

Inflation and Unemployment in Algeria: Testing the Philips Curve Hypothesis Using a VAR Model (1990–2025)

Seddiki Meriem

University of Ain Temouchent, Algeria
meriem.seddiki@univ-temouchent.edu.dz

Bouazza Abid Imene

University of Ain Temouchent, Algeria
imiabid324@yahoo.fr

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Abstract:

This study aims to analyze the relationship between inflation and unemployment rates in Algeria within the framework of the Phillips Curve over the period 1990–2025. To achieve this objective, the study employs a Vector Autoregression (VAR) model, along with stationarity tests, cointegration analysis, and impulse response functions. The empirical findings reveal the absence of a long-run equilibrium relationship between inflation and unemployment, while indicating weak and unstable short-run dynamic effects. The results also show that both variables are more strongly influenced by structural and external factors, particularly oil price fluctuations and the low flexibility of the labor market. Furthermore, diagnostic tests confirm the statistical adequacy of the model, enhancing the reliability of the findings. The study concludes that explaining the inflation–unemployment relationship in Algeria requires a broader structural and dynamic approach that takes into account the specific characteristics of the Algerian economy, rather than relying solely on the traditional interpretation of the Phillips Curve.

Keywords: Inflation, Unemployment, Phillips Curve, VAR Model, Cointegration.

Introduction:

Inflation and unemployment constitute two fundamental pillars in the analysis of macroeconomic performance, given their direct impact on economic and social stability. Reducing unemployment rates is considered a primary objective of economic policies; however, achieving this goal may involve potential costs in terms of price stability, particularly in light of the complex interactions between aggregate demand and the level of economic activity. Within this context, the relationship between inflation and unemployment has emerged as one of the central issues widely discussed in economic literature, especially within the framework of the Phillips Curve.

From a theoretical perspective, this relationship reflects the existence of a short-run trade-off between price stability and employment levels, whereby an expansion in aggregate demand may reduce unemployment at the expense of higher inflation rates. Nevertheless, this relationship is not stable, as it is influenced by several structural and institutional factors, including supply-side policies, economic agents' expectations, and external shocks, causing it to vary across economies and over time.

In the context of developing economies, particularly the Algerian economy, studying this relationship becomes increasingly important due to challenges associated with structural transformations, dependence on the hydrocarbon sector, and fluctuations in global prices. Over recent decades, the Algerian economy has experienced notable imbalances reflected in volatile inflation rates and persistently high unemployment levels, raising questions regarding the nature and stability of the relationship between these two variables.

Accordingly, this study aims to analyze the dynamic relationship between inflation and unemployment in Algeria by employing modern econometric models that allow for a better understanding of the short-run interactions between the variables and provide economic insights that may support policymakers in achieving a better balance between price stability and employment promotion.

Previous Studies:

Previous studies examining the relationship between inflation and unemployment within the framework of the Phillips Curve can generally be classified into three main strands according to their findings and methodological approaches.

First: Studies Supporting the Validity of the Phillips Curve

A number of studies confirm the existence of an inverse relationship between inflation and unemployment, whether in the short or long run. In Nigeria, the studies of (BARA, 2024) and (IDOWU OKEOWO, 2023) found evidence of a long-run equilibrium relationship between the two variables using ARDL models and cointegration analysis, while emphasizing the role of monetary policy in regulating this relationship. Similarly, the study by (ATGÜR, 2020) in Turkey confirmed the existence of a statistically significant relationship between inflation and unemployment using the Johansen cointegration test, thereby supporting the validity of the Phillips Curve in developing economies.

Second: Studies Indicating Weakness or Instability of the Relationship

In contrast, other studies concluded that the Phillips Curve is no longer stable in its traditional form. The study by (Yılmaz, 2026) in Turkey showed that the relationship between inflation and unemployment is unstable over time and appears only during specific periods, particularly when focusing on youth unemployment. Likewise, the study by (Haschka, 2024) in the United States revealed that this relationship has weakened considerably since the 1980s due to factors such as globalization and the anchoring of inflation expectations, thereby reducing the explanatory power of the traditional Phillips Curve framework.

