Study of the Relationship between Inflation and Unemployment Rates in North African Countries (Algeria, Morocco and Tunisia) during the Period 1991-2017

دراسة العلاقة مابين معدلي التضخم والبطالة في دول شمال افريقيا (الجزائر، تونس، المغرب) خلال الفترة 1991-2017

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Abstract: This study aims to show the relation between the inflation rate and unemployement rate in North African countries: Algeria, Tunisia, and Morocoo, depending on the Panel Data Modeling. This relation was estimated by the three models : the Pooled model, , Fixed-impact models and random-impact models. The study found a negative effect of the unemployment rate on the inflation rate; according to the country's fixed-impact model as the 1% increase in the unemployment rate would lead to a decrease in the inflation rate by 0.45%. In addition, there is an adverse effect on the unemployment rate at the level of significance of 5% on the three countries, with an estimated ratio of 28.51%, and the fixed impact does not vary from country to country.

Keys words: **Inflation-unemployment, Panel Data Models, Algerian economy, Tunisian economy, Moroccan economy.**

JEL classification codes: E31; E24;

ملخص: تهدف هذه الدراسة إلى تبيان العلاقة القياسية بين معدل التضخم ومعدل البطالة في دول شمال افريقيا المتمثلة في الجزائر، تونس والمغرب، حيث اعتمدنا على الاقتصاد القياسي معتمدين على نماذج معطيات البانل ومستخدمين متغيرين وهما معدل التضخم ومعدل البطالة، وقد تم تقدير هذه العلاقة بالنماذج الثلاثة: النموذج التجميعي، نماذج الأثر الثابت ونماذج الأثر العشوائي ، وتوصلت الدراسة الى أن أفضل نموذج هو نموذج التأثيرات الثابتة ، ووجود أثر سالب لمعدل البطالة على معدل التضخم وفقا لنموذج الاثر الثابت للدول، حيث بلغت القيمة المقدرة للمرونة الجزئية حوالي 0.45- ويعني هذا أن الزيادة لمعدل البطالة بنسبة 1% سوف تؤدي إلى انخفاض معدل التضخم بـ 0.45 %، بالاضافة الى ان هناك تأثير غير معنوي عكسي لمعدل البطالة عند مستوى معنوية 5% على الدول الثلاثة ونسبة هذا التأثير تقدر بـ 28.51%، كما أنه الأثر الثابت لا يختلف من دولة إلى أخرى.

الكلمات المفتاحية: التضخم . البطالة، نماذج معطيات **Panl**، الاقتصاد الجزائري، الاقتصاد التونسي، الاقتصاد المغربي.

تصنيف JEL: E31، E24

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1- Introduction

Human societies suffer from some harmful social and natural phenomena such as (wars, drought, floods, etc.), which affect the lives and security of members of society includes economic inflation, or as sometimes called the phenomenon of price and unemployment. One of the most prominent social phenomena in terms of the prevalence and seriousness of the effects. Hence the policy-makers, decision makers and community-concerned seek to formulate policies and strategies that limit the emergence and control of this phenomenon and protect the family and individuals from its effects. Inflation is a form of economic shock to the family.

Many economists believe that there is a strong correlation between the level of inflation and unemployment, with a rise in inflation accompanied by a fall in unemployment, and vice versa. The first pointed out this phenomenon was New Zealand's economist Willem Phillips in 1958, when he observed this relationship in the British economy over 100 years. Despite the simplicity of the conclusion, this topic became one of the most important tools used in Keynesian theory, relative to the famous economist John Minard Keynes, and seven people later received the Nobel Prize in Economics for their work on the Phillips curve, between supporters and opponents. What is the relationship between the economies of the North African countries with this relation between the two variables? Is the supposed relationship between the level of inflation and unemployment exist in the Algerian, Tunisian, and Moroccan economies?

In light of the previous presentation, we highlight the problematic aspects of this study, which can be frame in the following question: How does the relationship between the rate of inflation and the rate of unemployment in North African countries (Algeria, Tunisia, Morocco) have a model during the period 1991 - 2017?

We can derive from the main question the following sub-questions:

1- What are the economic variables that explain the phenomena of unemployment and inflation?

2- Does lowering unemployment inevitably raise inflation?

3- What is the best appropriate model for studying the study data?

Analyzing the problem in question requires testing a set of hypotheses:

1- The most important economic variables affecting the unemployment rate are the size of the total population, real GDP, inflation, and public expenditures.

