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The impact of purchasing power on economic growth rate in Algeria: An econometric study using autoregressive distributed lag model (ARDL) during the period 2001-2020

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Abstract---This study explores the relationship between purchasing power in Algeria and economic growth throughout the period from 2001 to 2020. Utilizing robust quantitative methodologies, we have developed an econometric model that elucidates the ramifications of fluctuations in purchasing power, as signified by the consumer price index, on the economic growth rate of Algeria. The results demonstrate a marked impact of fluctuations in the Algerian dinar's purchasing power on the country's economic expansion, despite the government's comprehensive subsidy measures covering a broad range of vital goods.

Keywords---Purchasing Power, Price Index at Consumption, Economic Growth.

Jel Classification Codes: J32, E31, O4.

1. Introduction

Economic expansion is a fundamental cornerstone of worldwide economic policy, representing a crucial component of the "magic square" of economic strategy. Its

primary objective is to increase investment rates and capital accumulation, thereby promoting higher growth levels. Nevertheless, numerous factors can detrimentally affect economic performance, leading to deleterious outcomes on economic growth, especially in developing nations beset by a variety of social and economic challenges, such as unemployment and low wages.

These issues add a critical dimension -purchasing power- which can impede the investment cycle by obstructing the capacity to satisfy even the most fundamental daily needs, thus engendering a demand-supply disparity for goods and services. In Algeria, the weakening purchasing power of the Algerian dinar is a major issue. The dinar's buying capability is considerably weak, as indicated by its ongoing depreciation against the US dollar and other principal currencies. This persistent depreciation serves as a deliberate measure by Algeria to mitigate the effects of oil price fluctuations and the reduction in hydrocarbon revenue, along with dwindling reserves of foreign currency and gold, and the inherent weaknesses of a rent-dependent economy.

This decline causes the prices of imported goods to rise, which also elevates the cost of local products made using these imports. This sequence of events contributes to higher inflation, further diminishing the dinar's value and negatively affecting key economic metrics, such as economic growth.

1.1 Research Problem

Arising from the aforementioned considerations, the principal research question is: To what extent does the purchasing power of the Algerian dinar impact economic growth?

1.2 Research Hypotheses

In order to tackle the main question, the study proposes the following hypotheses:

- Wages play an instrumental role in catalyzing demand.
- The economic growth rate in Algeria during the study period is characterized by its low and volatile nature.
- An inverse relationship exists between purchasing power and economic growth in Algeria.

1.3 Research Objectives

This study aims to explore how the purchasing power of the Algerian dinar affects economic growth rates, using statistical analysis to clarify this impact. Furthermore, the study endeavors to trace the developments in both purchasing power and economic growth throughout the designated study period.

1.4 Research Significance

The importance of this research lies in the criticality of the variables it investigates; growth is a fundamental goal of economic policies, and preserving purchasing power is a primary concern for policymakers, who implement various strategies such as wage policies and actions to maintain inflation within manageable limits.

1.5 Study Divisions

The research is structured into two main sections to explore the posed question. The first section offers a succinct overview of essential concepts pertaining to purchasing power and economic growth. The latter section explores the practical aspects, involving the formulation of a model that clarifies the influence of purchasing power on economic growth in Algeria over the period from 2001 to 2020.

1.6 Previous Studies

- In 2021, Nadia Lagoun conducted a study titled "*Analytical Study on the Impact of the Official Exchange Rate on the Purchasing Power of the Currency - The Case of Algeria (1970-2019)*," which examined how changes in the official exchange rate affected the purchasing power of the Algerian dinar, as measured by the consumer price index during the designated period. The results highlighted difficulties in achieving economic diversification and emphasized the Algerian economy's heavy dependence on the hydrocarbon sector. This dependency has contributed to the ongoing devaluation of the dinar, leading to higher inflation and reduced purchasing power.
- Omar Charafi (2022) conducted an "*Analysis and Evaluation of Purchasing Power in Algeria - A Measurement Study during the Period 1980-2019*." This study aimed to shed light on the purchasing power in Algeria for wage earners from an economic and quantitative perspective during the specified period, using a dynamic model that correlates individual nominal wage growth with influencing factors based on the extended Phillips relationship.

