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The impact of public expenditure on the unemployment rate in Algeria: An empirical study using the ARDL Model during the period (1990–2023)

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Abstract---This study aims to analyze the impact of public expenditure on the unemployment rate in Algeria during the period (1990–2023), using the Autoregressive Distributed Lag (ARDL) model and annual time series data. The research seeks to estimate the relationship between public spending and unemployment in both the short and long run. The results revealed an inverse relationship between the two variables, indicating that an increase in public spending contributes to reducing the unemployment rate, especially when directed toward productive sectors. Furthermore, the results of the cointegration test showed the existence of a long-term equilibrium relationship between public spending and unemployment. The error correction term (CointEq(-1)) was statistically significant at the 5% level, with an adjustment speed of approximately 40.61%. This implies that the Algerian economy requires about two years and five months to return to equilibrium following any economic shock affecting one of the variables.

Keywords---Public Expenditure, Unemployment Rate, Econometric Model, ARDL Model.

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Introduction

Unemployment is considered one of the fundamental issues on both social and economic levels, affecting all countries to varying degrees. It occupies a significant share of the attention, thoughts, and efforts of scholars, economists, and policymakers due to its numerous negative implications. Consequently, economic policies place great importance on addressing it, with increasing employment opportunities and reducing unemployment rates being among the most prominent economic, social, and political objectives pursued by planners and decision-makers.

Public expenditure is one of the most important fiscal policy tools used by the state to achieve its economic goals, especially with the expanding role of the state in economic life by influencing purchasing power, employment levels, and addressing economic crises. In this context, and contrary to the classical economic school—which advocates for full employment and the elimination of unemployment based on the "laissez-faire" principle, assuming that markets can automatically correct imbalances through supply and demand mechanisms without government intervention—the Keynesian school sees the necessity of state intervention using fiscal policy tools, such as increasing public expenditure or reducing taxes, to stimulate aggregate demand and achieve full employment. This, in turn, helps reduce unemployment rates, emphasizing the central role of the government in managing the economy and ensuring its stability (Abu Hanif et al., 2023).

Theoretically, public expenditure is considered one of the key drivers through which the state can create job opportunities, helping absorb and mitigate unemployment. This implies an inverse relationship between public expenditure and unemployment rates: the higher the public expenditure, the lower the unemployment. Fiscal policy is considered one of the most effective tools in addressing underemployment or recessionary gaps. In this framework, government projects contribute to the provision of sustainable employment opportunities in the long term, and the impact of fiscal policy—especially through the multiplier effect—is often stronger than that of monetary policy (Hammad et al., 2023).

In this regard, Algeria, in collaboration with the International Monetary Fund (IMF) and the World Bank, adopted a series of economic reforms that led to structural changes in many macroeconomic variables. However, due to fluctuations in global oil prices, fiscal policy faced instability, directly or indirectly impacting the labor market and unemployment rates. Public expenditure in Algeria went through various phases aligned with the economic policies of each period, which had a clear impact on economic activity and growth levels. This growth was closely tied to the size of public expenditure allocated to various investments across different sectors, particularly during the years 2001–2014, when Algeria adopted a fiscal expansion policy. The country launched several development programs such as the Economic Recovery Program (2001–2004), the Complementary Growth Support Program (2005–2009), which contributed to creating permanent jobs, reducing unemployment, and improving citizens' welfare. Later, the Growth Enhancement Program (2015–2019) was adopted, but the sharp decline in oil prices led to its suspension in 2016 (Mecheri & Bouketir, 2019), prompting the government to adopt austerity measures in public expenditure.

Numerous studies have shown that increasing public expenditure—especially in productive sectors such as infrastructure, education, and healthcare—can help reduce unemployment rates. Fiscal policy based on public expenditure is one of the primary tools used by developing countries, particularly those dependent on oil revenues, to address labor market challenges and generate employment. Given the lack of a strong industrial base that would enable these countries to implement effective tax policies, they heavily rely on revenues from the energy and hydrocarbon sector to finance their budgets and direct these funds towards government projects to stimulate economic activity and create jobs, thus achieving stability and balance in the labor market (Hammad et al., 2023).

Nevertheless, these countries must manage public expenditure cautiously to ensure that resources are directed toward sectors that yield the highest economic and social returns, while avoiding overreliance on oil revenues, which are susceptible to global market fluctuations.

Accordingly, the central problem of this research lies in analyzing the relationship between public expenditure and the unemployment rate in Algeria, using the adopted econometric approach. From this standpoint, the following research question is posed:
To what extent does public expenditure affect the unemployment rate in Algeria during the period 1990–2023, in both the short and long term?

Research Hypothesis:

To answer this research question, the following main hypothesis has been formulated: **"There is a short- and long-term equilibrium relationship between public expenditure and the unemployment rate in Algeria during the study period."**

Research Objectives:

This research aims to study and analyze the evolution of the volume of public expenditure in Algeria during the period 1990–2023 and its role in stimulating the national economy. It also seeks to assess the extent to which this spending contributes to job creation and reducing the severity of unemployment. Additionally, the research aims to measure the impact of public expenditure on the unemploy**ment rate** in both the short and long run by constructing an econometric model based on the Autoregressive Distributed Lag (ARDL) theory, grounded in the theoretical framework and a review of previous studies.

Research Methodology:

The study adopts a descriptive-analytical approach to examine the development of both public expenditure and the unemployment rate in Algeria during the study period. Furthermore, a quantitative methodology is applied using econometric modeling, specifically the Autoregressive Distributed Lag (ARDL) model, in order to estimate the relationship between the two variables and determine the speed of adjustment toward long-run equilibrium. This was carried out using the statistical software **EViews 10.**

Literature Review:

Economic literature indicates that unemployment is one of the major challenges facing the economy. Numerous studies have addressed this issue from various angles, particularly focusing on the impact of economic policies—especially public expenditure—on unemployment rates. Despite the diversity of these studies, research on this topic in Algeria using econometric models remains limited, both in terms of the time span of data and the nature of the variables studied.