2- There is an adverse relationship between inflation and unemployment.

3- The fixed effects model is appropriate indicating the importance of including tomographic effects and time effects.

The importance of the study is that it deals with one of the most discussed topics among economic researchers. Through studying the accuracy of the relation between inflation and unemployment in North African countries. Which is more concerned with this study than with the controversy that exists over the nature of this relation and the trend of inflation effect on unemployment. Both are, by any measure, economic dilemma if action is not take to limit them.

Research objectives: This research aims to come out with the following objectives:

1- Addressing the basic concepts of both inflation and unemployment;

2- Indicate the relation between inflation and unemployment of the three countries of study, depending on Panel Data Models (PDM).

The boundaries of spatial study were in North African countries (Algeria, Tunisia, and Morocco) and temporal borders from 1991-2017.

To answer the questions asked and test previous hypotheses, we adopted the deductive approach using that historical method in order to understand the theoretical aspect of the problems of unemployment, inflation, mathematical and statistical methods in studying the evolution of the two phenomena over time using the analysis tools used in economic measurement.

2- Literature Review

The Inflation and unemployment are considered as the most important economic phenomena facing any economy in the world. The problems of inflation and unemployment are considered as the basic cores that direct governmental policies and programs, and the government also provides economic reform programs aimed at confronting these two problems.
(Habib, K and al, 2014, p.113)

2-1-Definition of unemployment:

Unemployment is considered as a natural phenomenon in contemporary economics due to the inability of full employment of workers to occur - unlike the classics who believed in the hypothesis of the occurrence of full employment - and this is what the treasure theory and the complementary theories brought about as they see that the occurrence of full employment is a theoretical ideal that is difficult to achieve. On the ground, and the natural one is the incomplete employment of labor, In the economic sense, unemployment means the existence of economic resources available that are unemployed and unemployed, that is, the failure to fully operate these productive resources, and in the concept of the labor market its meaning is limited to the labor component and refers to the unemployed, as it is an unhealthy phenomenon in society due to its negative economic, social and political implications (Al-Wadi,M and al, 2007, p. 294)

2-2- Definition of inflation:

The phenomenon of inflation is multi-dimensional and has complex aspects and raises many theoretical and practical issues, and this shows us that defining inflation is a difficult task, as it collides with many ambiguities and contradictions, through the intellectual and sectarian divergence between schools (Juma, A,F, 2000, p357) .

Where inflation is defined as the issuance of legal money in absolute terms without regard to other factors, such as the existence of a cover for this issued money (Inaya, G, H , 2006, p. 09)

2-3-The relationship between inflation and unemployment

The relationship between inflation and unemployment has traditionally been an inverse correlation. However, this relationship is more complicated than it appears at first glance and has broken down on a number of occasions over the past 45 years.

William Phillips is the first introduced the relationship between inflation and unemployment in 1958 using inflation and unemployment data in the United Kingdom. According to which there existed a trade-off relationship between unemployment and inflation (Sinha, A, 2017, p1608). In addition to the studies McDonald and Solow (1981); Dixon(1988); Lockwood and Manning (1989); Lockwood et al. (1998);Nickell (1990, 1998); Caballero and Hammour (1994) and Pissarides (2000)(Bhattarai, 2016, p94), Since then, the inverse relationship between unemployment rate and inflation rate has been known as the “Phillips curve” . Although this hypothesis has some criticisms regarding the basic assumptions, the Phillips curve remains one of the most important foundations in macroeconomics. (Sinha, A, 2017, p1608), As the logic of the Phillips curve means that it is difficult to reconcile between achieving full employment goals and maintaining price stability (Siham,y, 2015, p. 6).

and the evidence is that the unemployment rate declined during the years when the real growth rate was high,while the unemployment rate increased in the years when the real growth rate remained low or even negative. (Sahnoun, & Abdennadhe, 2019, p.82), That is, in periods that witness an increase in the unemployment rate, workers are willing to accept low wages in pursuit of them to find work instead of the unemployment they were in, and this makes the wage rates decrease, and the exact opposite happens in the case of low unemployment rates (Hajar, O, 2019, pp. 29-30).

