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Modeling the effect of exchange rate regimes on inflation dynamics: empirical evidence from Algeria

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Abstract:

This study aims to economically measure the impact of exchange rate regimes, under the real classification of Reinhart and Rogoff (2017), on inflation dynamics in Algeria. The analysis period chosen was from 1985 to 2020, using the Fully Modified OLS in the long term and Error Correction Model in the short term.

The study found a significant long-term negative relationship between the crawling peg exchange rate regime and inflation, while there was no relationship between exchange rate regimes and inflation in the short term.

Keywords: Exchange rate regime, inflation, FMOLS, ECM, Algeria.

1. Introduction:

It is of paramount importance, when making the right choice for the exchange rate system, to have empirical evidence of the economic performance of different exchange rate systems. Several studies have been conducted in recent years aiming to uncover the exchange rate system that has the best overall economic performance, and to investigate the impact of different exchange rate systems on inflation in particular. Until recently, pegged exchange rate systems were the most effective systems in combating inflation compared to floating and intermediate exchange rate systems. Consequently, there was a growing trend towards adopting fixed exchange rate systems, especially in developing countries until the 1990s and the financial crises witnessed. This led to a shift towards adopting floating exchange rate systems, which also received a lot of support in theoretical work regarding credibility and consistency over time. The design of a set of local policies that lead to a reduction in inflation and long-term expectations of low-level inflation is consistent with the monetary independence associated with floating exchange rates. Given the need to assess the efficiency of the system in reducing inflation, studying and comparing the economic performance of different systems with regard to inflation is important, especially in determining the appropriate exchange rate system for the Algerian dinar that will achieve lower inflation.

1.1. Study Problematic:

Based on the above, we can pose the following question: **What is the impact of actual exchange rate systems on inflation dynamics in Algeria?**

1.2. Sub-questions:

To answer the main problem, the following sub-questions were posed:

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- Does Algeria follow a floating exchange rate system for the dinar?
- What is the relationship between actual exchange rate systems for the Algerian dinar and inflation?
- Does the actual exchange rate system for the Algerian dinar help reduce inflation rates?

1.3. Hypotheses of the study:

- Algeria adopts an unannounced exchange rate system consisting of a crawling peg and a band around the dollar and the euro.
- There is a significant relationship between actual exchange rate systems for the Algerian dinar and inflation dynamics.
- Intermediate exchange rate systems are suitable for achieving low inflation rates for Algeria.

1.4. Importance of the study:

Research is one of the topics of interest to conferences and modern research, where the main concern of international finance experts is to search for the exchange rate system that best suits financial and monetary international developments, in order to ensure overall stability and provide the best economic performance. Also, the significant role played by the exchange rate system in determining the government's success in achieving overall economic goals, including controlling inflation levels.

1.5. Objectives of the study:

The study aims to investigate the extent of the impact of exchange rate systems on inflation and also aims to identify which of the exchange rate system arrangements is associated with less inflation.

1.6. Study Methodology and Tools

To answer the research problem and test its hypotheses, a descriptive methodology was adopted in the analytical aspect, and a standard methodology was relied upon to test the existence of a relationship between the actual exchange rate systems of the Algerian dinar and inflation.

1.7. Study Structure

The research paper is divided into six main sections, where the first part focuses on a general introduction on the subject of the study, while the second part focuses on the results of the most important previous empirical studies, while the third section provides a theoretical summary of modern classifications of exchange rate regimes, and the fourth section presents standard modeling for the impact of systems The actual exchange rate of the Algerian dinar on the dynamics of inflation, Finally, the fifth section presents the conclusion of the study.

2. Exchange Rate and Inflation Systems: A Brief Survey of Empirical Literature

The fixed exchange rate system is traditionally considered better at combating inflation than the flexible system. Among the empirical studies on this topic, a study by Caramazza and Aziz (1998) indicated that inflation was consistently weaker and more stable in countries that adopt the fixed exchange rate system compared to the floating systems. However, the importance of this performance difference has decreased since the beginning of the 1990s. (Caramazza et Aziz 1998) The most important explanation for the superior performance of the fixed exchange rate system in combating inflation compared to the floating systems lies in the regulatory discipline (monetary restraint) involved in adopting the fixed exchange rate system. Countries that adopt this system experience weak growth in the monetary aggregate (money supply) that translates the impact of the regulatory discipline and credibility of these systems (Ghosh, Gulde et Wolf 2003). In addition, fixing the exchange rate increases confidence in holding the local currency and encourages an

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increase in demand for the currency (the desire to hold money instead of spending it) at a given level of money supply, which contributes to maintaining low inflation rates.

Combining these two advantages results in a slowdown and recording weak rates in the velocity of money circulation and rapid decline in interest rates, such that they may decrease to reach the global level if the stability is credible. The results obtained for local price inflation differ slightly from those for interest rates in low-income countries. Countries that adopt the intermediate exchange rate system between strict stability and full flexibility generally experience higher interest rates compared to other systems, where interest rates follow the same path as prices (A. Ghosh, A.-M. Gulde, et al. 1996).

