# العلاقات الديناميكية بين التضخم والبطالة ضمن منحنى فيليبس في الاقتصاد الليبي خلال الفترة (1990 - 2019)

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## خلاصة:

يعد الحفاظ على استقرار الأسعار وتحقيق العمالة الكاملة من أهداف الاقتصاد الكلي المهمة في أي اقتصاد ، لا تزال ليبيا تواجه مشاكل ارتفاع التضخم والبطالة. تبحث هذه الورقة في فرضية منحنى فيليبس (التضخم ومقايضة البطالة) واستقرارها في ليبيا من عام 1990 إلى عام 2019. تكشف نتائج اختبار التكامل المشترك عن عدم وجود علاقة طويلة الأمد بين التضخم والبطالة. لذلك ، قمنا بتطبيق متجه الانحدار الذاتي (Var). تشير نتائج تقديرات (Var) إلى وجود علاقة مقايضة بين المتغيرات في الفترات السابقة ، على المدى القصير. تؤكد اختبارات الجودة للنموذج استقرار معلمات المدى القصير. كما أظهرت نتائج اختبار السببية باستخدام اختبار جرانجر للسببية تحت نهج نموذج (فار) أن هناك علاقة سببية ثنائية الاتجاه بين التضخم والبطالة ، وهذه النتائج تقدم دليلًا على أن كلا المتغيرين يؤثران على بعضهما البعض على المدى القصير ، وبالتالي ، كانت نتائجنا داعمة لمنحنى Philips.

## *The dynamic relationships between inflation and unemployment within the Phillips curve in Libyan economy during the period (1990 – 2019)*

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## Abstract:

The maintenance of price stability and the attainment of full employment are important macroeconomics goals in any economy, Libya still contends with problems of high inflation and unemployment. This paper examines the Phillips curve hypothesis (inflation and unemployment trade-off) and its

stability in Libya from 1990 to 2019 . The results of the cointegration test reveal the no existence of a long-run relationship between inflation and unemployment. So, we applied the Vector autoregression (Var) .The results of (Var) estimations indicate that there is a trade-off relationship between variables in previous periods, in the short-run. Quality tests of model confirm the stability of the short-run parameters. Also the results of the causality test using the Granger causality test under (Var) Model approach demonstrate there is a bi-directional causality relationship between the inflation and unemployment .These results provide evidence both variables affect each other in the short-run , thus, our results were a supportive of Philips curve .
**KEY WORDS:** ***inflation, unemployment, Libya, Cointegration, VAR and Causality***.

## I. Introduction

Libya economy has witnessed a dramatic rise in inflation and unemployment over the last years. Little information exists on the relationship between inflation and unemployment in macroeconomics literature about Libyan economic, aforementioned creates an important and interesting question in my minds, how to examine the relationship between inflation and unemployment in Libya economy. Inflation needs efficient government policy to curb/reduce the rate of inflation in Libya. This study is about the Phillips curve whether it would work for Libya or no. some of research has prompted the realization that a relationship between inflation and unemployment is only true in the short term, and this is also not constant (Gordon, 1997), with other research standing against the theory concerning a positive relation between inflation and unemployment (Gali et al., 2005), while other papers have captured a long run relationship (Schreiber and Walters, 2002). With this work, I would like to help to resolve this dispute by providing information concerning the Libyan Phillips curve through Modern applied econometrics tools.

The analysis of Libyan Phillips curve is interesting for two reasons: firstly, Libya is one of the largest developing countries have such problems, and secondly, Libya has a variety of events that may have influenced macroeconomic situations over the course of history. Such noteworthy events include the two oil price shocks in the 1970s, and 1980s. Finally, political instability

**1.1 Problem of study:**

We will analysis the relationship between inflation and unemployment between the years 1990-2019. This is because this period contains recession slowdown and political instability in Libya's economy. This situation may be more attractive when evaluated in terms of the relationship between unemployment and inflation within the Phillips Curve. Many of the previous studies reviewed in the literature a short-run relationship between inflation and unemployment (Li & Huang, 2008). However, on another hand, there are very few studies that have found a long-run relationship between inflation and unemployment in the literature (e.g. Rutledge et al., 2014; Nieh and Yau, 2010). also The dynamic relationships Between inflation and unemployment As such, building on most of the previous studies that will review in the literature, then the Problem of study is to what extent does inflation and unemployment explain the shape and consistency of the of Libyan Phillips curve and if the explicit relationship of these variables constitutes an efficient instrument in macroeconomic policy between 1990 and 2019?

Firstly , on a practical level, this study provides additional empirical evidence on the ongoing debate about the type and direction of the relationship between inflation and unemployment in Libya in the short and long-run in Libya using Modern

econometric analysis, which in turn contributes to increasing the empirical studies on this relationship in the literature of development and economic growth.

Secondly, on the empirical level, although previous studies (Bagsic, C. B. (2004).; Karanassou, M., Sala, H., & Snower, D. J. 2010; Shahid, M. 2014; Vermeulen, J. C. 2017) have examined the relationship between inflation and unemployment, this study is the first of the few studies which provide an up to date empirical examination to study the relationship between the inflation and unemployment within the Phillips curve in Libyan Economy.

### 1.2 Importance:

The study Phillips Curve theory is important for the Libyan economy In order to visualize its consistency or inconsistency for our economy .The importance of this paper can be summarized in the following points:

• It is important for the Libyan economy; the relationship between inflation rates and unemployment rates has been evaluated in the context of the Phillips Curve theory. In order to visualize its consistency or inconsistency for our economy.

• If the estimated Phillips Curve for the Libyan economy is consistent with the theory, then the behavioral relationship of inflation rates and unemployment rates can be used as an instrument of economic policy.

• It is important for future research, where students and researchers can take as a reference work or carry out comparative research to verify the changes that have occurred in the relationships between the inflation rate and the unemployment rate and their corresponding use as an instrument. Economic policy.

