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Measuring and Analyzing the Interchangeable Relationship between Inflation and Unemployment in Iraq: Phillips Curve

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ABSTRACT: Inflation and unemployment are key macroeconomic variables considered by governments and policymakers. The **relationship** between these two variables is crucial for understanding a country's economic performance, as controlling and reducing both inflation and unemployment are among the primary indicators for the economic stability in the country. The main objective of this article is to identify both short- and long-term **Interchangeable Relationship** between the inflation rate and unemployment rate in Iraq using the Phillips Curve framework, with an application of the ARDL-ECM model based on secondary data from 2003 to 2023. The study's key finding is an inverse relationship between the unemployment rate and the inflation rate. However, the impact of the unemployment rate on inflation is stronger in both the short and long run than the reverse. In the short term, a one-unit increase in the unemployment rate leads to a decrease in the inflation rate by 3.8369. Conversely, a one percent increase in the inflation rate results in a decrease in the unemployment rate by 0.0017. In the long term, a one-unit increase in the unemployment rate causes the inflation rate to rise by 0.0118, whereas a one percent increase in the inflation rate leads to a decrease in the unemployment rate by 0.0019. To effectively reduce both inflation and unemployment in line with population growth, the government and relevant authorities should implement a strategic plan focused on job creation and investment promotion. Expanding the supply of goods and services can help lower prices and curb inflation, while fostering investment can generate employment opportunities, thereby reducing the unemployment rate.

Keywords: Inflation rate, Unemployment rate, Phillips Curve, ARDL – ECM.

1. INTRODUCTION

The Iraqi economy had a significant decrease in growth and development in the 1980s after great progress in the 1970s.Since then, numerous wars and invasions of various types have resulted in infrastructural disarray, anomalous inflation, and sluggish economic growth, accompanied by elevated unemployment and poverty levels. The relationship between inflation and unemployment has, over the past decade, generated intense controversy among politicians, economists, and the general public. The detrimental impacts of unemployment and inflation on economic growth have garnered the attention of governments and experts globally. A primary issue for policymakers is maintaining low and steady unemployment levels alongside reasonably stable pricing to facilitate robust economic growth. Numerous researches have examined the effects of unemployment and inflation on economic growth [1].A central theme in macroeconomic theory and policy discussions since the 1970s is the interplay between inflation and unemployment [2]. Inflation and unemployment constitute the most pressing issues in numerous countries. These variables impact different economic activities, including saving, investment, exports, poverty, and economic growth. The elevated inflation rates, for instance, will diminish the degree of social benefit. Conversely, a low level of inflation may lead to slower economic growth, increased poverty, reduced job opportunities, and, ultimately, a recession. This is because inflation encourages higher production and incentivizes investors to increase their investments. During periods increased production and investment. This growth stimulates demand for factors of production, particularly labor, resulting in lower unemployment

rates and a general reduction in poverty. The impact of unemployment rates can be illustrated by several socioeconomic variables, including decreased economic growth and increasing crime rates [3].

The correlation between inflation and unemployment has been a significant topic of discussion in macroeconomics, particularly following the work of Samuelson and Solow (1960). The authors, modifying the theoretical and empirical correlation between unemployment levels and the rate of change in nominal wages (where the former influences the latter) identified by Phillips (1958), assessed a functional relationship between unemployment and inflation in the United States. The relationship is referred to in the literature as the Phillips Curve [4].

Inflation, which represents the overall rise in price levels, serves as a broad measure of price changes. However, individual prices may fluctuate, either increasing, decreasing, or remaining stable at any given time. A sustained escalation in prices adversely impacts the economy, especially affecting the impoverished who possess minimal or no savings to mitigate the effects of rising costs. The typical individual in a household recognizes when their financial resources may acquire a diminished number of products and services compared to prior levels. Typically, economic agents (households, the private sector, and government) would express concern owing to a decrease in their actual incomes resulting from escalating prices. Uncertainty exacerbates the situation following price rises [5].

Unemployment refers to the condition in which individuals possessing the ability and willingness to work are unable to secure employment. In other terms, it constitutes the definitive exclusion of labor. Unemployment is typically classified into three categories: frictional, structural, and cyclical unemployment. The aggregate of frictional and structural unemployment rates constitutes the natural rate of unemployment. The global natural rate of unemployment is estimated to range between 3% to 5%. An unemployment rate ranging from 3% to 5% suggests that the economy does not experience an unemployment issue. Classical economics posits that every individual desiring employment at the current wage level may secure a job, rendering unemployment optional [6].

1.1. RESEARCH PROBLEM:

The research problem lies in studying the interchangeable relationship between unemployment rates and inflation rates, given the strong interconnection between them and the impact of this relationship on most economic activities, including Gross Domestic Product (GDP). It is noteworthy that an important factor within this relationship is the population size, as it represents a part of demand and will influence inflation rates if it increases at a rate higher than the supply of goods and services. Conversely, population size represents a part of supply and will affect unemployment rates if it increases at a rate higher than the increase in job opportunities. In reality, the interchangeable relationship between inflation and unemployment rates is more complex in the Iraqi economy, as Iraq suffers from numerous structural imbalances and problems that intertwine with inflation and unemployment dimensions.