Third: Recent Studies Emphasizing Expectations and Structural Factors

Recent literature has increasingly reinterpreted the Phillips Curve within the framework of the New Keynesian Phillips Curve, with a stronger emphasis on expectations and structural transformations. The study by (Yoshimori, 2026) in the United States demonstrated that inflation expectations and inflation persistence explain a larger share of inflation fluctuations compared to traditional recession indicators. Similarly, the study by (Crump, Eusepi, Giannoni, & Şahin, 2024) found that changes in the natural rate of unemployment following the COVID-19 pandemic play a central role in explaining inflation dynamics.

In the same context, the study by (Senci & Afful, 2025) in Slovakia showed that the strength of the inflation–unemployment relationship weakened due to institutional changes, particularly after joining the European Union and adopting the euro. Furthermore, the study by (Kruľický, Šanderová, & Dolejš, 2022) in the Czech Republic revealed that the shape of the Phillips Curve differs from its traditional form, reflecting its evolving nature over time.

Fourth: General Quantitative Studies on Explaining the Relationship

The study by (Vincent, Timothy Dantong, Dawak Velji, & Ayuba Sitdang, 2024) showed that the Phillips Curve model possesses a relatively strong explanatory power ($R^2 \approx 0.69$); however, it remains insufficient on its own, as other variables also contribute to determining inflation. This finding reinforces the idea that the relationship is multidimensional rather than purely bilateral.

Analytical Synthesis of Previous Studies

The review of the literature reveals a lack of consensus regarding the validity of the Phillips Curve:

- Some studies, particularly in developing economies, continue to support the traditional inverse relationship.
- Other studies, especially in advanced economies, indicate a flattening or weakening of the curve.
- Recent literature highlights the importance of inflation expectations and structural factors as more accurate explanatory mechanisms.

Accordingly, the Phillips Curve can no longer be considered a sufficient standalone framework; rather, it has become part of a broader model integrating expectations, economic policies, and labor market characteristics.

Research Gap

Despite the abundance of literature on the Phillips Curve, several methodological and analytical shortcomings justify the need for further research. These gaps can be summarized as follows:

1. Divergence of Results Across Economies

Empirical studies have produced significantly different findings between developed economies (such as the United States) and developing economies (such as Nigeria and Turkey), reflecting the absence of a unified framework capable of explaining the inflation–unemployment relationship across diverse economic structures.

2. Limited Explicit Integration of Inflation Expectations

Many traditional studies focused primarily on the direct relationship between inflation and unemployment while neglecting or oversimplifying the role of expectations, despite modern literature—particularly within the New Keynesian Phillips Curve framework—emphasizing their critical importance in explaining inflation dynamics.

3. Insufficient Analysis of Dynamic Shock Transmission

A considerable number of studies relied on static or semi-static models such as OLS without thoroughly examining the intertemporal transmission of shocks, which requires the use of dynamic models such as VAR and impulse response functions.

4. Neglect of Structural Labor Market Factors

Variables such as union density, youth unemployment, and the natural rate of unemployment have often been overlooked, despite their proven influence on shaping the inflation–unemployment relationship.

5. Limited Empirical Studies in Certain Economic Contexts

There remains a shortage of empirical research in Arab economies and structurally similar developing economies, creating a need for applied studies that address this gap.

Research Hypotheses

Based on the identified research gap, the study formulates the following hypotheses:

Main Hypothesis

- There is a statistically significant relationship between inflation and unemployment within the Phillips Curve framework; however, its nature may differ between the short and long run.

Sub-Hypotheses

1. Cointegration Hypothesis

- A long-run equilibrium relationship exists between inflation and unemployment, reflecting a structural linkage between the two variables.

2. Short-Run Dynamics Hypothesis

- Inflation rates respond dynamically to unemployment shocks in the short run, which can be analyzed using the VAR model and impulse response functions.

3. Expectations Hypothesis

- Inflation expectations play a pivotal role in explaining inflation behavior and may exert a stronger influence than real variables such as unemployment.

4. Structural Instability Hypothesis

- The relationship between inflation and unemployment is not stable over time but changes according to economic transformations and external shocks.

5. Structural Factors Hypothesis

- Labor market characteristics, such as structural unemployment and changes in money supply, influence the shape and strength of the Phillips Curve.