• It is also important, because it is a research topic that will allow us to visualize the consistency or inconsistency of the economic policies that have been applied, under the concept of the Phillips Curve.

## 1.3 Objectives of study:

The purpose of the paper is to explore the relationship between inflation and unemployment for Libya, we will examine by the Phillips Curve approach in macroeconomics literature during the period from 1990 to 2019 so the behavior ratio of inflation rates and unemployment rates can be used as an instrument of economic policy If the Phillips Curve estimated for the Libyan economy is consistent with the economic theory. Also evaluate the dynamic relationship between inflation rates and unemployment rates in the context of the Phillips Curve theory are important for the Libyan economy In order to visualize its consistency or inconsistency for our economy. Finally the highlighted essential relationships and general characteristics of the subject of study. It will help us systematize knowledge about inflation, unemployment and the Phillips Curve for the Libyan economy.

The overall aim of this research is to examine the dynamic relationship between inflation and unemployment, In order to achieve this overall aim; the following objectives have been formulated:

1- To detect both short and long–run relationships between inflation and unemployment

2- To determine the direction of the relationship between inflation and unemployment and discover which of them affects the other or whether both affect each other

3- To examine the dynamic relationship between inflation and unemployment Through Phillips curve.

4- Assess the extent to which inflation and unemployment explain the shape and consistency of the Phillips Curve for the Libyan economy between 1990 and 2019.

## 1.4 Hypotheses of the study:

In our study we have five hypotheses as following:

**$H_{01}$:** there is a long-run relationship between: inflation and unemployment.

**$H_{02}$:** the inflation and unemployment have both affect each other.

**$H_{03}$:** there is a short-run relationship between inflation and unemployment

**$H_{04}$:** there is a significant causality relationship between inflation and unemployment.

**$H_{05}$:** the analysis of the Philips curve verify in the context of the Libyan economy, or no.

This paper proposes an empirical investigation to determinate the nature of the relationship among these variables in the Libyan context, i.e. the existence of this relationship is in the short-run and/or the long-run, and the determination of causality direction between these variables, within the Phillips curve.

The remaining paper is organized as follows: Section 2 and 3 presents theoretical framework and concise review of literature on inflation-unemployment relationship. Section 4. Explains and discusses data and methodology while empirical findings are presented and discussed in section 5. Finally, the conclusion of the study is provided in section 6.

## 2. Theoretical framework

### 2.1 The origins of the Phillips Curve:

The link between the unemployment rate and the decreasing rates of nominal wages and prices was a concern both in the academic environment and in the field of the implementation of economic policy in the post-war period in England. As a teacher, Phillips, A. W. (1958) actively participated in preparing his cited article "The Relation between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861-1957"

Mortensen, D. T. (1970) found Phillips; the behavior of the nominal wage exchange rate depends on three variables. In general terms, when the demand for a product or service exceeds the supply, its price increases; and the greater the excess demand, the higher the price rise. On the other hand, when the supply is greater than the demand, the price decreases. It seems reasonable then that this principle works in the case of the price of labor. According to Phillips, the growth rate of labor demand affects the rate of change of nominal wages. Levels of employment and nominal wages are pro-cyclical, and the employment rate is a countercyclical variable.

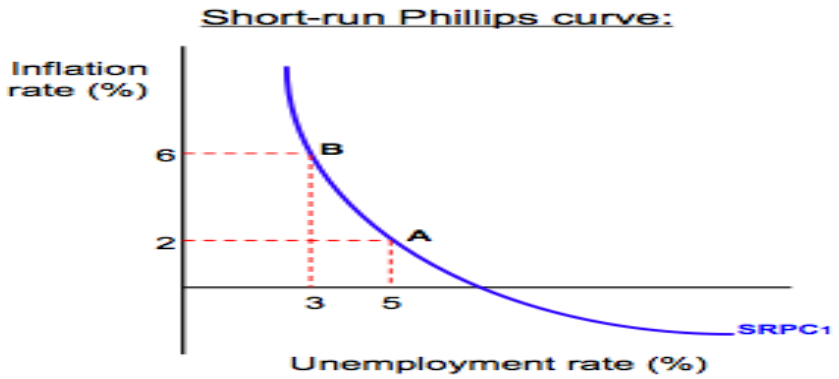
Phillips interpreted that the decrease in the level of unemployment causes an increase in the level of nominal wages, giving rise to the well-known dilemma in the field of economic policy in the short term. Subsequently, the nominal wage rate is replaced by the price level.

### 2.1.1 Short-term Phillips curve:

The Phillips Curve represents the negative relationship between inflation and unemployment in the short term. Which means that

a reduction in the level of unemployment is preceded by an increase in wages, which, GGthat the lower the unemployment rate is, there will be fewer workers looking for work. So, to get workers, employers will have to raise wages. This increase in wages translates into higher production costs and higher aggregate demand, because workers earn more money. These two factors would cause a price increase or inflation. This curve, however, shows that the relationship between inflation and unemployment is not linear, that is, for the purposes of inflation on unemployment, it is asymmetric: first, the change in unemployment has important effects on inflation, while above a certain unemployment rate; the change in unemployment has little impact on inflation. As in Diagram 1. Phillips curve in short-term

**Fig 1**




## 2.1.2 Long-term Phillips curve:

The monetarists of the Chicago school, released by Friedman, incorporate changes to the Phillips Curve model, They suggested Freedman, C., Harcourt, G. C., & Kriesler, P. (2016) a long-term Phillips Curve, in this view, the unemployment-inflation relationship was no longer invariable, since the attempts of the In

order to increase employment, the government only had an effect in the short term and caused shifts up the curve; in the long term it remained in the concept known as the Natural Rate of Unemployment . As in Diagram 2... Long-term Phillips curve.

