

Macroeconomic impact of interest rates and exchange rates on unemployment: VAR approach

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Abstract:

This study uses a Vector Autoregression (VAR) model to examine the impact of two macroeconomic indicators, the real interest rate and the real exchange rate, on the unemployment rate in Algeria over the period from 2000 to 2023.

The results of the econometric estimation reveal a significant and positive effect of the real interest rate on the unemployment rate. Furthermore, the analysis also highlights a significant and positive impact of the real exchange rate on unemployment.

Keywords: Interest rate, exchange rate, unemployment, Algeria, Vector Autoregression (VAR) modeling.

JEL Classification Codes: E43, F31, E24, O55, C32.

1. INTRODUCTION

Unemployment is one of the most pressing economic and social challenges worldwide. No nation, regardless of its level of development, is completely immune to this structural phenomenon, which has become a central topic in economic and political debates. In Algeria, unemployment particularly affects young people, women, and higher education graduates.

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This scourge is the result of a combination of interrelated factors, including rapid demographic change, the mismatch between skills and labor market needs, the lack of decent jobs, and the lingering effects of global economic crises. Furthermore, the growing reliance on foreign labor is exacerbating the situation.

Beyond its social implications, unemployment has complex interactions with certain macroeconomic variables, notably the real interest rate and the real exchange rate. Monetary and exchange rate policy choices can influence economic activity, the cost of credit, the competitiveness of businesses, and, consequently, the level of employment. An increase in interest rates, for example, can curb investment and slow growth, while exchange rate fluctuations can affect the trade balance and labor demand in sectors exposed to international competition.

This article aims to analyze the effects of real interest rates and real exchange rates on unemployment. The central question we ask is: What is the impact of interest rates and exchange rates on the unemployment rate in Algeria during the period 2000-2023?

To address this issue, we adopted an empirical approach based on vector autoregressive (VAR) modeling. This method allows us to first determine the optimal number of lags for the model variables. It also allows us to verify the existence of a cointegration relationship between the variables studied, analyze Granger causality links between the exogenous variables (the real interest rate and the real exchange rate) and the endogenous variable (the unemployment rate), and finally to estimate the VAR model in order to assess the dynamic impact of these macroeconomic variables on unemployment in Algeria.

This study is structured as follows: in the first part, we will outline the theoretical relationships between interest rates, exchange rates, and unemployment, drawing on key macroeconomic principles. The second part will be devoted to presenting the variables selected for our study, as well as an initial descriptive analysis of these variables. In the third part, we will detail the econometric methodology adopted, the use of the VAR model, with

the aim of analyzing the effect of macroeconomic indicators on unemployment in Algeria. Finally, the fourth part will focus on the interpretation of the empirical results obtained from the model estimation, to highlight the dynamic interactions between the variables studied.

2. Theoretical relationships between interest rates, exchange rates, and unemployment

2.1 The real interest rate and unemployment

Interest rates and unemployment are two major macroeconomic indicators with complex and dynamic relationships. Understanding the interaction between these two variables is fundamental for policymakers, economists, and economic actors alike. This article aims to analyze the impact of interest rate fluctuations on the level of unemployment in an economy (Feldmann, 2013).

The link between these two variables can be understood through the monetary policy transmission mechanism. A fall in interest rates makes it easier for businesses to access credit, reducing the cost of financing their investments. This stimulation of investment can lead to an increase in production, thereby promoting job creation and helping to reduce unemployment (Paul, 2025)

2.2 The exchange rate and unemployment

The relationship between exchange rate regimes and unemployment rates remains relatively unexplored in economic literature, despite its potential importance in understanding labor market mechanisms. Few studies have examined in depth the impact of changes in exchange rate regimes on unemployment dynamics (Zahra Bakhshi, 2016).

In this context, Fränkel and Rose (2006) analyzed the effect of the real exchange rate on labor market performance in Latin American countries. Their results indicate that this relationship cannot be ignored and deserves special attention in macroeconomic analysis.