1.2. RESEACH QUESTION:

- Does inflation cause an increase in unemployment rates, or does unemployment cause an increase in inflation rates?
- Does the population size strengthen the relationship between inflation and unemployment?

1.3. IMPORTANCE OF THE REAEARCH:

The importance of the research lies in analyzing the interchangeable relationship between two macroeconomic variables using the Phillips Curve, along with an attempt to apply the curve and its analyses to the Iraqi economy using an advanced econometric model to illustrate the reciprocal relationship between inflation and unemployment in both the short and long run.

1.4. RESEACH OBJECTIVE:

The objective of the research is to measure and analyze the interchangeable relationship between unemployment rates and inflation rates in the short and long run.

1.5. RESEARCH HYPOTHESIS: The research hypothesis is divided as follows:

- Null Hypothesis (H0): Inflation does not cause or lead to unemployment.
- Alternative Hypothesis (H1): Inflation causes or leads to unemployment.

2.THEOR ETICAL FRAMEWORK OF INFLATION AND UNEMPLOYMENT:

Inflation is defined as a condition in the economy where the money supply increases at a rate surpassing the production of new goods and services inside that economy [6]. Inflation is characterized as an upward movement [7] Deflation represents a decline in the average price level. Inflation may arise from an expansion of the money supply, a reduction in the demand for money, a contraction in the supply of goods and services, or a combination of these factors.

Unemployment refers to a condition wherein individuals who are capable and eager to work at the current wage rate are unable to secure employment. The International work Organization (ILO) stipulates that the work force of a country should comprise individuals aged 15 to 65 years. Unemployment can be defined as the disparity between potential full employment and the actual number of employed individuals. Unemployment is defined as the disparity between the quantity of labor available at prevailing wage rates and working conditions and the quantity of labor that remains unutilized at these levels. Unemployment is defined as a condition in which individuals wanting to work at the prevailing wage rate are unable to secure employment. National Bureau of Statistics (N.B.S.) Nigeria characterizes unemployment as the percentage of the labor force that is available for employment but did not engage in work for a minimum of thirty-nine (39) hours during the week prior to the survey period [8].

2.1. NEXUS BETWEEN UNEMPLOYMENT AND INFLATION:

Although unemployment inflicts suffering on individuals lacking income, mitigating unemployment incurs costs. In the short term, a decrease in unemployment may result in an increased inflation rate, particularly if the economy is at full capacity, where resources are nearly fully utilized. This link can be explained by two factors: one pertaining to the short-term and the other to the long-term. In the short term, an inverse link exists between unemployment and inflation (Phillips curve), although economists have noted that in the long term, unemployment and inflation are unrelated. The link has posed several challenges for regulators [9].

2.2. THE PHILIPS CURVE:

A. W. Phillips, a British economist, illustrated in 1958 the inverse relationship between the unemployment rate and the inflation rate through a graphical representation. The Phillips curve indicates that a decrease in the unemployment rate, or an increase in the employment rate, corresponds inversely with increases in the inflation rate [10]. Samuelson and Solow (1960) employed the Phillips hypothesis in their empirical analysis of the relationship between unemployment and inflation in the United States. The inverse relationship between the level of unemployment and the rate of inflation was explicitly stated [11].

The Phillips curve possesses significant theoretical relevance and carries substantial political implications. The Phillips curve continues to be a significant factor for policymakers and central banks [12]. The Phillips curve comprises several assumptions: the negative hypothesis, the natural hypothesis, and the positive hypothesis. The relationship between inflation and unemployment has evolved since the end of World War II. The initial phase involved the acceptance of the Phillips hypothesis, which posits a consistent negative relationship between unemployment levels and wage change rates [13].

Empirical macroeconomists regarding inflation and unemployment as fundamentally hard, prompting several studies in more developed nations. Suggestions emerge regarding the possibility of stabilization without incurring a recession. Additionally, several models propose that stability may be expansionary, particularly in nations experiencing excessive inflation. Nonetheless, stabilization without recession is likely unattainable [14].

3. LITERATURE REVIEW

Numerous studies have examined the correlation between inflation and unemployment, yielding diverse conclusions. Nevertheless, research utilizing the Phillips curve theory in developing nations is limited. This study seeks to address a gap and serve as a consideration for policymakers concerning inflation and unemployment policy.

Maximova [15] demonstrated the relationship between inflation and unemployment in Russia through the Phillips Curve, assessing the significance of this relationship and identifying the defining variables using data from 1999 to 2015. In conclusion, inflation and unemployment are integral components of the market economy and are regarded as significant challenges of our era. In recent years, unemployment has increased significantly, and the challenge of securing employment for the workforce remains a pressing issue. The increase in prices persists steadily. A certain level of inflation and unemployment is necessary to maintain market balance. The aforementioned statistics indicate that the Phillips curve is not applicable to the contemporary Russian context.