**Fig 2**


Friedman (1977) argued that Phillips' study and the real economic situation is incompatible, since it depends on the level of unemployed, this being a problem that develops in a short or transitory term, while in the long term an index coexists normal unemployment and that this in turn is final by a compendium for non-constant Phillips curves, expectations of inflation and optimal unemployment over time.

However, in the mid-60s, the authors Edmund S. (1967). accompanied by Milton Friedman, transcendental characters of the renowned school called: "Monetarist School of the University of Chicago" questioned this exchange; holding that the Phillips curve establishes an exchange between unemployment and inflation, but that this relationship is not constant in the long period of time, the Phillips Curve in the long term; completely vertical and situated at the natural rate of unemployment. Since if it starts from an unemployment situation that the government wants to correct, it will initiate an expansive fiscal policy; which will create employment, but at the same time will raise prices; and so, the

resulting inflation will be reduced with a restrictive fiscal policy, which will increase unemployment, creating another new curve. Subsequently.

## 3. Literature Review:

This paper gives some literature on Phillips curve for non-identical countries in the world. The papers found no evidence on such Phillips curve. Considering inflation and unemployment in the Libya economy, a growing wish to evaluate the relationship between inflation and unemployment has been inveterate in the empirically studied , into some of these literatures Economists have been trying to explain the correlation between inflation and unemployment using the Phillips curve both in the short and long term which include general Information on Unemployment and Inflation .The historical relationship between inflation and unemployment noted by Phillips is the starting point for major economic debates and developments and has been the subject of several studies in economic Literature as following :

Solow, R. M. (1976). And Onder 2004 and they studied the theoretical background of the Phillips curve. The eventual trade-off helps policymakers to solve the macroeconomic disequilibrium. The Phillips curve did not succeed to predict the economic crisis in 1970s. There are more groups of researchers regarding their opinion about Phillips curve validity: the group against the use of this curve (Phelps (1967), Friedman (1977), Okun (1975), Lucas (1976)) and the group that demonstrated a non-linear relationship (Onder (2004), Kustepeli (2005), Furuoka (2007), Tang and Lean (2007), Schreiber and Wolters (2007), Dammak and Boujelbene (2009)).

On the other hand, there are Researchers that proved an unstable relationship between the two variables (Okun (1975), Lucas (1976), Turner (1997); Atkeson and Ohanian (2001); Demers (2003) and Karanassou et al. (2005) they proved that there is existing long-run relationship between inflation and unemployment. Franz (2005) showed a long-run relationship between inflation and unemployment for Germany.

Johannes (2010) used Co-integration, Unit Root Test, and Error Correction Method to test the determinants of unemployment for the period 1971-2007 in Namibia. They found that Phillips curve works in Namibia. They stated further that it is essential to reduce unemployment by increasing aggregate demand. 1971-2004 supported the long run Phillips curve by using Engle-Grangers, Johansen Co-integration, and Vector Error Correction (VEC).

Youssef, S. M., & Sami, O. S. (2017) analyzed and measure the relationship between unemployment and inflation, the relationship between unemployment and inflation has been estimated and measured, and the pattern and nature of the relationship between them was determined during the study period using standard quantitative analysis, which is the time series tests and the joint integration approach in addition to the causal relationship test for the Granger and model of (var). The results of the Granger Causality test showed no bilateral or bilateral relationship between inflation and Unemployment.

Emmanuel, U. (2017) in a similar investigation on price expectations and the Philips curve hypothesis in the Nigerian economy made use of Parsimonious Error Correction Model and Johansen method of cointegration. Their result revealed the prevalence of a direct (positive) relationship between inflation and

unemployment in Nigeria and thus invalidates the Philips curve hypothesis of an inverse (negative) relationship.

Buba, S., & Aljadi, S. (2017) undertook a study on inflation and unemployment in Nigeria using an ARDL model approach. They made use of annual time series data of 1977 to 2011 in their analysis. The result of the cointegration result indicates that a long-run relationship exists between the variables of inflation and unemployment in Nigeria. Their finding supports, Friedman (1968), Okun (1975).

The study of Karahan, P., & Uslu, N. Ç. (2018). Searched the Phillips curve, which expresses the trade-off between inflation and unemployment, using Bound test approach, ARDL method and Kalman Filter for the period between 1996 and 2016 of Turkish economy. In the empirical analysis, co-integration relationship between inflation and unemployment has been determined by Bound test. ARDL model results suggest that unemployment rate is statistically significant and negatively affects inflation rate in the long run. Although the short-run coefficient obtained from ARDL model is not statistically significant, the trade-off has been stated between inflation and unemployment in the long run.

The study of Abu, N. (2019) the Phillips curve hypothesis (inflation and unemployment trade-off) and its stability in Nigeria from 1980 to 2016 using the Autoregressive Distributed Lag (ARDL) bounds testing approach. Other estimation techniques including the Fully Modified Ordinary Least Squares (FMOLS), the results of the cointegration test reveal the existence of a long-run relationship between inflation and unemployment. Indicate that there is a trade-off relationship between the variables, and higher

unemployment leads to lower inflation in the long-run... The results of the causality test using the standard Granger causality test and the Toda and Yamamoto approach demonstrate that there is unidirectional causality from inflation to unemployment.

Coibion, O., , Y., &, M. (2019), a similar study titled understanding the relationship between unemployment and inflation in Nigeria between 1980 – 2018. They modeled unemployment as a function of inflation and adopted causality test, VECM and Johansen cointegration tests in their analysis. Their findings indicate that inflation had a significant impact on unemployment in Nigeria both in International the short and long-run. They maintain that increases in government expenditure reduce unemployment and such government spending creates employment to the extent that inflation remains within the single digit ambit.