In this context, Amina Zerbout and colleagues (2023) conducted a study on the impact of public expenditure on the unemployment rate in Algeria under the fluctuations of oil prices during the period 1990–2020 (Zerbout et al., 2023). The researchers used oil prices as a key indicator of government revenues and the money supply as a measure of the available liquidity in the economy, applying the Autoregressive Distributed Lag (ARDL) model. The study concluded that there is a weak inverse relationship between public expenditure and the unemployment rate. An increase in government spending leads to a rise in aggregate demand, which stimulates the production system and contributes to the creation of new job opportunities, consistent with the Keynesian approach. However, this relationship remains relatively limited due to the high dependence on oil revenues to finance the public

budget and the weak flexibility of the productive apparatus to respond to increased demand. Nonetheless, the economic data in our study have changed since 2020, and the methodology adopted in the present study differs from this one by using the co-integration methodology and focusing solely on the volume of public expenditures as a single independent variable, as spending is considered a primary tool that affects economic activity.

As for the study by Houari and Neqal (2021), titled: *"The Impact of* Public Expenditure *on Unemployment and Inflation in Algeria during the Period 1990–2020: An Econometric Study Using the ARDL Model"*, it aimed to analyze the extent to which public expenditure affects unemployment and inflation, and to determine the nature of the relationship between them in Algeria. The study found both a short-run and a long-run equilibrium relationship between public expenditure and unemployment. Public expenditure policy had a weak and inverse effect on the unemployment rate. Similarly, the study found both short-run and long-run equilibrium relationships between public expenditure and inflation, with public expenditure having a weak and inverse effect on the inflation rate as well.

Moreover, two other studies addressed similar topics: Shadi Saraireh (2020), in her study titled "The Impact of Government Expenditures on Unemployment: A Case Study of Jordan", estimated the impact of government spending on the unemployment rate in Jordan during the period 1990–2019. Hammad et al (2023), in their study titled "The Impact of Public Spending on Unemployment: A Study on the Iraqi Economy for the Period 2004–2021", focused on Iraq during the period 2004–2021. Both studies used the ARDL model and co-integration tests, and both concluded that there is a statistically significant long-term negative relationship between government spending and the unemployment rate in Jordan and Iraq. Specifically, a 1% increase in Jordanian government spending as a share of GDP leads to a 0.43% decrease in the unemployment rate, while in Iraq, the same increase leads to a 3% decrease. However, both studies noted that in the short term, the effect might be positive.

Another relevant study was conducted by Holden and Sparrman (2018), titled "Do Government Purchases Affect Unemployment?", which covered 20 OECD countries for the period 1980–2007 using panel data. The study concluded that a 1% increase in government spending as a percentage of GDP results in a decrease in the unemployment rate by about 0.3 percentage points in the same year, reflecting the positive impact of government spending on employment opportunities.

Although these studies addressed the relationship between public expenditure and the unemployment rate, their time coverage remains limited (mostly up to 2020), and the nature of the independent variables differs from the current study, as most of them rely on multiple independent variables. Therefore, the current study aims to fill this gap by expanding the time period to include data from 1990 to 2023, focusing solely on total public expenditure as a single independent variable, and analyzing its impact on the unemployment rate in Algeria in both the short and long term using the co-integration methodology and the ARDL model. This approach enhances the accuracy of understanding the relationship in light of the current economic conditions.

2. Theoretical Framework of the Study :

This research paper requires, first, a study of the definition of unemployment and how it is measured, followed by the presentation of the concept of public expenditure through its definition and the classifications provided by Algerian legislation. Additionally, it involves an examination of the evolution of the volume of public expenditure and the unemployment rate during the study period.

2.1. Concept of Unemployment :

Unemployment currently represents one of the major challenges facing countries across the world, regardless of their levels of development or their economic, social, and political systems.

Unemployment is no longer a problem confined to third-world countries, but has become one of the most pressing issues even in developed nations. Perhaps the most severe and prominent characteristic of the global economic crisis affecting all countries is the worsening unemployment problem, with approximately one billion unemployed individuals distributed around the world.

2.1.1 Definition of Unemployment :

Although various definitions of unemployment differ in wording, they all converge on a common understanding of its core meaning. Moreover, there is a standard approach to measuring unemployment; however, practical difficulties in measurement vary from one country to another.

Unemployment is defined as "the number of individuals capable of working who are not currently employed, despite actively seeking employment." (Abd al-Rahman, 2004). The unemployed are individuals within the working-age population (15–65 years) who are seeking employment or a source of income, but are unable to find one. This definition excludes children, the elderly (due to their inability to work), as well as housewives and students, who are not considered economically active (Rahmat & Saeidi, 2017).

According to the definition adopted by the **International Labour Office (ILO)** during its **18th International Conference on Labour Statistics in 1982**, a person of working age is considered unemployed if three basic conditions are met (Muller et al., 2004):

- They are without work.
- They are available for work.
- They are actively seeking work.

Thus, we observe that the ILO uses these criteria to define unemployed persons.

From these definitions, we can conclude that most share a common conceptual foundation of unemployment, based on specific characteristics that define a person as unemployed—primarily the conditions set by the ILO (being without work, available for work, and actively seeking work). In general, unemployment can be briefly and comprehensively defined as follows:

"Unemployment is the state of being without work despite being capable of, willing to, and actively seeking employment."

2.1.2 Measuring the Unemployment Rate :

Developed countries, in particular, regularly and systematically calculate unemployment rates—monthly, quarterly, or annually—using sample surveys rather than full population counts, due to the time and high costs involved in general censuses. A sample is drawn from the economically active population, from which the number of unemployed is identified, and the unemployment rate is then determined. The unemployment rate is typically measured by official institutions as the ratio of the number of unemployed persons to the labor force (economically active population) at a given point in time, using the following formula (Gregory, 2006):

$$\text{Unemployment Rate} = (\text{Number of Unemployed} / \text{Labor Force}) \times 100$$

2.1.3 Types of Unemployment :

Distinguishing between the different types of unemployment is of great importance, as it helps identify the underlying causes and determine the appropriate mechanisms for addressing them. Unemployment takes various forms depending on the nature and level of development of the economy, as well as its current condition. These forms often result in numerous negative economic, social, and political consequences.

Due to the varying causes and associated factors of unemployment, economists generally classify it into three main types: **cyclical unemployment**, **frictional unemployment**, and **structural**

unemployment. This classification is often considered a traditional one. However, other types of unemployment are also recognized across different economies, such as **seasonal unemployment**, which occurs when there is a lack of demand for labor during specific seasons (Rahmat & Saeidi, 2017).