In South Africa, Nyahkuri and Nkoday (2013) examined the impact of exchange rate fluctuations on unemployment. Their study revealed a significant finding: among several macroeconomic factors (such as interest rates, economic growth, and exports), the exchange rate proved to be the most influential determinant of the unemployment rate.

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That said, the link between exchange rate movements and the labor market is neither linear nor immediate. It is often mediated by the nature of economic shocks (real or monetary), the characteristics of the exchange rate regime in place, and the flexibility of prices and wages (Marston, 1984). In general, a depreciation of the exchange rate can improve external competitiveness and support economic activity, while a rigid exchange rate regime can amplify the impact of external shocks on the labor market (Duarte, 2016).

3. Changes in macroeconomic variables in Algeria: Interest rates, exchange rates, and unemployment

3.1 Exchange rate developments (Real effective exchange rate)

The exchange rate is one of the economic and financial indicators that reflects the quality of a country's economic performance. The exchange rate is a highly sensitive economic variable (Eichengreen, 2008).

The following table shows the evolution of the exchange rate (real effective exchange rate) (%) during the period 2000-2023:

Table 1. Exchange rate trends

Year	Exchange rate
2000	75,2597917
2001	77,2150208
2002	79,6819
2003	77,394975
2004	72,06065
2005	73,2763083
2006	72,6466167
2007	69,2924
2008	64,5828
2009	72,6474167
2010	74,3859833
2011	72,9378833
2012	77,5359667
2013	79,3684
2014	80,5790167
2015	100,691433

2016	109,443067
2017	110,973017
2018	116,593792
2019	119,353558
2020	126,7768
2021	135,064058
2022	141,994975
2023	135,842933

Source: World Bank, 2025

The table above shows annual data on the real exchange rate in Algeria for the period 2000–2023. Looking at the values, we can identify three phases in the evolution of the exchange rate. However, to better illustrate and interpret this dynamic, a more detailed analysis is provided in the graph below.

Fig.1. Exchange rate trends



Source: author's name, year, page

Analysis of the evolution of the real exchange rate (RER) in Algeria over the period 2000-2023 reveals a dynamic marked by three distinct phases. During the early years (2000-2009), the RER remained relatively stable, hovering around an average of 72, reflecting a relatively balanced macroeconomic situation, supported by a strong accumulation of foreign exchange reserves and a relatively cautious exchange rate policy.

Between 2010 and 2014, slight fluctuations were observed, without any major structural changes, due to stable import prices and a gradual adjustment

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of the nominal rate. However, from 2015 onwards, the CRT showed a clear upward trend, reflecting a real depreciation of the Algerian dinar.

This deterioration is mainly due to the fall in oil prices from 2014 onwards, which reduced the country's foreign exchange earnings, as well as persistent domestic inflation. The CRT thus rose from 80.57 in 2014 to a peak of 141.99 in 2022, before settling at 135.84 in 2023.

This trend reflects the structural vulnerability of the Algerian economy to external shocks and highlights the need for exchange rate reform as part of a broader economic diversification strategy.

3.2 Interest rate trends

Real interest rates are an important macroeconomic indicator because they affect borrowing costs and return on investment (Neely, 2008).