In the recent decades many studies have focused on analysing this relation whether in developed or developing countries, we can summarize the most important studies on the subject in the following table :

Table1. The some recent studies on the relation between unemployment and inflation

Author (s)	**Countries**	**Econometric techniques**	**Main results**
(Habib and al , 2014)	Algeria	Granger Causality Tests	There was no relationship between the two phenomena during the period 1990-2013
(Siham,2015)	Libya	- The conversion formula is upside down	The relationship between the inflation rate and the unemployment rate is positive. The increase in the inflation rate by approximately one point leads to an increase in the unemployment rate by 09.0
(Bhattarai, 2016)	OECD countries	Cointegration and Granger causality tests and a panel VAR model	Along-term relationships between unemployment and inflation rate
(Sinha, 2017)	India	Vector Error Correction Model Approach	There is no causality running between inflation and unemployment in the short run. There is one direction of causality running from unemployment to inflation in the long run in India. The existence of the Phillips curve in the long run in India.

(Hadjer,2019)	Libya	Estimating the Phillips curve using data on unemployment and inflation.	Non-linear reverse relationship between unemployment and inflation in Libya during 2003-2017
(Sahnoun.M & Abdennadher , 2019)	North African countries	Cointegration, Granger Causality	unidirectional causality running from inflation to economic growth, from economic growth to unemployment and from inflation to unemployment

Source : Prepared by researcher.

The current study is distinguished from the rest of the aforementioned studies in that it studies the simple relationship between two variables only, namely unemployment and inflation, by relying on the simple model using a different tool, which is the outputs of the Panels for three countries represented in North Africa (Algeria, Tunisia, Morocco), based on new statistics showing the degree of sensitivity And the relationship between the study variables for the three countries, which were from 1990 to 2017.

3. Methods and Materials:

3.1. Study variables:

According to our applied study to test and estimate the relationship between inflation and unemployment by building a standard model for the different ideas and developments defined in the field of study, independent and dependent variables can be identified during the period covered by the study as follows:

3.1.1. Independent variables

These variables affect the studied phenomenon without being affect by it, as their value is determined from outside the model and is therefore know in advance, and according to the study is the unemployment rate. Table 2 shows the evolution of North African unemployment rates over the 1991-2017 period.

Table 2. Evolution of the unemployment rates for North African countries during the period 1991-2017. Unit (%)

2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	Countries
17.7	23.7	27.2	27.3	28.9	28.9	28	26.4	25.9	28.1	24.4	23.1	23.8	21.2	**Algeria**
10.82	11.92	11.59	12.46	13.57	13.93	13.75	13.72	13.97	13.62	13.74	13.35	12.87	12.88	**Morocco**
14.22	14.51	14.55	14.39	14.93	15.21	15.43	15.93	16.02	15.88	15.81	15.47	15.15	15.07	**Tunisia**
	2017	**2016**	**2015**	**2014**	**2013**	**2012**	**2011**	**2010**	**2009**	**2008**	**2007**	**2006**	**2005**	**Countries**
	11.99	10.05	11.2	10.6	9.8	11	10	10	10.2	11.3	13.8	12.3	15.3	**Algeria**
	9.05	9.30	9.46	9.69	9.22	8.98	8.9	9.09	8.96	9.56	9.56	9.67	11.01	**Morocco**
	15.37	15.51	15.21	15.05	15.93	17.62	18.33	13.04	13.29	12.44	12.36	12.51	12.87	**Tunisia**

Source: Prepared by the researcher based on World Bank statistics

3.1.2. Dependent variables

Their value is determine by the model's relationship, inflation, and Table 03 shows the evolution of North African inflation rates over the period 1991-2017.

Table 3. Evolution of North African inflation rates during the period 1991-2017 **Unit (%)**

2004	**2003**	**2002**	**2001**	**2000**	**1999**	**1998**	**1997**	**1996**	**1995**	**1994**	**1993**	**1992**	**1991**	**Countries**
3.96	4.26	1.41	4.22	0.33	2.64	4.95	5.73	18.67	29.77	29.04	20.54	31.66	25.88	**Algeria**
1.49	1.16	2.79	0.61	1.89	0.68	2.75	1.03	2.98	6.12	5.14	5.18	5.74	7.98	**Morocco**
3.63	2.71	2.72	1.98	2.96	2.69	3.12	3.65	3.72	6.24	4.73	3.97	5.82	8.19	**Tunisia**
	2017	**2016**	**2015**	**2014**	**2013**	**2012**	**2011**	**2010**	**2009**	**2008**	**2007**	**2006**	**2005**	
	5.59	6.39	4.78	2.91	3.25	8.89	4.52	3.91	5.73	4.85	3.67	2.31	1.38	**Algeria**
	0.75	1.63	1.55	0.44	1.88	1.28	0.90	0.99	0.97	3.71	2.04	3.28	0.98	**Morocco**
	5.30	3.62	4.43	4.62	5.31	4.61	3.24	30.85-	3.66	4.34	2.96	3.22	2.01	**Tunisia**

