ), is 99.64%.

## 2-5- Model Diagnostic Tests :

### A. Detection of Autocorrelation Among Residuals

**Table 4: Autocorrelation Test Results for Residuals**

| Breush-Godfrey serial correlation LM Test |      |                     |      |
|-------------------------------------------|------|---------------------|------|
| F-statistic                               | 0.82 | Prob. F(1,28)       | 0.37 |
| Obs*R-squared                             | 0.86 | Prob. Chi-Square(1) | 0.35 |

**Source:**Author's computation using EViews software

As evident from Table 4, the LM Test results present a p-value of 0.37 for the F-statistic, which is more than the 5% level of significance. This means that the null hypothesis, which means no autocorrelation exists among the residuals, and the rejection of the alternative hypothesis which states that there is autocorrelation.

## B. Test for Heteroscedasticity

**Table 5: Results Test for Heteroscedasticity**

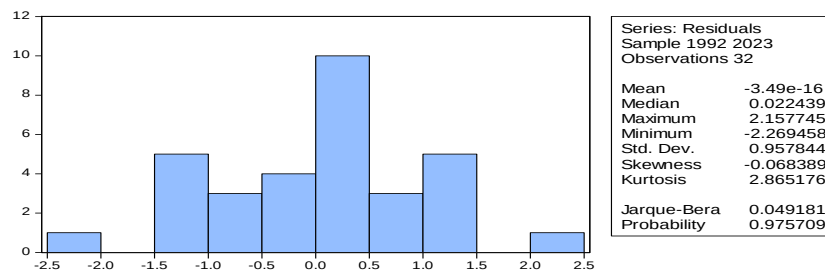
| ARCH Test for Heteroscedasticity |      |                     |      |
|----------------------------------|------|---------------------|------|
| F-statistic                      | 0.02 | Prob. F(1,28)       | 0.86 |
| Obs*R-squared                    | 0.03 | Prob. Chi-Square(1) | 0.85 |

**Source:** Author's computation using EViews software

Table 5 shows the p-value for Fisher's statistic is 0.86, which exceeds the 5% significance level. This means that the null hypothesis of no heteroskedasticity must be accepted.

## C. Test for Normality Residuals

**Figure 2: Residual Normality Test Outcomes**



**Source:** Author's computation using EViews software

Figure 2 shows that the Jarque-Bera statistic returns a p-value of 0.97, much higher than the 5% significance level. Hence, we conclude that the regression residuals are normally distributed.

## D. Model Specification

**Table 6: Model Specification Results**

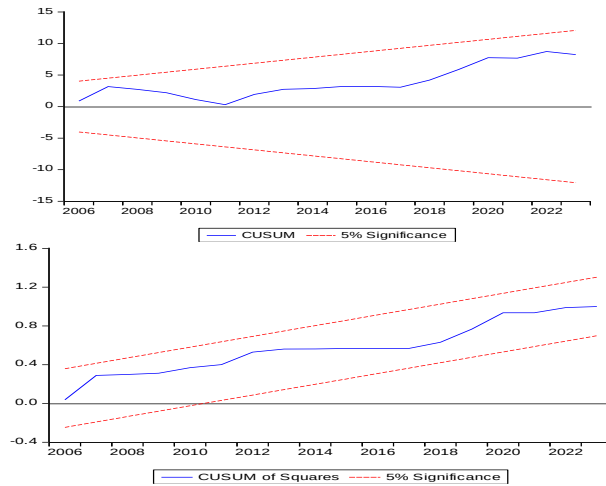
| Ramsey RESET Test |       |        |             |
|-------------------|-------|--------|-------------|
|                   | Value | df     | Probability |
| t-statistic       | 0.15  | 17     | 0.87        |
| F-statistic       | 0.02  | (1,17) | 0.87        |

**Source:** Author's computation using EViews software

Table 6 shows a value of probability to be 0.87, much higher than the significance level of 5%, thus the model being well specified.