[16] aimed the relationship between inflation and unemployment in Ghana. The model is dynamic and expands upon the static Keynesian framework. The framework consists of three interrelated components: desired prices, price adjustments, and overall price levels. The results indicate that the estimated coefficient of inflation inertia for the periods 1970 to 1981 (1.0), 1982 to 2003 (0.97), and 1970 to 2013 (0.99) is notably high, approaching 1.0. A change in unemployment does not influence inflation in Ghana. The increase in employment does not lead to higher inflation from rising wage rates due to factors such as a large labor force and extended job search durations. This study concludes that inflation dynamics policies grounded in the Phillips curve hypothesis may be less effective in Ghana. Monetary policies aimed at influencing inflation do not create a trade-off between inflation and unemployment.

[17] This research investigates the correlation between inflation and unemployment. This study utilizes the new Keynesian curve model on annual time series data from 1991 to 2015 to examine the presence of the Phillips Curve in The Gambia. The findings indicate statistically significant variables that validate a negative relationship between inflation and unemployment. The coefficient of the output gap is significant at 1%, indicating that changes in unemployment may result in inflation moving in the opposite direction. This study recommends that the government develop a robust agricultural sector with significant potential to enhance the supply of agricultural products and other essential goods.

The study of [18] investigated the relationship between inflation and unemployment, assessing the validity of the Phillips Curve in Turkey. The data set utilized for the econometric analysis is annual and spans the period from 1988 to 2017. The study employs econometric methods, specifically ordinary least squares (OLS) estimation. The findings demonstrate a correlation between inflation and unemployment, confirming the validity of the Phillips Curve. This context reveals a mutually negative interaction between unemployment and inflation. The study demonstrated effectiveness regarding inflation, as well as the prices of export and import goods, in addition to the broad definition of the monetary growth rate and the unemployment rate. The results demonstrate a trade-off relationship between inflation and unemployment in Turkey. This indicates that unemployment is likely to decline with rising inflation or to rise with falling inflation.

[19] This study seeks to evaluate the validity of Phillips curve hypotheses and investigate potential factors contributing to inflation and unemployment in Nigeria. This study utilized secondary data from 1981 to 2020. The analysis employed Vector Autoregressive and Error Correction methods. The research indicated no causal relationship between inflation and unemployment in Nigeria. The findings indicate that Philip's hypothesis is present in Nigeria. The study concludes that inflation and unemployment issues stem from inefficiencies in monetary and fiscal policies. There is a need to enhance the efficiency of government spending. Investment stimulation is necessary through the implementation of monetary and fiscal policies, alongside the efficient allocation of private credit to optimal uses. This study recommends that the central bank and the ministry of finance take all necessary measures to elevate output levels to meet or exceed the rising domestic demand, while also implementing strategies to enhance exports and improve the competitiveness of the naira.

[20] conducted an analysis of the causal relationship between inflation and unemployment in Indonesia through a Phillips Curve framework. To achieve this objective, secondary data from 1986 to 2018 are utilized through the Granger causality method. The research concluded that no causal relationship exists, whether unidirectional or bidirectional, between inflation and unemployment. Additionally, the study found that inflation has a significant positive effect on unemployment. It is recommended that policymakers and future research examine these indicators more thoroughly by utilizing an extended dataset, incorporating additional control variables, and employing advanced research methodologies to yield more robust results than those achieved in this study.

The study conducted by [21] analyzes the causal relationship between the inflation rate and the unemployment in Iraq from 2004 to 2021, utilizing the Phillips curve framework. aiming to investigate the causes of unemployment and inflation in Iraq. The findings indicate that the low frequency of the inverse relationship between the inflation rate and the unemployment rate in Iraq suggests a relative disconnection in the effects of changes in inflation and unemployment. Specifically, a decrease in the unemployment rate by an average of 0.013% corresponds to an increase of one percentage in the inflation rate. This study recommends a genuine focus on revitalizing the real sectors, particularly the government sector, to ensure high GDP growth rates, rather than depending on imports, which may result in imported inflation. This strategy may decrease unemployment and optimize the use of the domestic labor force.

[9] This study investigated the correlation between unemployment and inflation utilizing the Phillips Curve framework, based on data from 1994 to 2021 in Nigeria. The study examines the dynamics, applicability, and limitations of the Phillips Curve relationship across various economic contexts. The model specification posits a linear relationship between unemployment and inflation. The research employs the Autoregressive Distributed Lag (ARDL) model. The study revealed a positive relationship between inflation and the unemployment rate. This contravened the prior expectation of a negative relationship between unemployment and inflation. The findings indicate that a 1% increase in unemployment will result in an 8% increase in inflation. This may result from an increase in the money supply without a corresponding rise in the production of goods and services. The study concluded that the government should enhance employment levels, as this would facilitate increased production of goods and subsequently lead to a reduction in their prices.

Current study seeks to fill gaps identified in prior research. The objective is to update the data, integrate new testing methods and indicators, and concentrate on assessing the predictive performance of model estimations.

4. METHODOLOGY AND DATA COLLECTION

To examine the interrelationship between inflation and unemployment in Iraq, the Phillips Curve analysis, along with the ARDL (Autoregressive Distributed Lag) error correction model, was applied. This analysis utilized annual data for the period 2003–2023,* focusing on the inflation, unemployment , and population .