Table 2. Interest rate trends

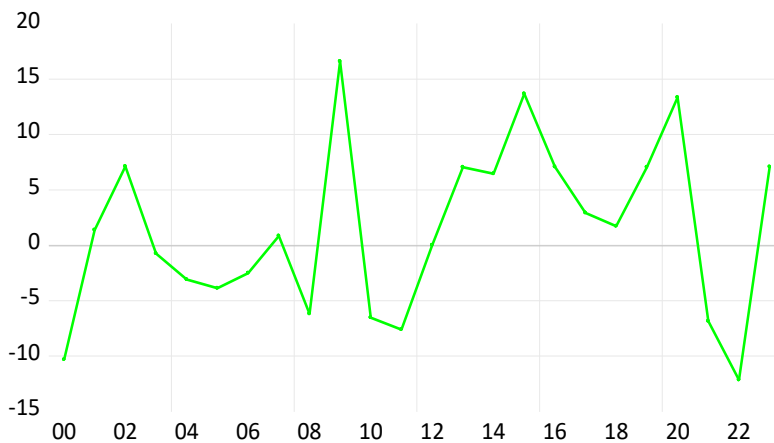
Year	Interest rate
2000	-10,334378
2001	1,37540694
2002	7,1128285
2003	-0,75036145
2004	-3,09251854
2005	-3,8817475
2006	-2,51051998
2007	0,84455844
2008	-6,18312466
2009	16,5976145
2010	-6,53956357
2011	-7,62022649
2012	-0,00226526
2013	7,04435829
2014	6,4559998
2015	13,6683506
2016	7,08263567
2017	2,91790628
2018	1,72874977

2019	7,05471455
2020	13,3398767
2021	-6,84242363
2022	-12,1603164
2023	7,08459692

Source: World Bank, 2025

The table shows the evolution of the real interest rate in Algeria between 2000 and 2023. The values show significant variability from one year to the next, reflecting an unstable economic environment. To better interpret this dynamic and highlight the most significant changes, a more detailed explanation is provided in the graph below.

Fig.2. Interest rate trends



Source: Conducted by the author, 2025

The graph highlights the instability of the real interest rate in Algeria during the period 2000–2023. There are significant fluctuations, with rates frequently falling below and rising above zero.

The years 2009, 2015, and 2020 show notable positive peaks, reflecting periods when monetary policy was likely aimed at containing inflation or stabilizing the economy.

Conversely, sharply negative rates are recorded in 2000, 2008, 2011, and especially in 2022, signaling a loss of real purchasing power for economic agents and a possible dominance of inflation over nominal rates.

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These variations illustrate the difficulty of maintaining a stable monetary policy in the face of external and internal shocks.

3.3 The evolution of the unemployment rate

The unemployment rate is a crucial economic indicator that quantifies the percentage of the labor force that is unemployed and actively seeking work (Kalinová, 2025).

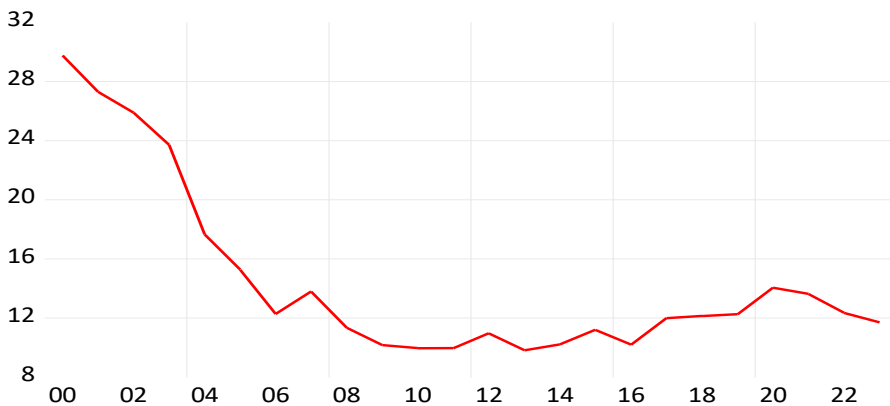
Table 3. evolution of the unemployment rate

Year	Unemployment rate
2000	29,77
2001	27,3
2002	25,9
2003	23,72
2004	17,65
2005	15,27
2006	12,27
2007	13,79
2008	11,33
2009	10,16
2010	9,96
2011	9,96
2012	10,97
2013	9,82
2014	10,207
2015	11,206
2016	10,202
2017	12
2018	12,137
2019	12,259
2020	14,057
2021	13,63
2022	12,346
2023	11,701

Source: World Bank, 2025

The table shows the annual change in the unemployment rate in Algeria over the period 2000–2023. The data reveals a general downward trend, followed by fluctuations. To better interpret these changes and highlight the main shifts, a more detailed explanation is provided in the graph below.

