Determinants of Inflation in Algeria: Analysis with a Vector Error Correction Model from 2001 to 2016

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Summary: This study aims to identify the determinants of inflation, highlighting the case of Algeria from 2001 to 2016. For better results, we have adopted the descriptive approach besides econometric methods on quadrennial data, by estimating a Vector Error Correction Model (VECM).

The empirical results showed that there is a positive causal relationship, starting from the broad money supply and public expenditure to inflation, whether in the short or the long term. The same is for oil rents while going through an inverse relationship in the short term. Another negative relationship was also found from the unemployment rate to inflation, and this only in the long term.

Keywords: Inflation; Money Supply; Oil Rents; Unemployment; VECM.

Jel Classification Codes : C22 ; E31 ; E37

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I-Introduction:

Price stability is an essential factor in maintaining the purchasing power of money. It contributes to attracting savings, increasing the competitiveness of exports and controlling unemployment. Price stability is therefore an indicator of economic stability, whatever its degree of development.

On this basis, the inflation rate reflects the health of whatever economy, which is confirmed by several economic theories, which have interpreted inflation according to its causes from various angles to monetary inflation, demand and cost inflation, and structural inflation.

In early 2001, Algeria experienced an exceptional economic situation, characterized by economic stability both internally and externally. In this context, the Algerian State has sought to develop and implement numerous programs to achieve a strong economic development; which will last over time, and in the same time improving the social situation. However, this period marked a low level of local production with a continuous increase in the general level of prices.

In this regard, this study focuses on the discovery of the determinants of inflation in Algeria, through an econometric study to see factors that led to high inflation rates despite all efforts, by answering the following main question:

What are the main determinants of inflation in the Algerian economy during the period 2001-2016?

This main question stimulates the following sub-questions:

- What are the main characteristics of inflation?
- How did economic theories explain inflation?
- What is the nature of inflation in the Algerian economy?

To answer all these questions, we developed four (04) major hypotheses, as follows:

- **First Hypothesis:** there is a statistically significant relationship, going from broad money supply to inflation.

- **Second Hypothesis:** there is a statistically significant relationship, going from general government spending to inflation.
- **Third Hypothesis:** there is a statistically significant relationship ranging from the unemployment rate to inflation.

- **Fourth Hypothesis:** there is a statistically significant relationship tends from oil revenues to inflation.

The importance of the study lies in the fact that it cares about an important issue in the Algerian economy, which is prices stability, especially with the worrying evolution of inflation rates in Algeria during the period 2001-2016, whichneed a lot ofmeditation. The study will highlight the causes of inflation in Algeria, which could help the state to better control its development policies, avoid disasters and maintain both economic and social stability.

I.1.Theoretical Literature Review

Today, inflation has become a well-known economic phenomenon. Inflation corresponds to a constant increase in the general level of prices. This increase causes a devaluation of the local currency and gradual erosion of purchasing power. However, trying to understand this phenomenon and determine its causes is a complex question. Jean Bodin (1566) is the first to evoke the phenomenon of inflation, when he was interested in investigating the reasons for the high prices, which hit France at that time, indicating that it was due to the flow of precious metals from America coming to France. For David Hume, he was the first to give a dynamic analysis of the process in which monetary changes affect prices by propagating from one economic sector to another(Totonchi, 2011, p. 459), given that if money increases five times in one night, prices will also multiply.

Indeed, many economists of classical thought, such as Richard Cantillon, David Ricardo, and John Mill Stuart, have interpreted inflation as being caused by inflation in the money supply. The same is true of neoclassical thinkers, which did not differ in absolute terms in that the increase in money supply is the main cause of inflation. The latter being anxious to place the phenomenon in a system of equations represented in particular in the work of Walras (1874), and Irving Fisher (1911) (Gilles, 1997, p. 27).

The monetarist Milton Friedman pointed out that inflation is a monetary origin “Inflation is always and everywhere a monetary phenomenon”. Therefore, each growth in money supply with greater real income is accompanied by an increase in inflation. If the authorities wanted to fight inflation, they had to follow the "monetary base" in the sense of moving the mass at a stable rate equal to the long-term growth rate of national production(Gilles, 1997, p. 27).

Nevertheless, some economic thinkers believed that the increase in the money supply does not necessarily lead to an increase in inflation. Michell Aglietta said that reality comes to contradict monetarist thought. As for the owners of the endogenous money theory, post-Keynesian, structuralists as well as the horizontal ones (horizontalist), considered that the money supply is linked to the state of the loan request. The interest rate is an external variable in the system because the banks provide cash at a rate, which fixes it, and this according to certain criteria approved by the central bank, such as political reasons, inflation, etc. On this basis, money is considered internal. Thus, money has no role during the inflationary process. In their view, it is possible that inflation emerges without an increase in money. For the majority, they consider that money is not a cause of inflation but rather a permissive condition for inflation (Bouvet, 1996, pp. 455-456).

On the other hand, this phenomenon may be a direct result of an increase in demand, which can sometimes come from expansionary spending policies causing an increase in demand. That’s what Keynes (1940) explained in his book "How to pay for the War", when he blamed the demand increase in the inflationary process, through the term inflationary gap (Motel & et.al, 2013, p. 15):A situation where supply is insufficient to meet excess demand. In the case of war, the means of production are oriented towards the armament process, which creates a rigidity of supply in terms of production means available for civilian production because it becomes unable to respond to the consumer demand as a whole(Gilles, 1997, pp. 29-30).

