Exchange rate pass- through to inflation in Algeria

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نفاذية سعر الصرف إلى التضخم في الجزائر

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Summary:
This article aims to test whether there is an impact of exchange rate pass-through on import prices as a first-stage effect and consumer prices as a second-stage effect in Algeria. To reach that objective, we used monthly data of three variables sampled between 2011M01 and 2022M02. We used a VAR model to determine the first stage effects, and then we applied an econometric approach based on a bounds cointegration test to ARDL approaches to measure the second stage effects. Multiple tests and econometric methodological techniques result in the general conclusion that the exchange rate does not pass through much to import and consumer prices on a monthly basis. In the first stage, exchange rate and import prices are not cointegrated; only exchange rate causes import prices; import price impulses are weak shocks on exchange rate; and import prices have a little share in exchange rate variance decomposition. The exchange rate and consumer prices are cointegrated in the second stage, but consumer prices are not elastic to the exchange rate. This article is divided into three main parts: the first is about the literature review and previous studies; the second part presents an empirical approach; and the last part highlights modelling results.
Keywords: exchange rate pass through, import prices, consumer prices, VAR, ARDL.
Jel Classification Codes: F31-E31

ملخص: يهدف هذه المقال إلى اختبار ما إذا كان هناك تأثير لتمرير سعر الصرف على أسعار الواردات كأحد تأثيرات المرحلة الأولى وأسعار الاستهلاك كمرحلة ثانية في الجزائر. للوصول إلى هذا الهدف، استخدمنا بيانات شهرية من ثلاث متغيرات تم أخذ عينات منها بين 2011M01 و2022 M02، واستخدمنا نموذج VAR لتحديد تأثيرات المرحلة الأولى، ثم طبقنا نهجًا اقتصاديًا قياسيا يعتمد على اختبار تكامل الحدود أو على مناهج ARDL لقياس المرحلة الثانية. تؤدي هذه الاختبارات العديدة والأساليب المنهجية الاقتصادية القياسية إلى نتيجة عامة مفادها أن سعر الصرف لا يمر ويَنْفُذُ كثيرًا في أسعار الاستيراد وأسعار الاستهلاك بالتواتر الشهري. في المرحلة الأولى، لا توجد علاقة التكامل المشترك بين سعر الصرف وأسعار الواردات، فقط سعر الصرف هو الذي يؤثر في أسعار الاستيراد، ويؤثر سعر الاستيراد بشكل ضعيف بالصدمات على سعر الصرف وله القليل من الأسهم في تحلل تباين سعر الصرف. في المرحلة الثانية، توجد علاقة التكامل المشترك بين سعر الصرف وأسعار المستهلك ولكن أسعار المستهلك ليست مرنة لسعر الصرف. ينقسم هذه المقال إلى ثلاثة أجزاء رئيسية: الأول يتعلق بمراجعة الأدبيات والدراسات السابقة، والجزء الثاني يقدم نهجًا. تجريبيًا، أما الجزء الأخير فيسلط الضوء على نتائج النمذجة ويناقشها.
الكلمات المفتاح: نفاذية سعر الصرف، أسعار الاستيراد، أسعار المستهلك , VAR، ARDL
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Introduction

- Description of subject

Since the stagflation crisis in 1970s and failure of Keynesian's effective policy about tradeoff between inflation and employment to explain it, economic literature focusses its researches in order to give an important place to inflation and Robert Locas's concept about expectations made by economic agents. By 1980s, world recession crisis and the increasing in openness economy between economics each other, especially in 1990s, when economic world experienced large real exchange rate depreciations, the economic world pay an increasing attention to another type of monetary policy which called exchange rate policy. In addition, economic external shocks are the new area of investigations by which changes in foreign currencies will be measured in order to protect national economy from its negative effects.

Since 1995, economic literature has been accustoming with exchange rate pass through concepts "The degree to which domestic prices adjust to exchange rate movements is key to understanding inflation dynamics, and hence to guiding monetary policy."[01]

monetary policy has to play a great role by in order to stabilize prices in such economic environment either a domestic price of currency (measured by inflation) or foreign price (valued by exchange rate) and deal with consequences of external shocks on the domestic value of currency.

Exchange rate pass-through is again at the center of economic policy and central bank thinking (Forbes, 2014 and 2015). We have to understand how the observed large exchange rate movements translate to consumer prices (inflation), especially as inflation remains well below central bank targets in many advanced economies.

- Objective: in this paper we aim to provide a clear framework to the relationship between exchange rate and import prices in one hand, between exchange rate and consumer prices in the other hand in Algeria, the last two variables become a key instrument for Algerian monetary policy to manage the oil price crisis.
- Results :

The result obtained does not confirm the main assumption about the pass-through character of exchange rate to import prices and consumer prices. Exchange rate does not have a considerable impact on import prices and consumer prices.

- Contribution :

The contribution of our paper to the literature is threefold: First, we analyze the exchange rate pass through to inflation with two stages that help us to catch and observe whether it be the impact on import price for the first stage or the impact on consumer prices for the second stage.

Second, we provide VAR and ARDL approaches in order to estimate the two effects; also, short run and long run have been measured for different elasticities by using ARDL and ECM techniques.

Third, we analyze three variables in monthly frequency that is the natural and known frequency of consumer price index and industrial price index, so we avoid transforming data into another unnatural frequency. To highlighting this relationship between exchange rate-pass through and inflation, we will test hypothesis, which come about the following problematic:

What is the effect of exchange rate pass through on import price and inflation in Algeria?

