



Analyzing the Dynamics of the Unemployment Rate in Algeria Using Wavelet Analysis: A Study for the Period 1991-2023

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Abstract:

This study analyzes annual unemployment rate in Algeria for data (1991–2023) using the Maximal Overlap Discrete Wavelet Transform (MODWT) to decompose time series into short-, medium, and long-term components. The results show that structural factors have a greater long-term effect, while economic cycles contribute to medium-term fluctuations. Additionally, short-term random shocks have a limited impact. Based on these findings, policies should integrate structural reforms with cyclical economic measures to support labor market stability.

Keywords: Unemployment, Wavelet Analysis, Labor Market , Algerian Economy , Variance Analysis, structural reforms.

Jel Classification Codes: C14; E24; J64; O55.

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1. Introduction

The unemployment rate is one of the most important economic indicators reflecting the overall performance of an economy and its ability to sustain employment levels. It encapsulates labor market dynamics and the balance between labor supply and demand. Unemployment rates are influenced by various factors, including economic cycles that lead to rising unemployment during recessions and declines during growth periods, structural changes such as sectoral shifts and technological advancements, and unexpected economic shocks like financial crises or significant policy changes. In this context, Wavelet Analysis provides a powerful tool for examining unemployment dynamics across different time scales, allowing for the distinction between short-, medium-, and long-term fluctuations. This enables a deeper understanding of how unemployment rates respond to economic shocks and structural transformations.

Unemployment is influenced by various factors based on their time horizon. Cyclical unemployment results from economic fluctuations, increasing in downturns and decreasing in recoveries, which Wavelet Analysis can detect in medium-term components. Structural unemployment stems from long-term shifts like technological changes, highlighting the need for labor market reforms. Frictional unemployment, caused by job transitions, appears in short-term analysis with limited impact. Economic shocks, such as financial crises or pandemics, cause abrupt unemployment spikes, which Wavelet Analysis helps identify across different time scales.

Understanding the interaction between unemployment, economic cycles, and external shocks is crucial. This study explores key question: What is the behavior of unemployment rates in Algeria during the period from 1991 to 2023?

This study tests hypotheses using Wavelet Analysis to understand the behavior of unemployment rates in Algeria during the study period (1991-2023, the source of the unemployment rate data

for Algeria is the World Bank WDI, and the study period was chosen based on the availability of this data) by decomposing temporal fluctuations into short-, medium-, and long-term components. The main hypotheses are as follows:

First Hypothesis: Long-term factors dominate unemployment trends. The study assumes that long-term changes in unemployment rates reflect the impact of structural factors, such as labor market reforms and long-term economic policies, indicating that unemployment in Algeria has a structural rather than a purely cyclical nature.

Second Hypothesis: Medium-term fluctuations are linked to economic cycles. This hypothesis suggests that medium-term fluctuations in unemployment rates are associated with economic cycles and macroeconomic conditions such as economic growth, inflation, and aggregate demand, reflecting unemployment's response to changes in the real economy.

Third Hypothesis: Short-term unemployment changes result from unexpected shocks. This hypothesis posits that short-term variations in unemployment rates are caused by unforeseen shocks, such as financial crises, sudden changes in oil prices, or abrupt economic policy shifts.

Fourth Hypothesis: Wavelet Analysis improves unemployment estimation. The study assumes that using Wavelet Analysis enhances the accuracy of analyzing and estimating unemployment behavior by separating true signals from noise in the data, providing a deeper understanding of labor market dynamics compared to traditional time-series methods.

This study analyzes annual unemployment rate data (1991–2023) using the Maximal Overlap Discrete Wavelet Transform (MODWT) to decompose time series into short-, medium-, and long-term components. Wavelet Variance Analysis assesses each time scale's contribution to overall variance, while Wavelet Shrinkage removes

noise for more accurate trend estimation. Lastly, anomaly detection methods identify sharp changes in unemployment rates.

2. Literature Review

Labor productivity growth reduces unemployment by increasing potential output and lowering labor costs, creating new job opportunities. It also raises wages and boosts domestic demand, encouraging firms to expand production and hire more workers. Additionally, higher productivity enhances economic competitiveness, supporting employment across sectors. According to neoclassical theory, higher wages incentivize greater labor supply, but some workers may reduce working hours as income rises. Thus, the relationship between productivity growth and labor supply remains a subject of debate.