2.2 The Concept of Government Expenditure:

Public expenditure —considered part of public finance—is one of the most important factors affecting economic performance. It is the primary tool through which the state seeks to achieve economic and social objectives. Thus, the efficiency in allocating public expenditure has a positive impact on providing the financial resources necessary for economic growth.

2.2.1 Definition of Public Expenditure :

The definitions of public expenditure vary in formulation but share a common core in meaning and concept. Among the commonly cited definitions are:

Public expenditure is defined as:"A monetary amount spent by a public entity with the aim of achieving a public benefit," or"A monetary amount disbursed by the state to satisfy a public need and to fulfill its role in the economic and social spheres" (Dhala'in et al., 2017).

Technically, public expenditure refers to: "What the state or its representatives at the central, regional, or local levels spend from public funds to purchase goods and services in order to fulfill their functions, aiming to achieve public welfare. Examples include expenditure on healthcare, justice, education, social protection, and the like"(Bretteville-Jensen et al., 2017).

It is also defined as: "An expenditure made by a public entity—namely, legal persons under public law—which may be the state itself or one of its public bodies or institutions with independent legal personality"(Khasawneh, 2014).

According to Grenade and Wright, public or public expenditure is defined as: "Monetary amounts spent by public authorities—such as central, national, and local governments—to meet the collective social needs of society" (Saraireh, 2020).

This implies that public expenditure is a monetary amount disbursed by the state or any of its public legal entities to achieve a public benefit. Based on this definition, public expenditure requires the presence of the following elements:

- **It must be a monetary amount;**
- **It must be spent by a legal person under public law;**
- **Its objective must be to achieve a public benefit**.

2.2.2 Classifications of Public Expenditures in Algeria

The state's intervention in economic life has led to a diversification of its activities, which requires an increase in the volume and variety of its expenditures. As a result, public expenditures have been categorized in different ways, depending on the economic, financial, and social circumstances the country is experiencing. Like other countries, Algeria classifies its expenditures based on the following criteria:

a. **Functional Classification:**
   Public expenditures are classified according to the functions carried out by the state, regardless of the nature of the expenditure. The purpose of this classification is to show the various areas of government spending (Jacobs et al., 2009). In Algeria, the functions of the state are divided into four main groups: General services, which include public administration, justice, police, and defense; Social and community services; Economic services related to agriculture, industry, transportation, etc.; Non-allocable or common expenditures, such as interest on public debt (Laamara, 2004).
b. **Economic Classification:**
   These are expenditures related to the state's provision of services aimed at achieving economic goals, such as investments intended to supply the national economy with basic services like transportation, power generation stations, irrigation, and drainage. This also includes housing

construction and various forms of economic subsidies provided by the state to support investments (Baali & Abu Al-Ala, 2003).

According to Article 23 of Law No. 84-17, dated July 7, 1984, related to finance laws, The Algerian legislator classified the state's public expenditures into two categories

- **Operating Expenditures**: These are expenditures directed toward providing state structures with the necessary funds to manage and operate the various functions of society (Sahel, 2017).
- **Investment or Capital Expenditures**: These are investment-related expenditures that contribute to creating added value in the economy (Zaghoud, 2005).

2.2.3 The Relationship Between Public Expenditure and Unemployment:

Through public expenditure policy, the state aims to achieve a range of economic objectives, most notably stimulating economic growth and creating new job opportunities, thereby helping to mitigate the worsening problem of unemployment. This is achieved by adopting expansionary government spending policies, especially during periods of recession or economic slowdown. High unemployment rates are considered an indicator of declining effective aggregate demand, which discourages producers from expanding production due to falling prices and returns, and may even lead some to halt certain projects**.**

This situation pushes the economy into a vicious cycle of declining demand and rising unemployment. In such cases, public expenditure can play a crucial role in stimulating economic activity by providing financial subsidies to producers, helping them better utilize available resources (Ayeb, 2010), or by implementing public works projects such as infrastructure and buildings, or expanding existing projects—thus contributing to job creation and absorbing part of the unemployed labor force**.**

The effectiveness of this policy depends on the flexibility of the production system; its efficiency increases when the system is more capable of adapting and responding to rising demand. An increase in public expenditure leads to a rise in effective demand, which positively affects production levels, provided that the economy is still operating below full employment of its production factors (Khalaf, 2008). This perspective aligns with Keynesian theory, which emphasizes the importance of state intervention in economic activity (Seccareccia, 2011), particularly during crises—a defining characteristic of the modern economic role of the state (Deubel et al., 2008)**.**

According to Akrani, public expenditure policy is not limited to accelerating economic growth and enhancing employment opportunities. It also plays a beneficial role in reducing poverty and income inequality in developing countries. He notes that recurrent expenditures are those government expenses paid regularly from year to year, whereas capital expenditures refer to the costs of new production, land expansion, and acquisition of other fixed assets (Saraireh, 2020).

3. An Analytical Study of Public Expenditures and the Unemployment Rate in Algeria During the Period (1990–2023):

The Algerian economy witnessed a significant increase in the volume of public expenditure allocations during the study period. This reflects the state's growing tendency to use public expenditure as a tool to achieve economic and social objectives. The following two figures illustrate and analyze the evolution of public expenditures and the unemployment rate in Algeria during the period from 1990 to 2023. This allows for a better understanding of the characteristics of the adopted public expenditure policy and its impact on economic performance indicators, particularly regarding the labor market and unemployment rates.