I. 2. Empirical Literature Review:

On the Among the studies that touched on the topic of inflation and its determinants, Yen Chee Lim and Siok Kun Sek (2015) examined factors affecting inflation using annual data from

1970 to 2011 in two groups of countries (high inflation group and low inflation group). They found that money supply, national expenditure, and GDP growth are the determinants of inflation in high inflation countries. However, they found that money supply, imports of goods, and services and GDP growth have a significant relationship with inflation in low inflation countries.

Eftekhari Mahabadi and Kiaee (2016) focused on studying the factors influencing the evolution of inflation rates using panel data from 2008 to 2012. To increase model predictability and precision, they used two thresholds. The results of both models show that monetary growth, GDP, oil prices, and income levels of the available countries are important predictors of the increase in inflation rates next year.

Mohanty and Klau (2001) studied the determinants of inflation in emerging economies. They used quarterly changes in the variable data in 14 emerging countries during the 1990s. the results showed that the money supply output gap and wages have a significant effect on inflation.

Lim and Papi (1997) have shed light on the determinants of inflation in Turkey. In this study, they have adopted time-series data from 1970 to 1995. The authors have applied the Johansen Cointegration technique to find out results. The analysis concludes that money, wages, prices of exports, and prices of imports have a positive influence on the domestic price level whereas the exchange rate exerts an inverse effect on the domestic price level in Turkey (Bashir & et.al, 2011).

Khan et al. (2007) have found the most significant explanatory factors for recent inflation trends in Pakistan. Time series data from 1972 to 2005 has been used in the study. The authors have employed the ordinary least square method to estimate results. The analysis concludes that government sector borrowing, real demand(Bashir & et.al, 2011)**,** import prices, exchange rate, government taxes, previous year consumer price index, and wheat support prices are found to have a direct contribution to the consumer price index of Pakistan(Bashir & et.al, 2011, p. 73).

From Algeria, Kori (2014) diagnosed the determinants of inflation in Algeria's economy during 1970- 2012, using a Structural Vector Autoregression (SVAR) model, Impulse response functions, and variance decomposition. The results show that wages bill, imported goods prices, GDP, money supply, and expenditures are the main determinants of inflation in the short run while money supply, prices of imports, wages bill and the fiscal revenues are determinants of inflation in the long run.

Rais (2017) analyzed the most important causes of the inflation phenomenon in Algeria during the period 2000-2015, a very complex phenomenon, according to him, because of multiplicity and overlapping causes between monetary and other structural variables. He found that imported inflation contributes significantly to the worsening of this phenomenon. He recommended that monetary and fiscal policy take more measures to face this problem.

II– Methods and Materials:

In this part, we will see the methodology, tools, and methods adopted to know the determinants of inflation in the Algerian economy during the period 2001 to 2016. We rely on the Eviews program that includes many tests and models that enable us to know the impact of the independent variables adopted in the econometric study on the dependent variable

a) Data Presentation:

This study relied on the annual time series data of the Algerian economy available in the World Bank database https://data.worldbank.org) from 2001 to 2016. To increase this number to more than thirty (30) views, we have converted the annual data to quarterly, based on the statistical analysis program Eviews. Thus, the number of observations has become an estimated sixty-four (64) views.

Through the theoretical & empirical review and the available statistics for the Algerian economy, we have formulated the mathematical formula of the multiple regression model, expressing the specific economic variables of inflation for the period (2016-2001) as follows:

$$LINF = f(LM_2, LGGS, LUNR, LOILR)$$

Whereas:

o LINF: represents the natural logarithm of annual inflation rate in Algeria, as it measures the annual change in the general level of prices calculated by Laspeyres method;

o M2: is the natural logarithm of the broad money supply. It includes central currency, bank's reserves (deposits) in Central Bank, quasi-money, such as time deposits and savings deposits at short term, and other securities and commercial paper.
o LGGS: represents the natural logarithm of the annual evolution of general government spending, represented by total public spending (in exception of military expenditure).
o LOILR: represents the natural logarithm of the country's oil rents. it represents the difference between the value of crude oil at its price on the international market and its total cost of production;
o LUNR: is the natural logarithm of the annual national unemployment rate.
Before estimating the model to be used in the study, it is worth using the results of the econometric methods that lead to choosing the appropriate standard model. these methods are represented in two main steps: the stability of the time series test of each variable, and the cointegration test.

b) Time Series Stability Test:

The stability of the time series is a necessary condition to reach logical and accurate results and to know the possibility of studying the long-term relationship between both inflation and independent variables.

In order to know the degree of stability, the Unit Root Test of Phillips-Perron is used for each series separately. The results showed that each variable used in the study settles at the first degree as it's shown in table (1).

According to the same table, we note that both the inflation rate and independent variables are not stabilized at their original state (at level) because the probability p-value for each of them is greater than the level of significance 5%. Thus we accept the null hypothesis sitting the existence of unit root problem. In turn, all variables became stable at the first difference as the P-values become smaller than the level of significance at 5%. In this case, we reject the null hypothesis and accept the alternative one that there is no unit root. Therefore, variables cointegrate in the same degree I ~ (1). This indicates the possibility of doing the cointegration test of Johansen.

c) Cointegration Test:

Since the variables are first-degree integrals, a test of a long-term relationship called cointegration between study variables can be done through Johansen's test of cointegration (Table (3)):

The results of the test show that there is a single common relationship of cointegration between the study variables, and this is either on the level of the Trace Test or on the Maximum Eigenvalues test

III- Results and discussion:

a) Model Study Estimation :

The cointegration relationship between inflation and independent variables indicates a causal relationship in at least one direction. The determination of this causal relationship for the long and short terms requires the introduction of granger causality on the ECM Error Correction Model. Therefore, the most appropriate model, in this case, is the Vector Error Correction Model (VECM) to determine this causality and estimate the speed of reaching in the long-run equilibrium of any short-term imbalance between the variables in the model.