2. Conceptual Framework for Purchasing Power and Economic Growth:

2.1 Purchasing Power:

2.1.1 Definition of Purchasing Power:

"Purchasing power refers to the capacity to acquire both the quality and quantity of goods and services over a specific period of time with one's income, irrespective of employment status, be it employed, unemployed, or self-employed." (Mazrou.H, 2022, p. 69)

Purchasing power is bifurcated into two categories: Internal Purchasing Power, which denotes the quantity of goods and services purchasable with a unit of currency domestically, and External Purchasing Power, which indicates the quantity of goods and services that can be bought internationally with the local currency. (Lagoun, 2021, p. 98)

2.1.2 Measuring Purchasing Power:

The Consumer Price Index (CPI) serves as a critical measure for evaluating purchasing power. It acts as both an economic and social indicator, monitoring changes over time in the price levels of goods and services that are bought, used, or paid for by households.

It serves as a statistical gauge, reflecting price fluctuations and service costs from one period to the next, hence illustrating purchasing power dynamics and delineating inflationary trends. This index is pivotal for calculating constant prices in national economic accounts. The CPI encompasses various forms,

including the overarching general index and the urban-specific index known as U-CPI. (Ben Khtou, 2015-2016, pp. 102-103)

The purchasing power inherent to a currency within the marketplace exhibits an inverse relationship with price index fluctuations, commonly referred to as the cost of living index. This relationship indicates that a rise in the Consumer Price Index (CPI) corresponds to a decrease in the purchasing power of the monetary unit, whereas a drop in the CPI leads to an increase in purchasing power. (Lagoun, 2021)

2.2 Economic Growth:

The notion of modern economic growth entered academic discussions through the pioneering work of American economist and Nobel laureate Simon Kuznets, who documented this phenomenon starting from the late 18th century. (Kapkaey, 2015, p. 62).

Economic growth is defined as the annual augmentation in material production quantified in value terms, or as the growth rate of Gross Domestic Product (GDP) or national income. (MladenM.Evic, 2015, p. 55)

François Perroux perceives it as a sustained increase across one or more extended periods in an economic metric, typically GDP per capita.

Conversely, Flemming Veer conceptualizes economic growth as rooted in the quantitative expansion of goods and services that an average individual acquires, disregarding the real income distribution structure among individuals or the structural characteristics of the goods and services received. Essentially, economic growth epitomizes a continual uptick in production volume within a nation, manifesting as GDP growth.

3. The Impact of Purchasing Power on Economic Growth in Algeria for the Period 2001-2020:

This dimension is scrutinized by estimating a model that evaluates the influence of the consumer price index on economic growth in Algeria during the span from 2001 to 2020.

3.1 Identification of Variables and Data Sources:

Our empirical investigation harnesses time series data pertaining to both the Consumer Price Index (CPI) and the economic growth rate in Algeria, employing annual data spanning from 2001 to 2021. This data is meticulously gathered from publications by the National Office of Statistics (ONS), the Ministry of Finance, and the World Bank.

To elucidate the connection between the consumer price index and economic growth in Algeria, and to develop a solid econometric model, quantitative econometric techniques are employed.

- **Dependent Variable - Economic Growth Rate (GDP):** Represented as a percentage, denoted by the symbol (GDP).
- **Explanatory Variable - Consumer Price Index (CPI):** Denoted by the symbol (IPC).

The study model is chosen as follows:

$$GDP=f(IPC).1$$

The mathematical form of the model is:

$$\text{GDP} = a + b\text{IPC} + U_i$$

Where:

- **GDP:** Economic growth rate.
- **IPC:** Consumer Price Index.
- **U_i :** Random variable.

