



The Impact of Public Expenditure and Money Supply on the Inflation Rate in North African Countries

An econometric study using PANEL models during the period (1990-2021)

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Abstract:

The study aimed to determine the effect of the Public expenditure and money supply on the inflation rate in North African countries During the Period (1990-2021), using dynamic panel data models and the adoption of estimate fixed individual effect model and the Methodology co-integration through use testing the stationarity and testing for co-integration and estimate FMOLS model, The study concluded that there is a long-term relationship between variables and a positive effect of public spending and money supply on inflation rates.

Key Words: Inflation, Public expenditure, Money supply, Panel data, North African countries.

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1. Itroduction :

The issue of inflation has received great attention, not only by economic scholars, but also by political researchers, universities, and scientific research centers, as well as people's interest in it because it is related to their lives, and therefore it has a negative influence on the economic efficiency of the individual, society and the state, and it is also one of the economic problems that afflict economies. In addition, it is conserved one of economic problems that afflict the economies of developing and developed countries alike; however, the causes that result in inflation in developing countries differ from those in developed countries, which results in a difference in the economic and social effects of inflationary pressures on the economies of those countries.

However, the fiscal and monetary policies are considered the most affected policies on the economic balance and macroeconomic variables, especially inflation, given that the conditions of inflation are characterized by a rise in the general level of prices and the tendency of wages to increase steadily according to the decrease in their real value, and then the increase in expenditures in general over the gross domestic product, and assuming the existence of full employment in the domestic economy, the use and activation of each of the tools of monetary and fiscal policy leads not only to an exit from the crisis, but also to achieving economic balance at the level of full employment and eliminating the gap between domestic product and public spending.

North African countries, like other countries, seek to achieve economic balance and reduce the rate of inflation and control it through the use of fiscal policy tools (guiding public spending policy) and monetary policy tools (controlling the money supply).

research problem:

Based on the foregoing, the following question can be asked: To what extent does the size of public spending and the money supply of North African countries affect their inflation rates during the period 1990-2021?

- This study seeks to test the following **hypothesis:**

The size of public spending and the money supply positively affect the rate of inflation in North African countries.

methods and tools:

In order to achieve the objectives of this study, answering the problem posed and testing its hypothesis, a descriptive and analytical approach will be relied upon by listing various definitions and concepts about public spending, monetary mass and

inflation, and analyzing the results, as well as the deductive-inductive approach by conducting a metric study, as we will use the spss26 and Eviews11 programs.

2. Theoretical framework:

2.1 Literature review :

The relationship between public spending, money supply and inflation rate has received many applied studies, including many countries, the most important of which are the following:

A. The study of Jalit Al-Taher and Qureshi Al-Eid (2019) entitled The Impact of Money Supply Measures on Inflation Rates in Algeria; An Econometric Study for the Period 1990-2017:

This study aimed to measure the impact of the money supply according to the different aggregates (the money supply in the narrow sense and the money supply in the broad sense) on the rate of inflation in Algeria, by building a standard model and using annual data for the period 1990-2017. The results of Johanson's co-integration test showed that there was no cointegration between the variables of the study. The study also examined Granger's causal relationship within the autoregressive vector model, which showed that there is a unidirectional causal relationship that applies from the money supply in the narrow concept to the rate of inflation. The money supply in the narrow sense has the greatest importance in the relative impact on the rate of inflation.

B. The study of Kafia Gasmiuri and Djamal Khanshour (2020) entitled: An Econometric Analytical Study of the Impact of Public Expenditure (operational Expenses and Equipment Expenses) on Inflation in Algeria during the 1980-2018 Period:

This study aimed to determine the effect of public spending in its two parts, Current (operating expenses) and investment (equipment expenses) on inflation in Algeria during the period 1980-2018, following the steps of modern standard analysis, starting with Dickie Fuller's test (ADF) for stability, then co-integration testing using the BOUNDS' TEST method, and then finally estimating the model using the ARDL method. The study concluded that all the variables of the model are integrated from the first degree at the 5% level, and accordingly the study turned to the error correction model (ECM) with a dynamic analysis. Upon its assessment, it became clear that the value of its coefficient was estimated at about 37.54% (statistically significant and negative sign), which indicated the existence of a short-term dynamic relationship between inflation and the explanatory variables. It also showed mixed results in the direction between a direct and inverse effect of investment spending and current spending towards inflation.

C. The study of Collins Frimpong Ofori and Benjamin Adjei Danquah, Xuegong Zhang (2017), Entitled: The impact of money supply on inflation, a case of Ghana

This study investigated the effect of money supply on inflation in Ghana during the period 1967-2015. By reviewing previous relevant studies, estimating the model, using the money supply as an independent variable on the dependent variable, which is inflation in Ghana, and applying the OLS method in estimating the model, the results showed that the Bank of Ghana is responsible for controlling the money supply and that the independence of the central bank very important. If policy makers want to minimize the effects of money supply on inflation, there is also a long-run positive relationship between money supply and inflation on an ordinary least squares basis.