According to Eviews outputs (see table (5)), the VECM model equation is estimated as follows:

$$\begin{aligned} D(LINF) = {} & C(1)(LINF(-1) - 0.93427834979\, LM2(-1) - 0.0275806315422\, LGGS(-1) \\ & + 2.50694855888\, LUNR(-1) - 1.33238559\, LOILR(-1) - 9.08176925454\,) \\ & + C(2)D\big(LINF(-1)\big) + C(3)D\big(LINF(-2)\big) + C(4)D\big(LM2(-1)\big) \\ & + C(5)D\big(LM2(-2)\big) + C(6)D\big(LGGS(-1)\big) + C(7)D\big(LGGS(-2)\big) \\ & + C(8)D\big(LUNR(-1)\big) + C(9)D\big(LUNR(-2)\big) + C(10)D\big(LOILR(-1)\big) \\ & + C(11)D\big(LOILR(-2)\big) + C(12) \end{aligned}$$

Whereas:
C(1): Is the speed of adjustement correction term"

C (1), C (2), ...,: C (11) represent the coefficients of the independent variables. Each variable has two coefficients, and this is according to the number of gaps used in the study (two gaps) (see Table (2)).
C (12): Relates to the constant term.
According to Eviews Outputs shown in table (4), the long-term cointegration formula takes the following form:

$$LINF = \underset{(5.14)}{0.9342}\ LM_{2\,t-1} + \underset{(2.088)}{0.0275}\ LGGS_{t-1} - \underset{(-7.15)}{2.5069}\ LUNR_{t-1} + \underset{(3.69)}{1.3323}\ LOILR_{t-1} + +9.0817$$

Since the t statistic calculated for all the coefficients is greater than the tabular value of t (2.00) at the significance level of 5% and the degree of freedom (56-4= 52). This indicates that all the coefficients are different from zero, and means that all variables are therefore significant.

Through this significant long-term equation, there is a direct relationship between both money supply and inflation, public spending and inflation, and the same thing for oil rents and inflation. For the unemployment rates, there is a negative relationship. The results indicate the important role of the unemployment rate and oil rents in influencing the inflation rate in Algeria.

o The speed of adjustment correction term is negative (C (1) = - 0.306064) and statistically significant (Prob = 0.0000) which indicates a long-term relationship between all study variables. It explains that independent variables correct themselves every quarter with a rate of 30.60% to reach equilibrium in the long run

o The coefficient of determination (R-Squared) is estimated at 0.5594, which means that 55.94% of inflation's changes are explained by the independent variables, whereas the remaining percentage (44.06%) is the result of other variables not included in the model (Table (5))

o The (Prob (F-statistic)) value is 0.000032, it is less than 0.05his. This indicates the significance of the model as a whole (Table (5)).

To verify the significance of the coefficients of the independent variables, and thus the relationship of each independent variable to inflation separately. We use Wald Test-coefficient Restrictions, and thus to verify the relationship of each independent variable to inflation separately. The Wald test (also called the Wald Chi-Squared Test) is, therefore, a way to find out if explanatory variables in a model are significant (Agresti, 2007, p. 11), i.e., if they add something to the model in the relationship between each variable and inflation. Its results shown in table (6) are shown as follows:

• **A positive relationship goes from money supply to inflation:** because the probability value is completely below the significance level 0.05, and therefore reject the null hypothesis of the Wald test.

• **A positive relationship that tends from public spending to inflation:** because the probability value is completely less than the 0.05 level of significance in the sense that the coefficients are not equal to zero and therefore reject the null hypothesis of the Wald test.

• **A relationship goes from the unemployment rate to inflation:** because the probability value is completely below the significance level 0.05, and thus accept the null hypothesis of the Wald test.

• **A negative relationship tends from petroleum revenues to inflation:** The probability value is also less than the 0.05 level of significance in the sense that the coefficients are not equal to zero, thereby rejecting the null hypothesis of Wald test.

The results obtained are logical by projecting them to the Algerian reality. Thus, we accept the four study hypotheses, which can be explained as follows:

- The first accepted hypothesis is explained by the existence of excess liquidity in the economy, without this having an impact on production. Agents get money in the form of salaries and increases that have not been restored or directed to productive projects as required by the needs of the country. This leads to increased consumer spending, which in turn has widened the gap between domestic supply and demand. Besides, money, during this period, is considered exogenous (it has no cause and effect relationship between it and the rest of the independent variables.) This corresponds to the monetarist view of inflation.

- Accepting the second hypothesis that there is a statistically significant relationship between government spending, and inflation in Algeria, both in the short and long term, is due to the expansionary spending policy pursued by the country, which is mainly focused on major

investment in infrastructure that has led to the development of new expenditure and income for workers in these projects.