The rise in European unemployment is linked to slower growth, driven by increasing labor costs, especially higher labor taxes. Wage hikes due to strong unions reduce labor demand, leading to higher unemployment and lower investment. From 1965–1995, a 14-point rise in EU labor taxes contributed to a 4-point unemployment increase, a 3-point investment drop, and a 0.4-point annual growth slowdown. (Daveri & Tabellini, 2000)

European unemployment trends are shaped by two key factors: its rise since the 1960s and cross-country differences. While adverse shocks contribute to rising unemployment, they fail to explain country-specific variations. Instead, the interplay between labor market institutions and shocks is essential, as evidenced by a panel study of 20 OECD nations since 1960. (Blanchard & Wolfers, 2000)

Furthermore, Abrams found a positive long-term relationship between public spending and unemployment rates. However, many studies have indicated that higher public spending can weaken labor market efficiency (Abrams, 1999). For instance, Algan et al., in a study covering 17 OECD economies, found that creating 100 public-

sector jobs could displace 150 private-sector jobs, leading to an increase of approximately 33 unemployed individuals. (Algan, Cahuc, & Zylberberg, 2002)

Testas' article examines the causes of unemployment in Algeria, attributing its rise to reduced domestic consumption after the 1986 oil price collapse and the 1994 industrial restructuring policy. It questions the accuracy of official statistics and suggests faster economic integration with Europe as a medium- to long-term solution.. (Testas, 2004)

Over the past 35 years, Singapore's unemployment rate declined from 7.85% to 2.74% amid stable inflation. Using a union bargaining framework, the study finds that rising capital in the export sector and relative prices reduced unemployment by increasing demand wages. Singapore's open trade regime and capital growth in exports were key factors in this decline.. (Kee & Teck, 2005)

Monastiriotis' paper analyzes macroeconomic factors affecting regional unemployment in the UK, emphasizing employment flexibility. Using Keynesian and monetarist theories, it examines price stability, macroeconomic shocks, and labor market rigidities. Empirical analysis highlights how flexibility influences unemployment persistence and economic adjustments. (Monastiriotis, 2006)

A reciprocal link may exist between productivity growth and employment, as lower productivity can boost labor demand and reduce unemployment. Kangni's study (1995–2005) finds that Algeria's low productivity growth is linked to higher unemployment compared to MENA and transition economies. However, recent trade shocks have helped narrow this gap, while labor market rigidities and taxation have a lesser impact. (Kangni, 2007)

Furceri's paper analyzes unemployment and labor market trends in Algeria, highlighting low output-employment elasticity and labor

market rigidity as key obstacles to job creation. Youth unemployment is particularly affected, and simulations suggest that improving labor market conditions is crucial for reducing unemployment in the short and medium term. (Furceri, 2012)

Youth unemployment among university graduates in the Maghreb exceeds 30% in Morocco, 30.5% in Tunisia, and 22% in Algeria (officially 10% in 2014). This issue has fueled social movements, especially after the Tunisian revolution. In response, unemployed graduates have formed associations to demand change, despite government efforts to suppress activism through repression or oil-funded stability measures. (Madoui, 2015)

Jo, Kim, & Lee develop a system dynamics (SD) stock-flow model to forecast unemployment based on GDP growth, inflation, and job vacancies. Applied to South Korea (1990–2030), the model finds that boosting reemployment and reducing voluntary unemployment are more effective in lowering unemployment than job creation policies alone. (Jo , Kim, & Lee , 2023)

Hasraddin's analysis examines the relationship between economic growth and unemployment, highlighting their direct and indirect interactions. It explores theoretical and empirical evidence across countries and periods, considering factors like technology, labor market flexibility, education, and policies. The study offers valuable insights for policymakers on labor market dynamics. (Hasraddin, 2023). Gayawan et al. use a two-parameter beta geospatial model to analyze unemployment patterns (1991–2020) concerning GDP and climate factors. The study finds that rising temperatures and rainfall contribute to higher unemployment, with neighboring countries often showing similar trends. (Gayawan, Mpandiko, & Ojo, 2025)

3.The Applied Framework for Wavelet Analysis

The Maxima Overlap Discrete Wavelet Transform (MODWT) is a method for decomposing a signal into multiple levels of wavelet and scaling coefficients. Compared to the conventional Discrete Wavelet Transform (DWT), MODWT offers several advantages. Notably, it can handle data of any sample size and is translation-invariant, ensuring that a shift in the original time series leads to a corresponding shift in the transform coefficients. These features make MODWT particularly effective for time series analysis. (Quilty & Adamowski, 2018)

wavelet and scaling coefficients W_j and V_j are defined as:

$$W_{j,t} = \sum_{l=0}^{n-1} \widetilde{h}_{j,l} p_{t-1 \bmod N} \dots \dots \dots eq1$$