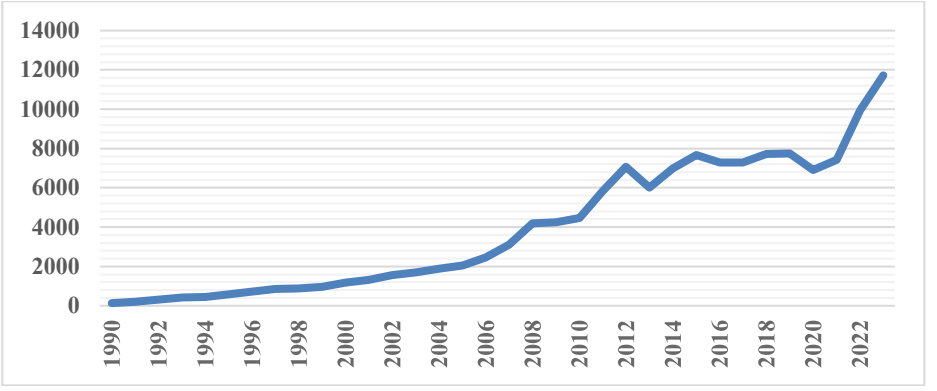

Figure N (01): Evolution of Public Expenditure Volume in Algeria During the Period (1990–2023)
Source: Prepared by the researchers based on reports and publications of the Bank of Algeria for the years (1990–2023). https://www.bank-of-algeria.dz/ar/

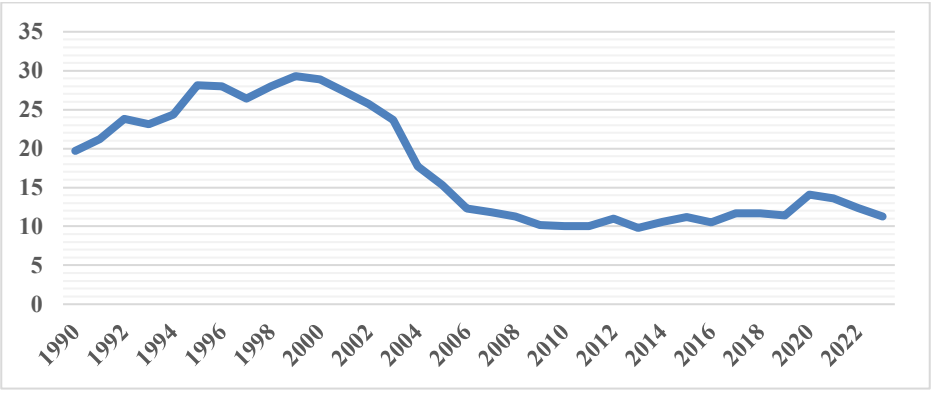

Figure N (02): Evolution of the Unemployment Rate in Algeria During the Period (1990–2023)
Source: Prepared by the researchers based on reports and publications of the Bank of Algeria for the years (1990–2023). https://www.bank-of-algeria.dz/ar/

From the two figures above, it is observed that Algeria adopted two different policies that had a direct impact on the labor market and consequently on the unemployment rate. Generally, public expenditures in Algeria have shown continuous growth throughout the study period due to population increase and higher allocations for economic development programs. Based on this, the evolution of public expenditures and the unemployment rate in Algeria can be discussed through the following phases:

Phase One (1990–1995):
This phase was characterized by a continuous increase in public expenditure. In 1992, the growth rate of expenditures reached 38.85% compared to the previous year, amounting to 320.2 billion DZD. This upward trend continued, reaching 589.3 billion DZD by 1995. The increase was attributed to rising oil prices on global markets and improved state revenues. However, this did not reflect positively on the labor market, as unemployment rates ranged from 19.7% to 28.1% during this period. The main reason was that the government focused on debt repayment rather than stimulating the national economy.

Phase Two (1996–1999):
Algeria adopted austerity measures due to the implementation of structural reforms that shifted its economic path during the structural adjustment period (1994–1998). Public expenditure growth

declined, reaching 18.67% in 1996 and falling to 3.53% in 1998, with total public expenditure estimated at 876.175 billion DZD. This clearly reflects the state's austerity policy aimed at rationalizing expenditures, improving efficiency, and reducing the budget deficit, especially with lower oil tax revenues and the inability of public enterprises to create new jobs. Consequently, unemployment rose, reaching 27.99% in 1996 and peaking at 29.30% in 1999 (Office National des Statistiques, 2001)

Phase Three (2000–2014):
After the end of the structural adjustment period, Algeria abandoned its austerity policy and adopted an expansionary spending strategy. From 2000 onward, there was an increase in the volume and growth rate of public spending. In 2000**,** public expenditures grew by 18.37%, reaching 1,178.122 billion DZD. By 2008, they climbed to 4,191.05 billion DZD, peaking in 2012 at 7,058.173 billion DZD. In 2014, spending reached 6,995.769 billion DZD (Central Bank of Algeria, 2016). This had a positive impact on employment, as unemployment fell from 28.89% in 2000 to 17.70% in 2004 (around 1.672 million unemployed). By 2013, the unemployment rate dropped further to 9.80% (about 1.214 million unemployed).

This expansionary policy was supported by large financial resources from high oil prices, improved security, economic stability, and social indicators. The average oil price rose from $12.85 per barrel in **1998** (Bank of Algeria, 2006) to $98.6 in 2008, $111.3 in 2011 (Aldawood et al., 2022), and $96.29 in 2014. This enabled the implementation of economic recovery programs (2001–2004), the supplementary growth support program (2005–2009), and the economic growth strengthening program (2010–2014), which consumed large financial envelopes and directed spending toward investment to boost overall economic performance and job creation—achieving the main goals of these programs.

Phase Four (2015–2020):
This phase saw a decline in public expenditure due to economic challenges resulting from the drop in oil prices starting mid-2014 and again in mid-2018. The Algerian government froze several development projects and adopted spending rationalization policies. Spending fluctuated between increases and decreases. For instance, in 2015, public expenditure grew by 8.62% (7,656.33 billion DZD), but in 2016, it fell by –4.91% (7,297.50 billion DZD), and similarly in 2017 and 2019 with –0.20% and –0.08% respectively. The lowest spending was recorded in 2020 at 6,902.9 billion DZD (Central Bank of Algeria, 2023). This decline coincided with rising unemployment, which peaked at 14.3% in 2020, up from 11.2% in 2015 (Central Bank of Algeria, 2022).

Phase Five (2021–2023):
During this period, public expenditures increased slightly compared to 2020, reaching 7,436.1 billion DZD and continuing to rise to 11,721.5 billion DZD in 2023 (Central Bank of Algeria, 2024). This increase was mainly due to the direct impact of the COVID-19 pandemic, which disrupted economic activity. In 2021, the Algerian state signed public contracts to secure vaccines, masks, disinfectants, gloves, and medicines, allocating more than 12 billion DZD for these purchases according to the Presidential Decree published in Official Gazette No. 30. (Journal Officiel de la République Algérienne, 2021) Unemployment during this period declined slightly, reaching 11.3% in 2023.