Source: Prepared by the researcher based on World Bank statistics

3.2. Presentation of the study model

Based on empirical studies on the relationship between inflation and unemployment, the study model is formulate as follows:

$$\ln INF_{it} = \alpha_{0i} + \beta \ln TC_{it} + \varepsilon_{it}$$

3.2.1. Model variables Guide:

INF_{it} Country inflation rate ***i*** during time period ***t.***

TC_{it} Country unemployment rate ***i*** during time period ***t.***

: α_{0i}: The constant of the function for country ***i.***

Ln Neiberian logarithm

: ε_{it} Random error limit, we assume that it has an arithmetic mean that equals zero and a constant variance.

The logarithm was use to estimate the relationship for the good results it showed, and for the data source we relied on the World Bank data.

3.2.2. Meta-analysis of study variables

Table 4 summarizes the descriptive characteristics of the time series of study variables by showing their most important statistical characteristics.

Table 4. Meta-analysis of study variables

	$\ln INF$	$\ln TC$
Mean	1.203169	2.648870
Median	1.292571	2.621257
Maximum	3.455359	3.363842
Minimum	-1.081274	2.187174
Std. Dev.	0.898564	0.326597
Skewness	0.169714	0.679035
Kurtosis	3.746340	2.739776
Jarque-Bera	2.240781	6.373561
Probability	0.326152	0.041305
Sum	96.25351	211.9096
Sum Sq. Dev.	63.78595	8.426578
Observations	81	81

Source: Prepared by researcher based on outputs. (E-views.9)

We observe through the table (3):

- **Series of the inflation rate** $(\ln INF)$**:** The series consists of 80 views for three countries during the period (1991-2017), a maximum value of 3.45 and a small value of -1.08, half median of 1.29, and the series values are separated from its average by a standard deviation of 0.89.

- **Series of the unemployment rate $(\ln TC)$** The series consists of 80 views for three countries during the period (1991-2017), a maximum value of 3.36 and a small value of 2.18, half an median of 2.62 and the average values of the series are dispersed by a standard deviation of 0.32.

3.3. Study of the co-integration of Panel Data

In order to assess Panel Data Models, the methodology used requires us to first examine the stability of the time and sector series of the various variables of this model, and then proceed to the study of the long-term relationship and the co-integration tests of variables with the same degree of integration. This is due using a number of tests developed to analyze and examine Panel Unit Root.

3.3.1. Stationary tests of $(\ln INF)$ and $(\ln TC)$ series:

Before testing co-integration, it is necessary to ensure the stationarity of the variables studied, for that, we have applied the following tests: Augmented Dickey-Fuller (ADF), Breitung (2000), The Levin–Lin–Chu (2002), Im–Pesaran–Shin (2003) , PP tests maddal.

We have applied these tests to the two series at once; the results of the study test are summarize based on the EviewS9 in the Tables 5 and 6.

Table 5. Results of unit root test for inflation rate

	Tests	First model		Second model		Third model	
		statistics	probability	statistics	probability	statistics	probability
The original series $\ln INF$	Levin,lin and chu	-1.974	0.024	-0.59	0.2776	0.6212	0.7328
	Breitung					-0.2553	0.3992
	Im, pesaran and shin			-1.241	0.1073	0.1776	0.5705
	ADF	14.16	0.027	9.177	0.1638	4.0717	0.6670
	PP tests maddal	17.45	0.007	19.566	0.0033	16.2456	0.0125
The series of first differences $D(\ln INF)$	Levin,lin and chu	-7.805	0.000	-2.733	0.0031	-1.0111	0.1559
	Breitung					-3.4981	0.0002
	Im, pesaran and shin			-5.444	0.0000	-4.5671	0.0000
	ADF	56.29	0.000	37.27	0.0000	29.041	0.0001
	PP tests maddal	120.65	0.000	85.88	0.0000	319.82	0.0000

Source: Prepared by researcher based on outputs. (E-views.9)

Table (5) shows the results of the tests for used the inflation rate series $\ln INF$ for its levels and first differences. The hypothesis of the presence of a unit root detected by the statistics of the unit root tests is accepted, we note statistical insignificant of the unit root in the three models. This indicates that the series is not stationary and it is DS type, but it is stationary at the first difference after taking the first difference probability values are less than 5%.