$$j = 1, 2, \dots \dots \dots l$$

$$V_{j,t} = \sum_{l=0}^{n-1} \widetilde{g}_{j,l} p_{t-1 \bmod N} \dots \dots \dots eq2$$

$$p = \{p_t, t = 0, 1, \dots, N - 1\}$$

Where $\widetilde{h}_{j,l}$ is the MODWT wavelet filters ($\widetilde{h}_{j,l} = \frac{h_j}{2^{j/2}}$); $\widetilde{g}_{j,l}$ the scaling filters ($\widetilde{g}_{j,l} = \frac{g_j}{2^{j/2}}$)

l the length of the filter, and j the level of decomposition.

The MODWT enables performing a multiresolution analysis (MRA), which decomposes the time series into a sum of simpler time series, Smooths S_j that captures the low-frequency dynamics, and detail D_j that capture the higher frequency characteristics. Hence, the original time series can be expressed as (Andries, Ihnatov, & Tiwari, 2015) :

$$X = \sum_{j=1}^{j-1} S_j + D_j$$

Where " j " is the number of multiresolution levels.

3.1 The continuous wavelet transform (CWT)

Wavelet methods are relatively new and powerful tools for analyzing non-linear and non-stationary economic and financial data. While rooted in Fourier analysis, they overcome its limitations by integrating information from both the time and frequency domains simultaneously. (Donoho & Johnstone, 1994) . The Continuous Wavelet Transform (CWT) is widely used for wavelet analysis and is a powerful mathematical tool for analyzing non-stationary time series in the time-frequency domain. For a time series $X(t)$, the Continuous Wavelet Transform (CWT) for a wavelet $\psi(t)$ is defined as:

$$W_{X,\psi}(\tau, s) = \int_{-\infty}^{+\infty} X(t) \frac{1}{\sqrt{|s|}} \psi^* \left(\frac{t - \tau}{s} \right) dt \dots \dots \dots eq1$$

Where (τ, s) indicate the time and the frequency domain of the wavelet respectively.

$\psi(t)$ is Morlet wavelet function, consisting of a plane wave modulated by a Gaussian:

$$\psi_0(\mu) = \pi^{-\frac{1}{4}} e^{i\omega_0\mu} e^{-\mu^2/2}$$

The Wavelet Power Spectrum (WPS) of the continuous wavelet transform is defined as:

$$WPS_x(\tau, s) = |W_x(\tau, s)|^2$$

The WPS depicts and measures the local variance of a time series at different time and scales. (Tastan & Sahin, 2020)

3.2 Wavelet squared coherence (WSC)

The wavelet squared coherence technique is a valuable tool for analyzing the co-movements between two time series across different time scales and frequency bands.

The wavelet coherence between two time series u and v is defined as:

$$R_t^2(\tau_s) = \frac{|\varepsilon(\tau_s^{-1} W_t^{uv}(\tau_s))|^2}{\varepsilon|(\tau_s^{-1} W_t^{uv}(\tau_s))| \cdot \varepsilon|(\tau_s^{-1} W_t^{uv}(\tau_s))|}$$

Where $R_t^2(\tau_s)$, is the squared wavelet coherence, its value ranges between 0 and 1, and measures the local linear correlation between two time series at a particular scale. Where:

S : is a smoothing operator defined as:

$$S(W) = S_{scale}(S_{time}(W_n(s)))$$

Where S_{scale} , represents smoothing along the wavelet scale axis, and S_{time} smoothing in time.

W_n^{uv} : the cross wavelet power, it is viewed as the local covariance of u and v , where $W_n^{uv}(s) = W_n^u W_n^v$

W_n^u, W_n^v are continuous wavelet transform of two time series $u(t)$ and $v(t)$ respectively. (Torrence & Webster, 1999)

The wavelet coherence phase difference is given by:

$$\phi_{u,v} = \tan^{-1} \frac{I W_n^{uv}}{R W_n^{uv}} \quad \phi_{u,v} \in [-\pi; \pi]$$

Where: I and R are the imaginary and real parts, respectively, of the smoothed cross wavelet power spectrum. Phase differences are indicated by arrows on the wavelet coherence plots. Right-pointing

arrows indicate that the time series are in phase, while left-pointing arrows indicate they are in anti-phase. When the arrows point vertically upward, the first time series leads the second. Conversely, downward-pointing arrows indicate that the second time series is leading. (Torrence & Compo, 1998)

4. Wavelet Analysis Application (case of Algeria)

Wavelet Analysis is an analytical technique used to examine signals or time series by decomposing them into multiple temporal levels. This type of analysis allows for the separation of short-term fluctuations from long-term trends, making it an effective tool for studying economic phenomena characterized by variations at different time scales. In the context of analyzing the unemployment rate (UNEMP), wavelet analysis enables the identification of various dynamics affecting the labor market over time. It helps distinguish between cyclical effects linked to economic expansion and contraction, structural influences resulting from long-term economic shifts, and sudden shocks that may cause abrupt labor market disruptions.