The fixed exchange rate system provides greater confidence than the intermediate exchange rate system, which in turn gives greater confidence in the system compared to the floating system. The advantage of the fixed system is more important in countries with weak institutional frameworks, high inflation rates, and low credibility, and it is preferable to adopt the intermediate system in countries with relatively high levels of economic development and financial stability (Frieden & Rogowski, 1996).

Using economic measurement tools, Ghosh, Gulde, Ostry & Wolf (1996) concluded that countries with weak inflation have a declared and explicit tendency to fix the exchange rate. However, a fixed exchange rate also leads to weak inflation. The causality direction was not well-defined, especially since some non-monetary variables such as budget deficits, according to (Boccara and Devarajan, 1993), and relative price changes and price liberalization, as indicated by (Cottarelli, Griffiths, and Moghadam, 1998), have a significant impact on inflation. (Cottarelli, Griffiths et Moghadam 1998)

Fixed exchange rates are statistically associated with better performance regarding inflation compared to flexible exchange rates, and there is a clear causal relationship between them. However, it should be noted that countries that frequently change exchange rates but retain a fixed exchange rate system will not be able to benefit from the inflation reduction gains achieved by fixed exchange rates. In this regard, Rogoff et al. (2003) point to fixed systems as having better performance regarding inflation and outperforming flexible systems. These results were based on the Facto classification proposed by Reinhart and Rogoff (2002). (Rogoff, et al. 2004)

However, they do not differ significantly from the results of studies that used the declared classification of the International Monetary Fund in 1999, or those presented by Ghosh et al. (2003), where Ghosh, Gulde, and Wolf used the official Facto classification to study and analyze data from a sample of 147 countries that are members of the International Monetary Fund during the period 1970-1999. The aim was to study the inflationary performance of exchange rate systems, where they compared three exchange rate systems: floating, intermediate, and fixed. The results showed that fixed systems had better performance regarding inflation compared to intermediate systems, and this difference in performance was more significant compared to floating systems.

Recently, the International Monetary Fund has shown the importance of polar systems, as in previous studies, thanks to the work of Ostry and Tsangarides, Ghosh (2010). Based on the declared and actual classification of exchange rate systems, researchers analyzed data from 153 countries during the period 1980-2007. They found that polar exchange rate regimes (fixed and floating) had better inflation performance compared to intermediate regimes. They also concluded that fixed exchange rates are associated with better economic performance in developing countries, while

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flexible exchange rates are more beneficial to advanced economies. (Ghosh, Ostry et Tsangarides 2010)

To confirm these results, an analysis was conducted by excluding observations regarding the Facto fixed exchange rate systems that were not considered as fixed systems in the De Jure classification. It was observed that transitioning to a fixed exchange rate system had a more significant impact (6.5%), which means that the central bank's strong commitment to tying its currency to a fixed rate enhances performance in controlling inflation. On the other hand, transactions related to the intermediate exchange rate system were not significant, indicating that there was no difference in performance between the intermediate and floating systems in reducing inflation in these countries. (Klein et Shambaugh 2010)

3. Exchange rate systems of the Algerian Dinar in light of the recent classification by Reinhart and Rogoff (2017):

The exchange rate system of the Algerian Dinar has moved from a fixed exchange rate system to a single currency system, to a currency basket system, to a fixed session system, and finally to a floating system. However, the latest transition has raised many questions due to conflicting statistics with theoretical literature. From the increase in international reserves to the decrease in inflation rates, which indicates that Algeria follows other systems besides the floating system in determining the exchange rate of its currency, confirming the existence of differences between official statements (by law) and what is done in determining the value of the dinar (in reality).

The disagreement between the arrangements that exist in reality and by law can be attributed to one of the following three reasons (Genberg et Swoboda 2005):

- Exchange rate stability is just a side effect of the overall monetary policy strategy, as the exchange rate is just one of the many variables monitored and interacted with by the central bank ;
- The central bank may estimate that the economy will be affected by shocks, especially those that require significant adjustments in the exchange rate, and thus it does not want to be tied to a prior commitment that may make settlement more difficult ;
- The last reason may be in a country that does not want to announce the balance for the exchange rate due to the fear of becoming a target for speculators, which would increase the likelihood of currency speculation attacks.

There are many studies that have addressed the actual exchange rate system classifications of the Algerian Dinar, but we will suffice with the classification by Reinhart and Rogoff (2017), which can be explained through the following Table (1):

Table Nº (1): Actual classification of the Algerian Dinar exchange rate system according to the classification by (RR) 2017.

Date	Classification (Primary/secondary)	Comments
1878- November 1942	Peg	The introduction of the Algerian franc, the French franc is the legal currency alongside the Algerian franc after August 08, 1920. On May 20, 1940 foreign exchange control was introduced.
November 1942- December 6, 1944.	Peg	British pound, and was founded in the area of the pound sterling.
December 6, 1944- December 1946.	Peg	Back to the French franc zone.