Table 6. Results of unit root test for unemployment rate

	Tests	First model		Second model		Third model	
		statistics	probability	statistics	probability	statistics	probability
The original $\ln TC$ series	Levin,lin and chu	-1.650	0.049	0.331	0.629	0.972	0.834
	Breitung						0.359
	Im, pesaran and shin			0.853	0.792	0.815	0.792
	ADF	8.307	0.216	3.369	0.761	2.356	0.884
	PP tests maddal	7.447	0.281	3.414	0.755	3.217	0.781
The series of first differences $D(\ln TC)$	Levin,lin and chu	-4.457	0.000	-2.236	0.012	-1.797	0.036
	Breitung						0.022
	Im, pesaran and shin			-2.349	0.009	-1.006	0.157
	ADF	27.88	0.000	15.87	0.014	8.966	0.175
	PP tests maddal	59.65	0.000	42.90	0.000	31.76	0.000

Source: Prepared by researcher based on outputs. (E-views.9)

Table (6) shows the results of the tests for used the unemployment rate series $\ln TC$ for its levels and first differences. The hypothesis of the presence of a unit root detected by the statistics of the unit root tests accepted, we note statistical insignificant of the unit root in the three models. This indicates that the series is not stationary and it is DS type, but it is stationary at the first difference after taking the first difference probability values are less than 5%.

3.3.2. Study of the co-integration relationship

After testing the stationarity, having found the study variables stable, and integrated of the same degree, it leads us to test the co-integration of these variables. This is similar to the 'Angel and Granger' method of discovering common integration relationships in order to avoid a falling into false regression that leads to a correlation between variables rather than a causal relationship, To know if unemployment rate is co-integrated with inflation rate or not, we applied *Pedroni* test. The results of the co-integration test for the relevant variables are shown in Table (7). Where the form of *Pedroni* test is:

- **H_0** (Null Hypothesis) : there is No co-integration.
- **H_1**(Alternative Hypothesis): there is a co-integration.

Table 7. Pedroni Test Results for co-integration relationships

Pedroni Test									
	First model			Second model			Third model		
Inside individuals	Statistics	Weighted Statistics	probability	Statistics	Weighted Statistics	probability	Statistics	Weighted Statistics	probability
Panel v-statictic	-1.177	-1.171	0.879	-0.966	-0.953	0.829	83.29	84.92	0.1145
Panel rho-statictic	-0.703	-0.697	0.242	1.575	1.549	0.939	-0.019	-0.093	0.462
Panel pp-statictic	-0.924	-0.955	0.169	2.303	2.240	0.987	-1.097	-1.143	0.126
Panel ADF-statictic	-0.619	-0.625	0.265	3.131	3.058	0.998	-0.730	-0.722	0.235
Among individuals	Statistics	probability		Statistics		probability	Statistics		probability
Group rho-ststistic	0.9282	0.823		2.3439		0.990	0.5918		0.723
Group pp-ststistic	-0.5689	0.284		3.3827		0.999	-1.0680		0.142
Group ADF-ststistic	-0.0888	0.464		4.2587		1.000	-0.5908		0.277

Source: Prepared by researcher based on outputs. (E-views.9)

The result of *Pedroni* test Shows absence of a co-integration relationship between the variables of the same degree I (1), which we observe through the statistics: *V,RHO,ADF,PP,* The null hypothesis of non-co-integration is accepted in the three models, since the three models have no statistical significance and probability value is more than 5%. Therefore, there is no co-integration within individuals.

The Rho, ADF, PP group statistics also shows that there is no co-integration relationship between first-degree individuals, because the probability value is more than 5% in the three models, which means accepting the null hypothesis.

4- Results and Discussion :

4.1. Analysis and estimation the dynamic model using Panel Data Modeling

The three types of panel models are estimate to measure the relationship between the inflation rate and the unemployment rate by applying Estimated Generalized Least Squares Estimation (GLSE) Based on the EViewS9 program, the Table (8) shows the estimation results.