3.2 Descriptive Analysis of Time Series:

Descriptive and statistical analyses are conducted on the study variables through the graphical depiction of both variables to provide a detailed portrayal of their evolutionary trends, as exemplified in the following figure:

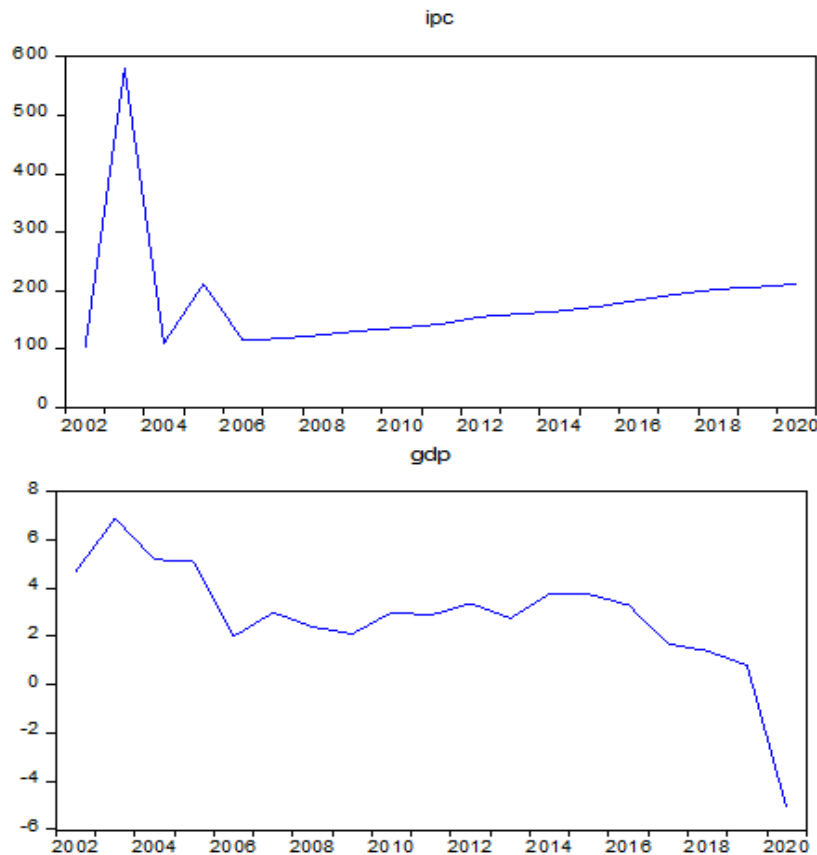


Fig.1. Description of the Consumer Price Index and Economic Growth Rate in Algeria

Source: Prepared by the researchers using EViews.10 software

From Figure (01), various fluctuations in the price index are evident during the period from 2001 to 2020. Notably, there was a pronounced increase in 2003, where the CPI soared to 580.1, a surge of 471.92% from its 2002 level of 101.43. This significant spike reflects a drastic reduction in purchasing power in 2003 as compared to the previous year. In 2004, the CPI dropped to 109.95, marking a decline of 81.04%, which indicates a rebound in purchasing power for that year.

The CPI experienced a rise by 92.33% in 2005, followed by a decrease of 46.06% in 2006, and a modest increase of 3.67% in 2007. The CPI continued to exhibit fluctuations throughout the subsequent years, reaching its peak in 2012 and its nadir in 2019.

In terms of the economic growth rate in Algeria, a noticeable downturn has been recorded; it declined from 6.9% in 2003 to 2.1% in 2009, increased to 3.3% in 2016, and subsequently dropped to 5.1% in 2020. Predominantly influenced by the oil and gas sector, which contributes 19% to the total GDP, comprises 93% of product exports, and represents 38% of budget revenues from 2016 to 2021, the Algerian economy has encountered intensified growth challenges stemming from the downturn triggered by the COVID-19 pandemic.

Nevertheless, the subsequent rise in hydrocarbon prices, fueled by the global recovery from the pandemic and the conflict in Ukraine, has resulted in a significant boost in Algeria's export and budgetary revenues. Despite these gains, the last fifteen years have seen a decline in investments, contributing to a recession in oil and natural gas production, while increased domestic consumption has precipitated a steeper decline in export volumes.