Assumptions:

We assume that exchange rate pass through on import prices and consumer prices.

- Interests of study

Under a flexible exchange rate regime in the last twenty years, since 2014 where price oil has been sharply decreasing inflation and exchange rate go up increasingly. With COVID pandemic and the slowdown in global economic activity across countries combined with the Ukrainian crisis, inflation

has hardened. Under this dark economic environment, reliable and accurate measurements of relationship between inflation and exchange rate are more than ever necessary in order to predict to analyze and avoid external economic shocks.

- The remainder of the paper is organised as follows: the first section is devoted to the introduction that describes exchange rate pass through and inflation, presents overall problematic and its assumption the contributions and interests of this paper.
  The second section devoted for the literature review about whether it be Algerian or worldwide previous studies.
  The third section reserved for results and discussion, finally the fourth section concludes.

II. Methods and Materials:

1. Definition

'Exchange rate pass-through is the effect of exchange rate changes on inflation. It has two dimensions: magnitude and speed" (Boughzala & Cobham, 2011).[02]

A low exchange rate pass-through helps to limit the impact of currency fluctuations on domestic demand and allows exchange rate adjustments to play a greater role in absorbing external shocks without undermining price or output stability. (Worldbank,2014) [03]

"By high exchange rate pass-through it is generally meant that one of the most important determinants of the future path of inflation is the rate change of the exchange rate.' (Boughzala & Cobham, 2011).[see 02]

Financial systems nowadays focus its objectives to price stability and targeted inflation in adequate rates that help economic activities to done in well conditions lead to a sustainable economic growth. This focusing has drove researchers to broaden their search field into other interesting fields like contribution of exchange rate to changes in domestic prices.

Firms and economic agents do not pass the temporary increasing in exchange rates and price imports into domestic prices if they know that economic policies pay great attention to pass through phenomenon and work to mitigate external shocks on domestic economic key variables like import prices and consumer prices. Common challenges for policies between development countries and emerging market regions are effectively the Price stability. Nevertheless, there are specific challenges for monetary policy between development countries and emerging market regions. Algeria adopts a flexible exchange rate regime to face the negative trade shocks on its economy and guaranty the price stability condition.

2. Previous studies

2.1 Algerian previous studies:

(Fekir & boulenouar , 2015) presented Ball and Sheridan model developped in 2003 to target inflation by 12 countries (except Algeria) which adopted targeteing inflation policy and countries which not adopted the last policy, then they estimated it by ordinary least square method . In the second part of their studies, they estimated the economic performence in two categories of countries by groowth economy variable. [04]

(BENADDA & BENSLIMANE, 2018) investigated the relationship between exchange pass through and inflation in Algeria by a VAR model that has been validate, Granger causality indicate that inflation in Algeria is caused by both nominal exchange rate and credits. In addition, inflation has been managed since 2000. [05].

Using a VAR model based on Mc Carty (2007) , (MIZI & ACHOUCHE, 2018). examined the pass-through of exchange rate and import price fluctuations to domestic producer (PPI) and consumer prices (CPI) or inflation. Mizzi & achouche have found that : " Impulse responses to the exchange rate shocks are estimated over a two-year (8-quarter) horizon » [06].

In the variance decomposition side, "EURO/DZ exchange rate explain near to 6% of import price forecast variance initially. This percentage increases gradually as the forecast horizon expands (14% in 8 period). "[06].

The relationship between Inflation and Exchange Rate Pass-Through in Algeria has been also estimated by (SEHAILIA & SAKHI,2021**)** , "The results of research show that Exchange Rate Pass-through during the studied period is significant, and plays a role very important in explaining the behaviour of inflation rates in Algeria. "

In addition, the innovation in Exchange Rate has a long and short-term impact on inflation [07]

2.2 Worldwide previous studies:

(Karahan, 2017) has investigated the relationship between exchange rate pass through and inflation by a single equation Error Correction Model estimation. The results indicate that the exchange rate pass through decreased in the post-IT period (2006-2014) compared to pre-IT period (1995-2000). [08].

(Borensztein & von Heideken, 2016) focused on exchange rate pass through in South America. This paper looks at the question of pass through and its determinants for the group of countries whose central banks are members of the financial stability and developpment. [09].

(Abiodun S & al,2016) focused on exchange rate pass through effect at the aggregate level into import and consumer prices by a vector error correction methodology , the paper found the exchange rate pass through into Nigeria's CPI inflation to be incomplete. The long run pass through elasticity's are 0.24 and 0.30 for the baseline and alternative models. [10]

(Lavern McFarlane, 2009) used a stochastic volatility model with time-varying parameters to estimate exchange rate pass-through for four emerging market economies. This work finds that both stages of pass-through have declined over time. Stability in inflation environment anchored on a monetary policy regime have contributed to decline the second stage pass through. However, in the first stage pass through the weak level of inflation has contributed in the decline of the first stage pass through. [11]

(Jašová & al , 2016) used generalized method of moments (GMM) following Arellano and Bover (1995) and Blundell and Bond (1998) in order to estimate coefficients of seasonally adjusted consumer price index, the nominal effective exchange rate that affect by a variation of exchange rate pass through. " the results further confirm the importance of price stability by showing that lower inflation, among its other benefits, also reduces exchange rate passthrough to consumer prices." [12]

(Hong Duc & Van Phuc, 2016) reexamined the degree of ERPT to the import, producer, and consumer price indices in four countries in the Asia-Pacific region. For their analyze, they used ARDL model in a single equation in their analysis.