Fig.3. evolution of the unemployment rate



Source: Conducted by the author, 2025

The graph clearly shows a downward trend in the unemployment rate from 2000 (nearly 30%) to 2010 (around 10%), likely to reflect sustained efforts in employment policy and economic growth. From 2011 onwards, the unemployment rate stabilized at around 10–12%, with some notable increases, particularly in 2017 and 2020.

The peak in 2020 (14.06%) coincided with the economic effects of the COVID-19 pandemic. Since then, a slight decline has been observed, reaching 11.7% in 2023, without returning to the historically low levels of the early 2010s.

4. Empirical analysis of the impact of interest rates and exchange rates on unemployment in Algeria from 2000 to 2023:

This study aims to analyze the impact of interest rates and exchange rates on unemployment in Algeria over the period 2000–2023.

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4.1 The econometric method used

The econometric model used in this study aims to analyze the impact of interest rates and exchange rates on unemployment in Algeria, using an empirical approach based on the estimation of a vector autoregressive (VAR) model. To do this, three variables were selected: one dependent variable and two explanatory variables.

The dependent variable is the unemployment rate (UEMP), while the explanatory variables are the real interest rate (INT) and the real exchange rate (EXR).

The analysis is based on annual data covering the period 2000–2023, for a total of 24 observations. The data were collected mainly from the World Bank.

4.2 The model specification

The purpose of the model specification is to model the impact of interest rates and exchange rates on unemployment. Once the explanatory variables and the variable to be explained had been identified, we proceeded to formulate the initial model in mathematical form, presented as follows:

$$\text{UEMP} = F(\text{INT}, \text{EXR})$$

Where:

- UEMP: the unemployment rate
- INT: the interest rate
- EXR: the real exchange rate

Once the economic function has been specified, it must be translated into an econometric model. To this end, we use the following form:

$$\text{UEMP} = B_0 + B_1 \text{INT}_t + B_2 \text{EXR}_t + u_t$$

Where:

- t : the years 2000 to 2023.
- u_t : the error term for year t .
- B_0, B_1, B_2 : parameters (weighting coefficients) of the econometric model. These coefficients are used to assess the direction and intensity of the relationship between the CHO variable (unemployment rate) and the explanatory variables included in the model.

5. The results of the econometric analysis estimates using Vector Autoregressive modeling (VAR)

In our study, analysis of the stationarity of the time series reveals that they are not integrated to the same order: the variable (EXR) is integrated to order one, $I(1)$, while the variables (INT) and (UEMP) are integrated to order zero, $I(0)$.

This heterogeneity in the order of integration implies the absence of a Granger cointegration relationship between the variables in the model. Consequently, it is not appropriate to estimate a vector error correction model (VECM). Therefore, the approach chosen for our empirical analysis is the vector autoregressive (VAR) model.

5.1 Stationarity test

To test the stationarity of the series used in our model, we apply the Augmented Dickey-Fuller (ADF) unit root test. The results obtained are presented in the table below:

Table 4. Stationarity test result (ADF test)

	LEVEL		1ST DIFFERENCE	
	t- statistic	Prob. *	t-statistic	Prob. *
UEMP	-3.791870	0.0092		
INT	-4.546882	0.0016		
EXR	0.704629	0.9895	-3.17154	0.0264

Source: EViews 12, 2025

The results of the ADF test indicate that the variable (EXR) is non-stationary in level, with a critical probability greater than 0.05, confirming the presence of a unit root.

However, this variable becomes stationary after initial differentiation, suggesting order 1 stationarity. On the other hand, the variables (INT) and (UEMP) have critical probabilities below 0.05, which allows us to reject the null hypothesis of a unit root. They are therefore stationary in level, i.e., order 0.