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$$lUE_t = B_0 - B_1\ lINf_t + B_2\ lPOP_t + U_t \ldots\ldots (1)$$

$$lINf_t = B_0 - B_1\ lUE_t + B_2\ lPOP_t + U_t \ldots\ldots (2)$$

An ARDL representation of Equation (1, 2) is formulated as follows:

$$\Delta ln\ UE_t = \alpha_0 + \sum_{i=1}^{p} \alpha_1\ \Delta lnUE_{t-i} - \sum_{i=1}^{p} \alpha_2\ \Delta lnINF_{t-i} - \sum_{i=1}^{p} \alpha_3\ \Delta lnPOP_{t-i} + U_t \ldots\ldots (3)$$

$$\Delta ln\ INF_t = \alpha_0 + \sum_{i=1}^{p} \alpha_1\ \Delta lnINF_{t-i} - \sum_{i=1}^{p} \alpha_2\ \Delta lnUE_{t-i} - \sum_{i=1}^{p} \alpha_3\ \Delta lnPOP_{t-i} + U_t \ldots\ldots (4)$$

Where:

ln UEt = natural logarithm of Unemployment rate in Iraq in year t;

lnINFt = natural logarithm of INF in Iraq in year t;

lnPOPt= natural logarithm of Population in Iraq in year t;

t = time period from 2003 to 2023;

P = optimal lag length;

α0 = the drift component;

α1-α3 = Coefficients or Parameters/ long-run dynamics of the model;

Ut = Error term .

5. EMPIRICAL RESULTS AND DISCUSSION

5.1. DESCRIPTION OF THE STUDY VARIABLES

The following table shows the results of some descriptive statistic indicators of study variables:

Table 1. Results of testing some statistical indicators (Descriptive Statistics) for the data and variables included in the model

Statistic indicators	Unemployment Rate	Inflation Rate	POP
Mean	10.96	10.27	35,464,687
Median	9.26	2.80	35,481,800
Minimum	7.96	-2.80	27,068,824
Maximum	16.23	53.10	45,504,560
Jarque-Bera(Prob.)	0.4027	0.7109	0.2493

Source: Prepared by researchers based on statistical results.

The above results show that the unemployment rate during the study period is between the lowest value (7.96) and the highest value (16.23), with a mean and median (10.96 and 9.26) respectively. Moreover, the Inflation rate during the same period is between the lowest value (-2.80) and the highest value (53.10), with a mean and median (10.27 and 2.80) respectively. Furthermore, during the same period, the population ranges from the lowest value (27,068,824) to the highest value (45,504,560), with a mean of 35,464,687 and a median of 35,481,800, respectively. As for the Jarque-Bera test, the results indicate that all the variables follow a normal distribution, as their values exceed the 5% significance level after taking the logarithm.

5.2. UNIT ROOT STATIONARITY TEST

Unit root tests are important tools for assessing the stability of economic and financial variables data, due to their instability and continuous change over time. One of the most famous of these tests is the Augmented Dickey-Fuller test, which is powerful and reliable compared to other tests. This test is used in research to verify the stability of data, as shown by the analysis results in the following table:

Table 2. Results of Unit Root Test

Variables	PP: Phillips-Perron				ADF: Augmented Dickey – Fuller			
	Level) (		) First Difference(		)Level (		) First Difference(	
	Intercept	**Trend**	**Intercept**	**Trend**	**Intercept**	**Trend**	**Intercept**	**Trend**
INF	-2.8396 *)0.0545(	-3.0820)0.1134(	-9.9188 ***)0.0000(	-9.8930 ***(0.0000)	-1.7705 (0.3943)	-2.3123)0.4249(	-9.1955 ***)0.0000(	-9.1401 ***(0.0000)
UE	-0.2794)0.9245(	-1.7065)0.7456(	0.2170 ***)0.9732(	0.6298)0.9996(	0.7647)0.4933(	-1.8781)0.6627(	-10.1626 ***(0.0000)	-10.2323 ***(0.0000)
POP	0.7792)0.9935(	-6.6647 ***)0.0000(	-11.3904 ***)0.0000(	-11.5719 ***)0.0000(	0.7792) 0.9935(	-0.9299)0.9498(	-11.0654 ***)0.0000(	-11.0822 ***)0.0000(

Denoted: (* 10%, ** 5%, ***1%) level of significant.

Source: Prepared by researchers based on statistical results.

It is clear from Table (2) and through (Dickey Fuller Augmented) test that all variables are significant at (5%) in the first difference in (Intercept /Trend), that is, there is all variables are stationary.

5.3. CORRELATION MATRIX "R":

There are several ways to measure the relationships between economic variables, the simplest of which is the correlation matrix. The correlation test is the relationship between two or more measurable variables, and the main purpose of this test is two main points. The first is to determine the type of relationship between the variables, and the second is to determine the size of the relationship between the variables of the research topic. The results of this choice are explained in the following table:

Table3. Results of Correlation Test

Variables	**INF**	**UE**	**POP**
INF	1	- 0.39	- 0.59
UE	- 0.39	1	0.90
POP	- 0.59	0.90	1

Source: Prepared by researchers based on statistical results.

Table (3) indicates a negative relationship between the inflation rate and the unemployment rate while showing a strong positive relationship between population and the unemployment rate. This suggests that an increase in population does not correspond with job opportunities, leading to a higher unemployment rate. However, the relationship between population and inflation rate is not clearly defined. This may be because population growth has a dual effect: on one hand, it contributes to production, increasing supply and potentially reducing inflation; on the other hand, it also increases demand, as the population represents consumers, which could drive inflation upward.