In the last two decades, Algeria has experienced substantial advancements in both economic and human development, primarily driven by the hydrocarbon boom. The nation notably eradicated its multilateral debts in 2008 and channeled investments into significant infrastructure projects to bolster economic growth. Concurrently, it enacted social policies aimed at redistributing wealth, which effectively alleviated the severity of poverty and yielded marked improvements in human development indicators. However, despite these strides, the quality of education remains a sector requiring enhancement, as evidenced by Algeria's Human Capital Index, which has plateaued at 0.53 since 2010, according to the World Bank. Despite exceeding the average for lower-middle-income nations, this metric falls short of the regional average for the Middle East and North Africa.

Similar to other oil-exporting countries in the region, Algeria faces the imperative of shifting towards a more diversified economy. This shift is crucial to augment employment opportunities, particularly vital considering the increasing proportion of youth within its population. In pursuit of this goal, since 2020, the government has implemented measures to stimulate both foreign and domestic investment through the enactment of a new investment law and the partial removal of restrictions on foreign ownership in local companies.

Furthermore, in September 2021, the government's action plan prioritized the transition to economic growth and job creation predominantly spearheaded by the private sector. This was to be achieved through the rationalization of public expenditure, reduction of imports, and enhancement of exports.

3.3 Testing the Stationarity of Time Series Data (Stationary Test):

The unit root test is applied to assess the time series properties of economic indicators from 2001 to 2020, ensuring their stationarity and identifying the integration order for each variable. The Dickey-Fuller test (ADF) is used to test the

stationarity of the variables in the model, operating under these assumption (Obben, 1998, pp. 109-121):

- **H0:** There is a unit root in the series, suggesting that the time series is non-stationary.
- **H1:** There is no unit root in the series, suggesting that the time series is stationary.

Initially, the analysis is conducted on the raw time series data. If found non-stationary, the data undergo first and second differencing until stabilization occurs. The null hypothesis of a unit root is discarded if the ADF test's absolute value exceeds the critical values at a 5% significance threshold, and the p-value is less than 5%. This indicates stationarity, and the ADF test for the regression equation is executed in three variants: with a constant limit, with a constant limit and trend, or without any constant limit and trend.

Table 1. Stability Tests Using ADF Test at a 5% Significance Level

Variable	Model	Original Series			1st Difference		
		t-Statistic .5%	ADF	Prob	t-Statistic .5%	ADF	Prob
GDP	None	-1.961409	0.704077	0.2674	-1.953858	-4.691723	0.0000
	trend and intercept	-3.580623	-2.049717	0.5500	-3.587527	-4.737057	0.0040
	intercept	-2.971853	-0.650177	0.8434	-2.976263	-4.863687	0.0006
IPC	None	-1.953381	-0.230775	0.5941	-1.953858	-4.635156	0.0000
	trend and intercept	-3.580623	-1.966792	0.5934	-3.587527	-4.518397	0.0067
	Intercept	-2.971853	-1.265691	0.6309	-2.976263	-4.606788	0.0011

Source: Prepared by the researchers using EViews.10 software.

From the evaluation of data derived from the preceding table, it was noted that the time series for both GDP and CPI display fluctuations in their initial series (level) because the outcomes from the Augmented Dickey-Fuller test did not reach statistical significance. Under such circumstances, first differences are implemented on the time series.

After adjustments, the series for both the DIPC and the DGDP reached stability at the first differences, meeting the criterion that the absolute values of the test statistics surpass the critical values in all three test models. The economic growth and Consumer Price Index time series are both first-order integrated, indicating a consistent degree of integration and suggesting a long-term relationship between them.

3.4 Determining the Number of Lag Periods:

The lag period measures how long it takes for one variable's effects to appear in another. This timing is crucial as it significantly affects the accuracy of model estimates. Especially in small samples, it's advised to keep the number of lags limited (Alawi, 2014).