- Accepting the third hypothesis that there is a statistically significant relationship goes from unemployment rates towards inflation in Algeria in the long run. Actually, the state's policy to eliminate unemployment in Algeria through various employment programs contributed relatively to reducing the unemployment rate, and this effect indicates that unemployment rate will not reach its natural rate in the long run. As for the short term, the insignificance of the relationship between the rate of inflation and unemployment is due to the lack of clarity on the relationship in Algeria. In the long run, oil revenues, like money, affect inflation rates up, as a source of monetary creation because it is a source of monetary creation.

b) VECM quality statistical tests:

To verify the quality of the form used, the following statistical tests are used:

- **Residuals Serial correlation test:**

The results of the "Breusch Godfrey Serial Correlation LM Test" shown in Table 6 demonstrate that the critical values of the statistic are greater than 5% and thus the null hypothesis that there is no serial correlation is accepted, which is indicates that the model does not have a serial correlation problem.

- **The Heteroskedasticity test:**

To ensure that the model does not have a heteroscedasticity problem, we use the heteroskedasticity tests (Breusch Pagan Godfrey and White Heteroskedasticity test). The results represented in Figure (1), show that the critical value of the statistic exceeds 5%, and hence the null hypothesis that there is no such problem

- **Stability Test and Cusum Curve**:

Since the CUSUM curve (Figure (2)) remains within the 5% level of significance throughout the study period, indicating the stability of the model as a whole.

c) Analyzing Shocks and impulse Response Functions:

VECM results indicate the homogeneity or heterogeneity of the system and direction of the causality Granger during a sample period. However, it can not provide us with the dynamic characteristics of the system. The analysis of the dynamic interactions between the variables in the post-sample period is performed through the Impulse Response functions and Variance Decomposition.

The impulse response functions measure the degree of the impulse response of a transitory or permanent shock to each of the endogenous variables (Rezitisa & Ahammad, 2015). Thus, The Impulse Response functions show future dynamic responses (in the long term) of the model's variables, as a relationship in the time, through their response to one or more future positive shocks from the independent variables.

According to Eviews outputs, for 24 period we obtain the following results:

• **Response of inflation rate to one or more positive shocks in the money supply**:

From the results shown in Figure (3), we see that a positive shock in money supply (LM2) will have a significant positive impact on inflation rates (LINF), this is evident from the fourth period (from the second year). Repeated shocks in money supply will further increase the inflation rates, which indicates that money in Algeria is exogenous.

• **Response of inflation rate to one or more positive shocks in public spending**:

As indicated in the graph (see Figure (3)), a positive shock in public spending will be positive, mostly from the first until the eighth period. After a slight dip, it goes back up from the fifteen period. An occurrence of repeated shocks leads to a continuous rise in inflation. This indicates public spending affects strongly inflation trends.

• **Response of inflation to one or more positive shocks in unemployment rate:**

The graph below (in Figure (3)) explains that a positive shock to the unemployment rate (LUNR) will have an opposite response to the inflation rate, i.e. the relationship between unemployment and inflation is inverse. The inflation rate decreases more and more in response to accumulated shocks.

• **Response of inflation rate to one or more positive shocks in the oil rents:**

In the same way, Eviews outputs provides in Figure (3) show that a positive shock in oil rents has a wavering positive increasing in inflation over time. In addition, the occurrence of accumulated positive shocks causes a continuous and slowly increasing in inflation rate.

d) Variance Decomposition Analysis:

The Variance Decomposition results for 24 periods yield the following results (see Table (10) :

• In the short term:

In the short term, variance decomposition results show that the largest percentage which is 100% of inflation rate changes , is explained by shocks in the same variable (inflatin) during the first period, represented in the first four periods (1 year) after which this percentage gradually decreases. As for the independent variables, the unemployment rate is the most important that explains inflation changes with an estimated rate of 6.37%, followed by petroleum revenues at 1.65%, then public spending at 0.55% and finally the money supply. 0.45%

• In the medium term:

In the medium term, which extends from the fourth period to the fifteenth period (one to five (5) years)), we see that money supply becomes the main interpreter in error variance during this period. Followed by unemployment rate, at a rate of 10.73%, which is the peak for this variable, and then public spending (8.43%) and finally petroleum rents at 3.77%.

• In the long run:

In the long run (sixteenth to twenty-fourth period) , money supply is still considered as the most important interpreter with a rate of 51.60% (the peak for this variable) followed by oil rents that peak at the level of 5.95% , public spending at 5.57% and finally, unemployment rate at 3.75%.

We conclude therefore that unemployment rate is the main interpreter high inflation rates in the short term for the post-sample period (the future period), but this effect tends to decrease to become less important in the long term, while money supply is the main interpreter in the medium to long term.

IV-Conclusion:

Finally, we consider inflation as one of the most important contemporary economic issues, which need a lot of comprehension and analysis. Moreover, the determinants of inflation differ in each economy or in the same economy over time.

We can summarize the main results of the study as follows:

- The determinants of inflation are many and different in nature and influence; as a result, it is hard to grasp them.
- The phenomenon of inflation received great attention in the economic literature. Some of the most important economists touched on this topic and explained the phenomenon of inflation for several causes.

Inflation in Algeria is primarily a monetary phenomenon, resulting from an increase in money supply, and hence in consumption, was not matched by an increase in production. This means that money supply growth is a determinant of inflation in Algeria through a direct positive relationship.