5.4. CO-INTEGRATION ANALYSIS:

The co-integration test is used to determine the degree of integration between the variables in the research, as well as to indicate the level at which they are integrated, i.e., the significance level at which these variables exhibit integration. (Johannsen) suggests two statistics to test the joint integration hypothesis, where the first is known as the trace test, where it tests the null hypothesis that (K) is less than or equal to the number (r) against the alternative hypothesis (r = k), while the second test is (Maximum EigenValue) [22]. The results of this test are shown in the following table:

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Table 4. Results of Co-integration Analysis

Variables	Maximum Eigenvalue Statistic	Critical Value (0.05)	Prob.	Trace statistic	Critical Value (0.05)	Prob.
INF	73.6224	21.1316	0.0000***	114.3849	29.7970	0.0000***
UE	36.0158	14.2646	0.0000***	40.7624	15.4947	0.0000***
PO	4.7465	3.8414	0.0293**	4.7465	3.8414	0.0293**

Denoted: (* 10%, ** 5%, ***1%) level of significant.

Source: Prepared by researchers based on statistical results.

It is clear from the (Johansen Test) shown in Table (4) that all the variables have a co-integration relationship at the significant level (5%), and these results support the procedure for estimating the econometrics model correctly for all variables.

5.5. GRANGER CAUSALITY TEST:

The concept of causality focuses on the existence of causal relationships between the variables of the research subject, in causal relationships in which a known incident is always followed by another specific incident and this sequence of events occurs during a certain period of time and the first incident is called the cause and the second is called the effect . Many tests are used to determine causal relationships between economic variables, but (Granger Causality) is currently one of the main and reliable tests in the field of economic analysis and determining the direction of variables (One Direction or Two Direction). The results of this test are presented in Table (5).

Table 5. Results of Granger Causality Test

Null Hypothesis	F-Statistic	Prob.
UN does not Granger Cause INF	3.7756	0.0245**
INF does not Granger Cause UN	5.0021	0.0075***
POP does not Granger Cause INF	6.0068	0.0029***
POP does not Granger Cause UN	7.9687	0.000***

Denoted: (* 10%, ** 5%, ***1%) level of significant.

Source: Prepared by researchers based on statistical results.

Table (5) shows that at the (5%) significance level, there is a bidirectional causal relationship between the inflation rate and unemployment rate. Additionally, there is a unidirectional causal relationship from population to both the inflation rate and unemployment rate.

5.6. SHORT AND LONG RUN ESTIMATION:

The (Autoregressive distributed lag) (ARDL) model is the most widely used among the models because it is a dynamic model and has many advantages, including: it helps to estimate short and long effects together, and thus avoids the problems associated with deleting some variables and allows the use of dummy variables...etc. [23]. The findings of the short- and long-term impacts are as follows:

The results from the table and the Bounds test indicate the presence of long-term co-integration among the variables included in the model. The ARDL-Bounds test values of 10.2553 for the inflation model and 14.0956 for the unemployment model Greater than the critical values of 3.870 and 4.610, respectively. These results confirm the validity of long-term estimates for all variables. Moreover, The Error Correction coefficient [CointEq (-1)] is expected to be negative and significant. The values of -0.0119 and -0.0003 for both models confirm the validity of the error correction model, indicating the speed of adjustment from short-term disequilibrium to long-term equilibrium.

In the short-term, an increase in the unemployment rate by one unit leads to a decrease in the inflation rate by -3.8369. Conversely, in the second model an increase in the inflation rate by one percent decrease in the unemployment rate by -

0.0017 . Wile, in the long term, an increase in the unemployment rate by one unit leads to a rise in the inflation rate by 0.0118, possibly indicating the onset of stagflation as unemployment continues to rise. On the other hand, a one percent increase in the inflation rate leads to a decrease in the unemployment rate by -0.0019, which may be due to the inflation-driven increase in profits for firms, leading to higher employment in the long run. Finally, based on the estimated

parameters, a one percent increase in the population results in increases in both the unemployment rate and inflation rate by 1.0437 and 0.0023, respectively.

Table 6. Results of short and long run estimation using ARDL – ECM method

Inflation Rate Model				
	Value	**Significant Level**	**I(0) Lower**	**I(1) Upper**
ARDL -Bounds Test	**10.2553**	10%	2.630	3.350
		5%	**3.100**	**3.870**
		1%	4.130	5.000
Variables	**Short run**		**Long run**	
	Coefficient	Prob.	Coefficient	Prob.
Unemployment Rate	-3.8369	0.0000***	0.0118	0.0236
Coint Eq(-1)	-0.0119	0.0000***	C0	28.5029 (0.0000)***
Unemployment Rate Model				
	Value	**Significant Level**	**I(0) Lower**	**I(1) Upper**
ARDL -Bounds Test	14.0956	10%	3.380	4.020
		5%	**3.880**	**4.610**
		1%	4.99	5.850
Variables	**Short run**		**Long run**	
	Coefficient	Prob.	Coefficient	Prob.
Inflation Rate	- 0.0017	0.0550*	- 0.0019	0.0000***
CointEq(-1)	- 0.0003	0.0000***	C0	1.4558 (0.0000)***
The impact of controlling variable population				
Population	Inflation	1.0437 (0.0000)***		
Population	Unemployment	0.0023 (0.0009)***		

Denoted: (* 10%, ** 5%, ***1%) level of significant.