The determination of the appropriate number of lags relies on the Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), and Hannan-

Quinn Information Criterion (HQ), seeking the smallest values among these metrics. The results of this analysis are summarized in the following table:

Table 2. Test of Number of Lags

VAR Lag Order Selection Criteria						
Endogenous variables: GDP IPC						
Exogenous variables: C						
Date: 01/16/23 Time: 23:06						
Sample: 2002 2020						
Included observations: 14						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-95.86320	NA	4044.811	13.98046	14.07175	13.97201
1	-54.06942	65.67593*	18.52434*	8.581346	8.855228*	8.555993
2	-50.53268	4.547242	20.85573	8.647526	9.103995	8.605271
3	-45.07052	5.462163	19.30020	8.438645	9.077703	8.379489
4	-39.73272	3.812713	21.16738	8.247531	9.069176	8.171473
5	-33.44035	2.696732	28.27463	7.920049*	8.924282	7.827089*

Source: Prepared by the researchers using EViews.10 software

From the table presented, it is apparent that the optimal number of lags to be incorporated into the model is five, indicating that the effects materialize in the fifth year.

3.5 Cointegration Regression According to the ARDL Model:

This analysis examines the long-term equilibrium relationship between the consumer price index and economic growth, capturing their long-term dynamics. It involves variables that are integrated, indicating their trend-based movements over time. Cointegration analysis requires at least one cointegration vector among the variables.

The Autoregressive Distributed Lag Model (ARDL) is preferred for this purpose because it allows for different integration orders among the variables being analyzed. The ARDL cointegration test is conducted using the "Bound Test" approach, developed by Pesaran et al. in 2001, which combines autoregressive models (AR(p)) with distributed lag models. This method models the time series based on its historical values and both the current and historical values of other explanatory variables.

Table 03. Results of Estimating the ARDL Model

DependentVariable: GDP				
Method: ARDL				
Date: 01/16/23 Time: 23:11				
Sample (adjusted): 2006 2020				
Includedobservations: 15 afteradjustments				
Maximum dependentlags: 4 (Automaticselection)				
Model selection method: Akaike info criterion (AIC)				
Dynamic regressors (4 lags, automatic): IPC				
Fixedregressors: C				
Number of modelsevaluated: 20				
SelectedModel: ARDL(4, 4)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
GDP(-1)	0.951161	0.645585	1.473332	0.2007
GDP(-2)	1.063060	0.766087	1.387650	0.2239
GDP(-3)	0.816240	0.581308	1.404145	0.2192
GDP(-4)	0.893990	0.728303	1.227497	0.2743
IPC	0.172803	0.096731	-1.786435	0.1341
IPC(-1)	0.125465	0.088908	1.411186	0.2173
IPC(-2)	0.069305	0.075512	0.917806	0.4008
IPC(-3)	-0.055853	0.023830	-2.343816	0.0661
IPC(-4)	-0.035213	0.022723	-1.549679	0.1819
C	3.252513	3.599578	0.903582	0.4076
R-squared	0.887056	Meandependent var	2.077333	
Adjusted R-squared	0.683757	S.D. dependent var	2.164369	
S.E. of regression	1.217143	Akaike info criterion	3.465611	
Sumsquaredresid	7.407185	Schwarz criterion	3.937644	
Log likelihood	-15.99208	Hannan-Quinn criter.	3.460583	
F-statistic	55.36309	Durbin-Watson stat	2.768581	
Prob(F-statistic)	0.029665			
*Note: p-values and any subsequent tests do not account for model selection.				

Source: Prepared by the researchers using EViews.10 software

The statistical results from the regression equation, shown in the previous table, verify the high dependability of the estimated model, highlighted by a determination coefficient (R^2) of 0.88. This figure suggests that the model accounts for 88% of the variations in the economic growth rate. Additionally, the genuine relationship between the dependent and explanatory variables is confirmed, as indicated by the significance level of the Prob(F-statistic), which is well below 5%.

3.6 Bound Test:

In this case, there are two hypotheses:

- **Null Hypothesis H0:** Suggests no long-term relationship from the explanatory variable to the dependent variable if the calculated F-value is below the I1 Bound.
- **Alternative Hypothesis H1:** Suggests a long-term relationship from the explanatory variable to the dependent variable if the calculated F-value exceeds the I1 Bound. The F-statistic is assessed against the I1 Bound.