By applying wavelet analysis using the maximum overlap discrete wavelet transform (MODWT) with the Haar filter, the unemployment rate series is decomposed into different analytical levels, facilitating a better understanding of the factors contributing to unemployment fluctuations. Additionally, this approach allows for the assessment of each time-scale component's contribution to the overall variance of the unemployment rate, providing a more precise insight into how unemployment interacts with various economic variables.

4.1 Analysis Using MODWT MRA:

The analysis will be conducted using the Maximum Overlap Discrete Wavelet Transform (MODWT) within a Multi-Resolution Analysis (MRA) framework. This technique allows for the decomposition of the time series into different components

corresponding to specific frequency ranges, facilitating the extraction of various patterns within the data.

This analysis is based on a time series representing the unemployment rate (UNEMP) over the period from 1991 to 2023, with a total of 33 observations. The Haar filter, the simplest wavelet filter, was used due to its ability to detect sharp and sudden changes in the data, making it suitable for analyzing fluctuations in the unemployment rate. The maximum analysis level was set at 3 (Max Scale = 3), allowing the series to be divided into different time-scale components, thereby capturing short-, medium-, and long-term variance patterns. Wavelet analysis using MODWT MRA with the Haar filter provides a detailed breakdown of changes in the unemployment rate across multiple time scales. This technique is useful for distinguishing short-, medium-, and long-term effects, aiding in the analysis of unemployment dynamics and the formulation of appropriate policies.

4.1.1. The Unemployment Rate in Algeria Using Wavelet Analysis (Level 3):

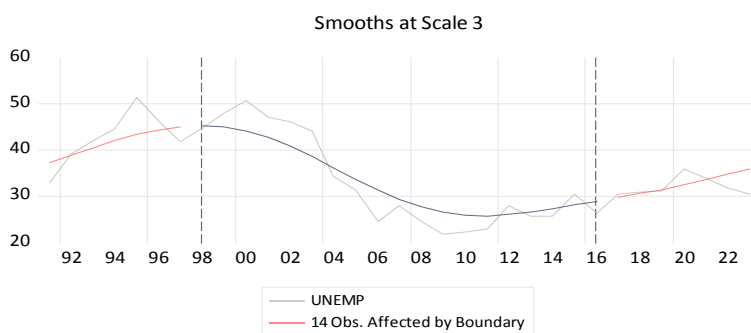
Based on wavelet analysis at the third scale, the evolution of the unemployment rate in Algeria from 1992 to 2023 can be divided into four main phases, each reflecting different economic and structural influences on the labor market. During the period from 1992 to 1998, the unemployment rate experienced a sharp increase, exceeding 50% in some years. This was due to the economic crisis triggered by the decline in oil prices, coupled with the implementation of structural adjustment programs that led to massive layoffs. Additionally, security instability negatively impacted the investment climate, further hindering job creation.

Between 1998 and 2008, Algeria's unemployment rate declined due to the oil boom, which boosted government revenues, funded development projects, and supported employment programs like

ANSEJ. Infrastructure expansion also created jobs. From 2008 to 2016, unemployment remained stable as public spending sustained employment, but limited economic diversification kept job creation reliant on the hydrocarbon sector.

From 2016, unemployment began rising due to the 2014 oil price decline, which led to cuts in public spending, including employment programs. Population growth added pressure, while economic diversification lagged. The COVID-19 pandemic (2020–2021) further worsened job losses. These findings underscore the need for sustainable strategies focused on diversification and labor market stability. (Refer to figure N°1)

Fig.1: Smooth at scale 3



Source: Outputs of the Eviews 13 program application.