5.2 Johannsen cointegration test

In our study, analysis of the stationarity of the time series reveals that they are not integrated to the same order: the variable (EXR) is integrated to order one, $I(1)$, while the variables (INT) and (UEMP) are integrated to order zero, $I(0)$.

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5.3 Determining the optimal number of delays

The following table shows the values of the two criteria after estimating the models up to an order of 2:

Table 5. Determining the optimal number of delays

VAR Lag Order Selection Criteria

Endogenous variables: UEMP D(EXR) INT

Exogenous variables: C

Date: 07/01/25 Time: 22:45

Sample: 2000 2023

Included observations: 22

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-205.4133	NA	33969.62	18.94666	19.09544	18.98171
1	-176.7687	46.87298*	5764.226*	17.16079*	17.75591*	17.30098*

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Source: EVIEWS 12, 2025

Based on the results obtained, the optimal number of lags is equal to one ($p = 1$), in line with the minimum value of the information criteria. This means that the effect of interest rates and money supply on sustainable development only becomes apparent after a delay of one year.

5.4 Vector Autoregressive (VAR) modeling:

VAR models are a commonly used statistical method for time series analysis. In our study, the UEMP, INT, and EXR series proved to be stationary, which means they can be modeled using a VAR process.

The table below, based on estimates made using EVIEWS 12 software, presents the results of the VAR (1) model, incorporating a lag:

$$\text{UEMP} = \text{B0} + \text{B1INT}_t + \text{B2EXR}_t + \text{ut}$$

Table 6. Vector Autoregressive modeling

Vector Autoregression Estimates			
Date: 07/01/25 Time: 23:17			
Sample (adjusted): 2002 2023			
Included observations: 22 after adjustments			
Standard errors in () & t-statistics in []			
	UEMP	INT	D(EXR)
UEMP(-1)	0.774657 (0.06436) [12.0359]	-0.252119 (0.35564) [-0.70891]	-0.371692 (0.24793) [-1.49921]
INT(-1)	0.040469 (0.04892) [0.82732]	0.092183 (0.27029) [0.34105]	0.281383 (0.18842) [1.49335]
D(EXR(-1))	0.001922 (0.06761) [0.02842]	-0.125875 (0.37360) [-0.33692]	-0.030412 (0.26045) [-0.11677]
C	2.355355 (1.00627) [2.34068]	5.620393 (5.56029) [1.01081]	7.473645 (3.87619) [1.92809]
R-squared	0.896188	0.030955	0.223579
Adj. R-squared	0.878887	-0.130553	0.094176
Sum sq. resids	39.10206	1193.894	580.2041
S.E. equation	1.473885	8.144165	5.677461
F-statistic	51.79706	0.191661	1.727769
Log likelihood	-37.54311	-75.14991	-67.21236
Akaike AIC	3.776646	7.195446	6.473851
Schwarz SC	3.975018	7.393818	6.672222
Mean dependent	13.20659	1.879506	2.664905
S.D. dependent	4.235137	7.659512	5.965299
Determinant resid covariance (dof adj.)	3492.119		
Determinant resid covariance	1912.663		
Log likelihood	-176.7687		
Akaike information criterion	17.16079		
Schwarz criterion	17.75591		
Number of coefficients	12		

Source: EVIEWS 12, 2025

To this end, we can write the results of our estimation in the following form:

$$\text{UEMP} = 0.77 * \text{UEMP} (-1) + 0.04 * \text{INT} (-1) + 0.0019 * \text{D} (\text{EXR} (-1))$$

R-squared 0.89

Adj. R-squared 0.87

F-statistic 51.79

5.5 Economic interpretation

The estimation of our Vector Autoregressive VAR (1) model shows that the equation is globally significant with (R²= 0.89, i.e., 89%). In addition, the VAR (1) model of the (UEMP) equation is significant because (F-statistic

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= 51.79 > F-statistic 5% of the table). Therefore, we can say that our model is globally significant.