4. Econometric study :

The econometric study begins by outlining the methodology employed, followed by the application of the Autoregressive Distributed Lag (ARDL) model.

4.1 Definition of the Methodology Employed in the Study

To assess the impact of the size of public expenditure on the unemployment rate, the study employs the Autoregressive Distributed Lag (ARDL) model, which measures both long-run and short-run relationships between economic phenomena. Originally developed by Pesaran and Shin (1998) and later expanded by Pesaran et al (2001).

The ARDL methodology is considered an effective tool for analyzing the relationship between the size of public expenditures and the unemployment rate in the case study, especially in light of the availability of limited time series data and the diversity of integration orders among variables.

4.2 Application of the ARDL Model to Assess the Impact of Public Expenditure on Unemployment Rate in Algeria (1990–2023)

To measure the effect of public expenditures on the unemployment rate in Algeria, we utilized annual data spanning from 1990 to 2023. The following steps were undertaken:

4.2.1 Definition of the Model Variables

Based on economic theory (Keynesian theory) and previous studies, two variables were identified in the model: the size of public expenditures and the unemployment rate. The data used in this study were obtained from statistics published by the Ministry of Finance from 1990 to 2023, in addition to relying on reports and publications of the Algerian Bank over several years. The EViews 10 software was used to process this data to estimate the study model. The symbols for the variables, the size of public expenditures and the unemployment rate, are as follows:

- ✓ **Dependent variable:** represented by the unemployment rate, symbolized as ***UNEPM***, expressed as a percentage (%).
- ✓ **Independent variable:** represented by the size of public expenditures, symbolized as ***PEXP***, expressed in billions of Algerian dinars.

The simple linear regression method will be used to estimate the standard model under study. The nonlinear (logarithmic) form will be used because it provides the long-term elasticities of the economic variables in their impact on the dependent variable. In this case, the proposed model for the study takes the following form:

$$\mathbf{LTch_t} = \boldsymbol{\alpha_0} + + \sum_{\mathbf{i=1}}^{\mathbf{p}} \boldsymbol{\alpha_i}\, \mathbf{LUNEPM_{t-i}} + \sum_{\mathbf{J=0}}^{\mathbf{q}} \boldsymbol{\beta_j}\, \mathbf{LPEXP_{t-J}} + \boldsymbol{\varepsilon_t}$$

Where:

- ✓ $\mathrm{LUNEPM_t}$: Natural logarithm of the unemployment rate at time t
- ✓ $\mathrm{LEXP_{t-J}}$: Natural logarithm of the Public expenditures at time $\mathrm{t-j}$
  - ✓ p: Number of lags for the dependent variable
  - ✓ q : Number of lags for the independent variable
  - ✓ α_0: Constant term
  - ✓ α_i: Coefficients of the lagged dependent variable
  - ✓ β_j: Coefficients of the lagged independent variable
  - ✓ ε_t: Error term

This model facilitates the analysis of both short-term and long-term dynamics between public expenditures and unemployment rates.

4.2.2 Data Processing

First: Detecting Outliers

Before testing the relationship between public expenditure (LPEXP) and unemployment rate (LUNEPM) in Algeria, it is necessary to verify the stationarity of the data and their cointegration. However, prior to that, it is essential to address any outliers in the time series data, if present, They can be detected in the data series through a Box-plot representation, and using the EViews 10 software, we obtain the following figure:"

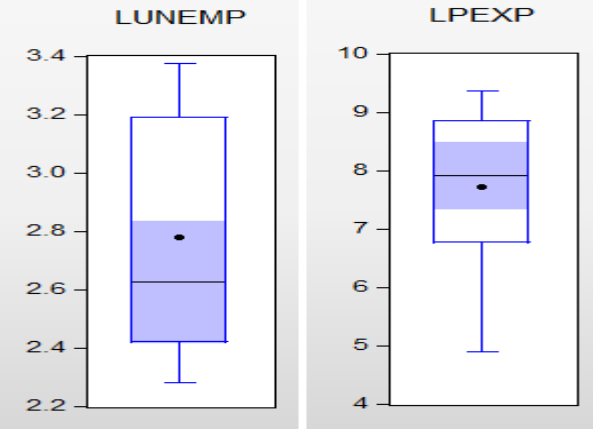

Figure N(03): Box Plots for LUNEPM and LPEXP
Source: Prepared by the researchers, based on EViews10 output.

From the above figure, we observe that both the public expenditure series and the unemployment rate series are free from outliers during the study years.

Second: Testing the stationarity of the study variables

To avoid the problem of spurious regression, the stationarity of the time series is examined and their order of integration is determined through Unit Root Tests (Isabelle & et al, 2004, p. 319).

The Augmented Dickey-Fuller (ADF) test will be used, which includes three different models, based on the following hypotheses (Byrne & Perman, 2007):

- **Null hypothesis (H_0):** The series has a unit root (i.e., it is non-stationary).
- **Alternative hypothesis (H_1):** The series does not have a unit root (i.e., it is stationary).

The results are presented in Table (01): Results of the Augmented Dickey-Fuller Test.

Table N(01): Results of the Augmented Dickey-Fuller Test

UNIT ROOT TEST TABLE **(ADF)**			
At Level			
		LUNEPM	**LPEXP**
With Constant	**t-Statistic**	-0.5546	-3.8652
	Prob.	0.8674	0.0058
		n0	***
With Constant & Trend	**t-Statistic**	-1.4130	-3.0013
	Prob.	0.8383	0.1470
		n0	n0
Without Constant & Trend	**t-Statistic**	-0.9650	4.7334
	Prob.	0.2921	1.0000
		n0	n0
		d(LUNEPM)	d(PEXP)
With Constant	**t-Statistic**	-4.1112	-1.3057
	Prob.	0.0031	0.6147
		***	n0
With Constant & Trend	**t-Statistic**	-4.0391	-6.3838
	Prob.	0.0173	0.0000
		**	***

Without Constant & Trend	**t-Statistic**	-4.0596	-0.1851
	Prob.	0.0002	0.6117
		***	n0

Source: Prepared by the researchers, based on EViews10 output.