Table 4. Bound Test Estimation Results

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	8.877479	10%	3.02	3.51
K	1	5%	3.62	4.16
		2.5%	4.18	4.79
		1%	4.94	5.58

Source: Prepared by researchers using EViews.10

The table shows that the calculated F-statistic of 8.877 surpasses the I1 Bound of 4.16 at a 5% significance level, leading to the rejection of the null hypothesis and confirmation of the alternative hypothesis, which establishes a long-term relationship from the consumer price index to the economic growth rate.

3.7 Using the Error Correction Model (ECM) Methodology:

The essential component of this estimate is represented by the error correction coefficient within the ARDL Cointegrating and Long Run Form. The findings are detailed in the following table:

Table 05. Estimation Results of Error Correction Model Methodology

ARDL Error Correction Regression				
DependentVariable: D(GDP)				
SelectedModel: ARDL(4, 4)				
Case 2: Restricted Constant and No Trend				
Date: 01/16/23 Time: 23:18				
Sample: 2002 2020				
Includedobservations: 15				
ECM Regression				
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-2.773291	0.858270	-3.231256	0.0232

D(GDP(-2))	-1.710230	0.598976	-2.855257	0.0356
D(GDP(-3))	-0.893990	0.475032	-1.881955	0.1186
D(IPC)	0.172803	0.056950	-3.034316	0.0289
D(IPC(-1))	0.021762	0.036327	0.599056	0.5752
D(IPC(-2))	0.091067	0.024329	3.743114	0.0134
D(IPC(-3))	0.035213	0.013290	2.649691	0.0454
CointEq(-1)*	-0.724452	0.601945	4.526081	0.0062
R-squared	0.833998	Meandependent var	-0.680000	
Adjusted R-squared	0.667996	S.D. dependent var	1.785277	
S.E. of regression	1.028674	Akaike info criterion	3.198944	
Sumsquaredresid	7.407185	Schwarz criterion	3.576571	
Log likelihood	-15.99208	Hannan-Quinn criter.	3.194922	
Durbin-Watson stat	2.768581			
* p-value incompatible with t-Bounds distribution.				

Source: Prepared by researchers using EViews.10

For this test, two conditions must be met: The CointEq(-1) must have a negative sign and be significant; from the table results, the error correction coefficient CointEq(-1) equals (-0.2744), is negative and significant because prob=0.0062 is less than 0.05, thus meeting both conditions. The long-term cointegrating equation includes the dependent variable (economic growth rate) and the explanatory variable (consumer price index):

$$GDP = -1.1938 + 0.0253IPC + U_i \dots \dots \dots 03$$

For the consumer price index with a positive sign, it aligns with economic theory, meaning that as the consumer price index increases, so does the economic growth rate in Algeria, reflecting the hypothesis's validity. Also, prob less than 0.05 means the consumer price index parameter has statistical significance.

Therefore, there is a direct long-term inverse relationship between the consumer price index and the economic growth rate in Algeria, indicating that every unit increase in the consumer price index will decrease the economic growth rate in Algeria by 0.02 percent, showing a close long-term correlation between the consumer price index and economic growth in Algeria.

This means that a decrease in purchasing power in Algeria negatively affects economic growth. A decrease in purchasing power would lead to a decline in effective total demand, i.e., demand for consumer and investment goods and government demand, contributing to a decrease in production and a downturn in gross domestic product between the concerned year and the base year.

Furthermore, the determination coefficient $R^2=0.83$ shows that the consumer price index accounts for 83% of the variations in the economic growth rate, while the remaining 17% is attributed to either errors, other unaccounted variables, or statistical inaccuracies.

3.8 Validating the Model Using Statistical Tests for the ARDL Model:

3.8.1 Error Correlation Test using LM Test:

Table 06. Autocorrelation Test among Errors using LM Test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.560413	Prob. F(2,9)	0.5897
Obs*R-squared	2.547125	Prob. Chi-Square(2)	0.2798

Source: Prepared by researchers using EViews.10 software.

Since the Prob. F-statistic is above 0.05, we accept the null hypothesis and reject the alternative, suggesting there is no serial correlation among the errors.