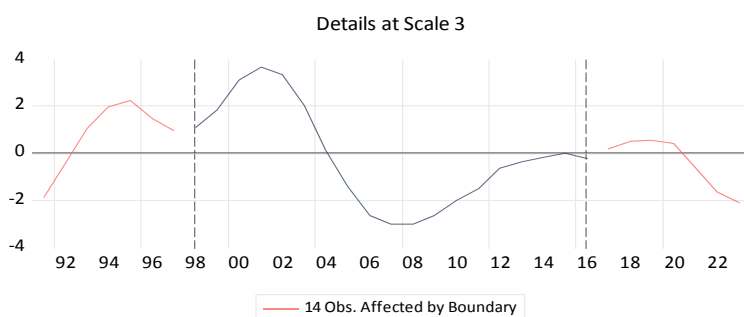
4.1.2. Analysis at the Third Scale (Details at Scale 3):

Figure N°2 highlights short- and medium-term unemployment changes after removing the overall trend, revealing economic shocks over time. Between 1992 and 1998, fluctuations increased, with temporary unemployment spikes, especially before 1998. This period coincided with economic and security instability in the 1990s, where crises drove higher unemployment rates.

Between 1998 and 2004, unemployment fluctuations intensified, with significant spikes due to structural adjustment programs and the shift towards an open economy. After 2002, these fluctuations declined, reflecting labor market improvements. From 2004 to 2010, unemployment dropped sharply, driven by rising oil prices, increased government investments, and employment support programs like ANSEJ and CNAC. Between 2010 and 2016, fluctuations remained weak, indicating labor market stability, supported by sustained government spending on major projects and social programs..

After 2016, fluctuations reappeared, with slight increases in positive values, suggesting a renewed rise in unemployment. Several factors contributed to this, most notably the collapse of oil prices in 2014 and its impact on the labor market, as well as weak job creation due to declining investments. Additionally, the COVID-19 pandemic (2020-2021) had a negative impact on the Algerian economy, further straining the labor market and contributing to rising unemployment rates during this period.

Fig.2: Details at scale 3



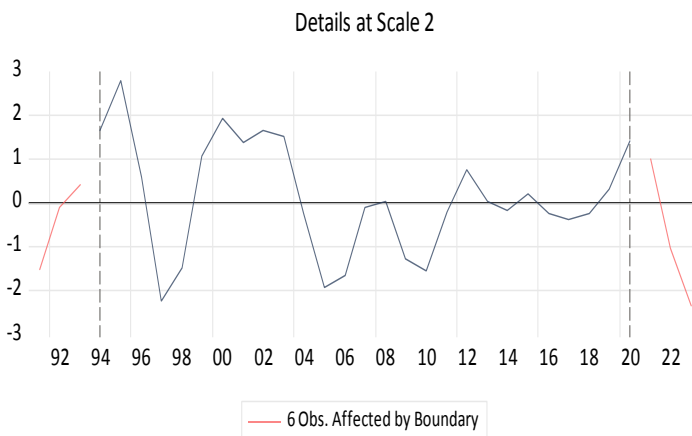
Source: Outputs of the Eviews 13 program application.

4.1.3. Analysis of Unemployment Rate Details at Scale 2:

Figure N°3 highlights short- and medium-term unemployment fluctuations, revealing economic shocks and cyclical trends. From

1992 to 1998, sharp changes were linked to Algeria's economic and political crisis, followed by slight improvement due to initial reforms. Between 1998 and 2006, privatization and restructuring caused fluctuations, while rising oil prices reduced unemployment. From 2006 to 2016, stability improved due to employment programs and high oil prices. Since 2016, sharp fluctuations reappeared, driven by declining oil prices and the COVID-19 pandemic. Scale 3 reflects long-term trends, while Scale 2 captures short- and medium-term economic shocks.

Fig.3: Details at scale 2



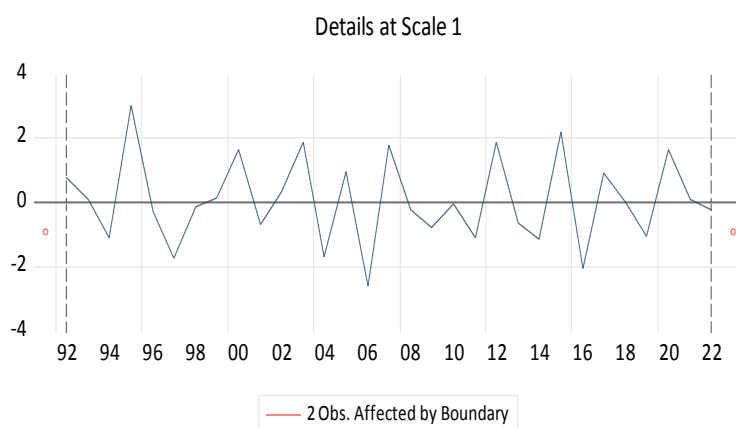
Source: Outputs of the Eviews 13 program application.