The table shows the following observations:"

- **LPEXP (Public Expenditures):** The series is stationary at level when using the model with a constant, as the p-value (0.0058) is less than 0.05. This leads to the rejection of the null hypothesis of a unit root, indicating that **LPEXP** is is stable at level I(0). LDep ∾ I(0)

- **LUNEPM (Unemployment Rate):** The series is non-stationary at level across all model specifications, as p-values are greater than 0.05. However, after first differencing, the series becomes stationary, with p-values less than 0.05 across all models. This indicates that **LUNEPM** is stationary at the first difference I(1). Ltch ∾ I(1)

Since the series are a mixture of I(0) and I(1), the most appropriate model to study the relationship is the ARDL model.

4.2.3 Applying ARDL Methodology Steps

To measure the impact of public expenditure on the unemployment rate in Algeria during the period 1990–2023 using the ARDL methodology, the following steps are followed:

4.2.3.1 Determining the Optimal Lag Length for ARDL Model Variables

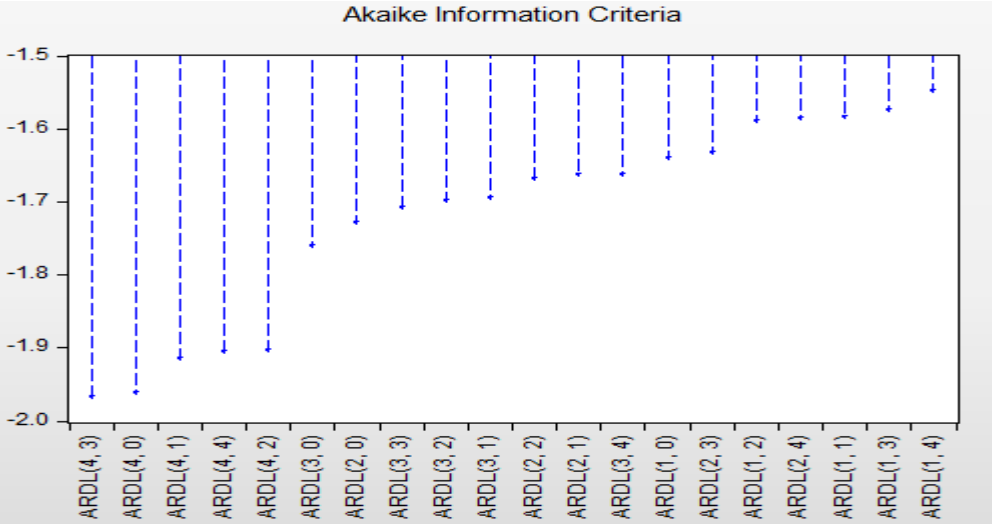

Figure N (04): Optimal Lag Lengths According to Akaike Information Criterion (AIC) for the ARDL Model

Source: Prepared by the researchers based on EViews 10 output

It is evident from the figure that the optimal lag lengths, determined according to the Akaike criterion, are **4** lags for the variable **LUNEPM** and **3** lags for the variable LPEXP. Therefore, the optimal model specification is: **ARDL (4,3).**

4.2.3.2 Testing for Cointegration Using the Bounds Testing Approach

To examine whether a long-term equilibrium relationship exists between public expenditure and unemployment rates, the ARDL bounds testing procedure is employed.

The results were as follows:

Table N(02): Bounds Test Results for the Model

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif	I(0)	I(1)
Asymptotic: n=1000				
F-statistic	5.369179	10%	3.02	3.51
K	3	5%	3.62	4.16
		2.5%	4.18	4.79
		1%	4.94	5.58
Actual Sample Size	30		Finite Sample: n=30	
		10%	3.303	3.797
		5%	4.09	4.663
		1%	6.027	6.76

Source: Researchers' compilation based on EViews 10 outputs

The calculated F-statistic of **5.369179** surpasses the upper bound critical value of 4.16 at the 5% significance level. Consequently, the null hypothesis of no cointegration is rejected, confirming the existence of a long-run equilibrium relationship between public expenditure and unemployment rates in Algeria. This finding indicates that changes in public expenditure have a significant long-term impact on unemployment levels

4.2.3.3 Estimating the Long-Run Equilibrium Relationship

Table N (03): Long-Run Coefficient Estimates of the ARDL Model

Levels Equation				
Case 2: Restricted Constant and No Trend				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LPEXP	-0.437116	0.051836	-8.432748	0.0000
C	6.374291	0.470309	13.55341	0.0000
EC = LUNEPM - (-0.4371*LPEXP + 6.3743)				

Source: Prepared by the researchers based on the outputs of Eviews10 software.

From The table above,, the nature of the relationship can be identified. as the results indicate that the coefficient of public expenditure (LPEXP) is statistically significant at the 5% level. This implies that a 1% annual increase in public expenditure leads to a 0.437116% decrease in the unemployment rate. In other words, the volume of public expenditures by the Algerian government contributes to reducing unemployment in the long run. This finding aligns with economic theory and previous studies, suggesting that increased public expenditure can stimulate economic activity and job creation over time.

4.2.3.4 Estimating the Short-Run Relationship and the Error Correction Model (ECM)

After estimating the long-run relationship, the short-run relationship is estimated along with the error correction term, where the results were as follows:

Table N (04): Estimation of the Error Correction Model and the Short-Run Relationship of the Model

ARDL Error Correction Regression				
Dependent Variable: D(LUNEPM)				
Selected Model: ARDL(4,3)				
Case 2: Restricted Constant and No Trend				
Date: 09/26/24 Time: 18:03				
Sample: 1990 2023				
Included observations: 30				
ECM Regression				
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LUNEPM (-1))	0.190140	0.150430	1.263981	0.2201
D(LUNEPM (-2))	0.281078	0.153790	1.827676	0.0818
D(LUNEPM (-3))	0.454666	0.150188	3.027317	0.0064
D(LPEXP)	-0.171603	0.122036	-1.406167	0.1743
D(LPEXP (-1))	-0.125409	0.126457	-0.991708	0.3326
D(LPEXP(-2))	-0.317995	0.134932	-2.356700	0.0282
CointEq(-1)*	-0.406012	0.096665	-4.200189	0.0004
R-squared	0.561446	Mean dependent var		-0.023906
Adjusted R-squared	0.447040	S.D. dependent var		0.102939
S.E. of regression	0.076547	Akaike info criterion		-2.100859
Sum squared resid	0.134767	Schwarz criterion		-1.773913
Log likelihood	38.51289	Hannan-Quinn criter.		-1.996267
Durbin-Watson stat	2.061992			

* p-value incompatible with t-Bounds distribution.