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January 1947- January 26, 1948.	Peg/ Free Market	French franc
January 26, 1948- September 20, 1949.	Free Fall/Dual Market	....
September 20, 1949- April 10, 1964.	Peg	French franc
April 10, 1964- August 1, 1972	Actual range/ Parallel Market	±5 horizontal bands around the French franc; The dinar replaces the Algerian franc; the introduction of foreign exchange controls in 1967; The parallel market premium is in the range of 30-70%.
August 01, 1972- January 21, 1974	Managed Float/Dual Market	Official peg to the French franc.
January 21, 1974- December 1987	Real Crawling Range/Dual Market Range	The range is ±5 around USD; The parallel market premium reached 469% in April 1985; The official exchange rate is linked to an undisclosed basket of currencies.
January 1988-March 1994	Managed Float/Parallel Market	....
April 1994-January 1995	Free Fall/ Managed Float/Parallel Market	....
February 1995- February 1999	Real Crawling Range/Parlle Market	The range is ±2 around the French Franc/Euro
March 1999- September 2016	Real Crawling Range/Parlle Market	The range is ±2 around USD

Source: Ethan ILZETZKI and Carmen REINHART and Kenneth ROGOFF: The Country Chronologies to Exchange Rate Arrangements into the 21st Century: Will the Anchor Currency Hold?, National Bureau of Economic Research, NBER Working Paper No. 23135, Cambridge, February 2017, P 5.

Through Table (1), we observe that the actual exchange rate systems for the Algerian Dinar, based on the Reinhart and Rogoff (RR) classification, differ significantly from the systems announced by the monetary authorities in the country. For example, during the period of 1974-1987, Algeria announced that it followed a basket of currencies system, but the RR classification indicates that the actual system followed was a crawling peg around the US dollar with a fluctuation of +5, along with the existence of a parallel market, where the premium of the parallel market reached 469% in April 1985, and the official exchange rate was linked to a basket of currencies that was not announced.

From January 1988 to March 1994, Algeria still claimed to adopt a basket of currencies system, but the RR classification indicates that Algeria followed a managed float exchange rate system, which may be attributed to the strength of the money market that was established at that time, and its ability to determine the Dinar through supply and demand, along with the existence of the parallel market.

From April 1994 to January 1995, the Algerian Dinar entered a free fall, which means that there were inflation levels exceeding 40%. This may be attributed to the announced and

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unannounced devaluations of the Algerian Dinar at that time (10% at the beginning of 1994 and 40% on April 10, 1994), while adopting a managed float exchange rate system.

From February 1995 until January 1, 1999, Algeria adopted the actual crawling peg system for the Dinar against the French Franc with a fluctuation of +2, and then switched to the actual crawling peg system against the US dollar with a fluctuation of +2 until September 2016, although official statements claim the adoption of a managed float exchange rate system for the Algerian Dinar.

This classification is considered one of the best recent classifications that show the reality of the exchange rate system followed in Algeria. This classification takes into account the exchange rate in the parallel market and the multiplicity of exchange rates, which are both experiences that Algeria has gone through and still goes through, unlike some other classifications that rely only on fluctuations in reserves and nominal exchange rates. Algeria does not follow a managed float exchange rate system, but rather another system that is hidden in determining its currency exchange rate, and the Reinhart and Rogoff classification is the only classification that confirms this fact, making it the realistic and... (the rest of the text is cut off)

4. Standard modeling of the impact of the Algerian dinar exchange rate regimes on inflation dynamics

We will carry out a standard study on the impact of the actual regimes of the exchange rate of the Algerian dinar on inflation based on the classification (Reinhart and Rogoff 2017), in light of the futility of studying this effect in the case of the declared exchange rate regimes, which lead us to unrealistic results and do not represent the state of the economy the actual Algerian.

4.1. Building the Study Model

For studying the impact of actual exchange rate systems on inflation dynamics in Algeria, the researchers relied on the Fully Modified Ordinary Least Squares (FMOLS) method to estimate the long-term effect. This method was designed by Philips and Hansen (1990) to provide optimal estimates of common integration slopes, where the FMOLS estimates are adjusted to account for the effects of serial correlation, and to test for the self-growth in independent variables resulting from the presence of common integration relationships, thus providing more efficient estimates. The application of this method requires stability tests and confirmation of the existence of a common integration relationship between the variables, which will be followed to provide the optimal estimate of common integration slopes. This method works to purify the estimated transaction values from spurious values that are estimated using Ordinary Least Squares (OLS) method, to obtain higher efficiency in estimation. In addition, this method modified the OLS method to eliminate the effect of self-correlation and maintain the effect of internal variables that build the common integration relationship. Although this method is of high quality, it may encounter some problems in the case of small samples. To apply this method for estimating long-term relationships, it is required to verify the condition of the existence of a common integration relationship between the variables under study and the relationship between them.

We relied on a set of variables that we believe will determine the relationship between the actual exchange rate systems of the Algerian Dinar and inflation. Based on the theoretical framework and previous studies presented above, the study model will be chosen as follows:

INF = f (M2, GROWTH, INT, GOVER, IMP, EXCH, REG)

Whereas:

INF: Inflation rate (dependent variable);

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M2: Broad money supply;
GROWTH: Per capita GDP at constant local currency prices;
INT: Interest rate;
GOVER: Government spending (investment and operational expenses) at constant local currency prices;
IMP: Value of imports at constant local currency prices;
EXCH: Official exchange rate (local currency versus US dollar, average period);
REG: The formal change in exchange rate systems.