4.1.4. Analysis of Details at Scale 1:

Figure N°4 shows short-term unemployment fluctuations due to seasonal, cyclical, or sudden economic shocks. The values oscillate around zero, reflecting frequent changes influenced by seasonal employment variations and temporary economic events. Government policies, like short-term employment programs, may also cause brief but non-lasting effects.

After 2000, short-term unemployment fluctuations remained stable, indicating that policies were ineffective in addressing structural issues. The first scale captures rapid, random changes, while the second reflects medium-term economic shifts, and the third highlights long-term trends like major reforms. Analyzing the first scale helps understand volatility and improve labor market stability.

Fig.4: Details at scale 1



Source: Outputs of the Eviews 13 program application.

4.2. Wavelet Analysis of Variance:

Wavelet Analysis of Variance (WAV) uses the Maximum Overlap Discrete Wavelet Transform (MODWT) to decompose time series into different temporal components. This technique identifies the contribution of each time scale to unemployment rate fluctuations, helping to determine which factors drive changes the most.

4.2.1. Wavelet Variance Analysis:

Table 1: The wavelet variance distribution

Scale	Variance	Rel. Proport	Cum. Proport
W1	3.707609	0.1586	0.1586
W2	5.701628	0.2439	0.4025
W3	13.96582	0.5975	1.0000

Source: Outputs of the Eviews 13 program application.

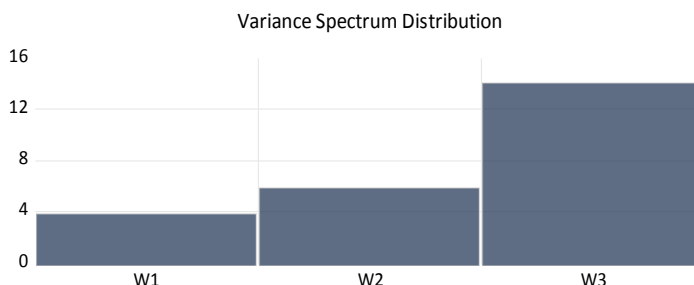
Table N°1 shows that short-term variance accounts for 15.86%, indicating a limited impact of short-term shocks on unemployment. Medium-term variance is 24.39%, highlighting the role of economic cycles, while long-term variance dominates at 59.75%, making long-term factors the main drivers. The cumulative percentage reaches 100%, fully explaining unemployment variations.

These findings have important economic implications. The dominance of long-term fluctuations in unemployment rates suggests that structural factors, such as economic and industrial shifts, have the greatest influence rather than temporary shocks alone. Additionally, the contribution of medium-term fluctuations highlights the impact of economic cycles, financial crises, and short-term government policies. Meanwhile, the limited effect of rapid fluctuations indicates that unemployment is not highly sensitive to random shocks but is mainly influenced by broader economic trends.

4.2.2. Analysis of Variance Spectrum Distribution:

The Analysis of Variance Spectrum Distribution examines how variance is spread across time scales, revealing the contribution of each to unemployment fluctuations. Most variance is concentrated in long-term scales, emphasizing the role of structural and economic trends, while short-term changes have a limited impact. This insight is essential for developing effective policies that address the main drivers of labor market dynamics.

Fig.5: Variance Spectrum Distribution



Source: Outputs of the Eviews 13 program application.

The figure N°5 illustrates the distribution of variance across three analytical levels using wavelets, providing insight into how each time scale contributes to unemployment rate fluctuations. The results indicate that short-term fluctuations have low variance, suggesting that random shocks and rapid changes do not significantly impact unemployment. In contrast, variance increases at the medium-term level, reflecting the influence of short economic cycles such as financial crises. At the long-term level, variance reaches its highest value, confirming that structural factors and major economic trends are the primary drivers of unemployment changes.

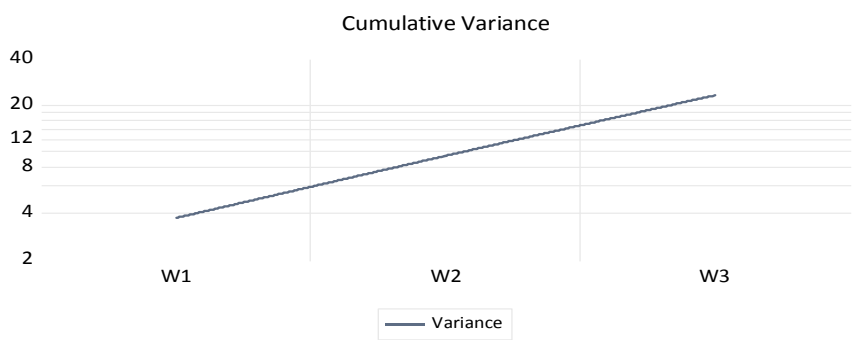
The analysis highlights that unemployment rates are mainly affected by long-term factors rather than random or momentary fluctuations. Medium-term variations capture the effects of cyclical economic crises, while short-term fluctuations remain limited in impact. This suggests that unemployment is not highly sensitive to rapid changes but rather follows deeper economic patterns that require long-term policies for effective management.