- The expansionary fiscal policy pursued by the government, based mainly on massive investments in infrastructure, created new spending, wages, and incomes. Thus it created an excess purchasing power that is not in line with the productive capacities of the country. For that, we consider public spending as a determinant of inflation in Algeria through a positive relationship.
- Unemployment is also a determinant of inflation in Algeria, and this, through an inverse long-run relationship.
- In lower oil rent periods, the government takes several restrictive measures in order to limit import operations. The demand for imported goods turns to a demand for locally produced goods that are not sufficient in the Algerian case because of a deficiency in the local production system, which public spending has not succeeded to revive it. Alternatively, the presence of monopolistic systems for the lack of economic dealers. This leads to “a contraction in the supply”, and this is what drives prices increase in goods and services. For this reason, oil revenues are also a major determinant of inflation in Algeria.

- The imbalance lies in the structural characteristics of the Algerian economy, which is the reason that makes various economic plans be encouraging in terms of goals and disappointing in terms of results, related to the rigidity of supply.

The results obtained make it possible to give a few recommendations that can help to reduce inflation, namely:

- Algerian government should encourage investments in necessary and productive sectors in order to reduce inflation pressure in the long run, especially by focusing on the agricultural sector because it is the main contributor to the replacement of imported goods.
- It is not advised to absorb liquidity by raising interest rates due to the lack of a culture of savings in Algerian society.;
- The Algerian government should rationalize spending policies and maintain a balance between the social and economic goals of the country;
- Avoid resorting to unconventional monetary policies focused on cash printing, as long-term inflationary pressures will increase if they are not tailored to financing productive investment.
- There is an imbalance in the development plans introduced in Algeria. The plans are poorly directed towards the priority sectors of the Algerian economy. It is, therefore, appropriate to replace these plans with three triple alternative plans: the first plan would encourage the primary sector (agriculture, fisheries, primary industries, etc.). The second plan should benefit the secondary sector (food industry, construction and public works, pharmaceutical, textile, and electronic industries). Finally, the third one concerns the promotion of the third sector (tourism, insurance, and services).

- Appendices:

Table (1) :Summary of Phillips Perron's Unit Root Test Results

Variables	Phillips Perron test			
	Level	P-values	1st Difference	P-values
LINF	-0.928338	0.3106	-4.192465	0.0001
M_2	-1.572045	0.1083	-4.310301	0.0000
LGGS	-1.857832	0.0606	-5.017894	0.0000
LOILR	-0.011351	0.6752	-3.513646	0.0007
LUNR	-1.296825	0.8797	-4.347577	0.0051

The source: Evviews outputs

Table (2): Johansen System Cointegration Test Results

Date: 05/08/18 Time: 16:44
Sample (adjusted): 2001Q4 2015Q3
Included observations: 56 after adjustments
Trend assumption: Linear deterministic trend
Series: LINF LM2 LOILR LUNR LGGS
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.559249	89.75916	69.81889	0.0006
At most 1	0.321660	43.87981	47.85613	0.1125
At most 2	0.198650	22.14583	29.79707	0.2905
At most 3	0.137100	9.744228	15.49471	0.3009
At most 4	0.026198	1.486676	3.841466	0.2227

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The source: Eviews outputs

Table (3): VAR Lag Order Selection Criteria

VAR Lag Order Selection Criteria
Endogenous variables: LINF LM2 LUNR LOILR LGGS
Exogenous variables: C
Date: 05/14/18 Time: 06:04
Sample: 2001Q1 2016Q4
Included observations: 56

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-245.2097	NA	0.005230	8.936060	9.116895	9.006169
1	120.0853	652.3125	2.77e-08	-3.217333	-2.132323	-2.796677
2	178.7432	94.27165*	8.50e-09*	-4.419401*	-2.430217*	-3.648199*
3	192.6141	19.81546	1.34e-08	-4.021931	-1.128571	-2.900182

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

The source: Eviews outputs

Table (4) : VECM Results (1)

Vector Error Correction Estimates
Date: 05/08/18 Time: 15:41
Sample (adjusted): 2001Q4 2015Q3
Included observations: 56 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LINF(-1)	1.000000
LM2(-1)	-0.934278 (0.18167) [-5.14286]
LGGS(-1)	-0.027581 (0.01320) [-2.08877]
LUNR(-1)	2.506949 (0.35015) [7.15968]
LOILR(-1)	-1.332386 (0.36101) [-3.69075]
C	-9.081769