McLeay, M., & Tenreyro, S. (2020).discussed different strategies to circumvent the identification problem and present evidence of a robust Phillips curve in US data. S has pointed out that inflation follows a seemingly exogenous statistical process, unrelated to the output gap, leading some to argue that the Phillips curve has weakened or disappeared, the reason is simple: if monetary policy is set with the goal of minimizing welfare losses (measured as the sum of deviations of inflation from its target and output from its potential) a central bank will seek to increase inflation when output is below potential. This targeting rule will impart a negative correlation between inflation and the output gap, blurring the identification of the (positively sloped) Phillips curve.

## 4. Methodology and data source\:

The empirical analysis is conducted using annual observations of inflation, and unemployment rate covering the periods 1990-2019. All data were obtained from the Libyan Central Bank and some World local and international statistics. Changing the registry can reduce the problem of heterogeneity because it presses the scale at which variables are measured, reducing the decimal difference between two values to a two-level difference (Gujarati, D. N. (2009). All economic estimates were made in this paper; modern econometrics software is adopted to develop results in this study. (Eviews, 10 - Stata, 12),

This study uses all the necessary procedure followed before testing for causality, start with testing whether the data series are stationary and test if they are cointegrated and lastly test for causality with Wald tests Furthermore graphs are used for further analysis to explain the relationship between inflation and unemployment in Libyan economy.

## 4.1 Testing for stationary:

Before testing the Johansen integration and Ganger relationship, the econometric methodology needs to examine the installation process for each individual time series. This study uses the Dickey-Fuller (ADF) and Phillips-Perron (p.p) sterilizers to examine the data series stability of the study variables.

### 4.1.1 The Dickey Fuller Unit Root Test:

The next step is to show how stationary can be tested. Many empirical papers concerning cointegration start with using either ADF test or ( p.p ) test for stationarity of the economic data [Kasa (1992), Richards (1995).

We will test whether there are one or more or no unit roots in the data. The performing such tests at the beginning of any analysis is necessary because of the possibility of getting misleading results if non-stationary variables are included. There are various ways to test for stationarity, but the most commonly used test is the Dickey-Fuller test ADF (Dickey and Fuller, 1979).

### 4.1.2 The Phillips-Perron Unit Root Test :

The Phillips and Perron (1988) test is a generalization of the ADF test procedure that allows for weak assumptions regarding the distribution of errors. This study employs the Phillips-Perron test to test for the existence of unit roots in the variables. The advantage of the Phillips-Perron test is that it allows for the effect of serial correlation and heteroskedasticity .There is evidence that the Phillips-Perron test supports the augmented Dickey-Fuller test (Davidson, R., & MacKinnon, J. G. 1993) if the variables are found to be I (1) stationary.

### 4 .2 Setting the Appropriate Lag Length of the Model:

The next important step after knowing that the data is stationary at the first different is to determine the optimal lag length because the analyses need to be the standard normal error terms that do not suffer from non-normality autocorrelation. For this purpose, the researcher uses the (VAR) lag order selection method available in E views 10 packages. This technique uses five different criteria, which are widely used in the literature to determine the lag lengths (Lütkepohl, 2005and Enders, 2010) • the sequential modified likelihood ratio (LR) test statistic. the final prediction error criteria (FPE) , the Akaike information criterion (AIC the Schwarz information criterion (SIC) , the Hannan-Quinn information criterion (HQ) n general, one should choose the model that

minimizes the AIC and SBC values (AIC), and select the one with the optimal lag length. The model chosen should pass all the diagnostic checks (Asteriou & Hall, 2011, pp. 373-375)

## 4.3 Cointegration analysis:

Because this study uses time series data, the second step after applying unit root tests we use co-integration tests to test the first hypothesis which detects whether there is a long-term equilibrium relationship between study variables. The analysis of the study will focus on one of the classical methods used to test the existence of the interrelationship between the variables, namely, the co-operation models of Johansen (1988, 1991).

Procedures use two tests to determine the number of cointegration vectors: the Maximum Eigenvalue test and the Trace test. The Maximum Eigenvalue statistic tests the null hypothesis of r cointegrating relations against the alternative of r+1 cointegrating relations for r = 0, 1, 2…n-1. This test statistics are computed as:

$$LR_{\max t}(r/n+1) = -T * \log(1-\hat{\lambda})$$

Where is the Maximum Eigenvalue and T is the sample size. Trace statistics investigate the null hypothesis of r cointegrating relations against the alternative of n cointegrating relations, where n is the number of variables in the system for r = 0, 1, 2…n-1. Its equation is computed according to the following formula:

$$LR_t(r/n) = -T * \sum_{i=r+1}^{n} \log(1-\hat{\lambda})$$

In some cases Trace and Maximum Eigenvalue statistics may yield different results and [^] indicates that in this case the results of trace test should be preferred (Johansen, S., & Juselius, K. (1990).

We will determinate the degree of integration of each variable. If the variables are all integrated in level, we apply an estimate based on a linear regression. However, if the variables are integrated in the first difference we will look into the cointegration between the variables. In this step, if the cointegration test denotes the absence of cointegration relationship, we will use the model (VAR) Vector Auto Regression model.

but if the cointegration test, Indicate the presence of a cointegration relation between the different variables studied, the model (VECM)) vector error correction model) will be applied.

## 5. Empirical Results and Analysis:

## 5.1. Graphical Analysis:

Our observation from the graphs below leads to the conclusions that the inflation and unemployment are trended and therefore they are non-stationary, as in the figure (3, 5). Including the trend line or the line of best fit to each of these series, shows that they have a slope. The plots of the first differenced variables (that is, D INFLN, DLNEXP,) are however stationary as in the figure (4, 6). This implies that these variables are likely to be integrated of order (I (1)).