4.2. Stability tests for study variables and cointegration test

4.2.1. Stability test of time series

As a first step, we test the stability of the time series, which is a condition for cointegration. Unit root tests are the most important method for determining the stability of time series and knowing their statistical characteristics, as well as identifying the degree of integration of the time series under study. The Augmented Dickey-Fuller and Phillips-Perron tests were used to test the presence of a unit root or stationarity in all variables under study. This test examines the hypothesis that the variable in question contains a unit root, indicating that it is unstable, against the alternative hypothesis that the variable in question does not contain a unit root, indicating that it is stable. This means determining whether the time series of the variable is stable at its original level or whether it is unstable. If it is found to be unstable, then differences must be taken until it reaches a state of stability.

Table Nº (02): Stability test of time series in their original state.

Augmented Dickey-Fuller Unit Root Test

At Level Test

	t-statistique Prob	**EXCH**	**GOVER**	**GROWTH**	**IMP**	**INF**	**INT**	**M2**
Constant	t-statistique Prob.*	-3.1573 0.0316 **	0.8350 0.9932 n_0	0.0605 0.9579 n_0	-2.0666 0.2587 n_0	-2.4627 0.1330 n_0	-4.3172 0.0023 ***	-1.4081 0.5671 n_0
Trend and Intercept	t-statistique Prob.*	-2.0938 0.5306 n_0	-3.3519 0.0746 *	-2.8983 0.1752 n_0	-3.0947 0.1232 n_0	-2.9273 0.1666 n_0	-8.5744 0.0000 ***	0.1646 0.9967 n_0
None	t-statistique Prob.*	1.3439 0.9520 n_0	2.2353 0.9926 n_0	1.1044 0.9268 n_0	-0.9981 0.2793 n_0	-1.2328 0.1955 n_0	0.1133 0.7118 n_0	8.8214 1.0000 n_0

*show values are significant at 10 %.
**show values are significant at 5%.
***show values are significant at 1 %.

Source: Prepared by researchers based on the results of the EViews 12 programme.

Phillips-Perron Unit Root Test

At Level Test

	t-statistique Prob	**EXCH**	**GOVER**	**GROWTH**	**IMP**	**INF**	**INT**	**M2**
Constant	t-statistique Prob.*	-2.4581 0.1341 n_0	0.6195 0.9883 n_0	-0.5039 0.8786 n_0	-2.1278 0.2355 n_0	-2.4548 0.1349 n_0	-2.7935 0.0695 *	-1.3083 0.6147 n_0
Trend	t-statistique	-1.3551	-3.5311	-2.6318	-3.0713	-2.9986	-2.4859	-0.0258

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and Intercept	Prob.*	0.8566 n_0	0.0514 *	0.2695 n_0	0.1287 n_0	0.1469 n_0	0.3326 n_0	0.9942 n_0
None	t-statistique Prob.*	1.5115 0.9652 n_0	1.9141 0.9849 n_0	0.6686 0.8557 n_0	-0.9981 0.2793 n_0	-1.2872 0.1789 n_0	0.3913 0.7915 n_0	7.1465 1.0000 n_0

*show values are significant at 10 %.

**show values are significant at 5%.

***show values are significant at 1 %.

Source: Prepared by researchers based on the results of the EViews 12 programme.

Through table (2), we observe the non-stationarity of the time series for all variables in their original form, which means the presence of a unit root for all time series at the level. Since all time series are non-stationary at the level, they will be retested by taking their first differences. The results are shown in table (3) as follows:

Table Nº (3): Stationarity test for time series after taking first differences.

Augmented Dickey-Fuller Unit Root Test

At 1 st Difference

	t-statistique Prob	**EXCH**	**GOVER**	**GROWTH**	**IMP**	**INF**	**INT**	**M2**
Constant	t-statistique Prob.*	-3.9605 0.0044 ***	-7.7018 0.0000 ***	-2.8994 0.0559 *	-6.1210 0.0000 ***	-8.2137 0.0000 ***	-14.8207 0.0000 ***	-4.6198 0.0008 ***
Trend and Intercept	t-statistique Prob.*	-4.7373 0.0030 ***	-8.3595 0.0000 ***	-2.6622 0.2574 n_0	-6.2354 0.0001 ***	-8.0836 0.0000 ***	-36.5811 0.0000 ***	-5.0357 0.0014 ***
None	t-statistique Prob.*	-3.1354 0.0027 ***	-7.0231 0.0000 ***	-2.8686 0.0055 ***	-6.2111 0.0000 ***	-8.2914 0.0000 ***	-4.2092 0.0002 ***	-1.9794 0.0470 **

*show values are significant at 10 %.

**show values are significant at 5%.

***show values are significant at 1 %.

Source: Prepared by researchers based on the results of the EViews 12 programme.