## 2-6- Model Stability Test :

**Figure 3: Model Stability Test Results**

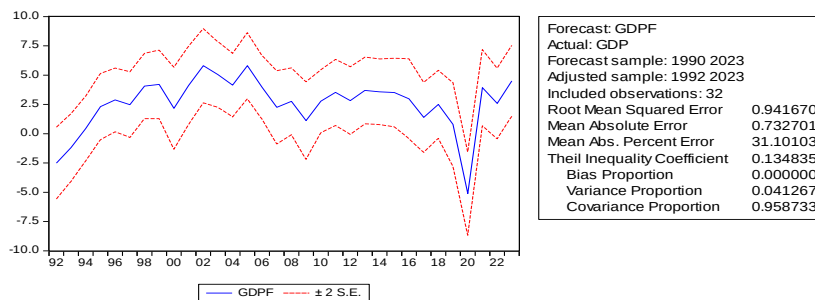


**Source:** Author's computation using EViews software

Figure 3, the CUSUM and CUSUM of Squares tests are below the critical values, suggesting that the model is stable at a 5% level of significance. The tests indicate structural stability of the model over time, which confirms consistency of both short-run and long-run estimates.

## 2-7- Predictive Performance Test of the NARDL Model :

**Figure 4: Predictive Performance Test Results for the NARDL Model**



**Source:** Author's computation using EViews software

From Figure 4, it is observed that the Theil Inequality Coefficient, Bias Proportion, and Variance Proportion are close to zero and less than one. Additionally, the Covariance Proportion is close to one, which indicates that the model possesses good predictive ability.

## 2-8- Wald Test :

**Table 7:Wald Test Results**

| Symmetry Test Results in the Short Run |       |         |             |
|----------------------------------------|-------|---------|-------------|
| Test Statistic                         | Value | df      | Probability |
| t-statistic                            | -1.45 | 18      | 0.1633      |
| F-statistic                            | 2.11  | (1, 18) | 0.1633      |
| Chi-square                             | 2.11  | 1       | 0.1461      |
| Symmetry Test Results in the Long Run  |       |         |             |
| Test Statistic                         | Value | df      | Probability |
| F-statistic                            | 3.66  | (1, 18) | 0.043       |
| Chi-square                             | 3.88  | 1       | 0.04        |

**Source:**Author's computation using EViews software

Table 7 indicates that the p-value of the Wald Test Results for long-run relationship is below the 0.05 significance level. This is employed to reject the null hypothesis ( $H_0$ ), suggesting that the positive and negative impacts of healthcare expenditure on economic growth are equal. In other words, there is strong statistical evidence of asymmetry in the long-run relationship. This suggests that increases in healthcare expenditure (CHE+) have a different impact on economic growth compared to decreases in healthcare expenditure (CHE-). This asymmetry may reflect the economy's varying responses to changes in healthcare spending over the long term, potentially due to cumulative effects such as improvements in human capital or productivity.

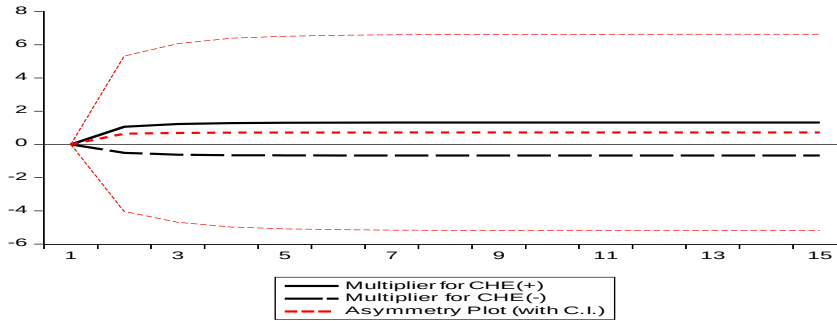
In contrast,

Conversely, the Wald Test for the short-run relationship yields a p-value greater than 0.05, supporting the acceptance of the null hypothesis ( $H_0$ ). This means there is insufficient statistical evidence to confirm asymmetry in the short run between the positive and negative effects of healthcare expenditure on economic growth. This could imply that the short-run effects are symmetric, or that changes in healthcare expenditure require a longer time frame to manifest asymmetric impacts on growth.