**Graph 3, 4, 5.6 shows trends for the variables INFLN and UMPT**

**Fig: 3**

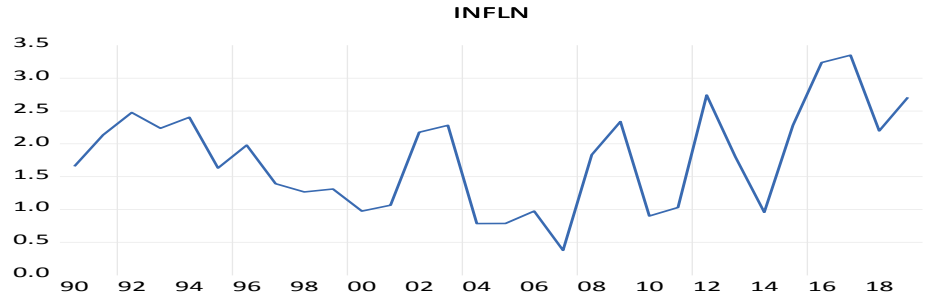


**Fig: 4**

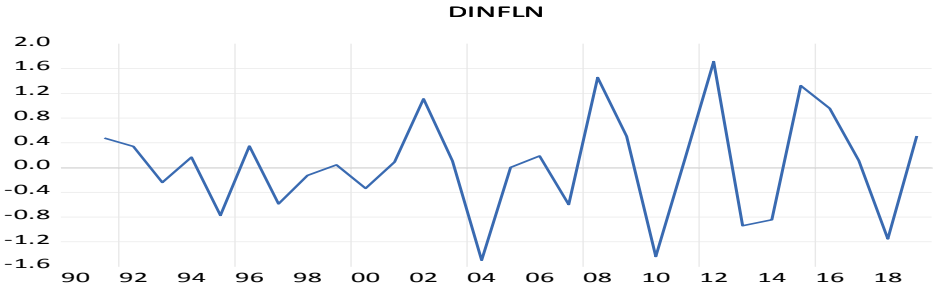



**Fig: 5**

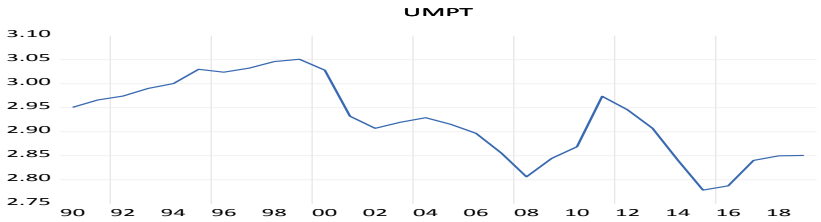
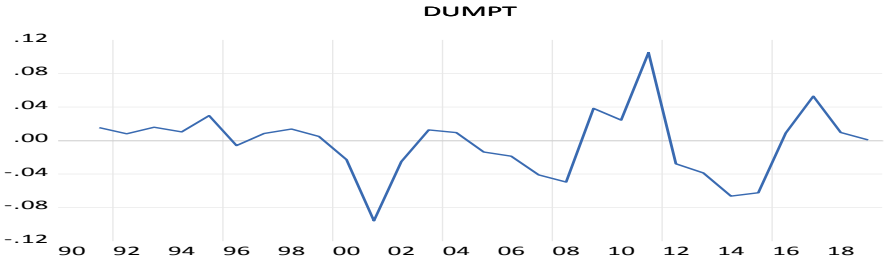



**Fig: 6**




## 5.2. Unit root/stationary test results:

The graphical analysis is useful in giving the first impressions about the properties of the time series. But it is always important to use the scientific methods to test for the stationarity of the series. Unit-root / stationarity tests have been performed on the levels and first differences of the series the results are summarized in Table 1 and 2 below. The Dickey Fuller and the Phillips-Perron Unit Root Test.

**Table 1: Results of (AD) Dickey Fuller test for level and first differences***

| | | level | 1st difference Leve | critical value | | |
|---|---|---|---|---|---|---|
| | | ADF test | ADF test | 1% | 5% | 10% |
| INFLN | Intercept | -1.0023 | -7.8995 | -3.6998 | -2.9762 | -2.6274 |
| | Constant and Trend | -1.1977 | -8.2645 | -4.3393 | -3.5875 | -3.2292 |
| | Non | -0.877 | -8.0276 | -2.6534 | -1.9538 | -1.6095 |
| UMPT | Intercept | -1.8527 | -4.6585 | -3.6891 | -2.9718 | -2.6251 |
| | Constant and Trend | -3.6850 | -4.6126 | -4.3239 | -3.8506 | -3.2253 |
| | Non | -1.0253 | -4.5454 | -2.6569 | -1.9544 | -1.6093 |

**Table 2: Results of (PP) Phillips-Perron test for level and first differences***

| | level | 1st difference Leve | | critical value | | |
|---|---|---|---|---|---|---|
| | | pp test | pp test | 1% | 5% | 10% |
| INFLN | Intercept | -2.0055 | -10.1959 | -3.6793 | -2.9677 | -2.6229 |
| | Constant and Trend | -3.2082 | -12.7705 | -4.3098 | -3.5742 | -3.2217 |
| | Non | -0.3531 | -10.0552 | -2.6471 | -1.9529 | -1.6100 |
| UMPT | Intercept | -1.1136 | -3.9871 | -3.6793 | -2.9677 | -2.6229 |
| | Constant and Trend | -2.1379 | -4.7790 | -4.3098 | -3.7542 | -3.2217 |
| | Non | -0.6149 | -3.4978 | -2.6471 | -1.9529 | -1.6100 |

The results of the stationary tests ADF and PP show that all variables are integrated in order (1), namely in first difference and in all levels (1%, 5% and 10%).

## 5. 3 VAR Lag Order Selection Criteria:

As soon as the order of integration of the studied variables is in first differentials, we will determine the cointegration between them. But before this step, one must determine the number of delay existing in this estimate. To accomplish this, we will apply the VAR Lag order selection criteria method.