D. The study of Cherakrak Samir and Gaham Wahiba, Noori Al-mihyaw Sabah (2020) Entitled: Measurement And Analysis The Impact Of Public Expenditure On Inflation In Algeria For The Period 1994-2017.

This research paper aims to study and measure the effect of public spending on inflation in Algeria for the period 1994-2017, using the error-corrected model and Granger's causality test. The study found that there is a causal relationship between public spending and inflation in Algeria, and that there is a long-term relationship between the variables that were examined, and the results showed that an increase in public spending by 1% leads to an increase in inflation rates by 35%, as well as an increase in current spending by 1% leads to a rise in inflation rates by 28%, and this study suggested the need to adopt an effective fiscal policy to reduce inflation rates in Algeria. As well as rationalizing public spending and allocating it to the productive sectors that contribute to economic development, with the need to reduce imports and replace commodities that can be produced locally to avoid imported inflation.

2.2 What is public expenditure?

Public expenditures are among the most important tools used by the state in affecting economic activity, production, and the general level of prices. In this point, we will address public expenditures in terms of definition, divisions, and components:

A. Definition of public expenditure:

There are several definitions of public expenditures, the most important of which are:

- Public expenditure is defined as an amount of money spent by the state for the purpose of achieving public benefit (Al-Obeidi, 2011, p. 56).
- Public expenditure is a monetary amount that comes out of the state's financial responsibility or one of its organizations with the intent of fulfilling a public need (Al-Jamal, 2006, p. 183).
- Public alimony is a monetary amount that comes out of the financial liability of a public legal person with the intention of satisfying a public need (Ben Azza and Shaleel, 2013, p. 50).

As a **summary** of the previous definitions: public expense is a monetary amount paid by a public body to achieve a public benefit that benefits the community as a whole.

B. public expenditure items:

Based on the previous definitions, public expenditure consists of three basic elements: the first element is that public expenditure is a monetary amount, the second element is that public expenditure is issued by the state, and the third element is that public expenditure is intended to achieve a public benefit.

C. Public expenditure divisions:

There are several divisions of public expenditures, most notably:

C.1. Classification according to the government finance statistics guide:

Public expenditures are divided and classified according to the government finance statistics guide as follows (Qadi, 2006, pp. 179-180):

- * Total expenses and net lending.
- * Ongoing expenses.
- * Capital expenditures.
- * Total lending minus repayments.

C.2. Classification in Algeria:

The Algerian legislator divides the public expenditures of the state into Operational expenses and equipment expenses (Mehrezi, 2015, pp. 66-68):

- * Operational expenses are those expenses that are necessary for the functioning of the state's administrative apparatus, which consist mainly of employee wages and maintenance expenses of government buildings....etc.
- * Equipment expenditures, which are distributed according to the annual development plan of the state and are listed in Table (C) attached to the annual Finance Law.

C.3. Other classifications:

Some countries adopt several classifications of public expenditures using various criteria such as the purchasing power criterion (transformational spending and real spending), a regional standard (central government expenditures and local expenditures), a functional standard (expenditure on agriculture or spending on education) (Qaddy, 2006, p. 181).

2.3 Basic concepts about inflation:

Inflation is considered one of the classical economic goals (the goals of Caldor's square), as all countries work to reduce its rate and control it. In this element, we will discuss the most important basic concepts of it.

A. Definition of Inflation:

There are many definitions of inflation, including:

Inflation is defined as the continuous and tangible rise in the general level of prices in a country. It is also defined as: an increase in the general level of prices of goods

and services accompanied by a decrease in the purchasing power of the monetary unit (Mokhtari and Bin Al-Bar, 2021, p. 109).

- The continuous and permanent rise of the general price level (Bramoullé & Augey, 1998, p. 239).
- The rise in the general level of prices as a whole, not the rise in the prices of some commodities only (Bremoud & Geledan, 1981, p. 212).
- Inflation is defined as a significant and continuous rise in the general level of prices. This definition includes several pillars, the first of which is the rise in the general level of prices, and the second is the greatness. Not every rise in prices is considered inflation (Al-Mattalib, 2010, p. 241).

B. Types of inflation:

B.1. Creeping inflation: characterized by a slow rise in prices at around 2%, where the increase is permanent, consecutive, and non-violent in the short term. This type is considered a general phenomenon that affects all countries of the world, as this type of inflation results either because of demand or because of costs (Sahab, 2022, p. 388).

B.2. Partial or temporary inflation: It occurs in cases where the average of a group of prices rises due to the rise in individual prices as a result of an unusual shortage of certain commodities, That is when the supply is limited as a result of natural conditions and cannot be increased quickly (Zakrir, 2016, p. 398).