Methodological Conclusion

This study seeks to go beyond traditional approaches through:

- Combining static and dynamic analysis;
- Employing stationarity tests (ADF) and cointegration analysis;
- Using the VAR model to analyze shock transmission mechanisms;
- Incorporating expectations and structural dimensions into the interpretation of inflation dynamics.

Econometric Study:

In this section, the relationship between inflation and unemployment rates in Algeria is estimated within the framework of the Phillips Curve using annual data covering the period 1990–2025, obtained from the World Bank database.

Model Specification

The study adopts the Vector Autoregression (VAR) model to analyze the dynamic relationship between inflation and unemployment. The general form of the model is expressed as follows:

$$Y_t = A_0 + A_1 Y_{t-1} + A_2 Y_{t-2} + \dots + A_p Y_{t-p} + \varepsilon_t$$

Where:

$$Y_t = \begin{pmatrix} INF_t \\ UN_t \end{pmatrix}$$

INF_t represents the inflation rate during period t .

UN_t represents the unemployment rate during period t .

A_0 denotes the vector of constants.

A_i represents the estimated coefficient matrices.

p refers to the optimal lag length.

ε_t denotes the vector of stochastic error terms.

Since the study employs a VAR model with four lag periods, the estimated model takes the following form:

$$Y_t = A_0 + A_1 Y_{t-1} + A_2 Y_{t-2} + A_3 Y_{t-3} + A_4 Y_{t-4} + \varepsilon_t$$

1. Stationarity Analysis of the Study Variables

The first step of the econometric analysis consists of examining the stationarity of the time series variables, as unit root tests are considered among the most important methods for determining the stability of time series data. Although several unit root tests exist in the econometric literature, this study employs the Augmented Dickey–Fuller (ADF) test due to its widespread use and reliability in testing stationarity properties.

The results of the ADF test for the study variables are presented in the table below.

Table (01): Augmented Dickey–Fuller (ADF) Unit Root Test Results

Variable	Difference	Calculated Value	Critical Value at 1%	Critical Value at 5%	Critical Value at 10%
Inf	0	-1.985198	-4.243644	-3.544284	-3.204699
Inf	1	-5.812808	-4.252879	-3.548490	-3.207094
Un	0	-2.105104	-4.252879	-3.548490	-3.207094
Un	1	-4.326068	-4.252879	-3.548490	-3.207094

Source: Prepared by the researcher based on EViews 10 outputs.

The results of the Augmented Dickey–Fuller (ADF) unit root test indicate that both unemployment ((UN)) and inflation ((INF)) are non-stationary at level form. However, they become stationary after taking the first difference, implying that both variables are integrated of order one, (I(1)), at the 1%, 5%, and 10% significance levels.

2. Johansen Cointegration Test

After verifying that the study variables are integrated of the same order (I(1)), the next step is to examine the existence of a long-run equilibrium relationship between inflation and unemployment using the Johansen Cointegration Test. This test is considered one of the most widely used approaches for detecting cointegration relationships within the framework of multivariate time series models, particularly the VAR model.

The Johansen methodology relies on two statistical tests, namely the Trace Test and the Maximum Eigenvalue Test, in order to determine the number of cointegrating vectors between the variables. The decision is based on comparing the calculated statistics with the corresponding critical values at different significance levels.

The results of the Johansen cointegration test are presented in the following table.

Table (02): Johansen Cointegration Test

Hypothesized No. Of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.273437	12.80572	15.49471	0.1221
At most 1	0.055603	1.945085	3.841466	0.1631
Hypothesized No. Of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.273437	10.86063	14.26460	0.1613
At most 1	0.055603	1.945085	3.841466	0.1631

Source: Prepared by the researchers based on EViews 10 outputs.

The results of the Johansen Cointegration Test, using both the Trace Statistic and the Maximum Eigenvalue Statistic, reveal the absence of a cointegration relationship between unemployment and inflation at the 5% significance level. This indicates that no long-run equilibrium relationship exists between the two variables.

Accordingly, since the time series are integrated of order one, (I(1)), the Vector Autoregression (VAR) model in first differences was adopted to analyze the short-run dynamic relationship between the variables. It should be noted that this specification does not allow for the analysis of long-run relationships.