3.8.2 Breusch-Pagan-Godfrey Test for Variance Homogeneity:

Table 07. Results of the Homogeneity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	0.612220	Prob. F(11,11)	0.7857
Obs*R-squared	8.733957	Prob. Chi-Square(11)	0.6464
Scaled explained SS	1.369170	Prob. Chi-Square(11)	0.9998

Source: Prepared by researchers using EViews.10 software.

The table indicates that Prob. F(11,11) is greater than 0.05, leading us to reject the alternative hypothesis H1 and uphold the null hypothesis, confirming that the model does not exhibit heteroskedasticity and the residuals display consistent variance.

3.8.3 Jarque-Bera Test for Normal Distribution of Model Residuals: Using EViews.10 software, the Jarque-Bera test was conducted to assess the normality of the residuals in the estimated model. The results of this test are shown in the figure below:

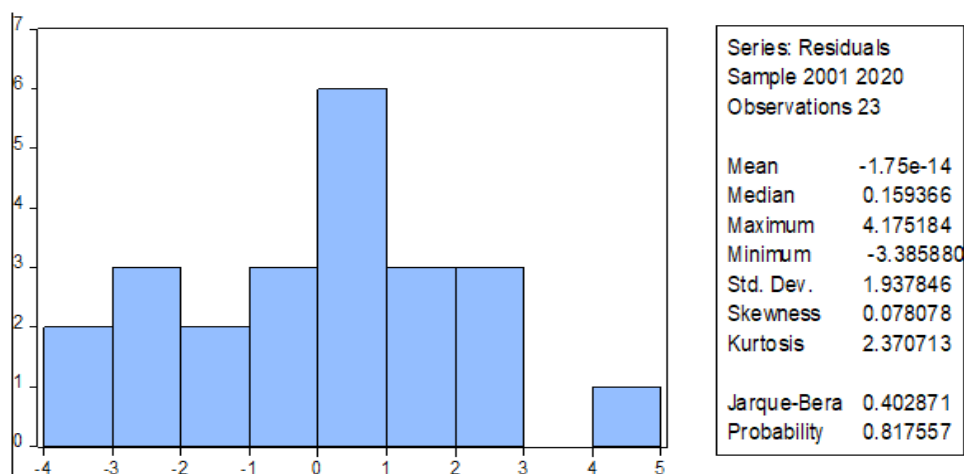


Fig.2. Test for the Normal Distribution of the Estimated Model's Residuals

Source: Prepared by researchers using EViews.10 software.

The Jarque-Bera test indicates that the probability statistic (Prob = 0.81755) exceeds 0.05 (5%), confirming that the residuals are normally distributed. Consequently, given that the estimated model for assessing the impact of purchasing power on economic growth in Algeria during 2001-2020 is robust economically, statistically, and econometrically, we conclude that this model is suitable for forecasting and decision-making purposes.

4. Conclusion

Through this research paper, we have conducted an econometric analysis utilizing the Autoregressive Distributed Lag Model (ARDL) to scrutinize the influence of purchasing power on economic growth in Algeria during the last two decades of this millennium. The study concludes with the following observations:

- _ Purchasing power in Algeria exhibits instability and has progressively deteriorated over time.
- _ The national minimum wage has failed to keep pace with the escalation in the general price level, resulting in inadequate coverage for essential goods.
- _ The government's reduction in support for some widely consumed goods, aimed at alleviating the fiscal burden, has led to diminished purchasing power and a degraded standard of living for the Algerian populace.
- _ A significant downturn in Algeria's economic growth rate to -5.1% in 2020, attributable primarily to the decline in oil prices since 2014.

4.1 Findings:

The analysis confirms a long-term equilibrium relationship between purchasing power and economic growth in Algeria, indicating that purchasing power consistently influences the country's economic growth rate.

4.2 Recommendations:

In light of the research findings, several pivotal proposals are suggested to bolster purchasing power in Algeria:

- _ Implementing a policy of periodic evolution of wages and prices.
- _ Outlining productive economic programs based on creating added value.
- _ The need to revise the wage structure to align with the economic and social conditions prevailing in the country.

4.3 Research Prospects:

- The wages in Algeria and their impact on economic variables.
- The effect of nominal wage increases on real wages amid rising inflation rates.

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