C. Causes of inflation:

Economic opinions differed in identifying clear reasons for the occurrence of inflation, and perhaps the most important of them are the following (Hamedi, Haroun, and Mousawi, 2014, pages 15-20):

- An increase in consumer and investment spending, in the sense of a decrease in the marginal propensity to save;
 - The budget deficit, which is the excess of the state's general expenditures over its general revenues;
 - increased ineffective spending;
 - inflexibility of the productive system;
 - reaching the stage of full use;
 - Expectations and psychological conditions such as changes in effective aggregate demand are based on realistic arguments, but at the same time and most often depend on psychological factors;
 - higher wage rate;
 - tax pressure;
 - a decrease in the exchange value of the national currency;
- Increasing the amount of debt its burdens;
- Cash expansion resulting from printing money without economic or in-kind consideration.

D. Inflation measures:

Inflation is measured using several indicators, the most important of which are (Quddy, 2006, pp. 46-49):

- The consumer price index, which reflects changes in the purchasing power of money, which is used in spending on various items of living.
- The implicit index: It is obtained by dividing the crude gross domestic product at current prices in a given year by the raw gross domestic product at constant prices for the same year multiplied by one hundred.
- Monetary stability coefficient: it is expressed in the following equation:

$$B = \frac{\Delta M}{M} - \frac{\Delta Y}{Y}$$

- Cash Excess Coefficient: It is expressed in the following equation: $\lambda = \frac{M}{Y}$

2.4 Monetary aggregates:

A. Definition of Monetary aggregates:

The concept of monetary aggregates differs from one country to another, according to its economic development and the development of its banking system, which is illustrated by the definitions and graded concepts of money supply, as the monetary mass can be defined in its broad sense as: "the sum of available funds: cash and semi-cash, which are managed by the banking system and the public treasury." Accordingly, the monetary mass or money supply is represented in all forms of money held by individuals and institutions, whose forms differ according to the extent of economic and social development and the banking systems in the country. This development is what produced several concepts of the money supply. Or, as some economists call it, measures of money supply or monetary aggregates (Laatwi and Janouhat, 2022, p. 48).

B. Components of the monetary aggregates:

The components of the monetary block or money offers are always divided depending on the degree of liquidity into:

B.1. Cash available: It is the liquid means of payment that were placed at the disposal of individuals and institutions, as it is considered absolute liquidity and the final asset to which all assets can be transferred, and this concept applies to both (Benmariam and Bukhari, 2022, p. 125) :

- **Fiduciary money:** It is the one issued by the Central Bank, such as banknotes and auxiliary money.

- **Bank money:** It is represented in the sum of current deposits or what is called book money, which varies according to the institution with which it deals, from deposits with the treasury to deposits with the Central Bank, as well as deposits with savings funds.

B.2. Semi cash available:

It represents the sum of assets in which the monetary essence disappears and is known as quasi-money. It is considered an illiquid means of payment and cannot be used directly. It includes the following deposits:

- Term deposits.
- Deposits notify.
- Deposits on the books.
- Financial assets with close maturity dates.

C. Cash pools:

The components of the monetary aggregates or the money supply are classified into monetary pools, and the purpose of this classification is to logically distinguish between these components. These pools have been arranged according to the degree of liquidity that characterizes the components of the monetary block. Thus, the monetary aggregates is divided into the following pools (Laatwi and Janouhat, 2022, pp. 48-49):

C.1. The First Monetary Pool (M1): This measure narrowly defines the money supply as it includes what society owns of paper money and coins (C), and money in the form of current deposits held by commercial banks (DD). Therefore, what is included in the money supply (M1) can be represented by the following equation:
 $M1 = C + DD$

C.2. The second monetary pool (MM22): This measure defines the money supply broadly, as it includes what is included in the definition of the money supply (M1), in addition to time deposits deposited in commercial banks as fixed deposits (for term) or savings deposits, which are called quasi-money (M2), that is, all deposits with the banking system that are not used directly as means of payment. Therefore, what is included in the M2 money supply can be represented by the following equation: **$M2 = C + DD + TD$**

C.3. The third monetary pool (M2): It is known as the local liquidity or the sum of the means of storing values. It includes, in addition to (M2), all of the time deposits with non-banking financial institutions and public treasury bonds and bills, whether they are written bonds or bonds on documents. This pool is Less liquid than the (M1) and (M2) aggregators. We can summarize these complexes in the following equation: **$E + D = M1 + TD = M2 + S = M3$**

3. Factorial analysis using ACP baseline components for the study variables:

We will try to analyze the study variables represented in the rate of inflation, public spending and money supply in North African countries for the period between 1990-2022, using one of the methods of factor analysis, the ACP method.

3.1. Means and Standard Deviations:

These variables can be described using a set of descriptive tests shown in the following table:

Table 01. Descriptive Presentation of Variables

	Minimum	Observations	Minimum	Maximum	Mean	Std. Deviation
LINE		4	0.547	2.110	1.432	0.657
LG		4	24.084	26.182	25.165	0.869
LMS		4	23.90	28.925	26.721	2.082

Source: Prepared by researchers based on the outputs of SPSS 26.