3. Lag Length Selection

Before estimating the Vector Autoregression (VAR) model equation, it is necessary to determine the number of lag lengths for this model, as shown in the table below.

Table (03): Lag Length Selection

Lag	Logo	LR	FPE	AIC	SC	HQ
0	-213.4590	NA	2417.469	13.46619	13.55780	13.49656
1	-152.3570	110.7474	68.21500	9.897314	10.17214*	9.988411
2	-150.3992	3.303826	77.81687	10.02495	10.48299	10.17678
3	-142.1751	12.85021	60.31371	9.760942	10.40220	9.973501
4	-135.5271	9.556480*	51.97924*	9.595443*	10.41992	9.868733*

Source: Prepared by the researcher based on EViews 10 outputs.

The optimal lag length in the VAR model was determined using several statistical criteria, namely the Akaike Information Criterion (AIC), the Schwarz Criterion (SC), the Hannan-Quinn Criterion (HQ), in addition to the Final Prediction Error (FPE) and the Likelihood Ratio (LR) test. The results showed that most criteria (AIC, HQ, FPE, LR) indicate the selection of four lag periods, while the Schwarz criterion suggests a single lag. Based on the majority-rule criterion, a VAR model with four lags, VAR(4), was adopted.

5. Estimation of the VAR Model

After determining the optimal lag length, which is equal to 4, the autoregressive vector model is estimated accordingly. The estimation results are presented in the following table.

Table (04): Estimation Results of the VAR Model

	INF	UN
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INF(-1)	0.776654 (0.18961) [4.09600]	-0.047714 (0.08158) [-0.58488]
INF(-2)	-0.171457 (0.21337) [-0.80356]	-0.154390 (0.09180) [-1.68180]
INF(-3)	0.473149 (0.22191) [2.13220]	0.206405 (0.09547) [2.16193]
INF(-4)	-0.447766 (0.18697) [-2.39486]	0.091177 (0.08044) [1.13346]
UN(-1)	1.018758 (0.44731) [2.27751]	0.933621 (0.19245) [4.85122]
UN(-2)	-0.936046 (0.61312) [-1.52669]	0.126210 (0.26379) [0.47845]
UN(-3)	-0.168207 (0.53581) [-0.31393]	-0.184271 (0.23053) [-0.79935]
UN(-4)	0.190410 (0.35545) [0.53573]	-0.058950 (0.15292) [-0.38551]
c	0.672536 (2.00236) [0.33587]	1.889212 (0.86149) [2.19295]
R-squared	0.773683	0.965129
Adj. R-squared	0.694964	0.953000
Sum sq. resids	336.0676	62.20789
S.E equation	3.822517	1.644594
F-statistic	9.828423	79.57119
Log likelihood	-83.03126	-56.04197
Akaike AIC	5.751953	4.065123
Schwarz SC	6.164192	4.477361
Mean dependent	6.350144	16.86466
S.D. dependent	6.921081	7.585920