- **In the Long Run:** Healthcare expenditure may have an asymmetric cumulative effect. For instance, an increase in healthcare spending could significantly enhance population health, thereby boosting productivity and growth, while a reduction in spending might lead to a slow but noticeable decline in growth due to diminished human capital quality.
- **In the Short Run:** Changes in healthcare expenditure may not immediately or differentially (positively or negatively) affect growth, possibly because the economy requires time to adjust to these changes.

## 2-9-Asymmetric Dynamic Cumulative Multiplier Test :

**Figure 5: Asymmetric Dynamic Cumulative Multiplier Test Results**



**Source:**Author's computation using EViews software

Figure 5 illustrates a clear asymmetric response of economic growth to changes in healthcare expenditure. While increases in spending lead to a modest and short-lived rise in GDP, reductions result in a sharper and more persistent decline. This indicates that cuts in healthcare spending have a stronger negative impact than the positive effects of increased spending, highlighting the presence of dynamic asymmetry in the relationship. These findings underscore the critical importance of maintaining stable and efficient healthcare investment, as reductions may generate economic losses that surpass the benefits of increased spending. The results are consistent with human capital theory, which emphasizes that neglecting health investment undermines workforce quality and hinders long-term growth.

## 2-10-Estimation Results of the Long-Run and Short-Run Relationships :

**Table 8: Estimation Results of the Short-Run Relationship**

| V variable  | Coefficient | t-Statistic | Prob |
|-------------|-------------|-------------|------|
| D(CHE POS)  | 1.04        | 0.32        | 0.75 |
| D(CHENEG)   | 0.11        | 0.05        | 0.95 |
| D(LIB)      | -0.009      | -0.003      | 0.99 |
| D(MED)      | 8.82        | 2.49        | 0.02 |
| D(MR)       | -0.12       | -5.17       | 0.00 |
| D(POP)      | -40.06      | -7.41       | 0.00 |
| CointEq(-1) | -0.85       | -6.92       | 0.00 |

**Source:**Author's computation using EViews software

**Table 9: Estimation Results of the Long-Run Relationship**

| Variable       | Coefficient | t-Statistic | Prob |
|----------------|-------------|-------------|------|
| <b>CHE POS</b> | 1.78        | 1.22        | 0.23 |
| <b>CHENEG</b>  | -5.20       | -2.27       | 0.03 |
| <b>LIB</b>     | -6.55       | -4.89       | 0.00 |
| <b>MED</b>     | 10.24       | 2.19        | 0.04 |
| <b>MR</b>      | -3.39       | -6.84       | 0.00 |
| <b>POP</b>     | -3.74       | -1.24       | 0.22 |
| <b>C</b>       | -255.13     | -3.06       | 0.00 |

**Source:** Author's computation using EViews software

From Tables 8 and 9, the following observations can be made:

- Positive healthcare expenditure change ( $CHE^+$ ) has a positive but statistically insignificant effect on economic growth both in the short and long terms. 1% increase in expenditure is linked with 1.04% increase in the short term and 1.78% increase in the long term. While there is such an upward trend, lack of statistical significance implies that healthcare spending alone may not be a major growth driver. This underscores the need for supporting measures such as enhancing quality of services and efficiency in the use of resources to ensure that health investments yield the full economic returns. Positive healthcare expenditure change ( $CHE^+$ ) has a positive but statistically insignificant effect on economic growth both in the short and long terms. One percent increase in expenditure is linked with 1.04% increase in the short term and 1.78% increase in the long term. While there is such an upward trend, lack of statistical significance implies that healthcare spending alone may not be a major growth driver. This underscores the need for supporting measures such as enhancing quality of services and efficiency in the use of resources to ensure that health investments yield the full economic returns.
- In the short run, negative healthcare expenditure ( $CHE^-$ ) shows a positive but statistically insignificant relationship with economic growth, where a 1% decrease in healthcare spending leads to a temporary 0.11% increase in growth. However, this relationship shifts in the long run, becoming negative and statistically significant, with the same 1% reduction resulting in a 5.20% decline in economic growth. These findings suggest that while cutting healthcare expenditure may offer short-term economic gains, it undermines long-term growth. This underscores the importance of maintaining adequate levels of healthcare investment to ensure sustainable economic performance, in line with human capital theory (Schultz and Becker), which highlights