Source: Prepared by researchers based on statistical results.

5.7. STATISTICAL CRITERIA AND DIAGNOSTIC TESTS:

The final step in building the econometric model is the evaluation of the estimated model to ensure greater accuracy. In this context, several statistical indicators were used, including (R2, Adjusted R2, Standard Error, SSR, and AIC). Additionally, several econometric tests were conducted, including tests for (Autocorrelation, Multicollinearity, Heteroskedasticity, Identification, and Non-normal data distribution. The results of these criteria and diagnostic tests are as follows:

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Table 7. Results of Statistical Criteria and Diagnostic tests

Inflation rate model			
Statistic tests	Prob.	Econometrics tests	Prob.
R-Squared	0.9137	LM/Breusch-Godfrey test for Serial correlation	0.5460
Adjusted R^2	0.9096	Variance Inflation Factors test for Multicollinearity	(4.95 – 6.63)
F-statistic Prob.(F-statistic)	224.70 (0.0000)	ARCH test for Heteroskedasticity	0.8489
S.E. of regression	0.0798	Ramsey Reset Test for Identification	0.3664
Sum squared resid	1.2189	Jarque – Bera test for Normality	0.7885
AIC	-2.1679		
Unemployment rate model			
Statistic tests	Prob.	Econometrics tests	Prob.
R-Squared	0.9994	LM/Breusch-Godfrey test for Serial correlation	0.1073
Adjusted R^2	0.9993	Variance Inflation Factors test for Multicollinearity	(2.08 -7.17)
F-statistic Prob.(F-statistic)	6368419 (0.0000)	ARCH test for Heteroskedasticity	0.2005
S.E. of regression	0.0006	Ramsey Reset Test for Identification	0.3064
Sum squared resid	0.0000	Jarque – Bera test for Normality	0.6641
AIC	-11.8474		

Source: Prepared by researchers based on statistical results.

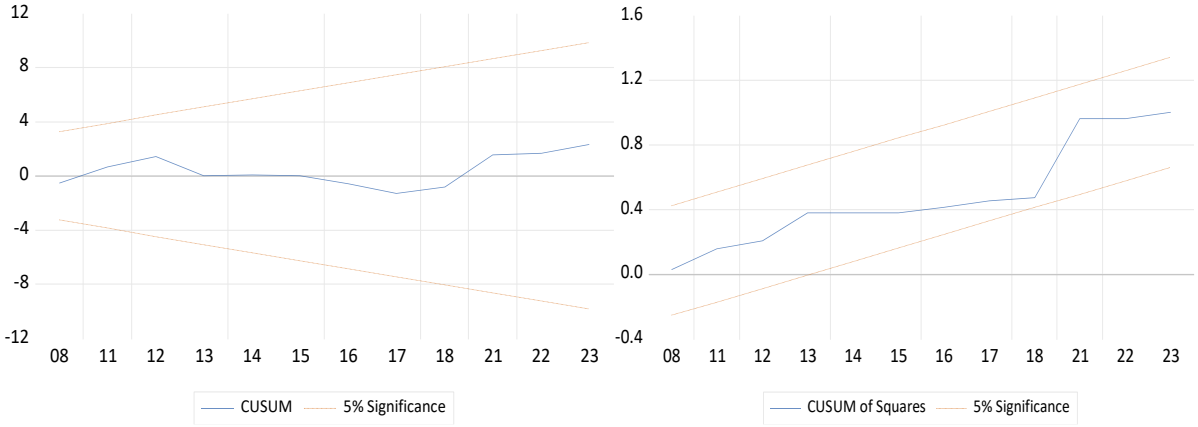
From table (7) we note that the value of (R2) and (Adjusted R2) are very high for the estimator model, with a value of (90%, 99%) respectively. Furthermore, the difference between (R2 and Adjusted R2) is very small, this means that all the variables included in the estimated model are necessary and important. Besides, the ARDL estimation passed all diagnostic tests, because the value of the estimated parameters is greater than (0.05) and the value of the (VIF) is less than (10).

The F-statistic exhibits a statistical significance of 0.0000, which is less than the critical threshold of 0.05 (P-value). Consequently, the null hypothesis, is rejected. Furthermore, the values of Standard Error (S.E.), Sum of Squared Residuals (SSR), and Akaike Information Criterion (AIC) are generally appropriate and acceptable, indicating the validity and accuracy of the estimation.

5.8. STABILITY TESTES (CUSUM and CUSUM OF SQUARES):

In order to ensure the stability of the estimated parameters in the adopted models and the absence of major structural changes in them, some appropriate tests should be used such as (CUSUM) and (CUSUM of Squares). Currently, these two tests are among the most important tests for discovering the structural stability of the estimated parameters, and they are often used to analyze dynamic relationships with time series data within the framework of a single model. If the result of (Cusum of Squares and Cusum Test) shows that the curve for the data and variables (blue color) lies between the two lines, this indicates the stability of the estimated parameters at the significant level (0.05), which means that there is no problem of instability of the estimated parameters [24].