In the first stage, pass-through alters import prices, the EPRT to IMP has the biggest effect among the price indices, and the impact is felt mostly within a quarter.

In the second stage, pass-through alters producer and consumer prices, the ERPT to PPI has a moderate effect in the short run and gradually transfers to the long run, "while the ERPT to CPI changes little between the short run and the long run, at a relatively low degree, around 10%."[13].

(Chew & al, 2011) assessed the degree of exchange rate pass-through using standard long-run model.

The degree to which domestic prices adjust to exchange rate movements is key to understanding inflation dynamics, and hence to guiding monetary policy. However, the exchange rate pass-through to inflation varies considerably across countries and over time.

By estimating structural factor-augmented vector-autoregressive models for 47 countries, this paper brings to light two fundamental factors accounting for these variations: the nature of the shock triggering currency movements and country-specific characteristics.
The empirical results in this paper are three-fold. First, an empirical investigation demonstrates that different domestic and global shocks can be associated with widely different pass-through ratios. Second, country characteristics matter, including policy frameworks that govern monetary policy responses, as well as other structural features that affect an economy's sensitivity to currency fluctuations. Pass-through ratios tend to be lower in countries that combine flexible exchange rate regimes and credible inflation targets. Finally, the empirical results suggest that central bank independence can greatly facilitate the task of stabilizing inflation following large currency movements and allows fuller use of the exchange rate as a buffer against external shocks.[14]
(Grigolava ,2012) aimed to estimate Exchange Rate Pass-Through to CPI and Inflation in Caucasian Countries by using Vector Auto Regression as the best method for this study.
Vector Error Correction shows that the lowest deviation from long-term equilibrium observed on Armenian economy, which can be explained by the effects of inflation targeting strategy.
Variance decomposition shows significant impact of exchange rates in the changes in CPI for Georgian economy, this last result can be a good warning for Georgian monetary policy makers in order to look out the changes in exchange rate. [15]

III. Results and discussion:

3.1 Methodology & Data

Methodology

Regression methodology

To reach the goal of measuring of effect of exchange rate pass through we will need to divide the overall impact into two stages:
The First–stage pass through measures the exchange rate impact on import prices.
The Second-stage pass-through: the subsequent impact of import price movements on consumer prices. For such purpose, it is suitable to use a method of ARDL and recursive autoregressive vector.
Variations of exchange rate pass-through have been measured by the following general equation:

$$\Delta \ln P_t = \beta_0 + \beta_1 \Delta \ln e_t + \beta_2 \Delta \ln P_t^* + \beta_3 \Delta \ln P_{t-1} + \varepsilon_t \quad \text{.....(01)}$$

Where:
P_t : is the consumer prices index (CPI)
e_t : is the nominal exchange rate
P_t^* : is an external price index
β_1 : measure the short-term pass-through effect
$\frac{\beta_1}{1-\beta_3}$: measure the long-term pass-through effect

$$\varepsilon_t \sim N(0, \sigma^2)$$

The first stage exchange rate pass through can be estimated by the following standard long run model:

$$DIP = \frac{(WSIP)^{\alpha}}{(REER)^{\beta}} \text{ with } 0 \leq \alpha, \beta < 1 \dots\dots\dots\dots\dots (02)$$

The first stage pass through takes its complete first stage in the long run if $\beta = 1$

$$DIP_t = \varphi + \alpha REER_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots(03)$$

, with $\lambda = -\beta, 0 \leq \alpha < 1, \text{and} -1 \leq \lambda \leq 0$

Where:

DIP: is the domestic imported price index

REER: is the nominal effective exchange rate

α : is the elasticity of domestic import prices to real effective exchange rate

For a small, open economy, first stage pass through is expected to be complete if $\lambda = -1$

The second stage exchange rate pass through can be estimated by the following standard long run model:

$$CPI_t = \alpha(REER_t)^{\beta}(DIP_t)^{\gamma} \ldots\ldots\ldots\ldots\ldots\ldots\ldots(04)$$

Where:

CPI : Consumer price index

REER: Unit labor cost

DIP: Domestic imported price index

$$cpi_t = \lambda + \beta reer_t + \gamma dip_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots(05)$$

Approach methodology: ARDL /ECM

ARDL (p, q, h):

In the first stage:

$$DIP_t = \varphi_0 + \sum_{i=1}^{P} \varphi_i DIP_{t-i} + \sum_{j=1}^{q} \alpha_j REER_{t-j} + \varepsilon_t$$

In the second stage:

$$CPI_t = \varphi_0 + \sum_{i=1}^{Z} \varphi_i CPI_{t-i} + \sum_{j=1}^{q} \alpha_j DIP_{t-j} + \sum_{k=1}^{h} \lambda_k REER_{t-k} + \varepsilon_t$$

“Since additional lags may induce multicollinearity, lag order restrictions are often imposed. A common restriction is the ARDL (1,1)”

Introduction logarithm

“It is also typical in the energy growth nexus to use logarithms of the variables in order to translate variable coefficients as elasticities.”