Through the previous table, we notice that most of the averages of the variables are considered and important, and that the largest average was for the money supply variable, while the smallest average was the inflation rate variable.

We also note that the variable inflation rate is responsible for the concentration of the studied population because this variable is characterized by the smallest standard deviation (0.657), and in contrast, the variable responsible for the dispersion of the studied population is the money supply because it is characterized by the largest standard deviation (2.082).

3.2. Sample sufficiency test for common observations and differences between study variables:

The adequacy of the sample observations will be tested for the subject of the study, and the effectiveness of the factorial analysis will be measured into basic compounds, using the two tests shown in Tables 2 and 3:

Table 02. Bartlett Test Results

Bartlett's sphericity test:	
Chi-square (Observed value)	1.556
Chi-square (Critical value)	7.815
DF	3
p-value	0.000
Alpha	0.05

Source: Prepared by researchers based on the outputs of SPSS 26.

Through the above table, we note that $p\text{-value}=0.000 < \alpha=0.005$, and therefore we reject the null hypothesis and accept the alternative hypothesis, that is, there is a general correlation between the variables of the study.

Table 03. KMO Test Results

Kaiser-Meyer-Olkin test:	
LINF	0.628
LG	0.648
LMS	0.669
KMO	0.666

Source: Prepared by researchers based on the outputs of SPSS 26.

Through the table, we notice that most of the KMO values are greater than 0.05, and other values are close to one, which means that there is a relationship between the variables of the study, which we can reduce to factors written in linear form in terms of the previous variables. That is, the factor analysis is useful and the ACP method helps us to compress and summarize the information, meaning that we can continue to apply the ACP basic component analysis method.

3.3. correlation matrix:

Table No. 04 below shows the correlation matrix between the inflation rate, public spending, and money supply in North African countries:

Table 04. The Correlation Matrix

Variables	LINF	LG	LMS
LINF	1	0.524	0.162
LG	0.524	1	0.715
LMS	0.162	0.715	1

Source: Prepared by researchers based on the outputs of SPSS 26.

From the previous table, we notice that:

- There is a positive correlation between the variable rate of inflation and the volume of public spending and the money supply.
- The variable total public spending and the money supply variable are the strongest positively correlated, as the correlation coefficient recorded a value of (0.715).
- There is a strong correlation between the inflation rate and the volume of public spending, as the correlation coefficient recorded a value of (0.524), in contrast to the money supply variable, as it has a weak correlation with the inflation rate.

3.4. eigenvalues:

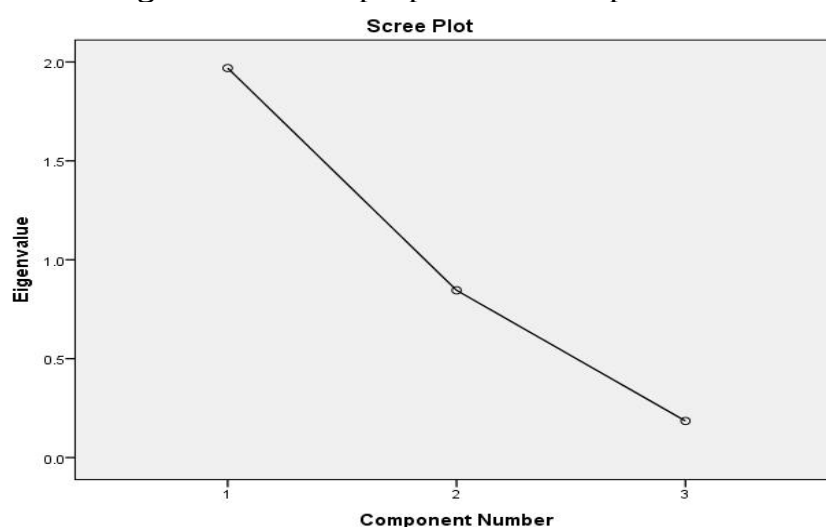
Depending on SPSS26 and the available data, we obtained the following results regarding the eigenvalues and representation ratios:

Table 05. The Correlation Matrix

	F3	F2	F1
Eigenvalue	1.969	0.846	0.185
Variability (%)	65.642	28.190	6.168
Cumulative %	65.642	93.832	100.000

Source: Prepared by researchers based on the outputs of SPSS 26.