Inflation Rate:



Unemployment Rate:

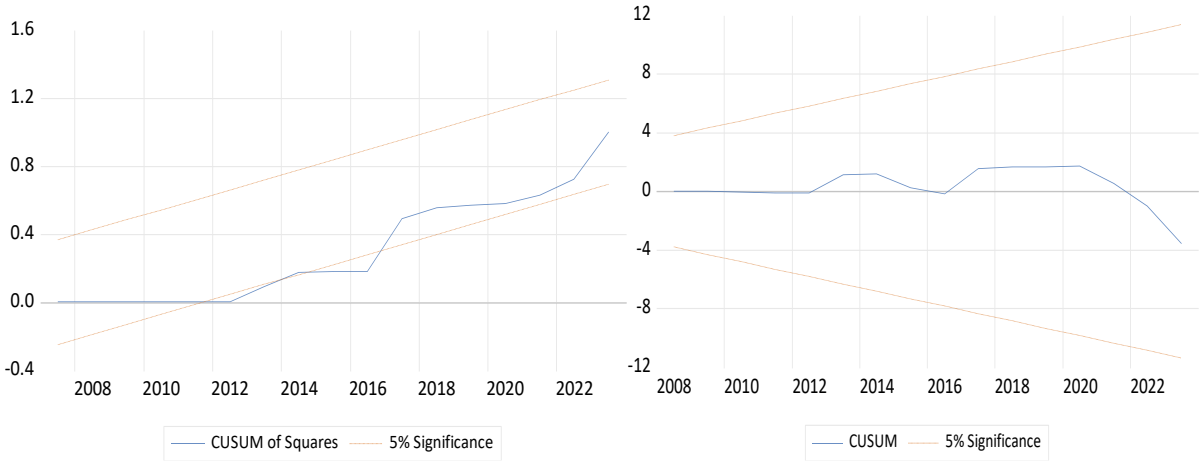


FIGURE.1. Stability testes (CUSUM and CUSUM OF SQUARES), shows that the curve for the data and variables (blue color) lies between the two lines.

Through the above diagrams, the coefficient estimators are stable, because the blue curve of the data lies between the two lines, and this indicates the stability of the estimated parameters at the level of significance (5%).

5.9. TESTING THE PREDICTIVE OERFORMANCE OF THE MODEL ESTIMATION:

The final and important step in completing the stages of building the standard model is the stage of predicting the behavior of economic phenomena. Through the prediction process, policy makers are able to judge the extent of the need to take certain measures to influence certain economic variables. In order to allow for prediction, it is necessary at least that the estimated models are free from standard problems and the estimated parameters are fairly stable [25]. Among the most common models in the field of forecasting time series data is the (Autoregressive Integrated Moving Average) (ARIMA) model. The (ARIMA) model is the most used in models that used time series data, as all models can be derived from it, whether autoregressive, moving averages or mixed. This model consists of three parts, the first part represents the autoregressive (AR) model, which is usually used in the process of forecasting time series, while the second part (I) represents the differences required by the series in order to be stable, and the third part represents the moving averages (MA) model, and therefore it expresses non-seasonal models according to the formula (ARIMA) [22]. The following is a brief presentation of some of the main tests and indicators for testing the predictive performance of the estimated model, which are:

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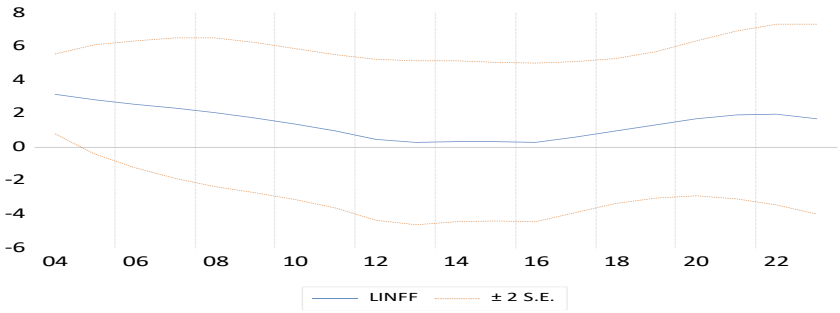
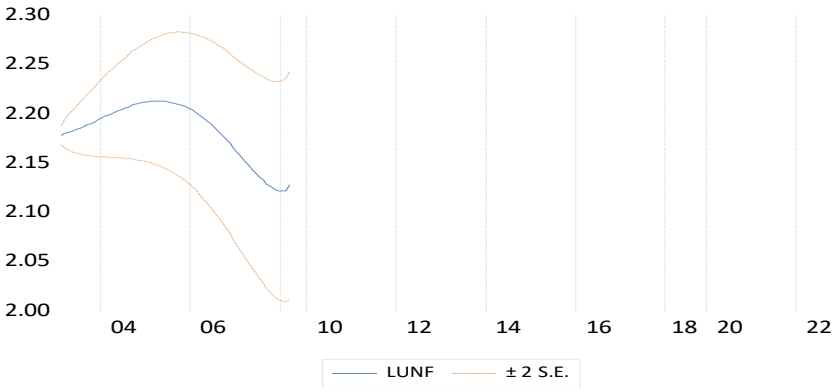
Inflation Rate :