4.2.3. Cumulative Variance Analysis:

The cumulative variance analysis illustrates the contribution of different time scales to fluctuations in unemployment rates. The x-axis represents short-, medium-, and long-term variance levels, while the

y-axis shows the cumulative variance, which increases as we move toward longer time scales.

Fig.6: Variance Spectrum Distribution



Source: Outputs of the Eviews 13 program application.

Results in figure N°6 indicate that short-term fluctuations have a minimal impact, while medium-term changes reflect the influence of economic cycles. The highest variance is observed at the long-term level, confirming that structural factors and long-term trends play the most significant role in unemployment dynamics.

Given that most variance comes from long-term changes, economic policies should focus on sustainable solutions such as economic diversification, improving education and vocational training, and encouraging stable investments to reduce economic fluctuations. However, short- and medium-term measures remain essential during economic crises or transitional periods to ensure labor market stability.

4.3. Outlier Detection Analysis:

The Bilen-Huzurbazar method relies on wavelet analysis to detect outliers in time series data, helping to identify periods of sudden or abnormal changes. Through this technique, unexpected economic disruptions such as financial crises, sharp shifts in

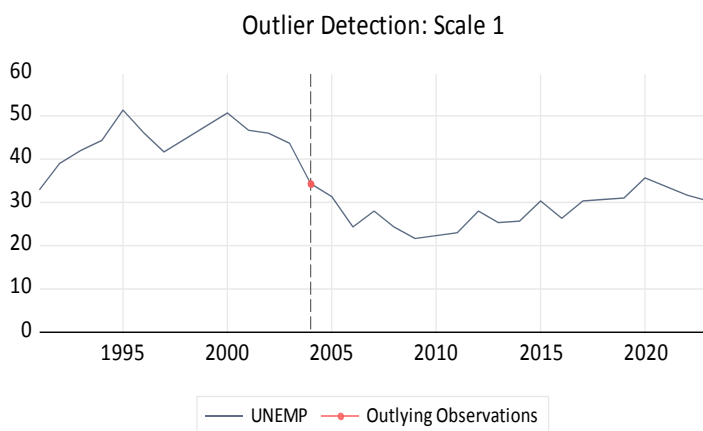
employment policies, or external shocks like fluctuations in oil prices can be detected.

What sets this method apart is its ability to isolate outliers at different levels of analysis, allowing for a more precise understanding of short- and long-term effects. This makes it an effective tool for analyzing complex economic data, as it helps pinpoint the sources of fluctuations accurately and provides deeper insights into market and labor stability.

4.3.1. Outlier Detection Analysis - Scale 1:

Outliers in unemployment data indicate sudden changes, with a sharp decline after 2004 marking a key labor market shift. This was driven by economic reforms, employment programs like ANSEJ, and rising oil prices (2003–2008), which boosted investment and job creation. Wavelet analysis helped detect these outliers, offering deeper insights into unemployment trends. Expanding the analysis can further distinguish between short- and long-term influencing factors. (Refer to figure N°7)

Fig.7: Outlier Detection: Scale 1



Source: Outputs of the Eviews 13 program application.

4.3.2. Outlier Analysis at Scale 2:

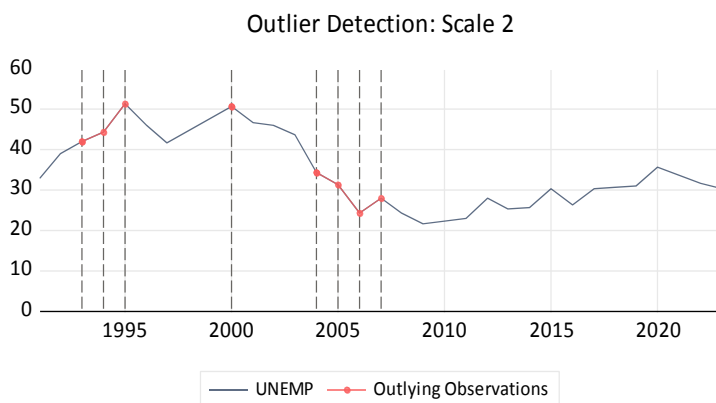
The analysis reveals significant outliers in different periods, indicating major shifts in unemployment trends. Between 1994 and 1995, unemployment peaked, likely due to Algeria's economic crisis in the 1990s. The structural adjustment program implemented in 1994 led to the restructuring of public enterprises and mass layoffs, contributing to the sharp rise in joblessness.