Table 8. Results of the dynamic model estimation between the inflation rate and the unemployment rate

$D(\ln INF)$: Dependent variable: Represents the rate of inflation			
Period :1991-2017 ; T=27 N=3 ;27x3=81 (views)			
Explanatory variables	*Pooled model*	*Fixed effects model*	*Random effects model*
C	-0.0201 (-0.47)	-0.0846 $(-1.71)^{*}$	-0.0883 (-1.20)
$D(\ln INF(-1))$	-0.5201 $(-6.76)^{***}$	-0.5331 $(-5.21)^{***}$	-0.5401 $(-5.36)^{***}$
$D(\ln TC)$	-0.3958 (-1.17)	-0.4585 (-0.73)	-0.7057 (-0.81)
R^2	0.3942	0.2851	0.2945
F	23.432^{***}	6.981^{***}	15.030^{***}
DW	1.91	2.08	2.12
Redundant Fixed Effects Tests		0.343^{***}	
Hausman Test			
*, **, *** Significant at level 1%, 5%, and 10% respectively. (...):Student's Statistics values			

Source: Prepared by researcher based on outputs. (E-views.9)

4.2. Select the most appropriate model for study data

The coefficient of determination usually used as a key indicator to comparing several models in terms appropriate to the data on which the study is conduct.

However, in the panel models, we cannot depending on coefficient of determination in choosing the appropriate data model because it depends on different measures in its calculation from one model to another. Therefor we rely on test values (F) to choose between the aggregate model and the fixed and random effects models, and *Hausman* test for the trade-off between fixed effects model and random effects model.

4.2.1.Choose between an Pooled and Fixed effects model

Depending on either Fisher's test or the *Chow* test, Where:

H_0: Pooled model is appropriate **H_1:** Fixed effects model is appropriate

Table 9. Chow test results

Redundant Fixed Effects Tests
Equation: Untitled
Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	0.220584	(2,70)	0.0000
Cross-section Chi-square	0.471197	2	0.0000

Source: Prepared by researcher based on outputs. (E-views.9)

It is clear from the table (**9**) that the opposite probability of Chi-square (0.000) is less than 0.05, so null hypothesis is rejected, and we accept the alternative hypothesis, which indicates that there is a difference between the aggregate model and the fixed effects model, so we say that the fixed effects model is appropriate. This indicates the importance of including tomographic effects and time effects.

4.2.2. Choose between Fixed and Random effects model

Depending on *Hausman* test, Where:

H_0: Random effects model is appropriate- **H_1:** Fixed effects model is appropriate

Table 10. Hausman test results

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	0.441168	2	0.0000

Source: Prepared by researcher based on outputs. (E-views.9)

From the Table (10) we found that probability value (0.000) is less than 5%, so null hypothesis is rejected, and we accept the alternative hypothesis. Which indicates that there is a difference between the random effects model and the fixed effects model, so we say that the fixed effects model is appropriate.

4.3. An analysis of the most appropriate model results (Fixed effects Model)

Through Table (6) based on Appendix (1) we find:

4.3.1. For the fixed effects model of countries:

- Significance effects at significant level 1% of the previous value of the inflation rate and for constant at 10%.
- Insignificance of the unemployment rate.
- The model is generally significant, according to Fisher statistics because probability value is less than 1 %.
- Durbin-Watson tests prove first-class error independence because the statistical value (2.08) is in the area of error independence.

- Explanatory variables in the model explain the change in inflation rate by 28.51%, the remaining ratio (71.49%) is due to other factors outside the model or to model errors.
- Negative impact of the inflation rate in the previous period to the inflation rate, where the estimated value of partial elasticity is (-0.533) which means that an increase in the inflation rate in the previous period of 1% would result in a decrease in the inflation rate of 0.533%.
- Negative impact of the unemployment rate on the inflation rate, where the estimated value of partial elasticity is (-0.45) which means that an increase in unemployment rate of 1% would result in a decrease in the inflation rate of 0.45%.

4.3.2. For the period fixed effects model

- Significance effects of the previous value of the inflation rate and for constant at significant level 1%.
- Insignificance of unemployment rate.
- The model is generally significant, according to Fisher statistics because probability value is less than 1 %.
- Durbin-Watson tests prove first-class error independence because the statistical value (1.63) is in the area of error independence.
- Explanatory variables in the model explain the change in inflation rate by (94%), the remaining ratio (6%) is due to other factors outside the model or to model errors.
- Negative impact of the inflation rate in the previous period to the inflation rate, where the estimated value of partial elasticity is (-0.724) which means that an increase in the inflation rate in the previous period of 1% would result in a decrease in the inflation rate of 0.724%.
- Partial elasticity is (-0.14) which means that an increase in unemployment rate of 1% would result in a decrease in the inflation rate of 0.14%.