ARDL for the First stage:

In this stage, relationships between DIP and REER are estimated by using Autoregressive distributed lag model, therefore we will need an ARDL with three time series:

$$LDIP_t = \varphi + \alpha_0 DIP_t + \alpha_1 DIP_{t-1} + \lambda_0 REER_t + \lambda_1 REER_{t-1} + \varepsilon_t \ldots\ldots\ldots(06)$$
$$\varepsilon_t \sim N(0, \sigma^2)$$

with $\lambda = -\beta, 0 \leq \alpha < 1, \text{and} -1 \leq \lambda \leq 0$

ARDL for the second stage

In this stage, relationships between IPC, DIP and REER are estimated by using Autoregressive distributed lag model, therefore we will need an ARDL with three time series:

$$IPC_t = \varphi_0 + \varphi_1 IPC_{t-1} + \lambda_0 DIP_t + \lambda_1 DIP_{t-1} + \lambda_0 REER_t + \lambda_1 REER_{t-1} + \varepsilon_t$$

Data

Data source

We use monthly data covering the period 2011M01 to 2022M02 for the four following variables: 123 observations are used in order to estimate impact of exchange rate pass through on inflation, data of CPI and DIP was obtained from Algerian office of statistics (ONS), and REER was obtained from Bank of Algeria' website.

Data describing

Standard deviation of these indexes are very high comparing to standard deviation of CPI and REER. It is knew that a normal distribution has a skew of zero and a kurtosis of three.

According to Skewness results, only CPI is a symmetric series, however, the three other series are asymmetric series.According to Kurtosis results, REER with large kurtosis exhibit tail data exceeding the tails of the normal distribution,DIP and CPI with low kurtosis exhibit tail data that are generally less extreme than the tails of the normal distribution. From Jarque Bera results , we reject the hypothesis of normal distribution at the 5% level.

The graph shows that all four series have the same general trend. High volatility for DIP, and a smooth appearance for the two other series. There is no break in the three-time series, the next unit root test will be ordinary and conventional tests such us ADF and others.

3.2 Results & Discussion

3.2.1 Results & Discussion_First stage

3.2.1 Unit root test & Cointegration

3.2.1.1 Unit Root Test: stationary

Stationary test aims to know whether statistic proprieties of the series (average, variance, autocorrelation) do not change over time. Before performing this test, it is suitable to determine a number of lags for each series. From correlograms (see appendix): lreer has one lag (p=1), ldip has three lags (p=3) and lcpi has one lag (p=1).

We perform a Unit root test at level then at First difference with this conventional null Hypothesis: Series has a unit root; non-stationary series

The table reports results of Unit root test, at 5% level, leer (-1) and LCPI (-1) are not stationary at level, except LDPI (-3) that is stationary by Philips Peron with trend component. By KPSS unit root test with trend and intercept LM stat value =0.60 is greater than asymptotic critical values, then the null hypothesis is rejected with trend and intercept, therefore KPSS unit root test result confirm the ADF unit root test for LDIP(-3). The presence of deterministic trend is considered as the source of this nonstationary.

The above Table shows that the series are not stationary in levels, we proceed then to first difference.

3.2.1.1 Cointegration test

Cointegration analysis is a useful tool in order to examine if there exists a long run equilibrium relationship between two or more time series. This means that an increase on REER is connected with an increase on DIP and IPC in the long run.

Null hypothesis to be tested is: no cointegration between LREER and LDIP

First stage impact (lreer (-1), ldip (-3)).

Lags order for VAR by information criterion:

VAR Lags Order Selection Criteria is another step to give us the suitable lag that is selected by Eviews by *, also, Eviews 10 releases the result of six criteria types presented in the following table.

Based on the result of Akaike information criterion (AIC), Schwarz information criterion (SC), and Final prediction error (FPE), the suitable lag will be three lags. From these results, lag intervals (in

first differences) are (1 to 3) for the next Johanson Cointegration Test that allow us to find out cointegration relationship between LDIP and LREER.

Johansen Cointegration Test

Under Trend assumption: Linear deterministic trend the result of JOHANSON cointegration test is as follow.

By comparing the statistical value of the trace and maximum Eigen analysis value to theoretical value respectively, null hypothesis of no cointegration is rejected or accepted at 5% level.

Johansen cointegration test shows that calculated value of trace statistics (7.56) does not exceed its critical value at 5% level (15.41), so we accept the null hypothesis of no cointegration between LEER and LDIP.

In this case," in the case of no co-integrated series, the vector auto regression (VAR) model is used".

Vector auto regression is used to model changing of each variable by past values of itself and changing of other variables, since we have two time series (LDIP and LREER), a system of two equations can be built to measure and calculate mutual influence of these variations.

VAR model will be estimated at first after checking granger causality, also checking both AR roots table and graphs, then chose the lags and plot residuals test before impulse response between variables and variance decomposition.

VAR MODEL:

This actual estimation is not used for forecasting purpose but for the purpose of analyzing the dynamic impact and identifying shocks that requires the stability and impulse response functions.