Forecast: LINFF	
Actual: LINF	
Forecast sample: 2003 2023	
Adjusted sample: 2004 2023	
Included observations: 20	
Root Mean Squared Error	1.122655
Mean Absolute Error	0.894150
Mean Abs. Percent Error	80.84001
Theil Inequality Coef.	0.303391
Bias Proportion	0.018726
Variance Proportion	0.327102
Covariance Proportion	0.654171
Theil U2 Coefficient	0.810488
Symmetric MAPE	79.01944

Unemployment Rate :



Forecast: LUNF	
Actual: LUN	
Forecast sample: 2003M01 2023M12	
Adjusted sample: 2003M02 2023M01	
Included observations: 210	
Root Mean Squared Error	0.034621
Mean Absolute Error	0.030536
Mean Abs. Percent Error	1.414904
Theil Inequality Coef.	0.007979
Bias Proportion	0.530516
Variance Proportion	0.375789
Covariance Proportion	0.093695
Theil U2 Coefficient	25.91174
Symmetric MAPE	1.403003

FIGURE.2. (Autoregressive Integrated Moving Average) (ARIMA) model.

Root Mean Square Error: It is the root mean square error (the lower its value, the better) and is symbolized by (RMSE). As for (Mean Absolute Deviation), it is the average absolute error (the lower its value, the better) and is symbolized by (MAE). On the other hand, (Mean Absolute Percentage Error) is the average absolute relative error, the lower its value (the better) and is symbolized by (MAPE). Finally, (Theil Inequality Coefficient) is one of the common criteria in measuring and testing the predictive ability of the standard model and verifying the accuracy of the predictions. In general, its value lies between zero and one, which is the best predictive performance indicator, its value is equal to (0.3033) for inflation rate model and equal to (0.0079) for unemployment rate model. This means that the predictive efficiency of the estimated model is very strong.

6. ECONOMIC DISCUSSION:

The key finding of this study is the inverse relationship between the unemployment rate and the inflation rate. However, the impact of the unemployment rate on inflation is stronger in both the short and long run than the reverse. This indicates a strong relationship and a mutually influential effect between the two variables. One crucial factor that must be considered in this relationship is population growth. Despite the annual increase in Iraq's population, it has not been effectively utilized to enhance the production process.

Moreover, inflation and unemployment directly and indirectly influence Iraq's economic, social, and political dimensions. Additionally, the country's monetary and fiscal policies have contributed to rising inflation and unemployment rates. At times, these policies have played a destabilizing role, leading to fluctuations in both inflation and unemployment rates. Furthermore, Iraq's heavy reliance on imports and its dependence on the oil sector have hindered economic diversification, preventing the country from maintaining a balanced and acceptable level of inflation and unemployment.

CONCLUSIONS

The primary objective of this article is to measure and analyze the interchangeable relationship between inflation and unemployment in Iraq through the Phillips Curve framework, using the ARDL model based on secondary data from 2003 to 2023.

The key findings indicate that inflation and unemployment directly and indirectly influence Iraq's economic, social, and political dimensions. A two-way causal relationship exists between inflation and unemployment, aligning with the Phillips Curve concept. The impact of unemployment on inflation is stronger in both the short and long term.

Additionally, population, used as a control variable, significantly affects both inflation and unemployment at varying levels. However, despite Iraq's annual population growth, this increase has not been effectively utilized to enhance the production process. To effectively reduce inflation and unemployment in line with population growth, the government and relevant authorities must prioritize addressing the relationship between these variables. A strategic plan should be developed to create job opportunities, encourage investment, and enhance economic productivity. Expanding investment would generate more employment opportunities, thereby reducing the unemployment rate. Furthermore, increasing the supply of goods and services would help lower prices and control inflation.

For the Iraqi economy to achieve sustainable stability, it is crucial to diversify financial resources and strengthen local economic sectors, aiming to boost local production, employment, and economic resilience. Future research should explore the application of the Phillips Curve framework to other countries and different time periods for comparative analysis.

CONFLICTS OF INTEREST

The author declares no conflict of interest.

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Data Source:

World Bank Open Data | Data
World Population Prospects
https://cbirq.org
Republic of Iraq - Ministry of Planning: https://mop.gov.iq/en

Appendix: Data

Year	Unemployment rate	Inflation rate	Population
2003	8.819	33.5	27068823
2004	8.605	20.9	27858948
2005	8.718	37.3	28698684
2006	8.654	53.1	28905607
2007	8.65	32.6	28660887
2008	8.48	2.8	29218381
2009	8.395	-2.8	30289040
2010	8.252	2.4	31264875
2011	8.125	5.6	32378061
2012	7.96	6.1	33864447
2013	9.263	1.9	35481800
2014	10.59	2.2	36746488
2015	10.729	1.4	37757813
2016	10.82	0.5	38697943
2017	13.02	0.2	39621162
2018	14.065	0.4	40590700
2019	15.11	-0.21	41563520
2020	16.23	0.6	42556984
2021	16.17	6.04	43533592
2022	15.547	4.5	44496122
2023	14	6.6	45504560