**Table 3: Optimal Lag Lengths of the VAR Model:**

Selection-order criteria
Sample: 1996 - 2019 Number of obs = 24

| lag | LL | LR | df | p | FPE | AIC | HQIC | SBIC |
|---|---|---|---|---|---|---|---|---|
| 0 | -1.03583 | | | | .004415 | .252986 | .279031 | .351157 |
| 1 | 14.9903 | 32.052 | 4 | 0.000 | .001625 | -.749189 | -.671054 | -.454675* |
| 2 | 17.6431 | 5.3056 | 4 | 0.257 | .001836 | -.636922 | -.506698 | -.146067 |
| 3 | 25.02 | 14.754 | 4 | 0.005 | .001417* | -.918336* | -.736022* | -.231138 |
| 4 | 26.1853 | 2.3305 | 4 | 0.675 | .001872 | -.682106 | -.447702 | .201435 |
| 5 | 27.7861 | 3.2017 | 4 | 0.525 | .002453 | -.482175 | -.195682 | .597708 |
| 6 | 34.6455 | 13.719* | 4 | 0.008 | .002162 | -.720457 | -.381874 | .555768 |

Endogenous: infln UMPt
Exogenous: _cons

The results of the VAR lag order selection criteria in table 3 show that the number of delay chosen is equal to 3. Therefore, and at this moment, we are ready to process the existing cointegration number.

## 5.4 Cointegration Analysis:

To determine if there is any long-term relationship between unemployment and inflation, or not? Existing in our situation, we use the most effective and suitable test, which is the Johanson test.

**Table 4: Johansen Co-integration Test Statistics Unrestricted Cointegration Rank Test Trac.**

Johansen tests for cointegration
Trend: constant Number of obs = 27
Sample: 1993 - 2019 Lags = 3

| maximum rank | parms | LL | eigenvalue | trace statistic | 5% critical value |
|---|---|---|---|---|---|
| 0 | 10 | 24.500791 | . | 10.4438* | 15.41 |
| 1 | 13 | 28.42892 | 0.25246 | 2.5876 | 3.76 |
| 2 | 14 | 29.722697 | 0.09139 | | |

| maximum rank | parms | LL | eigenvalue | max statistic | 5% critical value |
|---|---|---|---|---|---|
| 0 | 10 | 24.500791 | . | 7.8563 | 14.07 |
| 1 | 13 | 28.42892 | 0.25246 | 2.5876 | 3.76 |
| 2 | 14 | 29.722697 | 0.09139 | | |

The results of the Johanson test cointegration rank test (Trace) and the cointegration rank test (Maximum Eigenvalue in table 4 show that the tau-statistic, which is referred by the t-statistic and the normalized autocorrelation coefficient, denoted by the (trace )

(max) statistic, both accept the null hypothesis of the Johanson test , which is no cointegration between inflation and unemployment at the 5% significance level because the probability value, referred by the prob* in table 4, are more than 5 percent of all the cases , Therefore , we will use an estimate based on the VAR model and the Granger causality test . Therefore, this study refuse the first research hypothesis: mean that there is no significant long-run relationship between inflation and unemployment.

## 5.5 Estimation of Vector Auto Regression (VAR) Model:

As the Johansen cointegration result indicates there was no cointegration (a long-run relationship between the unemployment and inflation). That means variables do not affect each other in the long-run, one can use the VAR models, the VAR model approach has some advantages. The first one is very simple: the econometrician does not need to determine which variables are internal or external, as all variables are internal (Asteriou & Hall, 2011, pp. 321-322 ) the second advantage is that the estimation is very simple, as each equation can be estimated separately with the Ordinary Least-Squares regression method (Asteriou & Hall, 20 11, pp. 321,322) , as the equation (1) (INFLN) and equation (2)(UMPT) , the third advantage is that the forecasts can be estimated by testing the VAR model, which is better than 'traditional structural' models according to Sims (1980). Sims argues that "large-scale structural models performed badly in terms of their out-of sample forecast accuracy" (Olsson & Grigorenko, 2013, p. 7) , the fourth advantage is that the optimal lag length can be chosen from a VAR model, which is important when estimating the cointegration models (Brooks, 2014, pp. 328-329). As in the results of the table 3.

Table 5 showed an estimate of the VAR model , which includes equation 1 inflation as a dependent variable and equation 2 unemployment as a dependent variable , to see if the inflation and unemployment have an have an affects the other or whether both affect each other .

**Table 5: VAR estimation results**

Vector autoregression

| | | | | | |
|---|---|---|---|---|---|
| Sample: 1993 - 2019 | | | | No. of obs | = 27 |
| Log likelihood = 29.7227 | | | | AIC | = -1.164644 |
| FPE = .0010959 | | | | HQIC | = -.9648485 |
| Det(Sigma_ml) = .0003792 | | | | SBIC | = -.4927288 |

| Equation | Parms | RMSE | R-sq | chi2 | P>chi2 |
|---|---|---|---|---|---|
| infln | 7 | .714784 | 0.3825 | 16.72517 | 0.0103 |
| UMPt | 7 | .041628 | 0.8095 | 114.7258 | 0.0000 |

| | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| infln | | | | | | |
| infln | | | | | | |
| L1. | .4049563 | .1971681 | 2.05 | 0.040 | .0185139 | .7913987 |
| L2. | -.1963676 | .20456 | -0.96 | 0.337 | -.5972979 | .2045626 |
| L3. | .2546064 | .1913426 | 1.33 | 0.183 | -.1204182 | .629631 |
| UMPt | | | | | | |
| L1. | 4.13367 | 3.10537 | 1.33 | 0.183 | -1.952744 | 10.22008 |
| L2. | -11.05333 | 4.355161 | -2.54 | 0.011 | -19.58929 | -2.517375 |
| L3. | 4.612012 | 3.348175 | 1.38 | 0.168 | -1.95029 | 11.17431 |
| _cons | 7.65936 | 5.372889 | 1.43 | 0.154 | -2.871309 | 18.19003 |
| UMPt | | | | | | |
| infln | | | | | | |
| L1. | .0337291 | .0114829 | 2.94 | 0.003 | .011223 | .0562352 |
| L2. | -.0247375 | .0119134 | -2.08 | 0.038 | -.0480874 | -.0013876 |
| L3. | .0278686 | .0111436 | 2.50 | 0.012 | .0060275 | .0497097 |
| UMPt | | | | | | |
| L1. | 1.16658 | .1808544 | 6.45 | 0.000 | .8121123 | 1.521048 |
| L2. | -.7365678 | .2536412 | -2.90 | 0.004 | -1.233696 | -.2394401 |
| L3. | .5405529 | .1949951 | 2.77 | 0.006 | .1583694 | .9227363 |
| _cons | .0195596 | .312913 | 0.06 | 0.950 | -.5937386 | .6328578 |

VAR Model:

==========

INFLN = L(1,1)*INFLN(-1) - L(1,2)*INFLN(-2) + L(1,3)*INFLN(-3) - L(1,4)*UMPT(-1) - L(1,5)*UMPT(-2) + L(1,6)*UMPT(-3) + L(1,7)…….(1)

UMPT = L(2,1)*INFLN(-1) - L(2,2)*INFLN(-2) + L(2,3)*INFLN(-3) + L(2,4)*UMPT(-1) - L(2,5)*UMPT(-2) + L(2,6)*UMPT(-3) + L(2,7)…….(2)

To check whether inflation and unemployment have an affects the other or whether both affect each other, we applied the Vector Auto Regression model (VAR) and then estimates the Wald test under the VAR model to know the direction of the short-run relationship between INFLN and the UMPT . According to the

VAR Lag Order Selection Criteria, estimation 3 lag, should be used when employing the VAR model.

Table 5 displays the estimation of the VAR model included to estimate the probability values, which are required to examine the Wald test to know the direction of the short-run relationship between the variables, mentioned above. In addition, table 4-16 illustrates two models. The first model is the (INFL), as a dependent variable to see if the LINFLN(-1) , INFLN(-2) , INFLN(-3) , UMPT(-1), UMPT(-2) , UMPT(-3) as an independent variables is sufficiently significant to explain the INFL as a dependent variable. The second model is the UMPT as a dependent variable to see if the INFLN(-1) , INFLN(-2) , INFLN(-3) , UMPT(-1) , UMPT(-2) , UMPT(-3) as an independent variables has enough significance to explain an dependent variable . In table 4 indicates that the probability values of The first model is (0.0103 ) less than 5%, which means independent variables are sufficiently significant to explain the dependent variable the INFLT , and the probability of the chi2_statistic more than 5% level which means independent variables are significant . The same result was obtained by the R-Squared, which shows that just 38.25 % of the changes which happened in the INFLT can be explained by the previous independent variables , while the 61.75 % is unexplained, which belongs to the variables not dealt with in the current study .

As for the second model the probability values is (0.0000 ) less than 5%, which means independent variables are sufficiently significant to explain the dependent variable the UMPT , and the probability of the $chi^2$_statistic more than 5% level which means independent variables are significant . The same result was

obtained by the R-Squared, which shows that just 80.95 % of the changes which happened in the INFLT can be explained by the previous independent variables in the second model, while the 19 .05 % is unexplained, which belongs to the variables not dealt with in the current study, therefore, this study accept the second and third research hypotheses, that inflation and unemployment affect each other and have short-run term relationship.

## .5.6 Var model stability:

The results of the of table 6 shows that the Var model is stationary at 5% level of significance, this mean the models have predictability.

**Table 6: Testing the VAR model for stability**

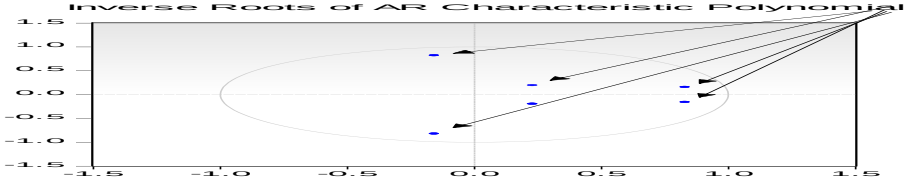
Eigenvalue stability condition

| Eigenvalue | Modulus |
|---|---|
| .12376 + .8496392*i* | .858605 |
| .12376 − .8496392*i* | .858605 |
| .8147491 + .1297493*i* | .825016 |
| .8147491 − .1297493*i* | .825016 |
| −.2248412 | .224841 |
| −.08064039 | .08064 |

All the eigenvalues lie inside the unit circle.
VAR satisfies stability condition.

The model's being stationary or no steady, depends on If the eigenvalues of the coefficient matrix are inside of the unit circle., the system is no stationary if at least one of them is on or outside of the circle, the system is not stationary and shows an expanding characteristic .As it can be seen in Figure 7, the positions of inverse roots of AR characteristic polynomial in the unit circle show the model is stationary.

**Fig 7: inverse roots of AR characteristic polynomial in the unit circle**




## 5 .7 Checking the quality of the model:

For the VAR model, 3 diagnostic tests are employed to check the problem of serial correlation, heteroscedasticity and normal distribution.

1- The Breusch-Godfrey lagrange multiplier (LM) test is used to check for the problem of serial correlation, the LM auto-correlation test consists of testing the non-auto-correlation nature of the residues. The null hypothesis is that there is no auto-correlation against the alternative hypothesis of the existence of auto-correlation, from the results of the test in table 8 we can see the probability of porb _chi2 is greater than 0.05 %, so we accept the hypothesis that there is no auto-correlation of the errors, so the errors are independent.