Var estimation is presented in the following two equations:

$$L\Delta DIP_t = \beta_{10} + \beta_{11} L\Delta DIP_{t-1} + \beta_{12} L\Delta DIP_{t-2} + \beta_{13} L\Delta DIP_{t-3} + \gamma_{11} L\Delta REER_{t-1} + \gamma_{12} L\Delta REER_{t-2} + \gamma_{13} L\Delta REER_{t-3} + \mu_{1t}$$

$$L\Delta REER_t = \beta_{20} + \beta_{21} L\Delta DIP_{t-1} + \beta_{22} L\Delta DIP_{t-2} + \beta_{23} L\Delta DIP_{t-3} + \gamma_{21} L\Delta REER_{t-1} + \gamma_{22} L\Delta REER_{t-2} + \gamma_{23} L\Delta REER_{t-3} + \mu_{2t}$$

Granger Causality:

Null Hypothesis (H0): Time series X does not cause time series Y to Granger-cause itself.

Alternative Hypothesis (H1): Time series X cause time series Y to Granger-cause itself.

EVIEWS displays the estimation result of granger causality test in the following table:

0.0055 represents the p-value of the Grangers Causality test for LREER causing LDIP, which is less that the significance level of 0.05. So, we reject the null hypothesis and conclude LREER causes LDIP.

0.4167 represents the p-value of the Grangers Causality test for LDIP causing LREER, which is high that the significance level of 0.05. So, we accept the null hypothesis and conclude LDIP does not causes LREER.

Var Autoregression estimates:

« VAR models can be estimated with raw data in levels if the non-stationary data is also cointegrated because recent theoretical work proves that estimation with such data will yield consistent parameter estimates ».

The First equation:

$$L\Delta DIP_t = \underset{\substack{(0.004)\\[2.495]}}{0.010} - \underset{\substack{(0.094)\\[-7.677]}}{0.727} L\Delta DIP_{t-1} - \underset{\substack{(0.104)\\[-5.300]}}{0.551} L\Delta DIP_{t-2} - \underset{\substack{(0.092)\\[-1.868]}}{0.173} L\Delta DIP_{t-3} - \underset{\substack{(0.174)\\[-1.394]}}{0.243} L\Delta REER_{t-1} + \mu_{1t}$$

Adjusted R-squared = 0.36

The second equation:

$$L\Delta REER_t = 0.005 + 0.083L\Delta DIP_{t-1} + 0.067L\Delta DIP_{t-2} + 0.003L\Delta DIP_{t-3} - 0.354L\Delta REER_{t-1} + \mu_{2t}$$

(0.002) (0.050) (0.055) (0.049) (0.093)
[2.363] [1.637] [1.213] [0.079] [-3.785]

Adjusted R-squared = 0.10

Standard errors are presented between brackets, meanwhile the corresponding t-statistics values are presented between parentheses.

Since LDIP has three lags and LREER has one lag, LDIP is presented by all his lags however LREER is presented only by his first lag.

The critical value of t-statistics (for 5% level of significance and 100 as approximated sample size) is 1.984. Since a null hypothesis will be rejected if calculated value exceeds critical value, then we conclude that:

In the first estimated equation:

All coefficients have a negative significance to explain changing in domestic import price, the biggest negative impact on import price is observed in the same variable lagged by one month, since logarithm is introduced to each time series, we can say that increasing by 1% in domestic import price is explained by 0.72% decreasing in real exchange rate lagged by one month. increasing in domestic index price by 1% is justified by 0.55% decreasing in the same variable lagged by two months, decreasing by 0.17% in domestic import price lagged by three periods can explain changing in 1% for itself which is considered as the smallest impact, by the same, decreasing in real exchange rate by 0.24 per cent leads to increase domestic import price by 1%.

Global significance given by F-Statistic is 12.03, this calculated value allows us to reject/accept null hypothesis about global significance of the second equation.

In the second estimated equation:

By the same comparison of calculated t-statistics presented between brackets and the critical t-statistics which is equal to 1.984, we conclude that:

the coefficients of the first domestic import price variable lagged until one previous month $LDIP_{t-1}$, two previous months, $LDIP_{t-2}$ and three previous months $LDIP_{t-3}$ respectively are significant to explain changing in real exchange rate, but that does not fit with granger causality test because domestic import price does not cause real exchange rate. However only the coefficient of exchange real effective rate lagged until one month (0.35) can explain variations of itself.

Global significance given by F-Statistic is 3.33, this calculated value leads to reject/accept null hypothesis about global significance of the second equation.

Additional information about regression summary statistics is released at the bottom of the first table:

Adjusted R sqaure statistics in the first equation (0.359) and in the second equation (0.10), it doesn't matter much because we are not in the Structural VAR case.

The smallest values of Akaike AIC criteria and Schwarz SC that expressed a best modeling for vector auto regression is in the model with three lags.

The higher likelihood values that expressed and measure the goodness of fit for model is in the vector auto regression model with three lags comparing with its values in the model with three lags

By combining these two comparing tools, we confirm the result of VAR Lags Order Selection Criteria showed in table 4.

AR root table & AR roots graphs

From VAR stability condition check table estimated by EVIEWS, there is no root lies outside the unit circle, we conclude that the vector autoregressive satisfies the stability condition. We can confirm graphically the same result from Inverse roots of AR characteristic Polynomial. The graph shows that all roots have modulus less than one and lie inside the unit circle, so the estimated VAR is stationary.

Lag Length Criteria

The lag chosen is three lags

Residual Tests: Portmanteau Autocorrelation test

After VAR estimates, we perform residuals portmanteau Tests for Auto correlation and a graph for autocorrelations between lreer and ldip, all p-values are bigger than 0.05 after the third lag, we cannot reject H0. These results show that there are no residual autocorrelations. This result is checked by autocorrelation graph.