Phillips-Perron Unit Root Test

At 1 st Difference

	t-statistique Prob	**EXCH**	**GOVER**	**GROWTH**	**IMP**	**INF**	**INT**	**M2**
Constant	t-statistique Prob.*	-4.1548 0.0026 ***	-7.6794 0.0000 ***	-2.8818 0.0580 *	-6.1144 0.0000 ***	-8.2137 0.0000 ***	-3.4199 0.0171 **	-4.6198 0.0008 ***
Trend and Intercept	t-statistique Prob.*	-4.7323 0.0030 ***	-8.3595 0.0000 ***	-2.9584 0.0184 **	-6.2354 0.0001 ***	-8.0836 0.0000 ***	-3.5825 0.0465 **	-5.0202 0.0014 ***
None	t-statistique Prob.*	-3.2638 0.0019 ***	-6.8972 0.0000 ***	-2.8751 0.0054 ***	-6.2023 0.0000 ***	-8.2914 0.0000 ***	-3.4076 0.0012 ***	-1.6616 0.0907 *

*show values are significant at 10 %.

**show values are significant at 5%.

***show values are significant at 1 %.

Source: Prepared by researchers based on the results of the EViews 12 programme.

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Through Table (3), we observe from the PP test that all variables are stationary at the first difference, and that all study variables are integrated at the same degree.

4.2.2. Johansen Cointegration Test:

Johansen proposed a test for cointegration, which can be performed by estimating the result of the trace test (**λTrace**) and the maximum eigenvalue test (**λmax**). If the computed test value is greater than the critical value, we reject the null hypothesis of no cointegration vector for the study variables (**H0: r = 0**) and accept the alternative hypothesis of at least one cointegration vector (**H1: r ≠ 0**). If the opposite is true, then we accept the null hypothesis of no cointegration. Table (4) shows the result of the trace test (**λTrace**) and the maximum eigenvalue test (**λmax**) for testing the existence of a long-term relationship between the study variables**.**

Table Nº 04: Johannes test of cointegration

Date: 04/16/23 Time: 12:06
Sample (adjusted): 1987 2020
Includedobservations: 34 afteradjustments
Trend assumption:Lineardeterministic trend
Series: LINF LEXCH LGOVER LGROWTH LINT LM2 LIMP REG
Lagsinterval (in first differences): 1 to 1

UnrestrictedCointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.832673	279.2140	159.5297	0.0000
At most 1 *	0.821871	218.4287	125.6154	0.0000
At most 2 *	0.754963	159.7704	95.75366	0.0000
At most 3 *	0.678436	111.9546	69.81889	0.0000
At most 4 *	0.614344	73.37957	47.85613	0.0000
At most 5 *	0.443756	40.98402	29.79707	0.0017
At most 6 *	0.356766	21.04138	15.49471	0.0066
At most 7 *	0.162737	6.038984	3.841465	0.0140

Trace test indicates 8 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

UnrestrictedCointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.832673	60.78531	52.36261	0.0055
At most 1 *	0.821871	58.65835	46.23142	0.0015
At most 2 *	0.754963	47.81576	40.07757	0.0056
At most 3 *	0.678436	38.57503	33.87687	0.0128
At most 4 *	0.614344	32.39555	27.58434	0.0111
At most 5	0.443756	19.94264	21.13162	0.0727
At most 6 *	0.356766	15.00240	14.26460	0.0382
At most 7 *	0.162737	6.038984	3.841465	0.0140

Max-eigenvalue test indicates 5 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

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Source: Prepared by researchers based on the results of the EViews 12 programme.

After the results of the unit root test showed that all time series are stationary at the first difference, according to Johansen, the non-stationarity of the time series at the level does not rule out the existence of a long-term linear relationship between the variables, and hence the Johansen cointegration test can be conducted.

The results of the Johansen test in Table (4) indicate rejection of the null hypothesis, which means the absence of any cointegrating vector at a significance level of 0.05, due to the results of the Trace statistic test, which shows that the computed maximum likelihood value of 279.2140 is greater than the critical value of 159.5297. Therefore, we reject the null hypothesis and conclude that there is at least one cointegrating equation.

These results are also confirmed by the Max Eigenvalue test, which tests the null hypothesis that the number of cointegrating vectors is equal to r versus the alternative hypothesis that it equals r+1. Since the computed maximum likelihood value of 60.78531 is greater than the critical value of 52.36261, we reject the null hypothesis and confirm the existence of at least one cointegrating equation. Thus, based on these results, it can be said that there is a long-term equilibrium relationship between the variables in the model.

4.3. Estimating the relationship between exchange rate systems and inflation rate in the long run

After confirming the existence of long-run cointegration relationships between the variables of the study model, we move on to the second step by estimating the study model using Fully Modified OLS (FMOLS) method, which takes the following formula:

LINFt = c + β1LEXCHt + β2GOVERt + β3GROWTHt + β4IMPt + β5INTt + β6M2t + β7REGt + εt

Where:

c: constant term;

β1, **β2**, **β3**, **β4**, **β5**, **β6**, **β7**: long-run relationship parameters;

εt: random term.

The estimation results are shown in Table (5).