4.3.3. Fixed effect tests

The objective of the fixed effect test is to test the ability of equate this effect in the three countries (the fixed impact of individuals) and in all years (the fixed effect of years). In the case of an unequal effect, there is a different effect from one country to another and from one year to another, given the differences between the three countries. This test base on Fischer's statistics and the hypothesis of this test is as follows:

H_0: There is no individual fixed effect **H_1**: There is individual fixed effect

4.3.3.1. **Fixed effect test of individuals**

The table below shows the results of this test:

Table 11. Test's results of the existence of the fixed effect of individuals

Redundant Fixed Effects Tests
Equation: Untitled
Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	0.343451	(2,70)	0.7105

Source: Established by the researcher based on outputs. (E-views.9)

Since Fischer's statistical probability is more than 5% $(P = 0.7105 < 0.05)$, We accept the null hypothesis, which provides that there is no individual fixed effect for countries, so the fixed effect is not different from one country to another.

4.3.3.2. Test period fixed effect: The results of this test shown in the following table

Table 12. Test's results of the period fixed effect

Redundant Fixed Effects Tests
Equation: Untitled
Test period fixed effects

Effects Test	Statistic	d.f.	Prob.
Period F	7.787244	(24,48)	0.0000

Source: Established by the researcher based on outputs. (E-views.9)

Since Fischer's statistical probability is less than 5% $(P = 0.000 < 0.05)$, We reject the null hypothesis, and we accept the alternative hypothesis which provides that there is period fixed effect, so the fixed effect is different from one year to year

5- CONCLUSION

This research aims to study the relationship between the inflation rate and the unemployment rate in the countries in question. Depending on the econometrics through models of the Panel data. Three models estimated this relation: The pooled model, Fixed-impact models and random-impact models. We use two variables, the rate of inflation and the unemployment rate; the most important findings of this study are summarize as follows:

- Unemployment and inflation are among the macroeconomic phenomena that have burdened both developed and developing countries, but they have been more severe in developing countries because of the ineffectiveness of economic policies.
- Unemployment is the breakdown (forced stoppage) of a part of the labor force in society with the capacity and desire to work and produce and has several types, and the normal rate ranges from 10 to 6% of the total labor

force.

– Inflation is the continuous and significant rise in the overall price level over a given period. It has types, and one of the reasons for it is demand pressure, cost-payment, forecasts and imported inflation.

- There is a strong correlation between the level of inflation and unemployment, with a rise in inflation accompanied by a fall in unemployment, and vice versa. The first pointed out this phenomenon was the New Zealand's economist Willem Phillips, and the evidence is that the unemployment rate has a negative impact on the inflation rate, according to the country's fixed-impact model. Where the estimated value of partial elasticity is (-0.45) which means that an increase in unemployment rate of 1% would result in a decrease in the inflation rate of 0.45%.
- The best model is the model of fixed effects.
- The fixed-impact model of countries has shown that there is an adverse non-significant effect on the unemployment rate at a 5% significance level on the three countries, with an estimated ratio of 28.51%, and the fixed effect is no different from one country to another.
- The period fixed-impact model has shown that there is an adverse non-significant effect on the unemployment rate at a 5% significance level on the three countries, with an estimated ratio of 94%, and the fixed effect is no different from one year to year.

In the light of our findings, we have made some recommendations:
- To promote adequate employment rates by pursuing a successful employment policy.
-Try to move the growth wheel by using unemployed forces.
– Controlling inflation rates through good management of the monetary mass.

The problems of unemployment and inflation are among the thorny issues that remain facing the economies of the developing and developed countries over time and the solutions suggested by economists remain ad hoc and valid in one place and do not work in another. Thus, the results we have reached remain the subject of constructive criticism from researchers, and this is of course in order to improve them by opening up prospects for research work in this field, which can be focuses on:

- Design a standard economic model for inflation and unemployment in North African countries.
- Economic variables affecting the preparation of an economic model for inflation and unemployment in the Algerian economy.
- The relationship of inflation to unemployment under the collapse of oil prices for the Algerian economy

6- Appendices

Appendix 1. Results of a dynamic model estimate between the inflation rate and the unemployment rate

1.Results of estimating the pooled model

Dependent Variable: D(LNINF)
Method: Panel EGLS (Period weights)
Date: 07/21/19 Time: 19:29
Sample (adjusted): 1993 2017
Periods included: 25
Cross-sections included: 3
Total panel (balanced) observations: 75
Linear estimation after one-step weighting matrix