Figure 01. The eigenvalues and proportions of representation in the axes



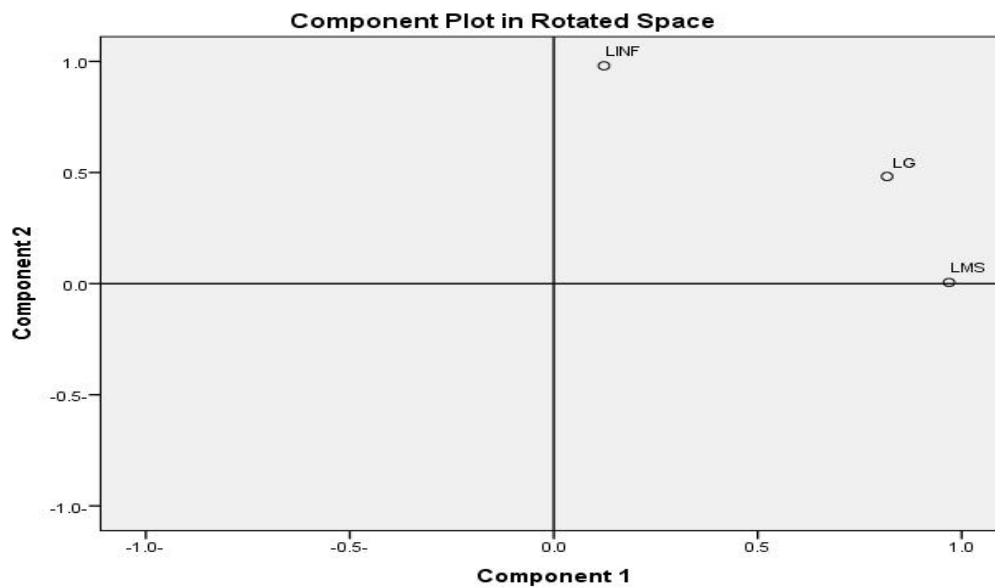
Source: Prepared by researchers based on the outputs of SPSS 26.

The first factorial axis F1 or the first basic component represents 65.642% of the inertia value, while the second axis F2 represents 28.190%, and in total the first and second axes (F2, F1) represent 93.832%, and from it we conclude that these two axes give the best representation of the scheme, and therefore We suffice to represent the variables on one orthogonal and homogeneous parameter with two dimensions (F2, F1).

3.5. Graphic representation of variables and individuals:

After finding the eigenvalues and determining the factors, in this part we drop the variables and individuals and summarize them in subgroups in order to classify them sequentially. The graphic representations were as follows:

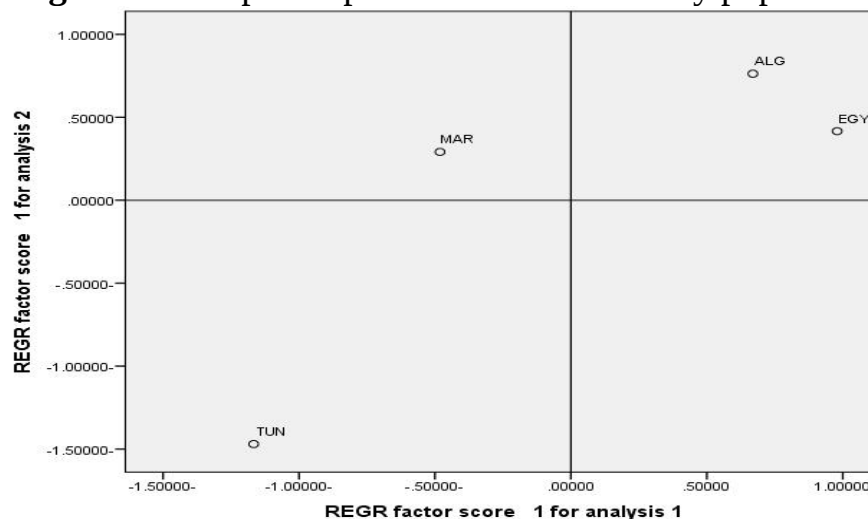
Figure 02. Variables Graph



Source: Prepared by researchers based on the outputs of SPSS 26.

The previous figure represents the graphic representation of the variables on the circle of correlations. Through this representation, we notice that the variables are far from the center and close to the periphery, which means that they are of good quality and acceptable in the study. We also note that the Euclidean distance between the variables is weak, and this indicates that there is a positive correlation between them in North African countries during the study period.

Figure 03. Graphic representation of the study population



Source: Prepared by researchers based on the outputs of SPSS 26.

The above figure is based on a cross-sectional study and does not take the time factor into account. We note that all the sample members are far from the principle, which means that they are well represented and accepted in the study and their

economics show a kind of convergence. Through this representation we also note that:

- Among all the countries, Algeria and Egypt have the largest volume of public spending, money supply and inflation rate;
- Among all countries, Tunisia and Morocco have the lowest volume of public spending, money supply and inflation rate.

4. Measuring the impact of public spending and money supply on inflation rates in North African countries:

In order to answer the problem of the study and then formulate the results and recommendations and to know the impact of public spending and money supply on inflation rates 1990-2021, we relied on the necessary data and appropriate statistical tests available on the Eviews11 program. But before that, the study model must be defined and the variables used in the study and their sources defined.