Table Nº 05: Estimates of the model parameters in the long run using the FMOLS method

Dependent Variable: LINF
Method: Fully Modified Least Squares (FMOLS)
Date: 04/17/23 Time: 03:34
Sample (adjusted): 1986 2020
Included observations: 35 after adjustments
Cointegrating equation deterministics: C
Long-run covariance estimate (Bartlett kernel, Newey-West automatic bandwidth = 4.6484, NW automatic lag length = 3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LEXCH	-1.630593	0.560200	-2.910732	0.2371
LGOVER	1.771329	0.857814	2.064934	0.0487
LGROWTH	-3.656135	4.126735	-0.885963	0.3835
LIMP	0.464844	0.200301	-2.320732	0.0281
LINT	2.505623	0.573580	4.368391	0.0002
LM2	0.316048	0.592994	0.532970	0.5984
REG	-0.953190	0.317536	-3.001832	0.0057
C	36.69310	38.57316	0.951260	0.3499

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R-squared	0.616671	Mean dependent var	1.710284
Adjusted R-squared	0.517289	S.D. dependent var	0.981002
S.E. of regression	0.681575	Sum squared resid	12.54268
Long-run variance	0.265095		

Source: Prepared by researchers based on the results of the EViews 12 programme.

From table (5) we note the following:

- There is a significant long-term relationship between the two real exchange rate systems in Algeria and the inflation rate ;
- There is a significant inverse relationship between the crawling peg system with a parallel market and the inflation rate in the long term, while the managed float system with a parallel market leads to inflationary pressures. The model assumes that in the long term and assuming the stability of all other explanatory variables, the application of the crawling peg system (when the value of the variable is equal to 1) will result in an expected decrease in the inflation rate by 0.953190% compared to the managed float system with a parallel market. This is consistent with the study by Ghosh et al (1996) who found that fixed exchange rate systems are better than intermediate systems, and intermediate systems are better than flexible systems.

4.4. Estimating the Error Correction Model:

The presence of a common integration means that the variables should be represented by the Error Correction Model to estimate short-term effects. The Error Correction Model is used to adjust the behavior of the variable in the short term with its behavior in the long term, where the differences (errors) between the estimated values and the actual values of the dependent variable in the integrated model are extracted, and then the estimation is repeated for the model by introducing the first differences of the errors as a new independent variable, according to the following equation (Patterson 2002):

$$\Delta Z_t = \alpha + \sum_{i=0}^{p} \beta_t \Delta Z_{t-i} + \lambda \mu_{t-1} + e_t$$

Where: Z represents the vector of variables to be tested, β parameters represent short-term elasticities, the difference parameter λ represents the speed of adaptation between the short and long term, and this variable is stable if its absolute value is less than one and its sign is negative (Patterson, 2002). This is the method known as the Angel and Granger method of error correction, which is extracted according to the following steps (Engle et Granger 1987):

4.4.1. Residual stability test

This method requires two steps, the first step involves estimating the relationship using ordinary least squares and obtaining the residuals (Resid) from this estimate. The second step is to test the stationarity of the residuals (denoted by the symbol Z) obtained from the first step. If the residuals are stationary at the level, it indicates the presence of a long-term cointegration between the variables, and the estimated relationship in the first step is valid and unbiased. However, if the residuals are non-stationary at the level, it suggests that there is no long-term equilibrium relationship between the variables, and the previous relationship is biased and cannot be relied upon (Patterson 2002).

To confirm the stability of the residuals (Z), we use the ADF test at the level (see Appendix 1), and summarize the results in Table 6.

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Table Nº 06: ADF Test Results for Z Residues

Constant		Constant, Linear Trend		None	
$t_{\Phi 1}$ *cal*	$t_{\Phi 1}$ *tab*	$t_{\Phi 1}$ *cal*	$t_{\Phi 1}$ *tab*	$t_{\Phi 1}$ *cal*	$t_{\Phi 1}$ *tab*
-5.618247	-3.632900 **:1%**	-5.531905	-4.243644 : **1%**	-5.708449	-2.632688 : **1%**
Prob	-2.948404 : **5%**	**Prob**	-3.544284 : **5%**	**Prob**	-1.950687 : **5%**
0.0000	-2.612874 : **10%**	0.0004	-3.204699 : **10%**	0.0000	-1.611059 : **10%**

Source: Prepared by researchers based on the results of the EViews 12 programme.

Through the results in Table (6) above, we notice that the calculated ADF test statistic is lower than the Mackinnon critical values at the 1%, 5%, and 10% significance levels. This indicates that the residual series Z is stationary, and therefore the estimated model variables are integrated and cointegrated. Hence, we can estimate an error correction model.

4.4.2. Estimation of the Short-Term Relationship between Exchange Rate and Inflation Systems

After confirming the existence of a cointegrating relationship and the stability of the model residuals, it is possible to estimate an error correction model. The results of the estimation are presented in Table (7) below:

Table Nº (7): Results of the estimated error correction model

Dependent Variable: D(LINF)
Method: Fully Modified Least Squares (FMOLS)
Date: 04/18/23 Time: 02:53
Sample (adjusted): 1987 2020
Included observations: 34 after adjustments
Cointegrating equation deterministics: C
Long-run covariance estimate (Bartlett kernel, Newey-West automatic bandwidth = 3.0334, NW automatic lag length = 3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LEXCH)	-1.610124	0.503852	-3.195631	0.0038
D(LGOVER)	1.673389	0.958629	1.745606	0.0932
D(LGROWTH)	3.750139	3.804685	2.985663	0.0037
D(LIMP)	0.397869	0.222938	1.784659	0.2865
D(LINT)	2.599146	0.522528	4.974173	0.0006
D(LM2)	1.429416	0.565430	3.759452	0.0047
REG	0.089998	0.307211	0.178044	0.6816
Z(-1)	-0.765598	0.047609	-14.44406	0.0000
C	-0.435268	0.355755	-0.914668	0.3691

R-squared	0.626316	Mean dependent var	-0.006608
Adjusted R-squared	0.506737	S.D. dependent var	0.985553
S.E. of regression	0.692180	Sum squared resid	11.97783
Long-run variance	0.023911		

Source: Prepared by researchers based on the results of the EViews 12 programme.