**Table 7: Testing residuals for autocorrelation**

Lagrange-multiplier test

| lag | chi2 | df | Prob > chi2 |
|---|---|---|---|
| 1 | 1.5453 | 4 | 0.81859 |
| 2 | 1.6734 | 4 | 0.79555 |
| 3 | 0.9252 | 4 | 0.92091 |

H0: no autocorrelation at lag order

**2-** White heteroskedasticity test is used to verify whether a problem of heteroscedasticity exists, the heterodasceticity test consists of verifying the consistency of the variance of the error over time. The series must be homoscedastic to present the best estimators. The test decision rule is based on significance at the 5% level or the assumption of homoscedasticity of errors accepted

if the probability is greater than5%. The homoscedasticity hypothesis is accepted, and vice versa, a according to the results obtained from table 8, the homoscedasticity hypothesis is reject, since the probability obtained is less than 5%**.**

**Table 8: White heteroskedasticity test**

Sample: 1990 2019
Included observations: 27

Joint test:

| Chi-sq | df | Prob. |
|---|---|---|
| 51.64570 | 36 | 0.0441 |

3- we can use three tests Jarque-Bera (J.B.) Skewness (SK), kurtosis (KU) to check if the error terms are normally distributed, Jarque-Bera (J.B.) The null hypothesis is that the error terms are normally distributed , against the alternative hypothesis not normally distributed,, from The results of the test in table 9 we can see the probabilities is greater than 0.05%, so we accept the hypothesis is terms are normally distributed, so the error terms are normally distributed.

**Table 9: Testing residuals for normality**

Jarque-Bera test

| Equation | chi2 | df | Prob > chi2 |
|---|---|---|---|
| infln | 0.700 | 2 | 0.70483 |
| UMPt | 1.143 | 2 | 0.56467 |
| ALL | 1.843 | 4 | 0.76467 |

Skewness test

| Equation | Skewness | chi2 | df | Prob > chi2 |
|---|---|---|---|---|
| infln | -.31554 | 0.448 | 1 | 0.50327 |
| UMPt | .49798 | 1.116 | 1 | 0.29080 |
| ALL | | 1.564 | 2 | 0.45750 |

Kurtosis test

| Equation | Kurtosis | chi2 | df | Prob > chi2 |
|---|---|---|---|---|
| infln | 2.5271 | 0.252 | 1 | 0.61597 |
| UMPt | 3.1552 | 0.027 | 1 | 0.86922 |
| ALL | | 0.279 | 2 | 0.86993 |

## 5. 8 Granger-causality test Under the Vector Auto Regressive (VAR) Model:

The Block Exogeneity Wald and the Wald tests can be applied under the VAR model the when the variables do not have any cointegrating relationship to test the direction of causality , in order to know the direction of the relationship between the UMPT and the INFLN we will applied the Wald test under the VAR model. INFLN (-3), UMPT

Table 4-11 shows that the Wald test rejected the null hypothesis that the UMPT is not a Cause the INFLN based on the chi-squared test of 8.8704 with df3 and the value of the probability is 0.031. On the other hand, the null hypothesis that the INFLN

Is not a Cause of the UMPT is rejected also, based on the chi-squared test of 14.961 with df 7 and the value of the probability equals 0.002. According to the Wald test, there is a bi-directional causality relationship between the inflation and unemployment.

**Table 10: Results of the VAR Granger Causality/Block Exogeneity Wald Tests:**

Granger causality Wald tests

| Equation | Excluded | chi2 | df | Prob > chi2 |
|---|---|---|---|---|
| infln | UMPt | 8.8704 | 3 | 0.031 |
| infln | ALL | 8.8704 | 3 | 0.031 |
| UMPt | infln | 14.961 | 3 | 0.002 |
| UMPt | ALL | 14.961 | 3 | 0.002 |

From table 10 It can be concluded that both the Block Exogeneity Wald report that there is short-run Granger-causality relationship, therefore, this study accepted the four and five research hypothesis, that there is short-run relationship between inflation, and there is a bi-directional causality relationship

between them, we can be concluded that Philips curve verify in the context of the Libyan economy.

## 6. Conclusion:

The aim of this study was to explain the nexus between inflation and unemployment of Libya during the period 1990-2019. The cointegration, VAR model and Granger's causality tests were applied to investigate the relationship between these variables. The unit root properties of the data were examined using the tests ADF and PP after that the cointegration and causality tests were conducted. The result shows that there is no long run relationship between these variables in Libya. And that there is short run relationship between the variables in previous periods; On the other hand, we found that there is a strong evidence of bidirectional causality between inflation and unemployment. These results provide evidence that this result is a supportive of Philips curve in short run term, Based on these findings, this study recommends policies to reduce both inflation and unemployment. However, we can conclude the following general results

1. The inverse econometric relationship between inflation and unemployment for the Libyan economy is weak, and does not match the theory developed by Williams Phillips, Sámuelson and Solow.

2. The empirical evidence shows that the hypothesis of the present investigation must be rejected, and also reject those theories that insist on raising the Phillips Curve as an instrument of economic policy. Because while it is true that there is an inverse relationship between inflation and unemployment, this relationship is weak for the Libyan economy...

3. Inflation and underemployment in Libya is explained by other variables that are not included in the model; such as the characteristics of economic policy and monetary policy, the presence of underemployment. Also the low significance of the model can be explained because the Libyan reality is different from the realities where the Phillips Curve is consistent with the theory. As a result of the distortion in the measurement of employment, since employment is equal to the sum of adequate employment and underemployment. Based on these findings, this paper recommends appropriate economic policies to reduce inflation and unemployment together.

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