4.1 Study methodology and model:

In order to test the impact of public spending and money supply on inflation rates 1990-2021 in the North African region, we selected the study model based on some previous studies, and the model used in this study takes the following form:

$$LINF_{it} = a_{0i} + a_1 LG_{it} + a_2 LMS_{it} + \varepsilon_{it}$$

whereas :

$LINF_{it}$: represents the logarithm of the inflation rate for country i in period t, which is the dependent variable, and it was obtained from the database approved by the World Bank.

LG_{it} : represents the logarithm of public spending of country i in period t, and data for this indicator were obtained from the database approved by the World Bank.

LMS_{it} : is the logarithm of the money supply of country i in period t, Data for this indicator has been obtained from the Arab Monetary Fund database.

ε_{it} : represents the random error limit.

- Selecting the study sample:

The study sample includes four North African countries: Algeria, Tunisia, Morocco, and Egypt, i.e. $N = 4$. As for the time period, it extends from the year 1990 to the year 2021, i.e. $T = 32$, with an estimated number of 128 views.

4.2 Choosing between the Aggregate Effects Model and the Single Effects Model:

According to the analysis methodology of the long data, the first step is to determine the appropriate model for the data of the study sample, where we distinguish two models, the aggregate regression model, and here the coefficients of the fixed limit are all equal, the individual effects model, and here the coefficients of the fixed limit are different, and to compare between the two models, we will use the Brash and Bagu test, and the results are shown in the table:

Table 06. Multiple Lagrangian Test Results

Lagrange Multiplier Tests for Random Effects
Null hypotheses: No effects
Alternative hypotheses: Two-sided (Breusch-Pagan) and one-sided
(all others) alternatives

	Cross-section	Test Hypothesis Time	Both
Breusch-Pagan	148.1072 (0.0000)	7.487327 (0.0062)	155.5945 (0.0000)
Honda	12.16993 (0.0000)	2.736298 (0.0031)	10.54029 (0.0000)
King-Wu	12.16993 (0.0000)	2.736298 (0.0031)	12.43343 (0.0000)
Standardized Honda	24.59965 (0.0000)	2.834119 (0.0023)	8.848332 (0.0000)
Standardized King-Wu	24.59965 (0.0000)	2.834119 (0.0023)	18.22981 (0.0000)
Gourieriou, et al.*	--	--	155.5945 (< 0.01)
*Mixed chi-square asymptotic critical values:			
	1%	7.289	
	5%	4.321	
	10%	2.952	

Source: Prepared by the researchers based on the outputs of the Eviews11 program.

Through the previous table, we notice that the statistical value is greater than the tabulated value, and therefore we reject the null hypothesis, and therefore the appropriate model for the data of the study sample is of the individual effect type.

4.3 Choosing between fixed and random effects models:

In order to find out the type of the previous effect, we use the Hausmann test to choose the appropriate model between the fixed and random effects models. The test result is shown in the following table:

Table 07. Hausmann 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	2.644156	2	0.2666	
Cross-section random effects test comparisons:				
Variable	Fixed	Random	Var(Diff.)	Prob.
LG	1.443233	1.121807	0.080357	0.2568
LMS	-0.769424	-0.625476	0.013197	0.2102

Source: Prepared by researchers based on the outputs of Eviews 11.

The results of the test shown in the previous table indicate that the probability value is equal to 0.2666, which is greater than the significance level of 0.05, and therefore we accept the null hypothesis That is, the random effects model is suitable

for this study, in other words, the sample countries differ in the values of the constants and coefficients.

4.4 Fixed Single Effect Model Estimation:

After selecting the appropriate model, we will estimate the random individual effect model by the least squares method with dummy variables (Greene, 2012) 'The results are shown in the following table:

Table 08. Single Fixed Effects Model Estimation Results

Dependent Variable: LINF				
Method: Panel EGLS (Cross-section random effects)				
Date: 05/07/23 Time: 10:09				
Sample: 1990 2021				
Periods included: 32				
Cross-sections included: 4				
Total panel (balanced) observations: 128				
Swamy and Arora estimator of component variances				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LG	1.121807	0.443134	2.531532	0.0126
LMS	-0.625476	0.180438	-3.466432	0.0007
C	-10.08528	6.756674	-1.492640	0.1381
Effects Specification			S.D.	Rho
Cross-section random			0.897050	0.6204
Idiosyncratic random			0.701754	0.3796
Weighted Statistics				
R-squared	0.125103	Mean dependent var	0.196187	
Adjusted R-squared	0.111105	S.D. dependent var	0.746235	
S.E. of regression	0.703560	Sum squared resid	61.87459	
F-statistic	8.937003	Durbin-Watson stat	0.899978	
Prob(F-statistic)	0.000236			
Unweighted Statistics				
R-squared	-0.288040	Mean dependent var	1.432159	
Sum squared resid	143.5719	Durbin-Watson stat	0.387860	

Source: Prepared by researchers based on the outputs of Eviews 11.