From table (7), we notice the lack of a significant relationship between exchange rate systems and inflation in the short term, meaning that the crawling peg system did not affect inflation rates in the short term.

4.5. Testing the validity of the model

To ensure the validity of the model, some tests are conducted as follows:

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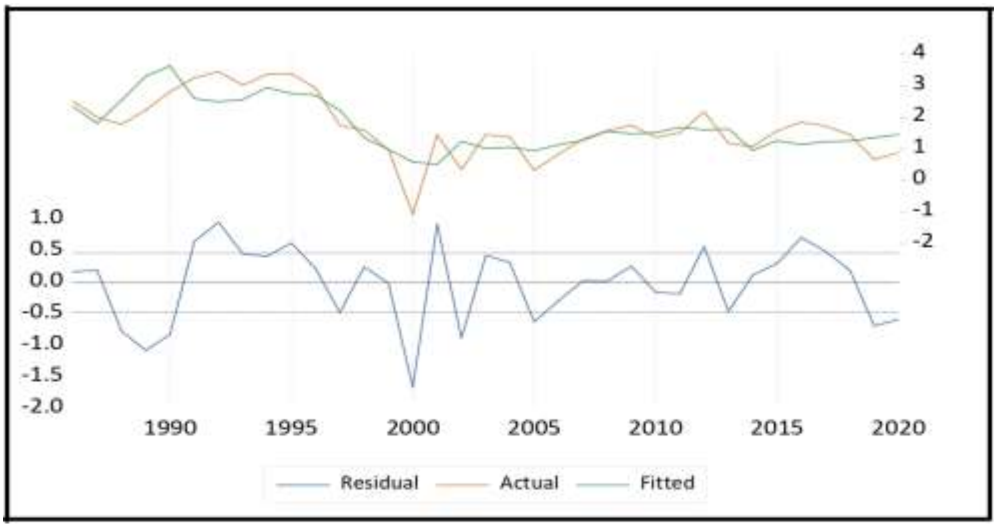
4.5.1. Testing the stability of residuals in the long term

From table (5), the R-squared coefficient of determination for the estimated model was 0.61, indicating that the independent variables explain 61% of the variation in the dependent variable. For further accuracy in estimation, actual values can be compared to estimated values through the following figure (1):

Figure Nº (01): Residual stability test for the estimated model

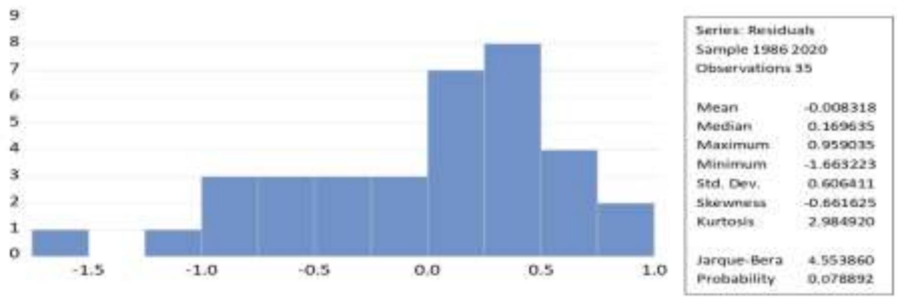


Source: Prepared by researchers based on the results of the EViews 12 programme.

Through Figure (1), we can observe the convergence of the estimated values to the true values, indicating the quality of the estimated model. We also note that the Durbin-Watson statistic for the inflation function is not present, because the fully modified least squares method used has the ability to solve the problem of autocorrelation.

Additionally, the normal distribution assumption for the residuals resulting from the model estimation is supported by the Jarque-Bera test, which found the test result to be insignificant. This supports the hypothesis that the residuals of the model follow a normal distribution. Figure (2) illustrates this.

Figure Nº (02): Testing the normal distribution of the residuals



Source: Prepared by researchers based on the results of the EViews 12 programme.

4.5.2. Testing the stability of residuals in the short run

To ensure the validity of the model in the short run, the following tests are conducted:

Through Table 7, we notice that the adjusted coefficient of determination is 0.62, meaning that the independent variables explain 62% of the variation in the dependent variable in the short run.