Error Correction:	D(LINF)	D(LM2)	D(LGGS)	D(LUNR)	D(LOILR)
CointEq1	-0.323760 (0.06821) [-4.74675]	0.122429 (0.11154) [1.09763]	1.284511 (0.75979) [1.69061]	-0.044757 (0.01396) [-3.20676]	0.049649 (0.02476) [2.00518]
D(LINF(-1))	0.503850 (0.12927) [3.89770]	-0.134680 (0.21139) [-0.63711]	-0.525129 (1.43999) [-0.36467]	-0.012706 (0.02645) [-0.48036]	0.014830 (0.04693) [0.31602]
D(LINF(-2))	0.188560 (0.14182) [1.32960]	-0.149119 (0.23191) [-0.64299]	-1.577117 (1.57978) [-0.99832]	0.026516 (0.02902) [0.91371]	-0.060206 (0.05148) [-1.16945]
D(LM2(-1))	-0.244550 (0.15368) [-1.59125]	0.817527 (0.25132) [3.25293]	0.581595 (1.71197) [0.33972]	-0.003228 (0.03145) [-0.10265]	-0.002898 (0.05579) [-0.05194]
D(LM2(-2))	-0.284486 (0.18503) [-1.53749]	0.008667 (0.30258) [0.02864]	2.333127 (2.06118) [1.13194]	-0.033870 (0.03786) [-0.89454]	0.044690 (0.06717) [0.66532]
D(LGGS(-1))	-0.042054 (0.02481) [-1.69487]	0.024430 (0.04058) [0.60207]	0.589746 (0.27640) [2.13365]	-0.004864 (0.00508) [-0.95797]	0.003452 (0.00901) [0.38322]
D(LGGS(-2))	-0.027856 (0.02226) [-1.25149]	-0.020433 (0.03640) [-0.56135]	0.180305 (0.24795) [0.72718]	-0.003074 (0.00455) [-0.67481]	0.002071 (0.00808) [0.25626]
D(LUNR(-1))	-1.768788 (1.15531) [-1.53101]	1.086879 (1.88928) [0.57529]	9.972624 (12.8696) [0.77490]	0.185558 (0.23641) [0.78490]	0.205654 (0.41940) [0.49036]
D(LUNR(-2))	-0.366173 (1.01887) [-0.35939]	-0.933355 (1.66617) [-0.56018]	5.941082 (11.3498) [0.52345]	-0.042464 (0.20849) [-0.20368]	0.047802 (0.36987) [0.12924]
D(LOILR(-1))	-0.896172 (0.68439) [-1.30945]	-1.073633 (1.11918) [-0.95930]	-2.354590 (7.62379) [-0.30885]	0.002597 (0.14005) [0.01855]	0.517634 (0.24844) [2.08350]
D(LOILR(-2))	-0.587531 (0.73985) [-0.79413]	1.212758 (1.20987) [1.00238]	-4.164518 (8.24155) [-0.50531]	-0.001225 (0.15139) [-0.00809]	0.021530 (0.26858) [0.08016]
C	-0.047641 (0.02976) [-1.60103]	-0.027272 (0.04866) [-0.56046]	0.272588 (0.33148) [0.82235]	-0.015164 (0.00609) [-2.49037]	0.002744 (0.01080) [0.25399]
R-squared	0.569982	0.483126	0.272157	0.462091	0.442150
Adj. R-squared	0.462477	0.353907	0.090196	0.327614	0.302687
Sum sq. resids	1.281193	3.426199	158.9829	0.053647	0.168837
S.E. equation	0.170640	0.279049	1.900855	0.034918	0.061945
F-statistic	5.301928	3.738823	1.495691	3.436202	3.170386
Log likelihood	26.31112	-1.231354	-108.6770	115.1586	83.05622
Akaike AIC	-0.511111	0.472548	4.309894	-3.684234	-2.537722
Schwarz SC	-0.077107	0.906552	4.743897	-3.250230	-2.103718
Mean dependent	0.007218	-0.072190	-0.112475	-0.015805	-0.004632
S.D. dependent	0.232746	0.347162	1.992852	0.042583	0.074181

Determinant resid covariance (dof adj.)	5.18E-09
Determinant resid covariance	1.55E-09
Log likelihood	170.6742
Akaike information criterion	-3.774077
Schwarz criterion	-1.423223
Number of coefficients	65

The source : Eviews outputs

Table (5) : VECM Results (2)

Dependent Variable: D(LINF)
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 05/08/18 Time: 16:55
Sample (adjusted): 2001Q4 2015Q4
Included observations: 57 after adjustments
D(LINF) = C(1)*(LINF(-1) - 0.93427834979*LM2(-1) - 0.0275806315422 *LGGS(-1) + 2.50694855888*LUNR(-1) + 1.33238559*LOILR(-1) - 9.08176925454) + C(2)*D(LINF(-1)) + C(3)*D(LINF(-2)) + C(4)*D(LM2(-1)) + C(5)*D(LM2(-2)) + C(6)*D(LGGS(-1)) + C(7)*D(LGGS(-2)) + C(8) *D(LUNR(-1)) + C(9)*D(LUNR(-2)) + C(10)*D(LOILR(-1)) + C(11) *D(LOILR(-2)) + C(12)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.306064	0.066307	-4.615849	0.0000
C(2)	0.527883	0.127543	4.138847	0.0002
C(3)	0.161811	0.139861	1.156937	0.2534
C(4)	-0.319460	0.137230	-2.327914	0.0245
C(5)	-0.229760	0.178207	-1.289288	0.2039
C(6)	-0.039070	0.024700	-1.581797	0.1207
C(7)	-0.025609	0.022199	-1.153623	0.2547
C(8)	-1.581639	1.144111	-1.382418	0.1737
C(9)	-0.331242	1.020126	-0.324707	0.7469
C(10)	1.139192	0.647129	1.760380	0.0851
C(11)	0.391539	0.718295	0.545096	0.5884
C(12)	-0.042757	0.029459	-1.451391	0.1536

R-squared	0.559455	Mean dependent var	0.008501
Adjusted R-squared	0.451766	S.D. dependent var	0.230862
S.E. of regression	0.170937	Akaike info criterion	-0.510384
Sum squared resid	1.314870	Schwarz criterion	-0.080268
Log likelihood	26.54593	Hannan-Quinn criter.	-0.343226
F-statistic	5.195112	Durbin-Watson stat	2.193334
Prob(F-statistic)	0.000032		

The source: Eviews outputs

Table (6) : Wald Test Results

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	5.602305	(2, 45)	0.0067
Chi-square	11.20461	2	0.0037

Null Hypothesis: C(4)=C(5)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(4)	-0.319460	0.137230

F-statistic	3.774869	(2, 45)	0.0305
Chi-square	7.549739	2	0.0229

Null Hypothesis: C(6)=C(7)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(6)	-0.039070	0.024700

Test Statistic	Value	df	Probability
F-statistic	2.001112	(2, 45)	0.1470
Chi-square	4.002224	2	0.1352

Null Hypothesis: C(8)=C(9)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(8)	-1.581639	1.144111

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	3.455595	(2, 45)	0.0402
Chi-square	6.911189	2	0.0316

Null Hypothesis: C(10)=C(11)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(10)	1.139192	0.647129
C(11)	0.391539	0.718295

Restrictions are linear in coefficients.