Impulse response

Impulse response gives an overview about the behavior and response of several series to a permanent and transitory shock applied in standard error of dependent variables,

The first stage effect from real effective exchange rate to domestic import price is showed in the second graph, we can see that increasing by 1% in standard deviation of real effective exchange rate decrease from the first to the third month, then if real exchange rate will be shocked by 1% in its standard deviation, domestic import price increases to reach its initial value.

After the fourth month, the shock by 1% applied on the standard deviation of real effective exchange rate will have no impulse response by import index.

From these weak results about response of import price to the impulse of exchange rate, we can say that domestic import price doesn't really respond to any impulse of exchange rate, even if the ordinary least square between lDIP and lREER has interesting results (Adjusted R square = 0.73).

Variance decomposition:

Dynamic interactions between variables are measured by both impulse response and variance decomposition, we conduct these two analyses through stationary time series, EVIEWS realses the following two outputs:

The weakness of shares about variance decomposition presented in the above figure is computed more clearly in the following variance decomposition table, where we can read percentages of these dynamic interactions.

since REER causes DIP according to granger causality test, the left side of the above table shows that the variance of LDDIP is divided between lddip and ldreer , it is obviously that lddip explains most share of this variance ., shares of ldreer in variance decomposition of lddip are weak , in the second period ldreer explains approximately 0.98% of change in lddip , after ten periods or ten months , it becomes only 3.35 per cent.

3.2.2 Results & Discussion_ Second stage

3.2.2.1 Cointegration test

3.2.2.2 Lags order for VAR by information criterion:

AIC and FPE criteria have chosen the same lag order which is (4) , meanwhile the three other criteria have chosen a different lag order from each other (LR =11,SC =1,HQ=2).So the next Johansen cointegration test will be performed under four lags.

3.2.2.3 Johansen Cointegration Test:

After comparing critical values to calculated values, presence of one cointegration relationship between REER and IPC has been confirmed, by following model specification, we pass to estimate the Optimal ARDL MODEL (3.1) which give significance statistical results with less parameters, then estimate short run and long run elasticity between REER and IPC.

The ARDL bounds test is based on the assumption that the variables are I (0) or I (1).
Among five lag order selection criteria's, AIC and FPE have chosen four lag to estimate ARDL model.
Based on ARDL estimation output, validation ARDL model starts with the serial correlation LM test that does not confirm null hypothesis, therefore, there is no autocorrelation between residuals [F-statistic (4,110)] =0.540, from Breusch Pagan godfry residuals are homoscedastic [F-statistic (5,114)] =1.358, meanwhile residuals are not normal according to normality test (jarque bera =31.38 with probability = 0.000).
From Bounds test results we confirm a presence of cointegration relationship between lcpi and reer since Fstatistic =7.88 is higher than 5.58 and 5.91 considered as superior bounds of Fisher test , this result allow us to estimate the long run and short run relationship between the two mentioned variables.
In the short run, the adjustment coefficient for domestic price index (-0.036 or 3.6%) is statistically significant (prob =0.000) and theoretically accepted because it has a negative value. Domestic price index adjusted itself by 3.6% from exchange rate shocks.
In the long run, only two lagged ipc variable is significance, and it apply a negative effect on itself.

IV. Conclusion :

From the first stage econometric results of pass-through effect applied by REER on dip and the second stage econometric results of pass-through effect applied by reer on ipc, we can conclude that exchange rate does not pass through much to both import prices and consumer prices in Algeria. This general conclusion has been found after several methodological econometric tests and techniques.
Three time series (real exchange rate , import prices, and consumer prices), monthly distributed, have been used to detect the impact in the two stages ,these three time series are stationary at first differentiation, real exchange rate and consumer prices have one lagged month , which means that current values are affected only by its previous values however import price which is a Pearsan index calculated by ONS has three lagged months , which means that current values of this variables are impacted by the three lagged months values.
In the first stage pass through of real effective exchange rate on domestic import prices, we found that these two mentioned time series are not cointegrated, also we found that lreer causes ldip but ldip does not cause lreer . Coefficients of three lagged time dip are statistically significant to explain itself. Coefficients of one lagged exchange rate is statistically significance to explain dip, at last we found that domestic import price doesn't really respond to any impulse of exchange rate shares of ldreer in variance decomposition of lddip are weak, in the second period ldreer explains approximately 0.98% of change in lddip, after ten periods or ten months, it becomes only 3.35 per cent. In the second stage pass through of real effective exchange rate on consumer prices, we checked with econometric tests that cointegration relationship exists between REER and ipc. In the short run, the adjustment coefficient for domestic price index (-0.036 or 3.6%) is statistically significant (prob = 0.000) and theoretically accepted because it has a negative value. Domestic price index adjuste itself by 3.6% from exchange rate shocks. In the long run, only two lagged ipc variable is significance, and it apply a negative effect on itself.