Between 2000 and 2001, another outlier appears, marking a renewed increase in unemployment. Despite initial signs of economic recovery, the labor market struggled to absorb the growing number of unemployed individuals. The continued reliance on oil as the primary source of revenue, without sufficient economic diversification, further exacerbated the situation.

A significant downward shift in unemployment is observed between 2004 and 2005, indicating a sudden improvement. This change can be attributed to economic reforms and employment support programs such as ANSEJ and CNAC. Additionally, the rise in oil prices during this period increased government investments and large-scale projects, which helped reduce unemployment.

Overall, the period from 1994 to 2001 was marked by outliers reflecting economic crises and labor market instability, whereas 2004-2005 represented a turning point with a significant decline in unemployment. The wavelet analysis effectively identified these unusual shifts, linking them to key economic events and policy changes. (Refer to figure N°8)

Fig.8: Outlier Detection: Scale 2

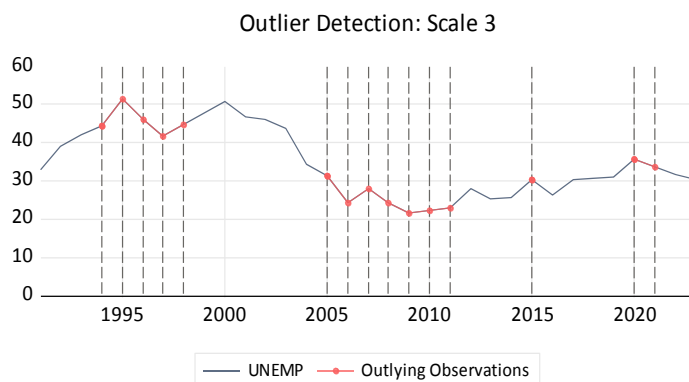


Source: Outputs of the Eviews 13 program application.

4.3.3. Outlier Analysis at Scale 3 for the Unemployment Rate in Algeria:

Outliers appear repeatedly in certain years, indicating significant fluctuations in unemployment rates. Between 1994 and 1995, there was a sharp increase in unemployment, reflecting a period of economic distress. In 2000-2001, the situation showed relative stability, though some anomalies were still present. A notable decline in unemployment occurred between 2004 and 2006, marking a shift in labor market conditions. The years 2009-2010 experienced minor fluctuations, while the period from 2018 to 2021 saw another rise in unemployment, accompanied by new outliers.

Several factors could explain these anomalies. Economic policies often play a crucial role critical periods of change may coincide with major policy reforms or shifts in government strategies. Oil prices also have a significant impact, as Algeria's heavy reliance on oil revenues makes its labor market vulnerable to price fluctuations. Additionally, global economic crises, such as the 2008 financial downturn, could have unexpected effects on unemployment, disrupting trends and creating outliers in the data.(Refer to figure N°9)

Fig.9: Outlier Detection: Scale 1

Source: Outputs of the Eviews 13 program application.

5. Conclusion:

Based on the results of this study, which analyzed the behavior of the unemployment rate in Algeria during the period from 1991 to 2023 using Wavelet Analysis, all the hypotheses tested were confirmed as follows:

- The first hypothesis, which states that long-term factors dominate unemployment trends, was supported by the finding that long-term fluctuations account for 60% of the total variance.
- The second hypothesis, relating medium-term fluctuations to economic cycles, was confirmed by the presence of 24% of the variance in this category.
- The third hypothesis regarding the impact of temporary shocks on short-term fluctuations was also validated, as these fluctuations accounted for only 16%, indicating a limited effect.
- Finally, the fourth hypothesis, which assumes that Wavelet Analysis improves the accuracy of unemployment rate estimation, was verified through enhanced estimation accuracy using the wavelet shrinkage technique.

As for the recommendations, they can be formulated as follows:

- It is necessary to implement structural reforms to enhance education, develop skills, and encourage innovation aimed at creating sustainable job opportunities.
- Adopt flexible fiscal and monetary policies that contribute to stabilizing the macroeconomy.
- Strengthen social protection mechanisms to mitigate the effects of sudden economic shocks.
- Expand the use of Wavelet Analysis to apply it to other important economic phenomena such as inflation, economic growth, and financial markets, benefiting from its accuracy and depth in analysis.

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