Based on the above table, the form is written as follows:

$$LINF_{it} = -10.08 + 1.12 LG_{it} - 0.62 LMS_{it} + \varepsilon_{it}$$

The value of the public expenditure parameter is positive, as it is consistent with theoretical expectations, but the value of the money supply coefficient is negative, and this is unacceptable from an economic point of view. Statistically, using the Student test, all the explanatory variables are statistically significant at the level of 5%, and on the basis of the Fisher test, the The model is completely significant at the level of 5%, and the multiplier coefficient of determination has reached 12.5%, meaning that 12.5% of the differences in the dependent variable, i.e. the inflation rate

index, are explained within the model using explanatory variables, public spending and money supply.

However, relying on the result of the Derbin Watson test ($DW = 0.89$) confirms that there is a self-correlation of errors, and these results mean that the model is rejected in this way, and this may be due to the instability of the chains of the model variables, which causes a false regression.

4.5 String stability test:

The standard methodology requires, before estimating any model, to ensure the stability of the time series used in the model under study, and unit root tests are essential tests to know the stability of the time series and determine the degree of their integration, because of their utmost importance to reach valid results and avoid the phenomenon of false regression, and the results of these tests are shown in the following table:

Table 09. Unit Root Test Results

Decision	test type			Variable
	IPS	LLC	ADF	
I(1)	-1.52	-1.36	12.67	level
I(1)	***-6.68	***-3.83	***55.63	first difference
I(1)	2.25	-0.40	1.08	level
I(1)	***-3.77	***-3.36	***29.30	first difference
I(1)	1.48	-1.09	5.23	level
I(1)	***-3.10	***-3.54	***23.83	first difference

Source: Prepared by researchers based on the outputs of Eviews 11.

The values in the table represent the statistic-t.

* indicates the rejection of the unit root hypothesis at the 10% level of significance.

** indicates the rejection of the unit root hypothesis at the 5% level of significance.

***indicates the rejection of the unit root hypothesis at the 1% level of significance.

The results of the unit root tests for each of the variables are shown in the table above, which includes the results of the tests at the level and the differences of the first order, and through the results of the tests, we notice that the variable series contain the unit root, as the statistical values of the tests are greater than the corresponding critical values at the level of significance 10% And 5% and 1%, and therefore they are unstable and of the DS type, and after conducting first-degree differences for the series of variables, we found that they have stabilized, as the statistical values of the tests are less than the corresponding critical values at the level of significance of 10%, 5%, and 1%, including stable study variables When the

differences are of the first order, consequently the series are complementary of the first order.

4.6 Concurrent integration test results:

After conducting stability tests and we found that the variables are stable and integrated to the same degree, means that they grow at the same pace as the trend over the long term, this leads us to do the Pedroni test to ensure the existence of a co-integration relationship (long term) between the variables in order to avoid the possibility of falling into the problem of false regression, and the results This test is shown in the following table:

Table 10. Pedroni Test Results

Pedroni Residual Cointegration Test				
Series: LINF LG LMS				
Date: 05/07/23 Time: 10:23				
Sample: 1990 2021				
Included observations: 128				
Cross-sections included: 4				
Null Hypothesis: No cointegration				
Trend assumption: No deterministic intercept or trend				
User-specified lag length: 1				
Newey-West automatic bandwidth selection and Bartlett kernel				
Alternative hypothesis: common AR coeffs. (within-dimension)				
	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	1.888791	0.0295	0.312809	0.3772
Panel rho-Statistic	-3.402201	0.0003	-4.548150	0.0000
Panel PP-Statistic	-3.403623	0.0003	-4.573290	0.0000
Panel ADF-Statistic	-1.284644	0.0995	-1.587328	0.0562
Alternative hypothesis: individual AR coeffs. (between-dimension)				
	Statistic	Prob.		
Group rho-Statistic	-2.647104	0.0041		
Group PP-Statistic	-3.735268	0.0001		
Group ADF-Statistic	-1.391840	0.0820		

Source: Prepared by researchers based on the outputs of Eviews 11.

Through the results of the Pedroni test, we note that all the statistical values of the tests are greater than the corresponding critical values at the level of significance of 10% and 5%. Thus, the null hypothesis that there is no co-integration between the variables was rejected at the level of significance of 10%, 5%, and 1%, and the alternative hypothesis was accepted, meaning The presence of co-integration between the two variables of the study, which confirms the existence of a long-term equilibrium relationship to the impact of public spending and money supply on the inflation rate.