The results of the empirical analysis, based on the VAR model, indicate a significant and positive impact of the real interest rate delayed by one year on the unemployment rate in Algeria. More specifically, a 1% increase in the real interest rate leads, with a one-year lag, to a 4% increase in the unemployment rate.

This relationship reflects the restrictive effect of monetary policy on economic activity: by increasing the cost of credit, high real interest rates curb business investment and household consumption. This contraction in aggregate demand weighs on economic growth and, ultimately, leads to a deterioration in the labor market and a rise in unemployment.

Furthermore, the results also show a significant and positive effect of the real exchange rate, delayed by one year, on the unemployment rate. In other words, a 1% increase in the real exchange rate leads, with a one-year lag, to a 0.19% increase in the unemployment rate.

This result can be interpreted as the consequence of an appreciation of the dinars, which makes domestic products less competitive for export. This loss of competitiveness leads to a decline in exports, a decrease in activity in sectors exposed to international competition, and consequently a reduction in labor demand, leading to an increase in unemployment.

5.6 Granger Causality Test

The Granger causality test identifies statistically significant causal relationships between the variables in the model. The following table shows the results of this test.

Table 7. Granger Causality Test

VAR Granger Causality/Block Exogeneity Wald Tests
Date: 07/02/25 Time: 12:05
Sample: 2000 2023
Included observations: 22

Dependent variable: UEMP

Excluded	Chi-sq	df	Prob.
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INT	0.684452	1	0.4081
D(EXR)	0.000808	1	0.9773
All	0.938838	2	0.6254

Source: EVIEWS 12, 2025

The results obtained show that the p-values associated with Wald statistics are well above the 5% significance threshold. Indeed, the probability associated with the null hypothesis of non-causality is 0.4081 for the real interest rate, 0.9773 for the real exchange rate variation, and 0.6254 for the joint test of the two variables.

These results indicate that we cannot reject the null hypothesis of Granger causality. In other words, neither the real interest rate nor the change in the real exchange rate Granger-causes the unemployment rate in the model used. This means that, from a predictive standpoint, the history of these two variables does not provide additional information that could improve unemployment forecasts.

However, this absence of causality in Granger's sense does not rule out the existence of significant dynamic or contemporary relationships between the variables, as confirmed by the VAR model results. It simply highlights that, within the tested time frame and structure, the variables studied do not have a significant unidirectional causal effect on unemployment.

6. CONCLUSION

Empirical analysis conducted using the VAR model over the period 2000-2023 has revealed significant relationships between certain macroeconomic indicators and unemployment in Algeria. The results show that both the real interest rate and the real exchange rate have a positive and significant effect on unemployment, with a one-year lag.

In concrete terms, an increase in the real interest rate leads to a slowdown in investment and consumption, which slows economic activity and worsens the employment situation. Similarly, an appreciation of the real exchange rate reduces the competitiveness of domestic exports, leading to a decline in production in sectors exposed to international competition and, consequently, an increase in unemployment.

These findings highlight the need for rigorous coordination between monetary policy and exchange rate policy in order to reduce their adverse

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effects on the labor market. In this regard, prudent interest rate management appears essential to support productive investment and promote job creation, while a consistent and flexible exchange rate policy would help preserve the country's external competitiveness and limit imbalances linked to fluctuations in the dinar.

Furthermore, diversifying the economy, which is still heavily dependent on hydrocarbons, is a strategic imperative in order to mitigate vulnerability to external shocks and stimulate demand for labor in other sectors such as industry, agriculture, and high value-added services.

In this regard, improving the investment climate and implementing structural reforms that promote entrepreneurship and access to finance are essential levers for boosting growth and reducing unemployment in a sustainable manner. In short, the implementation of integrated economic policies, combining monetary, exchange rate, and structural components, appears to be a fundamental condition for strengthening the resilience of the Algerian economy, stimulating inclusive growth, and promoting a development trajectory capable of absorbing labor and reducing unemployment in a sustainable manner.

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