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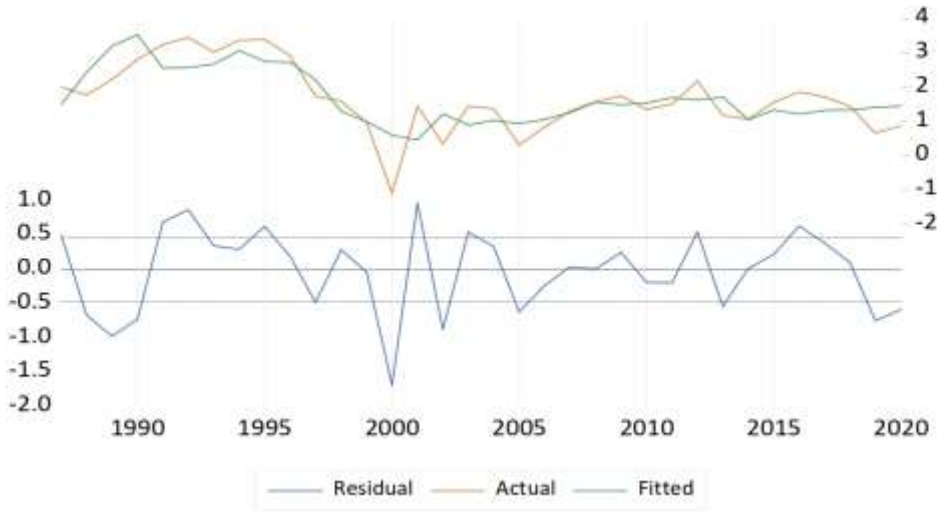
Furthermore, the boundary parameter for error correction, Z(-1), appears in the previous table as negative at a significance level of 1% and a value of 0.765598, confirming the validity of the long-run equilibrium relationship and the presence of error correction mechanism in the model. When the inflation rate deviates from its long-run equilibrium value in period (t-1), 76% of this deviation is corrected in period (t).

To ensure that the error correction model is free of specification problems, we compare the actual values with the estimated values. This is shown in the following figure.

Figure Nº (03): Testing the stability of residuals in the error correction model.



Source: Prepared by researchers based on the results of the EViews 12 programme.

We can observe from the above figure the convergence of the estimated values to the actual values, indicating the quality of the model, which can be relied upon for interpretation and analysis of the results.

4.5.3. The problem of multicollinearity

To perform tests on the validity of the model, it is important to note the independence of the independent variables from each other to avoid the problem of multicollinearity, which negatively affects the estimation results. To check for the absence of multicollinearity, we conducted a test for the Variance Inflation Factor (VIF), which usually indicates a value less than 10 for this factor to weaken the negative effect of this problem. Through the VIF test, it was observed that the value of the variance inflation factor for all variables is less than 10, indicating the absence of the negative effect of multicollinearity. Therefore, we can rely on the results of the estimated model, and the following table illustrates this.

Table Nº (08): VIF coefficient, error correction model

Variance Inflation Factors
Date: 04/26/22 Time: 03:38
Sample: 1985 2020
Included observations: 34

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
D(LEXCH)	0.253867	3.527181	3.029133
D(LGOVER)	0.008970	1.466991	1.773808
D(LGROWTH)	3.447563	3.151935	2.604765
D(LIMP)	0.099701	1.674497	2.180645
D(LINT)	1.373036	2.400584	1.307452

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D(LM2)	0.319711	4.181383	1.933009
REG	0.004379	1.191250	2.452574
Z(-1)	0.021788	1.216091	1.215908
C	0.040569	22.42020	NA

Source: Prepared by researchers based on the results of the EViews 12 programme.

5. Conclusion:

Determining the optimal exchange rate system is important for determining the exchange rate policy's impact on the overall economy. Therefore, the study aimed to identify the appropriate exchange rate system that gives the lowest inflation rate for the Algerian case. Firstly, we identified the actual exchange rate systems for the Algerian dinar by adopting the approach of Reinhart and Rogoff (2017). Then, we measured their impact on inflation rates.

We used the Fully Modified Ordinary Least Squares (FMOLS) method and the error correction model during the period (1985-2020). After conducting some tests on the model variables, we arrived at the following results.

- It has been shown that exchange rate systems vary from country to country, depending on objectives, priorities, the level of local economic development, and surrounding circumstances. These systems range from fixed to intermediate to floating, and it cannot be said that a fixed exchange rate system is the best system that has a performance in reducing inflation rates in all countries. In developing countries, a fixed exchange rate system has better performance in combating inflation, while in advanced countries with advanced financial markets, they can benefit from flexible exchange rate systems to reduce inflation. As Ghosh et al. (1996) mentioned, one system cannot help and suit all countries at the same time. Therefore, the country must choose between these systems and see and apply the system that serves and achieves the best performance to reduce inflation ;
- Algeria follows a different exchange rate system that is not officially announced, through the study of Reinhart and Rogoff (2017), which reveals that Algeria did not follow the fixed system, but followed the crawling band system for the US dollar before the conversion. The classification also indicated that Algeria carried out a managed float of its currency during the period (1988-1994), during which Algeria stated that it followed a basket currency system and was moving towards a managed float system. When Algeria began to follow the managed float system, according to statements, this classification came to refute that. It is worth mentioning that since the beginning of 1995 until now, Algeria has been following the crawling band system for its currency ;
- Through FMOLS and ECM tests, it was found that there is a significant inverse relationship between the crawling band system with the existence of a parallel market in the two periods (1985-1987, 1995-2020) and long-term inflation rate, while the managed float system with the existence of a parallel market leads to an increase in inflation ;
- There is no significant relationship between the two real exchange rate systems for the Algerian dinar and short-term inflation.

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