health investment as a key driver of economic growth and productivity of labor.

- Life expectancy is negatively linked to economic growth in both the short and long term—statistically insignificant in the former but significant in the latter. A 1% rise in life expectancy is linked to a 0.009% drop in short-run growth and a 6.55% decline in the long run at the 5% significance level. Although perhaps a counterintuitive outcome, this can be accounted for by the ageing population's economic pressures, such as rising welfare and healthcare spending, without attendant productivity gains. In Algeria's case, it can indicate mounting demographic and fiscal pressures associated with an ageing population.
- There is a statistically significant and positive association between doctors and economic growth in both the short run and long run. Increasing 1% of doctors leads to an 8.82% increase in short-run growth and a 10.24% increase in the long run at the 5% significance level. These findings emphasize the importance of healthcare professionals in increasing efficiency of services, attracting investment, and finally, production and overall economic performance.
- There is a statistically significant negative correlation between infant mortality and economic growth both in the short run and the long run. An increase in infant mortality of 1% is associated with a decline in short-run growth of 0.12% and a fall in the long run of 3.39% at the 5% level of significance. This shows declining public health standards, which hinder economic growth by lowering the overall quality of human capital.
- Negative Relationship Between Population growth with economic growth, statistically significant in the short term but not so in the long term. Specifically, 1% greater population growth translates to a reduction of 40.06% in economic growth in the short term and by 3.74% in the long term. This means that rapid population growth, if not augmented by adequate infrastructure and resources, puts pressure on the economy—once again in accordance with Malthusian philosophy. But the insignificance in the long term suggests that the effect will be muted in the long term in Algeria.
- Negative and significant at the 5% level is the error correction term (CoinEq(-1)), which has a value of -0.85. This suggests the existence of a long-run equilibrium relationship between the variables, and this indicates that any short-run deviations are corrected back towards equilibrium within less than one year.

### **Conclusion :**

Healthcare expenditure is a crucial element in supporting economic growth, not only by improving societal health indicators but also by enhancing labor productivity and

the effectiveness of human capital. The findings indicate that the connection between healthcare spending and economic growth does not follow a linear pattern, linear nor symmetric, with reductions in spending causing greater economic losses than the benefits gained from increases. These findings emphasize the importance of maintaining a stable and effective level of healthcare expenditure, directed toward sectors with direct impacts on healthcare quality and productivity. The study recommends integrating health as a core component in economic strategies.

#### Results :

1. The NARDL model confirmed a long-run equilibrium relationship between healthcare expenditure and economic growth, indicating that changes in healthcare spending have a sustainable impact on growth.
2. An asymmetric effect of healthcare expenditure changes on economic growth was evident in the long run: reductions in healthcare spending led to significant declines in economic growth, while increases resulted in modest improvements, highlighting the economy's sensitivity to healthcare expenditure cuts.
3. In the short run, the relationship between healthcare expenditure and economic growth showed no strong significant effect, suggesting that the impacts of healthcare spending changes are more pronounced and clearer over the long term.
4. The results indicated that certain health indicators, such as the number of doctors per 1,000 people, had a positive and significant impact on economic growth, while high infant mortality rates and excessive population growth exerted a clear negative effect on growth.

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