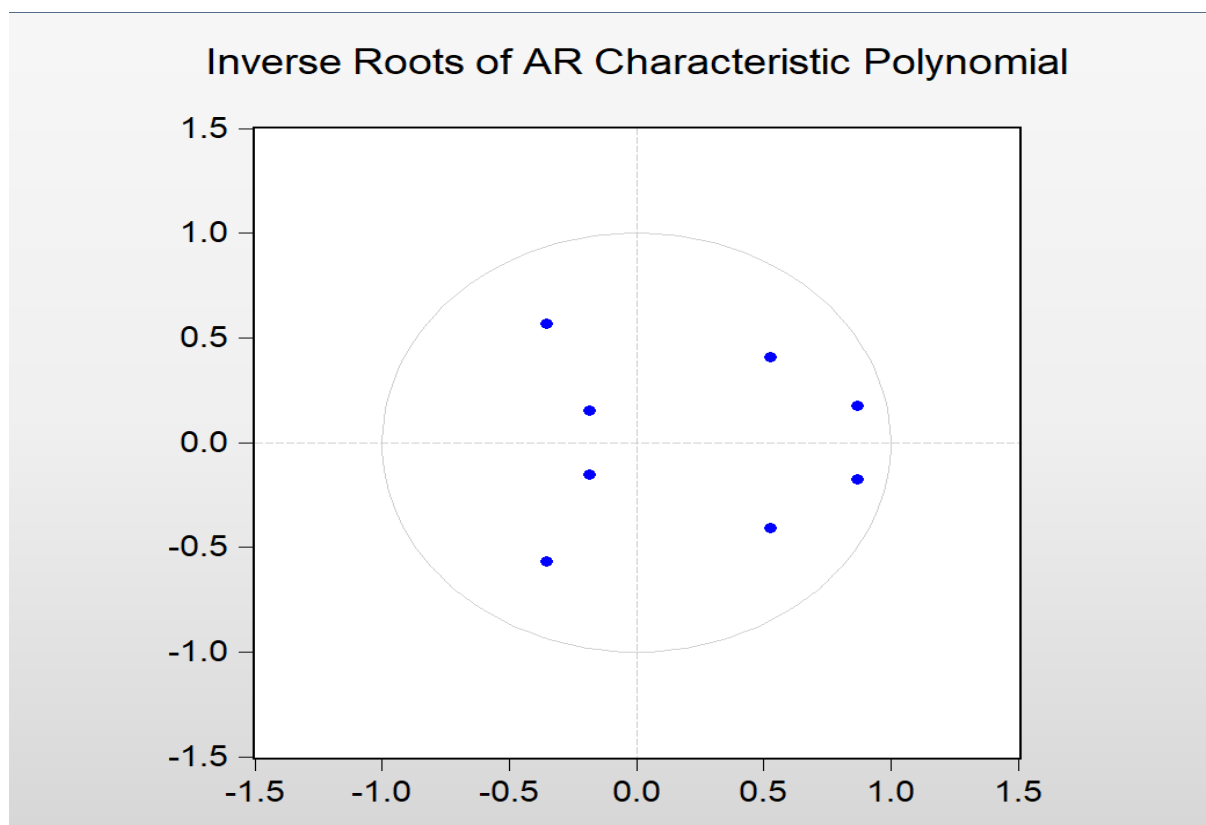
Source: Prepared by the researcher based on EViews 10 outputs.

The study concludes that the VAR model exhibits an acceptable level of statistical explanatory power. However, the econometric results indicate the absence of a long-run relationship between unemployment and inflation, while short-run effects appear weak and unstable. Moreover, the relationship between the two variables does not conform to the traditional Phillips Curve, as no inverse relationship is observed; instead, a weak positive effect of inflation on unemployment is detected. This outcome can be attributed to the structural characteristics of the Algerian economy, which limit the validity of classical theoretical relationships between macroeconomic variables.

6. Study and Analysis of the Model Residuals:

1. Inverse Root of the Characteristic Polynomial Test for the Stability of the AR Model

Figure (01): Inverse Root of the Characteristic Polynomial Test for the Stability of the AR Model



Source: EViews 10 output.

The results of the VAR stability test, based on the inverse roots of the characteristic polynomial, indicate that all roots lie within the unit circle. This confirms that the model is dynamically stable. This implies that shocks affecting both inflation and unemployment are temporary, as their effects gradually diminish over time. Such a result reflects the existence of a short-run dynamic equilibrium in the economy.

2. Extraction of the Jarque–Bera Normality Test for Residuals:

Table (05): Jarque–Bera Normality Test of Residuals

Component	Skewness	Chi-sq	df	Prob.
1	-0.099909	0.053236	1	0.8175
2	-0.161196	0.138581	1	0.7097
Joint		0.191818	2	0.9085
Component	Kurtosis	Chi-sq	df	Prob.
1	3.590957	0.465640	1	0.4950
2	2.487240	0.350563	1	0.5538
Joint		0.816203	2	0.6649
Component	Jarque-Bera	df	Prob.	
1	0.518876	2	0.7715	
2	0.489145	2	0.7830	
Joint	1.008021	4	0.9086	

Source: Prepared by the researcher based on EViews 10 outputs.