The source : Eviews outputs

Table (7): VECM Residual Serial LM Tests

VEC Residual Serial Correlation LM Tests
Date: 05/08/18 Time: 18:30
Sample: 2001Q1 2016Q4
Included observations: 56

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	24.01471	25	0.5185	0.961842	(25, 131.5)	0.5218
2	14.29243	25	0.9564	0.552894	(25, 131.5)	0.9569
3	21.15678	25	0.6838	0.838731	(25, 131.5)	0.6865

The source : Eviews outputs

Table (8): Heteroskedasticity Test Breusch-Pagan-Godfrey

F-statistic	0.651050	Prob. F(15,41)	0.8146
Obs*R-squared	10.96502	Prob. Chi-Square(15)	0.7551
Scaled explained SS	21.90399	Prob. Chi-Square(15)	0.1103

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/08/18 Time: 18:37
Sample: 2001Q4 2015Q4
Included observations: 57

The source: Eviews outputs

Table (9): VECM Residual Heteroskedasticity Tests (Levels &Squares)

VEC Residual Heteroskedasticity Tests (Levels and Squares)
Date: 05/08/18 Time: 18:44
Sample: 2001Q1 2016Q4
Included observations: 56

Joint test:

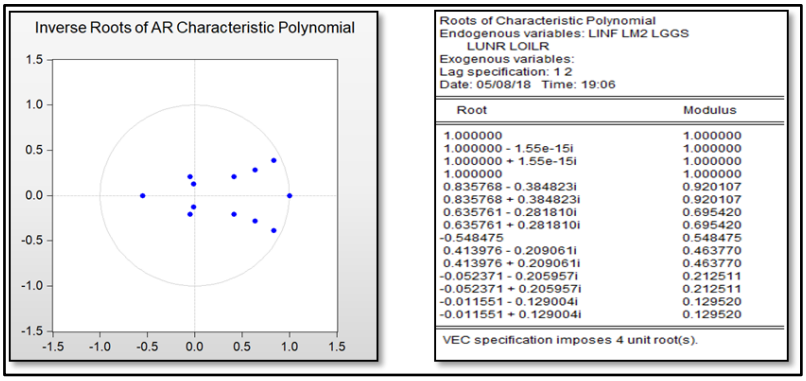
Chi-sq	df	Prob.
252.5441	330	0.9994

Individual components:

Dependent	R-squared	F(22,33)	Prob.	Chi-sq(22)	Prob.
res1*res1	0.256353	0.517087	0.9456	14.35579	0.8884
res2*res2	0.312147	0.680698	0.8259	17.48022	0.7363
res3*res3	0.342366	0.780906	0.7249	19.17252	0.6347
res4*res4	0.207718	0.393265	0.9876	11.63221	0.9645
res5*res5	0.188105	0.347530	0.9942	10.53390	0.9808
res2*res1	0.201935	0.379547	0.9899	11.30837	0.9701
res3*res1	0.165717	0.297950	0.9979	9.280126	0.9917
res3*res2	0.126997	0.218207	0.9998	7.111824	0.9988
res4*res1	0.128120	0.220419	0.9998	7.174698	0.9988
res4*res2	0.147775	0.260099	0.9992	8.275409	0.9964
res4*res3	0.273843	0.565669	0.9175	15.33521	0.8475
res5*res1	0.142346	0.248957	0.9994	7.971373	0.9972
res5*res2	0.221357	0.426428	0.9801	12.39598	0.9487
res5*res3	0.191604	0.355527	0.9933	10.72983	0.9784
res5*res4	0.216329	0.414068	0.9832	12.11442	0.9550

The source: Eviews outputs

Figure (1) : Stability Test



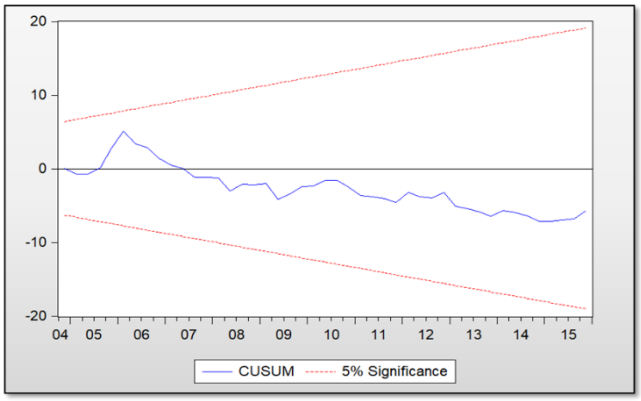
Roots of Characteristic Polynomial
Endogenous variables: LINF LM2 LGGS LUNR LOILR
Exogenous variables:
Lag specification: 1 2
Date: 05/08/18 Time: 19:06

Root	Modulus
1.000000	1.000000
1.000000 - 1.55e-15i	1.000000
1.000000 + 1.55e-15i	1.000000
1.000000	1.000000
0.835768 - 0.384823i	0.920107
0.835768 + 0.384823i	0.920107
0.635761 - 0.281810i	0.695420
0.635761 + 0.281810i	0.695420
-0.548475	0.548475
0.413976 - 0.209061i	0.463770
0.413976 + 0.209061i	0.463770
-0.052371 - 0.205957i	0.212511
-0.052371 + 0.205957i	0.212511
-0.011551 - 0.129004i	0.129520
-0.011551 + 0.129004i	0.129520

VEC specification imposes 4 unit root(s).