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNINF(-1))	-0.520109	0.076884	-6.764887	0.0000
D(LNTC)	-0.395897	0.336801	-1.175461	0.2437
C	-0.020172	0.042211	-0.477890	0.6342

Weighted Statistics

R-squared	0.394271	Mean dependent var	-0.009454
Adjusted R-squared	0.377445	S.D. dependent var	0.765596
S.E. of regression	0.602946	Sum squared resid	26.17517
F-statistic	23.43247	Durbin-Watson stat	1.915214
Prob(F-statistic)	0.000000		

Results of the estimation of fixed impact models

2.1. Countries Fix ed impact Model

Dependent Variable: D(LNINF)
Method: Panel EGLS (Cross-section weights)
Date: 07/21/19 Time: 19:30
Sample (adjusted): 1993 2017
Periods included: 25
Cross-sections included: 3
Total panel (balanced) observations: 75
Linear estimation after one-step weighting matrix

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNINF(-1))	-0.533124	0.102168	-5.218110	0.0000
D(LNTC)	-0.458516	0.621369	-0.737913	0.4630
C	-0.084659	0.049372	-1.714739	0.0908

Effects Specification

Cross-section fixed (dummy variables)

Weighted Statistics

R-squared	0.285176	Mean dependent var	-0.046270
Adjusted R-squared	0.244329	S.D. dependent var	0.719952
S.E. of regression	0.626619	Sum squared resid	27.48557
F-statistic	6.981556	Durbin-Watson stat	2.087330
Prob(F-statistic)	0.000087		

2.2 Period Fixed impact Model

Dependent Variable: D(LNINF)
Method: Panel EGLS (Period weights)
Date: 07/21/19 Time: 19:30
Sample (adjusted): 1993 2017
Periods included: 25
Cross-sections included: 3
Total panel (balanced) observations: 75
Linear estimation after one-step weighting matrix

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNINF(-1))	-0.724188	0.032202	-22.48922	0.0000
D(LNTC)	-0.140687	0.180850	-0.777921	0.4404
C	-0.090002	0.018081	-4.977628	0.0000

Effects Specification

Period fixed (dummy variables)

Weighted Statistics

R-squared	0.940032	Mean dependent var	-0.005280
Adjusted R-squared	0.907549	S.D. dependent var	1.762922
S.E. of regression	0.535163	Sum squared resid	13.74718
F-statistic	28.93944	Durbin-Watson stat	1.638007
Prob(F-statistic)	0.000000		

3. Random impact model results models

3.1.Countries Random impact

Dependent Variable: D(LNINF)
Method: Panel EGLS (Cross-section random effects)
Date: 07/21/19 Time: 19:31
Sample (adjusted): 1993 2017
Periods included: 25
Cross-sections included: 3
Total panel (balanced) observations: 75
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNINF(-1))	-0.540193	0.100702	-5.364275	0.0000
D(LNTC)	-0.705774	0.870282	-0.810972	0.4201
C	-0.088389	0.073635	-1.200366	0.2339

Effects Specification

	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.627791	1.0000

Weighted Statistics

R-squared	0.294540	Mean dependent var	-0.051411
Adjusted R-squared	0.274944	S.D. dependent var	0.729250
S.E. of regression	0.620958	Sum squared resid	27.76239
F-statistic	15.03051	Durbin-Watson stat	2.124961
Prob(F-statistic)	0.000004		

3.2.Period Random impact model

Dependent Variable: D(LNINF)
Method: Panel EGLS (Period random effects)
Date: 07/21/19 Time: 19:32
Sample (adjusted): 1993 2017
Periods included: 25
Cross-sections included: 3
Total panel (balanced) observations: 75
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNINF(-1))	-0.595025	0.093696	-6.350577	0.0000
D(LNTC)	-0.571437	0.826818	-0.691127	0.4917
C	-0.089334	0.084619	-1.055720	0.2946

Effects Specification

	S.D.	Rho
Period random	0.278731	0.2097
Idiosyncratic random	0.541034	0.7903

Weighted Statistics

R-squared	0.352980	Mean dependent var	-0.038360
Adjusted R-squared	0.335008	S.D. dependent var	0.676097
S.E. of regression	0.551337	Sum squared resid	21.88602
F-statistic	19.63974	Durbin-Watson stat	2.149409
Prob(F-statistic)	0.000000		

Source: Established by the researcher based on outputs. (E-views.9)

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