The results of the VAR residual normality test indicate that the null hypothesis stating that the residuals follow a multivariate normal distribution cannot be rejected. Skewness tests show

that the probability values for both variables, as well as the joint test, are (0.8175, 0.7097, 0.9085), all of which exceed the 0.05 significance level, indicating no evidence of asymmetry in the residuals. Similarly, the kurtosis test results, with probability values of (0.4950, 0.5538, 0.6649), also exceed 0.05, suggesting that the distribution does not exhibit abnormal peakedness or flatness. In addition, the Jarque–Bera test confirms these findings, with probability values of (0.7715, 0.7830, 0.9086), all greater than 0.05. Accordingly, it can be concluded that the residuals follow a multivariate normal distribution, which supports the validity of the model and enhances the reliability of its econometric results.

3. Heteroskedasticity Test: Breusch–Pagan–Godfrey

Table (06): Breusch–Pagan–Godfrey Test for Heteroskedasticity

Joint Test		
Chi-sq	df	Prob.
61.11352	48	0.0969

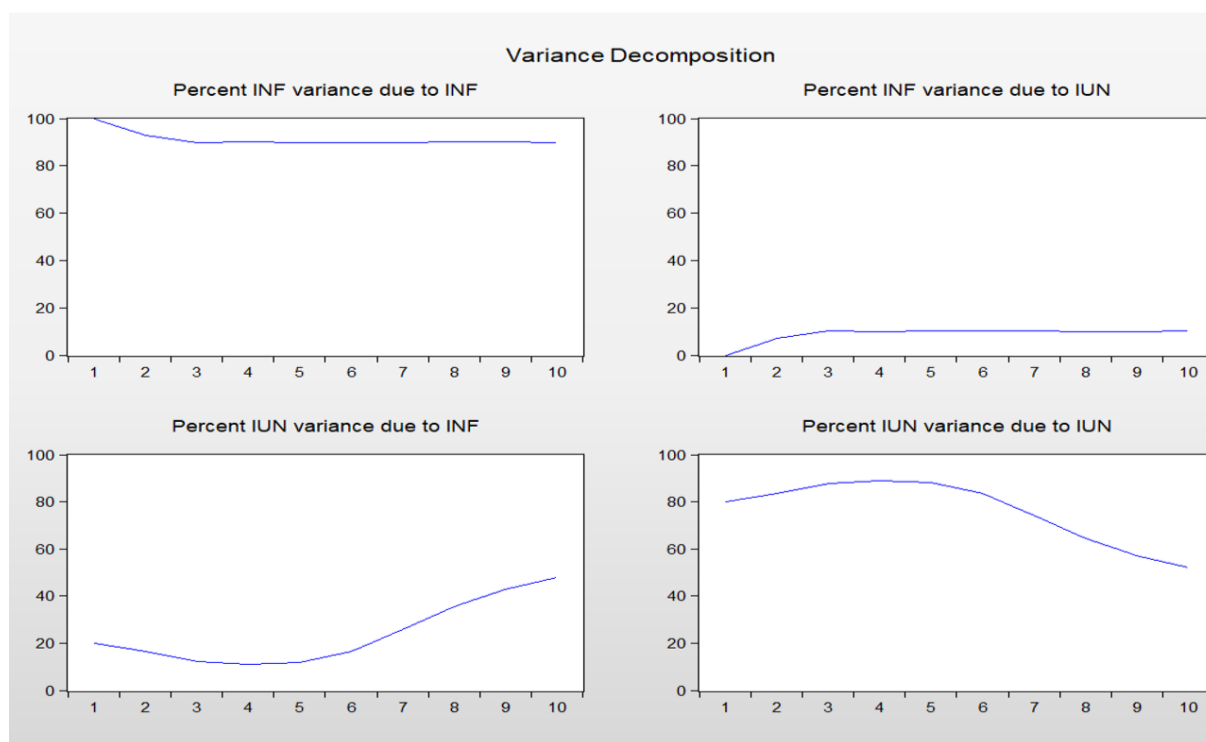
Source: Prepared by the researcher based on EViews 10 outputs.

The joint results of the heteroskedasticity test in the VAR model indicate a probability value of (0.0969), which is higher than the 0.05 significance level. This leads to the failure to reject the null hypothesis of constant error variance. Accordingly, there is no statistical evidence of heteroskedasticity in the model, implying that the residuals exhibit homoskedasticity. This confirms the adequacy of the model from this perspective and supports the reliability of its econometric results.