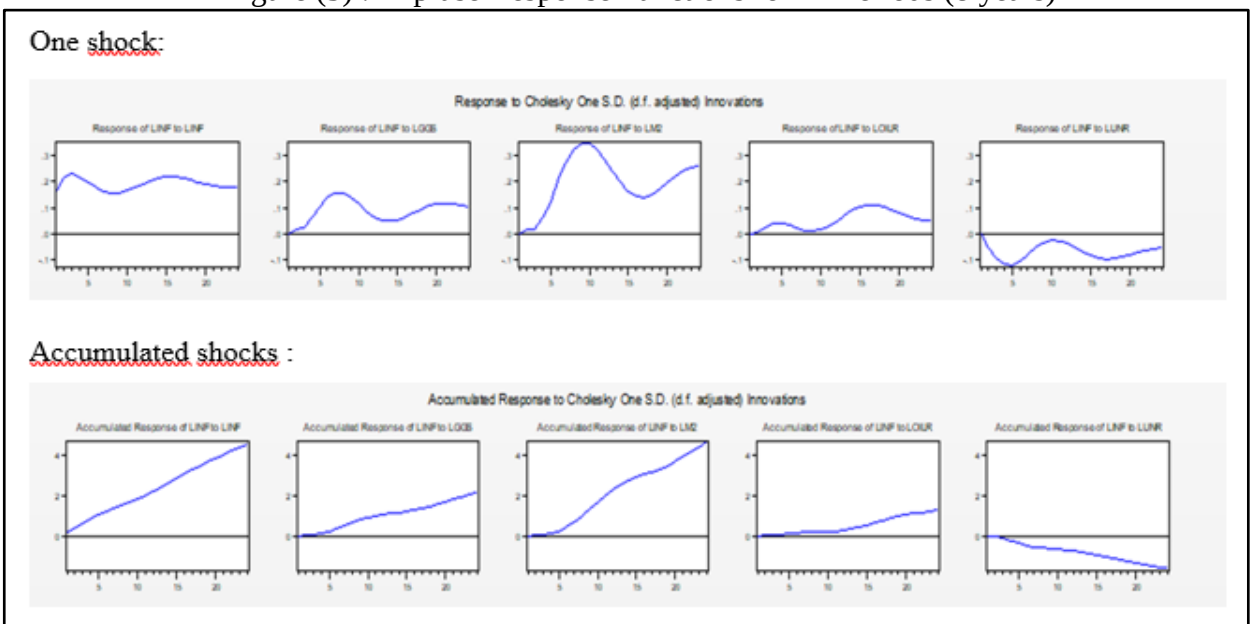
The source: Eviews outputs

Figure (2) : CUSUM Test



The source: Eviews outputs

Figure (3) : Impluse Response Functions for 24 Periods (8 years)



The source: Eviews outputs

Table (10): Variance Decomposition Results for 24 Periods

Variance Decomposition of LINF: Period	S.E.	LINF	LM2	LGGS	LUNR	LOILR
1	0.170640	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.279844	96.00117	0.364334	0.336230	2.843652	0.454610
3	0.374509	90.96772	0.451544	0.553579	6.372920	1.654236
4	0.458082	82.85821	2.532655	1.928500	9.557861	3.122773
5	0.539933	73.24035	7.955781	4.296718	10.73450	3.772651
6	0.628852	62.09871	17.44734	6.765792	10.09664	3.591522
7	0.725897	51.75887	28.53648	8.182537	8.530656	2.991458
8	0.826689	43.51143	38.73842	8.431250	6.924604	2.394295
9	0.922751	37.84934	46.56667	7.956954	5.671153	1.955879
10	1.007498	34.45199	51.82006	7.244139	4.801477	1.682333
11	1.077910	32.83258	54.80025	6.567967	4.227083	1.572127
12	1.135005	32.48541	55.97120	6.023183	3.859147	1.661062
13	1.182178	32.95700	55.80197	5.606712	3.640488	1.993824
14	1.223303	33.84793	54.75054	5.290795	3.537936	2.572806
15	1.261268	34.84559	53.23627	5.063763	3.525816	3.328566
16	1.297598	35.74295	51.60965	4.935374	3.574855	4.137168
17	1.332926	36.43020	50.13329	4.917760	3.650797	4.867953
18	1.367694	36.86203	48.98587	5.003878	3.720240	5.427973
19	1.402520	37.03057	48.27059	5.159822	3.757984	5.781034
20	1.438082	36.95645	48.01515	5.334489	3.751937	5.941974
21	1.474757	36.69104	48.16951	5.478793	3.703570	5.957086
22	1.512359	36.31320	48.61766	5.562362	3.624187	5.882589
23	1.550187	35.91362	49.20881	5.579068	3.529110	5.769390
24	1.587318	35.57280	49.79659	5.541282	3.432605	5.656722

Source : Eviews Outputs

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