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Appendices

Abbreviation	Definition	Source	possession
REER	real effective exchange rate	Bank of Algeria	Loaded from website
DIP	domestic index price	National statistical office	Loaded from website
CPI	consumer price index	National statistical office	Loaded from website

Table 1: definition of used time series

Statistics	REER	DIP	CPI	LREER	LDIP	LCPI
Mean	96.85	111.07	186.12	4.55	4.70	5.22
Standard.Deviation	18.75	15.16	19.81	0.196	0.132	0.109
Skewness	0.021	0.670	-0.380	-0.0725	0.522	-0.546
Kurtosis	1.349	2.223	2.133	1.312	2.011	2.334
Jarque Berra	13.971	12.298	6.811	14.694	10.609	8.392
probability	0.000	0.002	0.033	0.000	0.004	0.015
Observations	123	123	123	123	123	123

Table 2**:** summary of variables produced by authors using Eviews 10

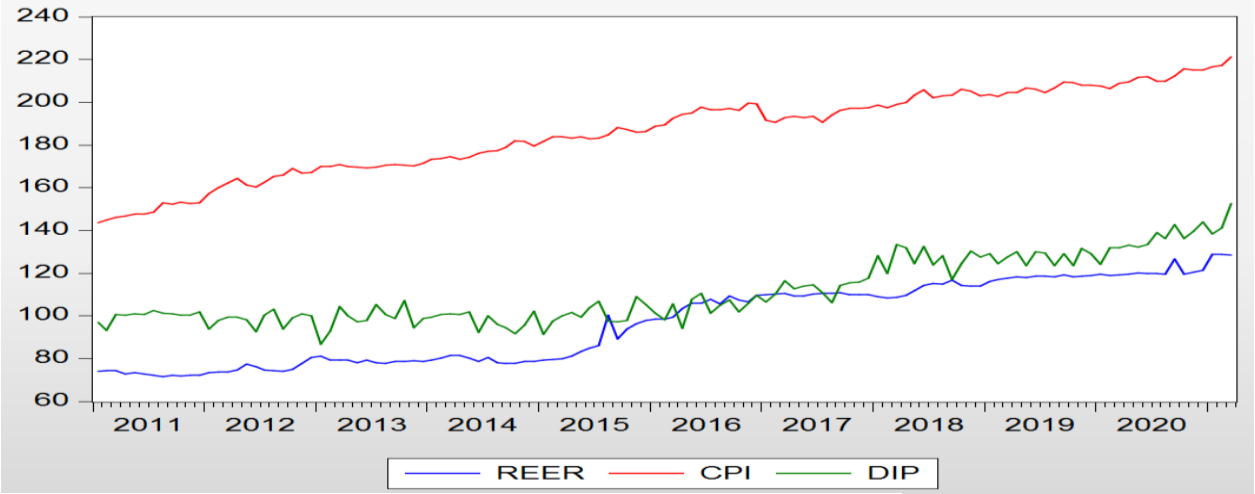

Figure 1: evolution of variables produced by authors using Eviews 10.

Variables	Prob[ADF (SIC,Fixed lag)]			P.P		
At Level	Constant	Trend and intercept	None	Constant	Trend and intercept	None
Lreer (-1)	0.951	0.570	0.99	0.936	0.384	0.997
Ldip (-3)	0.991	0.726	0.98	0.88	0.001	0.965
Lcpi (-1)	0.387	0.098	0.999	0.332	0.106	1.000
variables	Prob[ADF (SIC,Fixed lag)]			P.P		
1st differentiation	Constant	Trend and intercept	None	Constant	Trend and intercept	None
lΔreer(-1)	0.00	0.00	0.00	0.00	0.00	0.00
lΔdip(-3)	0.00	0.00	0.00	0.00	0.00	0.00
lΔcpi(-1)	0.00	0.00	0.00	0.00	0.00	0.00

Table 3: Unit root test estimated by Authors using Eviews 10.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	173.281	NA	0.000174	-2.978	-2.931	-2.959
1	449.045	537.139	1.54e-06	-7.705	-7.561	-7.647
2	464.746	30.038	1.26e-06	-7.908	-7.669	-7.811
3	478.963	26.701	1.06e-06*	-8.086*	-7.752*	-7.950*
4	481.168	4.064	1.09e-06	-8.055	-7.625	-7.880
5	481.885	1.297	1.15e-06	-7.998	-7.472	-7.784
6	482.379	0.877	1.23e-06	-7.937	-7.316	-7.685
7	488.169	10.069*	1.19e-06	-7.968	-7.252	-7.677
8	490.506	3.982	1.23e-06	-7.939	-7.127	-7.609

Table 4: Eviews' output of VAR lags order selection produced by authors

Hypothesized NO.OF CE(s)	Eigenvalue	Trace Statistic	5 percent Critical Value	1 Percent Critical Value
None	0.0615	7.564	15.41	20.04
At most 1	2.41E-05	0.002	3.76	6.65
Hypothesized NO.OF CE(s)	Eigenvalue	Max-Eigen Statistic	5 percent Critical Value	1 Percent Critical Value
None	0.0615	7.561	14.07	18.63
At most 1	2.41E-05	0.002	3.76	6.65
Hypothesized NO.OF CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob**

None	0.0615	7.564	15.49	0.513
At most 1	2.41E-05	0.002	3.84	0.955
Hypothesized NO.OF CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob**
None	0.0615	7.561	14.26	0.425
At most 1	2.41E-05	0.002	3.84	0.955

Table 5: EVIEWS' Output of Johanson cointegration test produced by authors

Null Hypothesis	Observation	F-Statistic	Prob
LREER does not Granger Cause LDIP	120	4.43281	0.0055
LDIP does not Granger Cause LREER	120	0.95504	0.4167