Source: Prepared by the researchers based on the outputs of Eviews10 software.

The results indicate that approximately 56.14% of the changes in the unemployment rate can be explained by the short-run dynamics of public expenditure and its lagged values, while around 43.86% are attributed to other variables not included in the model. Additionally, the Fisher statistic shows that the model is statistically acceptable overall.

The negative and statistically significant coefficient of the error correction term (CointEq(-1)), which has a value of -0.406012 at the 5% significance level, indicates the existence of a stable long-term equilibrium relationship. About 40.6% of the disequilibrium is corrected each period, suggesting that the system returns to equilibrium within approximately two years and five months.

These findings reflect a short-term inverse relationship between public expenditure and unemployment in Algeria, consistent with economic theories and previous studies that emphasize the role of increased public expenditure in stimulating economic activity and job creation, thereby supporting long-term economic stability.

4.2.3.5 Diagnostic Testing

To ensure the quality of the model used in the analysis and verify that it is free from econometric problems, a series of diagnostic tests were conducted, including the following:

A- Test for the Absence of Autocorrelation (Serial Correlation)

To examine the hypothesis of no autocorrelation among the residuals, the **Breusch-Godfrey Serial Correlation LM Test** was applied. The results of the test are presented in the following table:

Table N(05): Result of the Breusch-Godfrey Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.823165	Prob. F(2,19)	0.4541
Obs*R-squared	2.392188	Prob. Chi-Square(2)	0.3024

Source: Prepared by the researchers based on the outputs of Eviews 10 software.

It is observed that the F-statistic value is 0.823165 with a probability of 45.41%, which is higher than the 5% significance level. This indicates that the null hypothesis is accepted, and therefore, there is no evidence of serial autocorrelation in the residuals.

B- Heteroskedasticity Test

To verify the presence of homoscedasticity in the residuals, the Breusch-Pagan-Godfrey Test was employed. The results of this test are presented in the following table:

Table N(06): Result of the Heteroskedasticity Test: Breusch-Pagan-Godfrey

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	0.584206	Prob. F(8,21)	0.7796
Obs*R-squared	5.461221	Prob. Chi-Square(8)	0.7073
Scaled explained SS	2.185045	Prob. Chi-Square(8)	0.9748

Source: Prepared by the researchers based on the outputs of Eviews10 software.

The F-statistic value reached 0.584206 with a probability of 77.96%, which is higher than the 5% significance level. This indicates that the null hypothesis is accepted, confirming the presence of homoscedasticity or constant variance in the residuals.

C- Test of the Normality Assumption of Random Errors

The "Jarque-Bera" test is used to verify whether the residuals follow a normal distribution. The following figure presents the results of this test:

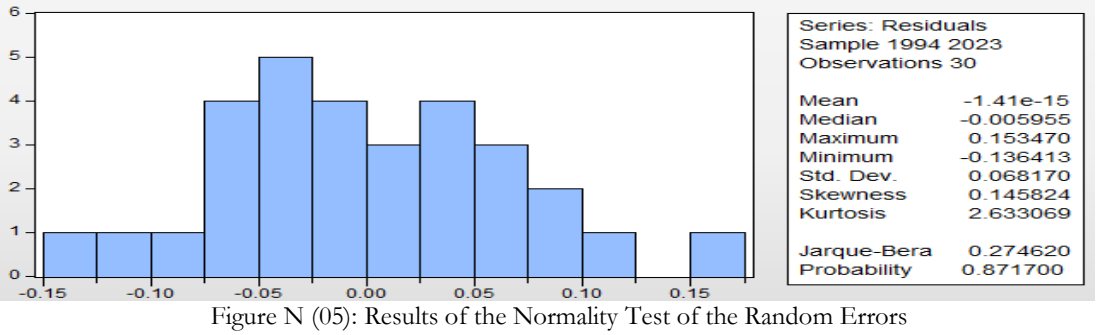

Figure N (05): Results of the Normality Test of the Random Errors

Source: Prepared by the researchers based on the outputs of Eviews10 software.

From Figure (5), it is observed that the value of the Jarque-Bera statistic is J-B = 0.27462 with a probability of 87.17%, which is higher than the 5% significance level. This indicates that the null hypothesis is accepted, and thus, the residuals of the estimated model follow a normal distribution.

D- Structural Stability Testing Phase:

To verify the absence of structural changes in the data used throughout the study period, two key tests were applied: the **Cumulative Sum of Residuals (CUSUM Test)** and the **Cumulative Sum**

of Squares of Residuals (CUSUM of Squares Test). The results of these tests are presented in the following figure:

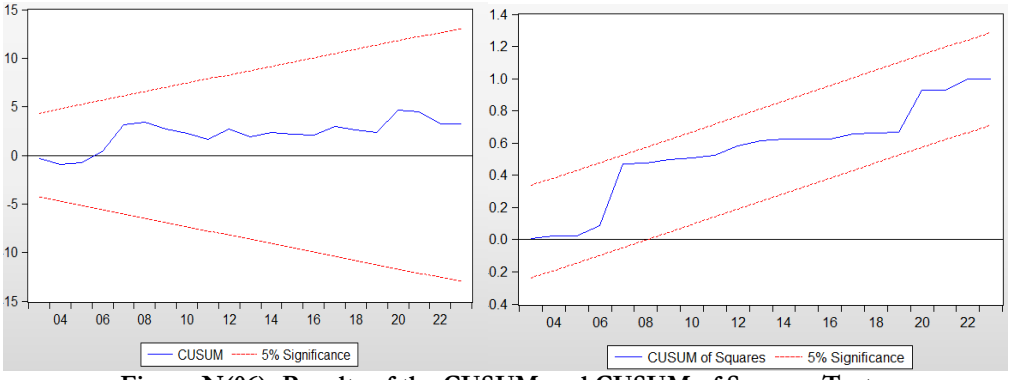

Figure N(06): Results of the CUSUM and CUSUM of Squares Tests.
Source: Prepared by the researchers based on the outputs of Eviews10 software.