4.7 Results of long-term relationship estimation:

After conducting stability tests and the variables were stable and integrated of the first order, the Badroni test was applied and it was confirmed that there is a co-integration between the inflation rate and its determinants, which are: public spending and money supply, The next step is to estimate the long-term relationship using the FMOLS fully corrected least squares method. The results of the estimation are shown in the following table:

Table 11. FMOLS Long-Term Relationship Estimation Results

Dependent Variable: LINF				
Method: Panel Fully Modified Least Squares (FMOLS)				
Date: 05/07/23 Time: 10:33				
Sample (adjusted): 1991 2021				
Periods included: 31				
Cross-sections included: 4				
Total panel (balanced) observations: 124				
Panel method: Weighted estimation				
Cointegrating equation deterministics: C @TREND @TREND^2				
Long-run covariance estimates (Bartlett kernel, Newey-West fixed bandwidth)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LG	1.751455	0.062092	28.20757	0.0000
LMS	1.363327	0.072623	18.77272	0.0000
R-squared	0.700886	Mean dependent var		1.402355
Adjusted R-squared	0.665536	S.D. dependent var		0.933109
S.E. of regression	0.539644	Sum squared resid		32.03368
Long-run variance	0.247729			

Source: Prepared by researchers based on the outputs of Eviews 11.

It is clear through the results of the estimation shown in the above table that all the parameters estimates agree with the economic theoretical expectations, statistically and by using the Student test, all the explanatory variables are statistically significant at the level of 5%, and the value of the determination coefficient was about 0.70, which means that the independent variables The data taken in this study explain the changes that occur in the inflation rates of North African countries by 70.08%, which is a large percentage, which indicates a great explanatory power of the model. Therefore, the results of the model estimate using the FMOLS method are acceptable, and the long-term relationship is as follows:

$$LINF_{it} = 1.75 LG_{it} + 1.36 MS_{it} + \varepsilon_{it}$$

From the results of this assessment, we can **conclude** the following:

- The existence of a direct relationship between the change in the volume of public spending and the rate of inflation, which is consistent with the economic theory and the study of Senussi Ali and Bin Albara Muhammad (2016) and the study of Boalkor Nouredine (2016) and the study of COSIMO MAGAZZINO (2011) and the study of Mohsen Mehrara and Mohsen Behzadi Soufiani and Sadeq Rezaei

(2016), as government spending has a direct effect and an indirect effect: the direct effect comes from an increase in direct government demand for goods and services. The indirect effect comes from the dependence of activities on one another, "the government buys goods and services, contracts with contractors to implement projects, provides maintenance services, and pays salaries to its employees, and all of these buy from other suppliers and so on, within the framework of multiples," which leads to an increase in demand Aggregate at a faster rate than total production, which causes prices to be strongly attracted to the top. We also note that the ability of public spending is equal to 1.75, meaning that if public spending increases by 1%, it leads to an increase in the inflation rate in the long run by 1.75%.

- The existence of a direct relationship between the change in the money supply and the rate of inflation, which is consistent with the quantitative theory of money and the study of Senussi Ali and Bin Albara Muhammad (2016), as inflation means the continuous rise in the prices of goods and services, and in equivalent words the continuous decrease in the value of money, there is a conviction Among economists in their analyzes is that inflation (internal, i.e. not imported) arises as a result of interactions between economic variables, the most important of which is money (the amounts of money available to people, especially paper money and bank accounts), and production, demand and supply. We also note that the ability of the money supply is equal to 1.36, meaning that if An increase in the money supply by 1% leads to an increase in the long-run inflation rate by 1.36%.

5. Conclusion:

Through this study, we tried to measure the impact of public spending and money supply on inflation rates in North African countries through the use of factor analysis using the ACP basic components. public spending and the rate of inflation. The most important findings can be summarized in the following points:

- All theoretical studies emphasized the positive impact of public spending and money supply on inflation rates, as they are considered one of its most important determinants.
- The existence of a strong correlation between the volume of public spending and the rate of inflation, which indicates that the volume of public expenditure is one of the reasons for the high rates of inflation in the North African region;
- There is a weak correlation between money supply and inflation rate in the North African region;
- There is a strong correlation between the volume of public spending and money supply in the North African region;
- According to the analysis methodology of long-term data and after conducting the necessary tests, the fixed individual impact model is the model that fits the study sample, meaning that the fixed limit is determined on the basis of the economic characteristics of each country, which are represented in the variables proposed in this study.
- The stability test results of (Levin, Lin et Chu), (Im, Pesaran et Shin) and (Fisher-type) proved that the chains are first order (I) stable at a level of significance of 5%;
- The results showed that the series are integrated of the first degree, and based on the Pedroni test, we found that the variables are in a state of cointegration of the first degree;
- Through the results of estimating a long-term relationship, it became clear to us that there is a positive impact of public spending and money supply on inflation rates in North African countries.

Based on the foregoing, the following recommendations can be suggested:

- Rationalizing public spending so that this volume is in line with the requirements for GDP growth;
- The need to give importance and a major role to investment spending and to reduce current spending;
- control of the money supply;
- Developing productive commodity sectors, especially industry and agriculture, to provide products and reduce dependence on imports to reduce inflation rates;

- Work to activate the money markets through a sophisticated banking system capable of providing channels for monetary policy tools to achieve the set goals;
- Public expenditure policy must be set in line with a monetary policy keen to maintain the stability of the inflation rate at a limited level.

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