Table 6: Eviews' output of Granger Causality test produced by authors

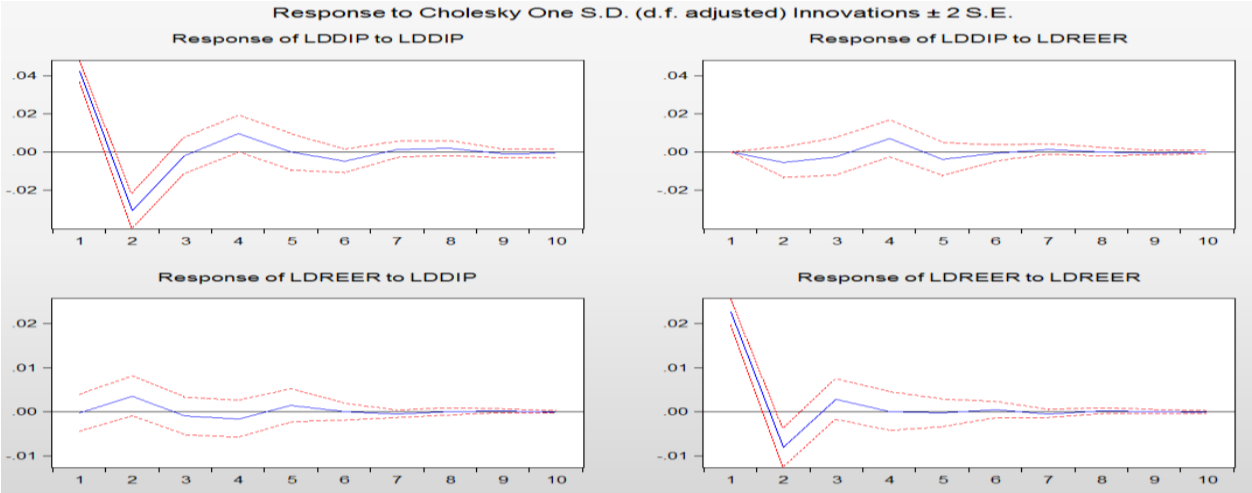

Figure 2: EViews' output of impulse response function with VAR.

Horizon	Due to Permanent Shock	Due to Transitory Shock
h =1	0.000	0.000
h =2	-0.006	-0.013
h =3	-0.003	-0.012
h =4	0.007	-0.002
h =5	-0.004	-0.013

Table 7: Eviews' output of permanent and transitory shock

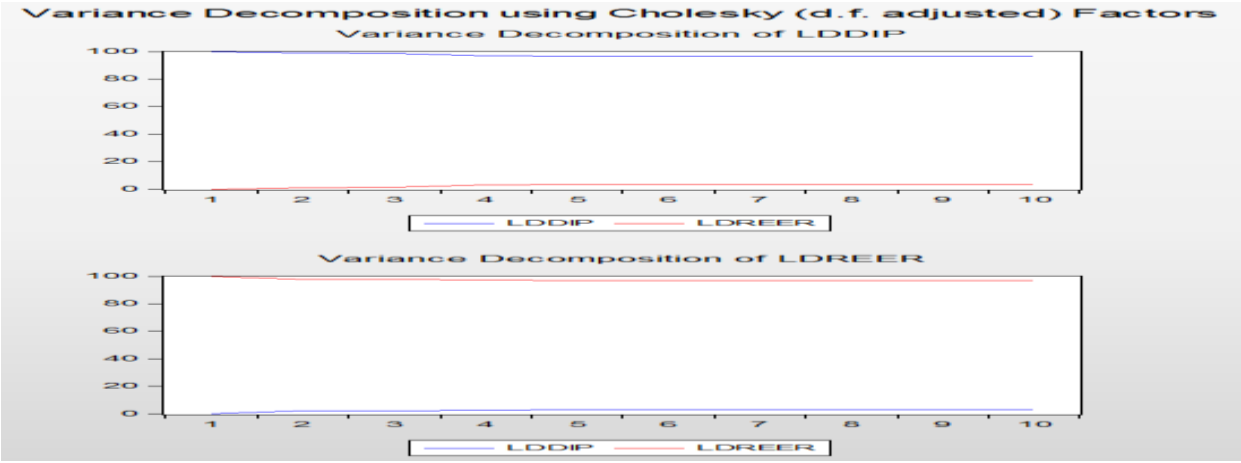

Figure 3 :Eviews' output of variance decomposition produced by authors

Variance Decomposition of LDDIP				Variance Decomposition of LDREER		
Period	S.E	LDDIP	LDREER	S.E	LDDIP	LDREER
1	0.022674	99.98	0.00	0.042332	0.00	100
2	0.024322	99.01	0.98	0.052611	2.09	97.90
3	0.024505	98.79	1.20	0.052701	2.21	97.78
4	0.024562	97.18	2.81	0.054073	2.65	97.34
5	0.024605	96.68	3.31	0.054211	2.98	97.01
Cholessky Ordering : LDREER LDDIP						

Table 8: variance decomposition output table produced by authors

Computed Fisher value		Critical fisher value	1%	2.5%	5%	10%
F-statistic	7.88	I(0)	4.94	4.18	3.62	3.02
K	1	I(1)	5.58	4.79	4.16	3.51

Table 9: F-Bounds test output produced by Authors

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