According to Figure 9, both the CUSUM and CUSUM of Squares plots lie within the critical bounds at the 5% significance level, indicating no structural changes in the data over the study period. This confirms the stability of the model and the consistency between short- and long-run error correction results, implying that the estimated coefficients of the ARDL model are structurally stable and remain constant over time.

4.2.4 Analysis of the Empirical Study Results

The study relied on the Autoregressive Distributed Lag (ARDL) model to analyze the relationship between public expenditure and the unemployment rate in Algeria during the period (1990–2023). The analysis of the results was conducted according to the following methodological steps:

- The results of the unit root test for the time series of the variables under study showed that the public expenditure series (LPEXP) is stationary at level, while the unemployment rate series (LUNEPM) is stationary at first difference. This means that the variables are integrated of order one, and thus, the Autoregressive Distributed Lag (ARDL) model can be used for the analysis in Algeria during the study period from 1990 to 2023.
- The results of the cointegration test revealed the existence of a long-term equilibrium relationship between public expenditure and the unemployment rate. The following coefficients were observed:
  - ✓ public expenditure (LPEXP) is statistically significant at the 5% significance level (prob = 0.00 < 0.05) and is negatively associated with the unemployment rate in the long run. It was found that a 1% annual increase in public expenditure leads to a 4.371160% decrease in the unemployment rate. This result indicates that public expenditure contributes to job creation and plays an active role in supporting employment sustainability, especially when directed toward productive sectors that stimulate economic activity. These findings are consistent with Keynesian theory, which emphasizes that public expenditurestimulates growth through the Keynesian multiplier effect.
  - ✓ As for the constant term (C), the results showed that it is statistically significant with a positive sign, indicating that other economic variables taken into account have a positive impact on the unemployment rate in the long term.
- When estimating the Error Correction Model (ECM) and analyzing the short-term relationship, the results showed that some lagged public expenditurevariables have a significant impact on the unemployment rate, as follows:
  - ✓ The volume of public expenditure at the beginning of the period has an inverse effect on the unemployment rate. A 1% annual increase in public expenditure leads to a 0.171303% decrease

in the unemployment rate, though this effect is not statistically significant at the 5% significance level.

- ✓ The volume of public expenditure at the first lag also has an inverse effect on the unemployment rate. A 1% annual increase in public expenditure results in a 0.125409% decrease in the unemployment rate, which is also not statistically significant at the 5% significance level.
- ✓ The volume of public expenditure at the second lag shows an inverse and statistically significant effect on the unemployment rate. A 1% annual increase in public expenditure leads to a 0.317995% decrease in the unemployment rate, significant at the 5% level. This implies that the impact of public expenditure on unemployment does not manifest immediately, but rather after two periods.

These results allow us to conclude that there is a dynamic relationship between the two variables in the short term, and they highlight the delayed response of unemployment to public expenditure.

- ➢ The error correction coefficient reflects the speed at which the system returns to equilibrium after a shock. In this model, the error correction coefficient was -0.40610, which is negative and statistically significant (prob = 0.00 < 0.05). This indicates the presence of a cointegration relationship between the variables. This value means that approximately 40.61% of the disequilibrium is corrected in each period. Consequently, the model would require about two years and five months (1 / 0.40610) to return to equilibrium after a shock resulting from a change in one of the included variables.
- ➢ The study results showed that the overall explanatory power of the model, measured by the Adjusted R^2, exceeded 56%. This indicates that the model has a moderate explanatory ability regarding changes in the unemployment rate. Moreover, the model's diagnostic tests (serial correlation test, heteroskedasticity test, and normality test of the residuals) confirmed that the model is free from common econometric problems such as autocorrelation, heteroskedasticity, and non-normal distribution of residuals. This enhances the reliability of the estimated results and supports the validity of using the ARDL model in this study.

5. Conclusion:

Based on this research study, which aimed to analyze the state of public expenditure in Algeria and examine its relationship with the unemployment rate during the period from 1990 to 2023, using one of the econometric models—namely, the Autoregressive Distributed Lag (ARDL) methodology—the following conclusions were reached:

- ➢ Public Expenditure in Algeria experienced various phases during the study period, and it was found that the volume of spending was closely linked to fluctuations in global oil prices. This, in turn, influenced Algeria's overall economic activity, which directly affected employment levels and thus the unemployment rate—one of the most critical objectives for countries aiming to improve societal welfare.
- ➢ Between 2000 and 2015, Algeria adopted an expansionary fiscal policy with the aim of implementing investments that would drive growth and economic development. This was achieved through the launch of several economic programs with substantial financial allocations, which contributed to job creation and a reduction in the unemployment rate.
- ➢ In recent years, Algeria has faced severe financial crises due to a significant drop in oil prices. As a result, it shifted toward an austerity policy, which led to a sharp decline in economic activity. Therefore, Algeria needs to seek alternative sources of investment financing and support for public expenditure.
- ➢ The econometric results indicate the existence of both long- and short-term relationships between public expenditure and the unemployment rate in Algeria during the study period. Public expenditureproves effective in reducing unemployment when directed toward productive sectors that contribute to growth. These findings align with Keynesian theory, and the ARDL

model used in the study proved appropriate based on the significance of the coefficients and the stability of the model.

6. Research Recommendations:

Based on the findings of the study, the researcher proposes a set of recommendations that could contribute to enhancing the effectiveness of public spending and reducing unemployment rates, as Work on improving the efficiency of public expenditure management by setting clear priorities and reducing excessive dependence on volatile oil revenues, in order to ensure sustainable economic stability.

- The need to provide an accurate and up-to-date labor market database to allow for precise sectoral analysis and to reduce structural distortions in the labor market.
- Support and develop the private sector as the primary driver of job creation, by offering necessary incentives and facilities to encourage private investment.
- Develop mechanisms for establishing small and medium-sized enterprises (SMEs) and simplify the related procedures, given their significant role in employment and reducing unemployment.
- Support startups due to their capacity to attract labor and enhance innovation and productivity.
- Diversify exports beyond the hydrocarbons sector and activate other productive sectors, as this would positively impact development and the creation of new job opportunities.
- Improve the investment climate by removing administrative and legal barriers that hinder investment flows and by opening up opportunities for the private sector and foreign investors.

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