4. Variance Decomposition:

Variance decomposition measures the proportion of the forecast error variance of a given variable that is attributable to unexpected shocks in each variable within the model over a forecasting horizon. In other words, it quantifies the contribution of each structural shock to the future fluctuations of a specific variable. The results of the variance decomposition for unemployment and inflation over a ten-year forecast horizon are summarized in the following figure.

Figure (02): Variance Decomposition Analysis



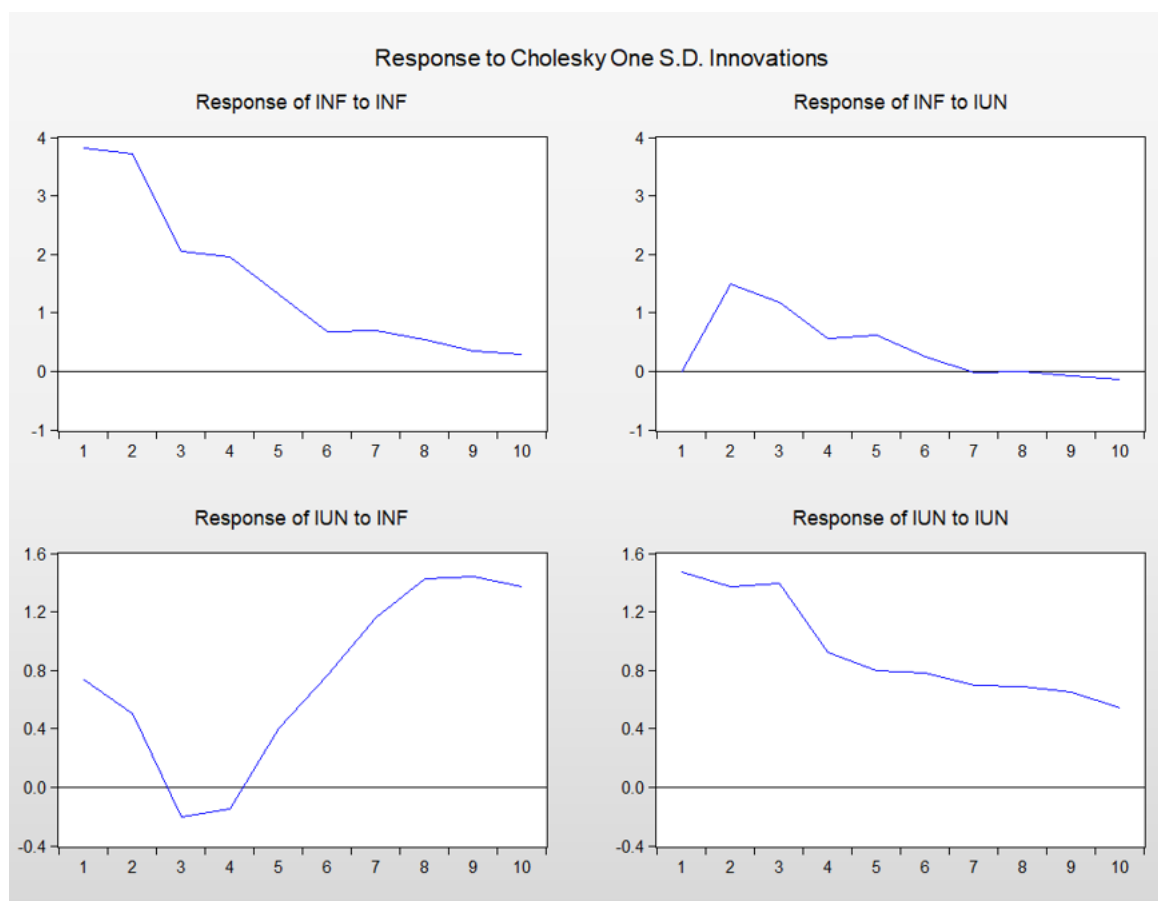
Source: EViews 10 output.

The variance decomposition results indicate the existence of an asymmetric relationship between inflation and unemployment in Algeria. Inflation remains largely self-explanatory, while its contribution to explaining fluctuations in unemployment increases in the long run. This suggests that inflation is mainly driven by structural and external factors, whereas the labor market is gradually affected by macroeconomic imbalances, particularly inflationary pressures.

5. Impulse Response Functions:

Impulse Response Functions (IRFs) are a key analytical tool in VAR models, allowing for the examination of the dynamic behavior of variables over time. They measure the effect of a one-standard-deviation shock in one variable on the current and future values of other variables, tracing the adjustment path across successive time periods.

Figure (03): Impulse Response Functions



Source: EViews 10 output.

The results of the Impulse Response Functions (IRFs) derived from the VAR model using Cholesky decomposition indicate that inflation in Algeria exhibits a high degree of short-run persistence. It responds strongly to a positive own shock in the first period, before gradually declining and converging toward stability in the medium and long run. This behavior reflects the presence of inflation inertia, which is typically associated with price rigidities and the slow transmission of economic policy effects, as well as the limited effectiveness of monetary policy channels in immediately influencing price dynamics.

Regarding the response of inflation to an unemployment shock, the results suggest a weak positive effect in the short run, followed by a gradual fading of this impact until it becomes nearly negligible in the medium term. This pattern does not clearly support the traditional inverse relationship predicted by the Phillips Curve, reflecting a weak linkage between the labor market and price levels in the Algerian economy. This can be attributed to structural characteristics such as the large informal sector, low wage flexibility, and the dominance of external factors—particularly import prices, exchange rates, and oil prices—in shaping inflation dynamics.

In contrast, unemployment's response to its own shock shows a gradually declining pattern, suggesting the presence of structural and frictional unemployment, where shocks in the labor market persist for some time before being partially absorbed through public employment mechanisms or the informal economy. Moreover, unemployment's response to an inflation

shock indicates a negative effect in the short run, followed by a gradual shift toward a positive effect in the medium term. This may reflect an indirect interaction between inflation and the labor market through channels such as purchasing power erosion and reduced real investment.

Overall, the results highlight that the relationship between inflation and unemployment in Algeria is weak and unstable, suggesting that the traditional or even the augmented Phillips Curve does not hold strongly in this context. Instead, the macroeconomic dynamics appear to be largely driven by structural and external factors, particularly oil price shocks, exchange rate fluctuations, and the rigid characteristics of the labor market.

Conclusion:

This study concludes that the relationship between inflation and unemployment in Algeria is complex and unstable, and cannot be adequately explained within the traditional framework of the Phillips Curve. The econometric results, based on unit root and cointegration tests, reveal the absence of a long-run equilibrium relationship between the two variables. Meanwhile, the Vector Autoregression (VAR) estimates indicate that short-run interactions remain weak and unstable, with a dominance of own shocks and structural disturbances in explaining the behavior of both inflation and unemployment.

Furthermore, the results from the impulse response functions and variance decomposition analysis show that the dynamics of both variables are more closely linked to structural and external factors—such as oil price volatility, low labor market flexibility, and the dominance of the informal sector—rather than to a stable direct relationship between inflation and unemployment. The diagnostic tests also confirm the robustness of the model in terms of stability, residual normality, and homoskedasticity, which strengthens the reliability of the findings.

Accordingly, the study confirms that the traditional Phillips Curve does not provide an adequate explanation for the Algerian economy. Understanding inflation and unemployment dynamics requires a broader analytical framework that accounts for structural characteristics and external economic conditions.

As for the limitations of the study, they mainly relate to the use of only two core variables without including other potentially influential factors such as exchange rates, oil prices, and government expenditure. Additional constraints include the selected time period and the reliance on linear models, which may not capture possible nonlinear relationships between the variables.

Future research directions include extending the model by incorporating additional macroeconomic variables and employing more advanced methodologies such as Structural VAR (SVAR) models or nonlinear econometric approaches. These extensions would allow for a deeper understanding of economic interactions, particularly in the context of structural changes in the Algerian economy.

Overall, this study contributes to re-evaluating the inflation–unemployment relationship in a developing economy context and highlights that effective economic policy analysis requires integrating structural and dynamic dimensions rather than relying solely on traditional approaches.

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